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Department of Information Science and Engineering

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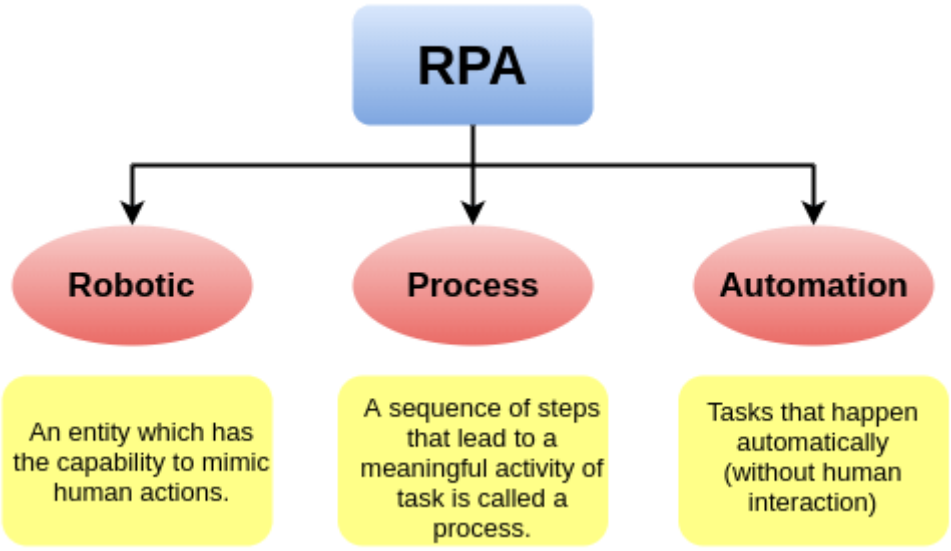
Faculty Name : Mrs. Vidhya Priya.V

Module 1: RPA Foundations

1.1 What is RPA?

- RPA stands for **Robotic Process Automation.**
- It is the technology used for software tools that automate human tasks, which are manual, rule-based, or repetitive.
- Typically, it is like a bot that performs such tasks at a much higher rate than a human alone.
- These RPA software bots never sleep and make zero mistakes, and can interact with in-house applications, websites, user portals, etc.
- They can log into applications, enter data, open emails and attachments, calculate and complete tasks, and then log out.



- The word 'Robot' in 'RPA' is not a physical robot but a virtual system that helps in automating the repetitive manual computing or business process tasks.

Why RPA

- Robotic Process Automation is economically capable as compared to any other automation solutions.

- It is the new buzz word in the IT industry. It has shifted the traditional way of doing the business task manually into an automatic task within an organization.
- RPA technology uses bots that interact with web applications, web sites, excel worksheets, and emails to automate the tasks just like a human.

BENEFITS OF RPA

Robotic Process Automation technology provides the following benefits:

Cost Savings

RPA helps organizations to save a huge amount of cost as it is typically cheaper than hiring an employee to perform the same set of tasks.

Less Error

RPA works on standard logic and does not get bored, distracted, or tired. Hence, the probability of making errors reduces to a great extent, which means less re-work and an enhanced reputation for efficiency.

Faster Processing

RPA works faster than human employees as computer software does not need breaks, food, rest, etc., and can perform repetitive operations tirelessly. With RPA, processing time becomes predictable and consistent, which ensures high-quality customer service across the operations.

Better Regulatory Compliance

RPA software works on the logic and data fed to it and does what is only needed as per the given instructions. Hence, there are minimal chances of not complying with the standard regulations.

Better Customer Service

When RPA is implemented in a business, it frees many of its employees who can spend their time working on customer-related services. It is very beneficial for businesses that receive a lot of customer queries. It also leads to increased productivity for employees.

Auditable & Secure

RPA bots will only access the data for which they are given permission and create a detailed audit trail of all activity.

Low Technical Barrier

RPA does not require any programming skills to configure the software robot. Since it is a code-free technology, any non-technical person can set up the bot using drag and drop features. It also includes the 'Recorder' to record the steps of automation.

1.2 Flavours of RPA

On a high level, you can divide the flavors into the following:

1) Attended RPA (which may be referred to as robotic desktop automation or RDA):

- This was the first form of RPA that emerged, back in 2003 or so.
- Attended RPA means that the software provides collaboration with a person for certain tasks.
- Example: would be in the call center, where a rep can have the RPA system handle looking up information while he or she talks to a customer.

2) Unattended RPA:

- This technology was the second generation of RPA.
- With unattended RPA, you can automate a process without the need for human involvement – that is, the bot is triggered when certain events happen,
  Example: such as when a customer e-mails an invoice.
- Consider that unattended RPA is generally for back-office functions.

3) Intelligent process automation or IPA (this may also be referred to as cognitive RPA):

- This is the latest generation of RPA technology, which leverages AI to allow the system to learn over time
  Example: would be the interpretation of documents, such as invoices.
- There may be even less human intervention .

1.3 History of RPA

During the past 70 or so years that computers have been a major catalyst for this trend. Along the way, there have been different period's of automation, based on the types of technologies available. They would also provide a foundation for RPA platforms.

- **Mainframe Era**: These were huge machines developed by companies like IBM. They were expensive and mostly available to large companies (although, innovators like Ross Perot would create outsourcing services to provide affordable options). Yet they were incredibly useful in helping manage core functions for companies, such as payroll and customer accounts.

- **PC Revolution**: Intel's development of the microprocessor and Microsoft's development of its operating system revolutionized the technology industry. As a result, just about any business could automate processes; say by using word processors and spreadsheets.

    - But the automation technologies – while powerful – still had their drawbacks. They could easily result in complex IT environments, which required expensive and time-consuming integrations and custom coding.
    - From this emerged the key elements for RPA, which came about in the early 2000s.
    - A big part of this was screen scraping, which is the automation of moving data among applications, which turned out to provide a nice boost to efficiency and effectiveness.
    - But the nascent RPA market got scant attention. It was mostly perceived as low-tech and a commodity.
    - Instead, investors and entrepreneurs in Silicon Valley focused their attention on the rapidly growing cloud market that was disrupting traditional IT systems.

But around 2012 or so, the RPA market hit an inflection point. There was a convergence of trends that made this happen, such as the following:

- In the aftermath of the financial crisis, companies were looking for ways to lower their costs. Simply put, traditional technologies like ERP were reaching maturation. So companies needed to look for new drivers.

- Companies also realized they had to find ways to not be disrupted from technology companies. RPA was considered an easier and more cost-effective way to go digital.
- Some industries like banking were becoming more subject to regulation. In other words, there was a compelling need to find ways to lessen the paperwork and improve audit, security, and control.
- RPA technology was starting to get more sophisticated and easier to use, allowing for higher ROI (return on investment).
- Large companies were starting to use RPA for mission-critical applications.
- Demographics were also key. As the millennials started to enter the workforce, they wanted more engaging work. They wanted careers, not jobs.

➢ Fast forward to today, RPA is the fastest growing part of the software industry. According to Gartner, the spending on this technology jumped by 63% to $850 million in 2018 and is forecasted to reach $1.3 billion by 2019. Or consider the findings from Transparency Market Research. The firm projects that the global market for RPA will soar to $5 billion by 2020.

1.4 The Benefits of RPA

When looking at RPA, the benefits are far more than just about the impact on the bottom line. The technology can transform a company.

➢ **The Impact of Small Improvements**: On the surface, an employee who saves 10 to 20 seconds on a task – even something as simple as a series of cut-and-paste actions –may seem trivial. But it's not. When scaled across thousands of employees across a global organization, the impact can certainly be significant.

- For example, some companies will keep track of the metric of how many hours are saved by using RPA, which becomes a part of the overall ROI calculation.

➢ **Relative Ease of Implementation**: Unlike traditional business applications like a CRM or ERP, RPA generally does not involve an onerous implementation and integration. Why? Note that the software sits on top of existing IT systems.

- RPA is also relatively easy for a person to use since there is no requirement for understanding complex coding.

- **The bottom line**: The people implementing RPA will get to their objectives quicker and the IT department will have more time to devote to higher priority items. This is important as there remains a trend of less investment in IT.
- **Compliance**: Just one violation of a government regulation can have a serious adverse impact on a company. It could even be a threat to its very existence.

    - Examples like Enron or Theranos:
    - (While employees are usually diligent and trustworthy, they do make mistakes or they may not understand some of the regulations. Yet this is not an issue with RPA. You can easily configure a bot to make sure the actions are compliant with regulatory requirements. Many RPA vendors also have built in their own compliance systems, handling such laws as the Sarbanes–Oxley Act, General Data Protection Regulation (GDPR), and HIPAA (Health Insurance Portability and Accountability Act of 1996)).

    - Another compliance benefit is that there will be less intervention with the data from people, which lessens the possibility of fraud.

- **Customer Service**: Nowadays, people want quick and accurate responses from their companies. But this is difficult to provide, especially when a company is overwhelmed from incoming contacts.But this is where RPA can make a big difference. The bots are programmed to make sure that all the necessary steps are taken – at scale. The result is often an increase in customer satisfaction metrics, like the Net Promoter Score (NPS).

- **Employee Satisfaction**: Yes, your team should also enjoy the benefits of RPA. After all, it means that they do not have to spend their valuable time on tedious activities. The result may be less turnover and higher productivity.
- **Wide Application**: It's common for an enterprise application to focus on a certain part of a company's departments or functions. But RPA is wide. It can be used for virtually any part of a company, such as legal, finance, HR, marketing, sales and so on.

- **Data Quality**: It should be greatly improved as there will be less chance of human error. In fact, there will probably be much more data because of the scalability of the automation. In other words, the datasets for analytics and AI will be more robust and useful.

- **Digital Transformation**: This is a major priority for CEOs. But many companies have legacy systems that would be expensive to replace or integrate. However, RPA is an approach that can help with this process, which is often quicker and less costly.
- **Scalability:** If there is a sudden jump in demand, it can be extremely difficult to hire new employees. But RPA can be a solution. It is much cheaper and faster to ramp up new bots to meet the demand.

1.5 The Downsides of RPA

RPA is definitely not a cure-all. The software has its inherent limitations and complexities.

- **Cost of Ownership**: The business models vary. Some have a subscription or multiyear license. Other vendors may charge based on the number of bots.
- **But there is more to the costs**. There is the need for some level of training and ongoing maintenance. Depending on the circumstances, there may be requirements for buying other types of software and hardware. Oh, and it iscommon to retain third-party consultants to help with the implementation process.
- **Technical Debt**: This is an issue with RPA. As a company's processes change, the bots may not work properly. This is why RPA does require ongoing attention.
- **Enterprise Scale** :. It can be extremely difficult to manage the numerous bots and there also needs to be strong collaboration among IT.
- **Security :** This is a growing risk with RPA implementations, especially as the technology covers more mission-critical areas of a company's processes. Let's face it, if there is a breach, then highly sensitive information could easily be obtained. Actually as RPA gets more pervasive in manufacturing, there may even be risks of property damage and bodily harm. This would likely be the case with attended RPA.
- **Expectations**:. According to a survey from PEGA, the average time it takes to develop a quality bot was 18 months, with only 39% being deployed on time.
- **Preparation**: You need to do a deep dive in how your current tasks work. If not, you may be automating bad approaches.
- **Limits**: RPA technology is somewhat constrained. For the most part, it works primarily for tasks that are routine and repetitive. If there is a need for judgment – say to approve a

payment or to verify a document – then there should be human intervention. Although, as AI gets more pervasive, the issues are likely to fade away.

For example, insurance companies can use the technology to adjudicate claims for payments, based on individual claims history and firm-wide payment policies.

- **Virtualized Environments**: This is where a desktop accesses applications remotely, such as through a platform. However, some of the latest RPA offerings, such as from UiPath, are solving the problem.

1.6 RPA Compared to BPO, BPM, and BPA

Business process management (BPM)

Business process outsourcing (BPO)

Business process automation (BPA)

They can get kind of confusing but they have key distinctions.

- **BPM**:

  For example, FileNet introduced a digital workflow management system to help better handle documents (the company would eventually be purchased by IBM). Then there would come onto the scene ERP vendors, such as PeopleSoft

  - .All of this would converge into a major wave called BPM .
  - For the most part, the focus was on having a comprehensive improvement on business processes. This would encompass both optimizing systems for employees but also IT assets.
  - There were also various business process management software (BPMS) solutions to help implement BPM.
  - One was Laserfiche. Nien-Ling Wacker founded the company in 1987, when she saw the opportunity to use OCR (optical character recognition) technology to allow users to search huge volumes of text.

So then how is BPM different from RPA?

With BPM, it requires much more time and effort with the implementation because it is about changing extensive processes, not tasks. There also needs to be detailed documentation and training. Because of this

rigorous approach, BPM is often attractive to industries that are heavily regulated, such as financial services and healthcare.

However, the risk is that there may be too much structure, which can stifle innovation and agility.On the other hand, RPA can be complementary to BPM. That is, you can first undergo a BPM implementation to greatly improve core processes. Then you can look to RPA to fill in the gaps.

- **BPO** : This is when a company outsources a business service function like payroll, customer support, procurement, and HR.
  - The market is massive, with revenues forecasted to reach $343.2 billion by 2025 (according to Grand View Research). Some of the top players in the industry include ADP, Accenture, Infosys, IBM, TCS, and Cognizant.

As should be no surprise, one of the big attractions of BPO is the benefit of lower wage rates in other countries (this is often referred to as "labor arbitrage"). The employee bases will also often be educated and multilingual.bases will also often be educated and multilingual.

BPO will have three types of strategies:

- Offshore: This is where the employees are in another country, usually far away.
- Nearshore: This is when the BPO is in a neighboring country. True, there are usually higher costs but there is the benefit of being able to conveniently visit the vendor. This can greatly help with the collaboration.
- Onshore: The vendor is in the same country. For example, there can be wide differences in wages in the United States.

There are drawbacks with a BPO : Perhaps the most notable one is the quality issue (you know the situation when you call a company and get an agent you can barely understand!).

Yet here are some others to consider:

- Security: If a BPO company is developing an app with your company's data, are there enough precautions in place so there is not a breach? Even if so, it can still be difficult to enforce and manage.
- Costs: Over the years, countries like China and India have seen rising labor costs. This has resulted in companies moving to other locations, which can be disruptive and expensive.
- Politics: This can be a wildcard. Instability can easily mean having to abandon a BPO operator in a particular country.

- **BPA** : This is the use of technology to automate a complete process. One common use case is onboarding.

For example, bringing on a new employee involves many steps, which are repeatable and entail lots of paperwork. For a large organization, the process can be time-consuming and expensive. But BPA can streamline everything, allowing for the onboarding at scale.

OK, this kind of sounds like RPA, right? Yes, this is true. But there is a difference in degree. RPA is really about automating a part of the process, whereas BPA will take on all the steps.

1.7 Consumer Willingness for Automation

The automation of consumer-facing activities, such as with chatbots on a smartphone or web site, are becoming more ubiquitous.

Consider a report from Helpshift, an AI-based digital customer service platform automating 80% of customer support issues for huge D2C (direct-to-consumer) brands including companies like Flipboard, Microsoft, Tradesy, and 60 others. Its report is based on the analysis of 75 million customer service tickets and 71 million bot-sent messages.

Here are some of the findings:

- A total of 55% of the respondents – and 65% of millennials – prefer chatbots with customer service so long as it is more efficient and reduces phone time to resolve an issue and explain a problem.
- A total of 49% say they appreciate the 24/7 availability of chatbots.- Granted, there is much progress to be made. Chatbot technology is still in the early phases and can be glitchy, if not downright annoying in certain circumstances. But in theyears to come, this form of automation will likely become more important – and also a part of the RPA roadmap.
- According to the CEO of Helpshift, Linda Crawford: “Seeing as the vast majority of Americans dread contacting customer support, there’s a huge opportunity here for chatbots to fill the void and improve the customer support experience for consumers—and agents

1.8 The Workforce of the Future

- The interesting thing is that the fundamentals of work have not changed much since then. True, there has been the trend of the gig economy, in which people get paid for offering services through Uber and Lyft. Yet when it comes to office work, the structure has remained quite durable.
- . According to research from the McKinsey Global Institute, white collar workers still spend 60% of their time on manual tasks, such as with answering e-mails, using spreadsheets, writing notes, and making calls.

- In light of all this, RPA is likely to have a significant impact on the workplace because more and more of the repetitive processes will be automated away. One potential consequence is that there may be growing job losses.
- A survey from Forrester predicts that – as of 2025 – software automation will mean the loss of 9% of the world's jobs or 230 million. Then again, the new technologies and approaches will open up many new opportunities.
- Its analysis shows that technologies like RPA could automate a whopping 45% of the activities of a company's workforce. Now when a company engages in an automation project, the CEO will usually not talk about job loss. It's something that will frighten the workforce and generate awful headlines. Instead the messaging will be vague, focusing on the overall benefits of the transformation.
- This may make it sound like not much is happening. But it does seem like a good bet that the reverberations will grow and grow, as RPA systems get increasingly robust. As we've seen in prior periods where technology resulted in job loss – such as in the Industrial Revolution – there are serious changes in politics and regulations.
- Companies really do try to avoid layoffs, since they are expensive and take a toll on the organization. But in the years ahead, managers will probably need to find ways to navigate the changes from automation, such as finding new roles or reskilling the workforce.
- All in all, the rise of automation has the potential for leading for a much better society. Again, workers can focus on more interesting and engaging activities – not repetitive and mundane tasks. There will also be ongoing renewing of knowledge and understanding. But there must be proactive efforts, say from companies and governments, to provide for a smoother transition

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The Technologies You Need to Know

While RPA does not require programming skills, there is still a need to understand high-level concepts about technology. Unfortunately, the concepts can get extremely complex and confusing. It seems like there is an endless number of acronyms like ACL, API, OCR, CPU, HTTP, IP, JSON, NOC, PCI, RAM, and SaaS.

Even tech veterans do not know many of the terms – or have just a vague understanding of their meanings. For example, here's how Kubernetes is defined:

Kubernetes (K8s) is an open-source system for

automating deployment, scaling, and management of containerized applications.[1]

Huh? To get a sense of this, you really need to have a deep understanding of computer and software architecture.

But the good news is that – to use RPA effectively – there are only a handful of terms and concepts you need to know. So this is what we'll cover in this chapter.

On-Premise Vs. the Cloud

The traditional IT system approach is the use of on-premise technology. This means that a company purchases and sets up its own hardware and software in its own data center.

Some of the benefits include:

- A company has complete control over everything. This is particularly important for regulated industries that require high levels of security and privacy.
- With on-premise software, you may have a better ability to customize the solution to your company's unique needs and IT policies.

However, the on-premise technology model has serious issues as well. One of the biggest is the cost, which often involves large up-front capital expenses. Then there is the ongoing need for maintenance, upgrades, and monitoring. And finally, the use of point applications like Excel can lead to a fragmented environment, in which it becomes difficult to centralize data because there are so many files spread across the organization.

- But as the Internet became more robust, there was a move to so-called cloud computing.
- One of the first business applications in this industry was developed by Salesforce.com, which made it possible for users to use the software through a browser.

- Companies could pay per-user, per-month fees for the services they used, and those services would be delivered to them immediately via the Internet, in the cloud.

The downsides with cloud software. Here are just some to consider:

- With less control of the platform, there are more vulnerability to security and privacy lapses.
- Outages do happen and can be extremely disruptive and costly for enterprises that need reliability.
- Cloud computing is not necessarily cheap. In fact, one of the biggest complaints against Salesforce.com is the cost.
- Regardless, the fact remains that the technology continues to gain traction.

Besides the impact of Salesforce.com and other cloud applications companies, another critical development was Amazon.com's AWS platform.

AWS essentially handles the complex administrative and infrastructure requirements like storage, security, compute, database access, content delivery, developer tools, deployment, IoT (Internet of Things), and analytics (there are currently more than 165 services).

This means the development of applications can be much quicker. The costs are generally lower and the fees are based on a per-use basis.

The cloud also has different approaches, such as the following:

- **Public Cloud**: The cloud is accessed from remote servers, such as from AWS, Salesforce.com, and Microsoft. The servers have an architecture known as multitenant that allows the users to share a large IT infrastructure in a secure manner.

  This greatly helps to achieve economies of scale, which would not be possible if a company created its own cloud.
- **Private Cloud**: This is when a company owns the data center. True, there are not the benefits of the economies of scale from a public cloud. But this may not be a key consideration. Some companies might want a private cloud because of control and security.
- **Hybrid Cloud**: This is a blend of the public and private clouds. For example, the public cloud may handle less mission-critical functions.

As for RPA, the **cloud** has different implications and impacts. One is that a platform needs to deal with complex distributed applications, which can be difficult if a company develops custom programs on a cloud service.

.In some cases, an **on-premise** RPA system may be loaded onto a cloud service like AWS. While there are benefits with this, it is not cloud native. This is because you will still need to upgrade and maintain the software.

Web Technology

The mastermind of the development of the World Wide Web – which involved the use of hyperlinks to navigate web pages – was a British scientist, Tim Berners-Lee.

At the core of this was HTML or hypertext markup language, which was a set of commands and tags to display text, show colors, and present graphics. A key was that the system was fairly easy to learn and use, which helped to accelerate the number of web sites.

For example, many of the commands in HTML involve surrounding content with tags, such as the following:

This is a Title

HTML would ultimately be too simple. So there emerged other systems to provide even richer experiences, such as with CSS (Cascading Style Sheets, which provides for borders, shadows, and animations) and JavaScript (this makes it possible to have sophisticated interactivity, say, with the use of forms or calculations).

RPA must deal with such systems to work effectively. This means it will have to take actions like identify the commands and tags so as to automate tasks.

Programming Languages and Low Code

- A programming language allows you to instruct a computer to take actions.
- The commands generally use ordinary words like IF, Do, While, and Then. But there can still be lots of complexity, especially with languages that use advanced concepts like object-oriented programming.
- Some of the most popular languages today include Python, Java, C++, C#, and Ruby.
- To use an RPA system, you have to use some code – but it's not particularly difficult. It's actually known **as low code**. As the name implies, it is about using minimal manual input.

  For example, an RPA system has tools like drag-and-drop and visualizations to create a bot.

This is not to imply that low code does not need some training. To do low code correctly, you will need to understand certain types of workflows and approaches.

OCR (Optical Character Recognition)

- A key feature for an RPA platform is OCR (Optical Character Recognition), a technology that has actually been around for decades.
- It has two parts:

  ->Document scanner (which could even be something like your smartphone)

  -> software that recognizes text.

  In other words, with OCR, you can scan an image, PDF, or even handwritten documents – and the text will be recognized. This makes it possible to manipulate the text, such as by transferring it onto a form or updating a database.

There are definitely many challenges with effective OCR scanning, such as:

- The size of a font
- The shape of the text
- The skewness (is the text rotated or slanted?)
- Blurred or degraded text
- Background noise
- Understanding different languages

Then how does this technology help with RPA?

- One way is with recoding a person's actions while working on an application. The OCR can better capture the workflows by recognizing words and other visuals on the screen. So, even if there is a change of the location of these items, the RPA system can still identify them.
- Something else: Automation involves large numbers of documents.
  Thus, OCR will greatly improve the processing. An example of this would be processing a loan. With OCR, a document will use OCR to extract information about a person's financial background, the information about the property, and any other financial details. After this, the RPA system will apply the workflows and tasks to process the loan, say, with applying various rules and sending documents to different departments and regulatory agencies.

But there are OCR systems that can help out, such as HyperScience. The software leverages sophisticated machine learning (ML) technology to quickly and accurately extract the information (understanding cursive writing, for example).

Databases

- At the heart of most applications is a database, which stores data that can be searched and updated. This is usually done by putting the information in tables (i.e., rows and columns of information).
- To interact with this, there is a scripting language called SQL (Structured Query Language), which was relatively easy to learn.
- It was not until the late 1970s that relational databases were commercialized, led by the pioneering efforts of Oracle.
- While relational databases proved to be quite effective, there were still some nagging issues. Perhaps the biggest was data sprawl. Another problem was that relational databases were not cheap. And as

new technologies came on the scene, such as cloud computing and real-time mobile applications, it became more difficult to process the data.

- In the meantime, there have been new approaches that have gone against the model for relational databases. They include offerings like MySQL (which is now owned by Oracle) and PostgreSQL. Yet these systems did not get enough traction in the enterprise.
- But there is one next-generation database technology that has done so: NoSQL. It also began as an open source project and saw tremendous growth. As of now, MongoDB has 14,200 customers across 100 countries and there have been over 70 million downloads.
- Where relational databases are highly structured, a NoSQL system is quite flexible. It's based on a document model that can handle huge amounts of data at petabyte scale.
- And going forward, there is likely to be much innovation with database technology. Yet relational databases will remain the majority of what companies use – which also means that this will also be what RPA interacts with as well.

APIs (Application Programming Interfaces)

- An API – which is the acronym for "application programming interface" – is software that connects two applications.

  For example: let's say you want to create a weather app. To get access to the data, you can setup an API, which often is fairly straightforward, such as by putting together a few lines of code to make data requests (say, for the city). By doing this, you will increase the speed of the development.
- APIs are pervasive in enterprise environments since they are so effective. They also have different structures. Although, the most common is a REST (representational state transfer) API.
- It's true that APIs can be used as a form of automation.
- The technology requires having people with technical backgrounds. The development of an API can take time and require complex integration.
- There is also the need for ongoing testing. However, there are third-party services that can help out. There must be a focus on maintaining an API (it's not uncommon for an API to break if there is a change in the structure).
- APIs can still have bugs and glitches, especially when in complex IT environments.

Because of the difficulties, RPA has proven to be a very attractive alternative. Again, the development is much easier and there is less of a need for integration. But, interestingly enough, an RPA platform can be a vehicle for delivering advanced APIs within the enterprise.

AI (Artificial Intelligence)

- A typical RPA system does not have much AI (Artificial Intelligence). The main reason is that there is a literal carrying out of tasks, which does not require any smart system. But as AI gets more powerful and accessible, RPA will increasingly start to use this powerful technology – which should greatly enhance the outcomes.

AI: It's software that ingests large amounts of data that is processed with sophisticated algorithms that help answer questions, detect patterns, or learn. Interestingly enough, AI is actually made up of a variety of subcategories

Machine Learning : This is where a computer can learn and improve by processing data without having to be explicitly programmed. Machine learning is actually one of the oldest forms of AI and uses traditional statistical methods like k-nearest neighbor (k-NN) and the naive Bayes classifier.

Deep Learning: Deep learning became a major force in AI. Some of the important factors for this included the enormous growth in data, the use of GPUs (graphics processing units) that provided for ultrafast parallel processing, and innovation in techniques like backpropagation.

Deep learning is about using so-called neural networks – such as recurrent neural networks (RNNs), convolutional neural networks (CNNs), and generative adversarial networks (GANs) – to find patterns that humans often cannot detect.

NLP (natural language processing): This is AI that helps understand conversations. The most notable examples of this include Siri, Cortana, and Alexa.

But there are also many chatbots that focus on specific uses cases (say, with providing medical advice).

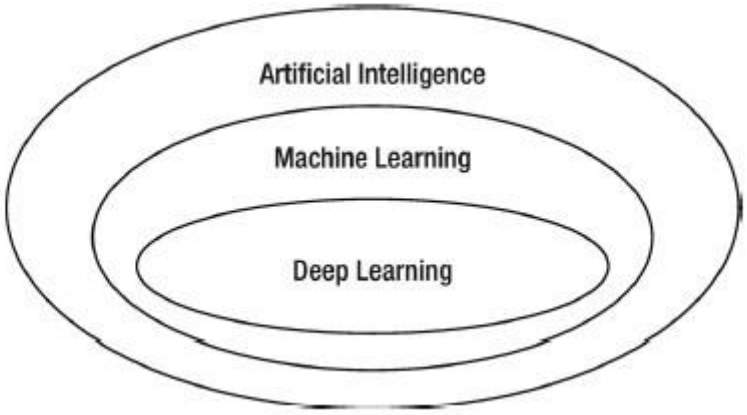


Figure 2-1 This is a high-level look at the key components of the AI world

Besides, AI has some major issues, such as the following:

Bias : According to IBM: "Bad data can contain implicit racial, gender, or ideological biases. Many AI systems will continue to be trained using bad data, making this an ongoing problem."

Causation: Humans have a strong grasp of this. We know what will happen if we use a hammer to hit a glass. It's pretty much instinctive. But AI is another matter. This technology is really about finding correlations in data not causation – and this is a major limiting factor.

Common Sense: A human does not have to process many cases to understand certain rules of thumb. We just naturally understand them. But with AI, common sense has been extremely difficult to code because of the ambiguity and the lack of useful data for the seemingly infinite use cases.

Black Box : Deep learning can have an enormous number of layers and parameters. This means it can be nearly impossible for a person to understand why the model is generating certain results. Now there is more innovation in trying to find ways to understand deep learning outcomes – which is something called "explainability" – but the efforts are still in the nascent stages.

Comprehension : An AI system cannot truly understand what it is reading or observing.

For example, if it read *War and Peace*, it would not be able to provide thoughts on the character development, themes, and so on.

Static: It is also possible to conduct millions of simulations to learn. But of course, the real world is much more dynamic, open-ended, and chaotic.

Conceptual Thinking: AI cannot understand abstract ideas like justice, misery, or happiness. There is also a lack of imagination and creativity.

Brain: It's really a miracle of evolution. A typical brain has 86 billion neurons and

.

Structured Data: This is data that is formatted (social security numbers, addresses, point of sale information, etc.) that can be stored in a relational database or spreadsheet.

Unstructured Data: This is data that is unformatted (images, videos, voicemails, PDFs, emails, and audio files).

- For the most part, RPA uses structured data. However, this represents about 30% of what's available in a typical organization. But with AI, an RPA system will likely be much more effective since it will be better able to process unstructured data.
- Furthermore, there are other potential benefits of the technology: judgement, the use of reasoning, and the detection of highly complex patterns. With these, the automation will be greatly enhanced, helping with things like detecting fraud.

Cognitive Automation

.Consider cognitive automation to be an application of AI, actually.

- First of all, it is automation uses a combination of technologies like speech recognition and NLP. By doing this, the goal is to replicate human actions as best as possible, such as by analysing patterns of workers and then finding patterns and correlations.
- Something else: Unlike other forms of AI, cognitive automation is usually effective with the use of much less data. There may also be not as much reliance on highly technical talent, such as data scientists.

Agile, Scrum, Kanban, and Waterfall

- In today's world, software development has become even more difficult because of the emergence of new platforms like the cloud and the hybrid cloud. This is why it's important to look at software management approaches.

- **Agile**

-One is called Agile, which was created back in the 1990s (a big part of this was the publication of the Manifesto for Agile Software Development).

-The focus of this was to allow for incremental and iterative development, which begins with a detailed plan. This also requires much communication across the teams and should involve people from the-business side of the organization.

-Nowadays, Agile has gotten easier because of the emergence of sophisticated technologies like Slack and Zoom that help with collaboration. "

- **Scrum:**

-This is actually a subset of Agile. But the iterations are done as quick sprints, which may last a week or two. This can help with the momentum of a project but also make a larger project more manageable (just as a side note: Scrum was first used for manufacturing but it was later found to work quite well with software development).

Kanban:

-This comes from the Japanese word for visual sign or card (the roots of the system go back to Toyota's high-quality manufacturing processes).

So yes, with Kanban, there is the use of visuals to help streamline the process. What's more, the general approach is similar to Agile as there is iterative development.

Waterfall

-This is the traditional code development model, which goes back to the 1970s.

-The waterfall model is a structured plan that goes over each step in much detail. To help this along, there may be the use of a project management tool, say, a Gantt chart.

-While the waterfall approach has its advantages, it has generally fallen out of favor. Some of the reasons are as follows: It can be tough to make changes, the process can be tedious, and there is often a risk of a project being late.

DevOps

- DevOps has emerged as a critical part of a company's digital transformation.
- The "Dev" part of the word is actually more than just about coding software.
- It also refers to the complete application process (such as with project management and quality assurance or QA). As for "Ops," it is another broad term, which encompasses system engineers and administrators as well as database administrators, network engineers, security experts, and operations staff.
- For the most part, DevOps has come about because of some major trends in IT. One is the use of agile development approaches . Next is the realization that organizations need to combine technical and operational staff when introducing new technologies and innovations.
- And finally, DevOps has proven effective in working with cloud computing environments.

Flowcharts

- An essential part of RPA is understanding workflows and systems, the use of flowcharts is common.
- It's usually at the core of the software application.
- With a flowchart, you can both sketch out the existing workflows of a department. And then from here, you can brainstorm ways of improving them. Then you can use the flowchart to design a bot for the automation.
- The flowchart is relatively simple to use and it also provides a quick visual way to understand what you are dealing with. As the old saying goes, a picture is worth a thousand words.
- some of the basics:

Terminator: This is a rectangle with rounded corners and is used to start and end the process, as seen in Figure 2-2

Figure 2-2 This is a terminator, which starts and ends a flowchart

Process: This is represented by a rectangle. With this, there is only one next step in the process. Figure 2-3 shows an example:

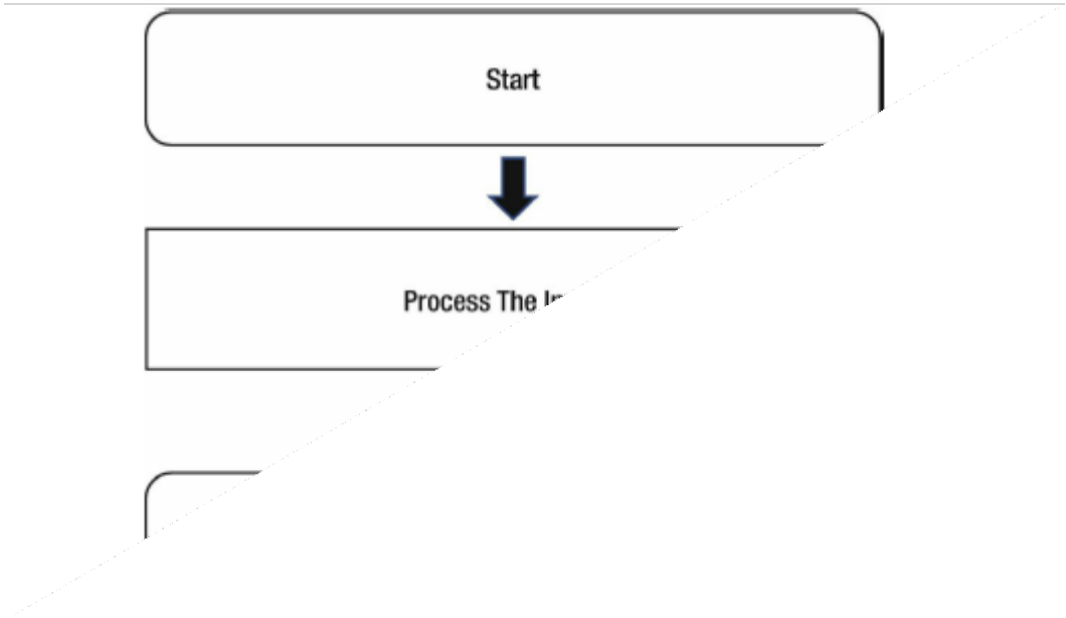


Figure 2-3 This shows a process in a flowchart

Decision: This is a square symbol that is at an angle. There will be at least two possible paths. Figure 2-4 is an example:

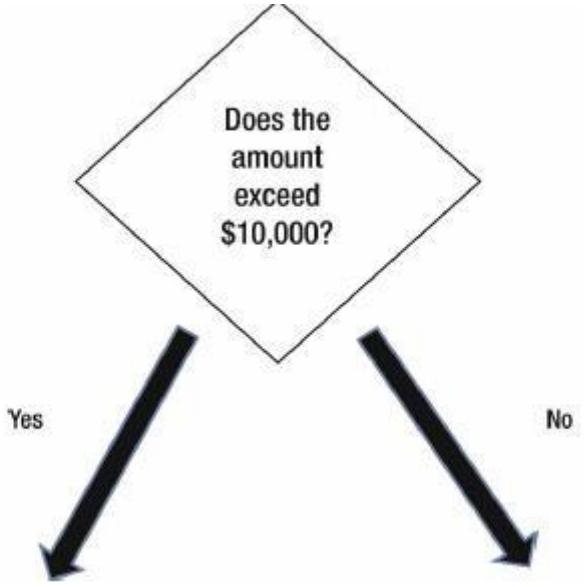


Figure 2-4 This shows a decision process in a flowchart

Module-2

RPA Platforms

2.1 COMPONENTS OF RPA

Any Robotics process automation platform provides some basic components, which together build the platform.

The following are the basic or core components of RPA:

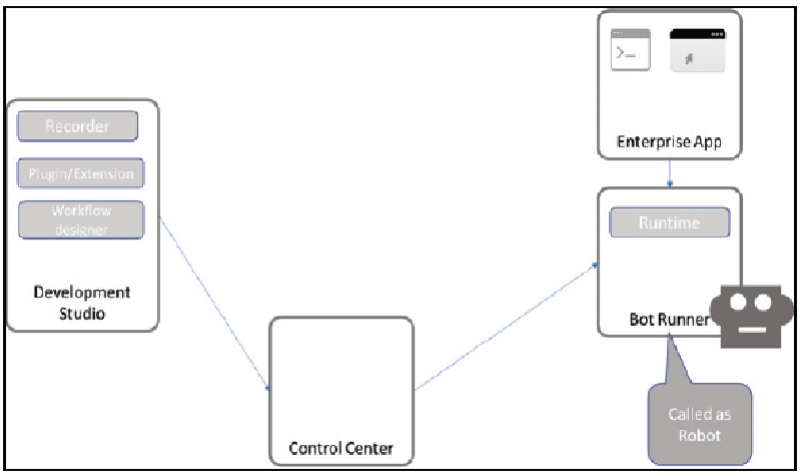
Recorder

Development Studio

Plugin/Extension

Bot Runner

Control Center:



Recorder

- The recorder is the part of the development studio that developers use to configure the Robots.

- It is like the macro recorder in Excel, the bot recorder in any platform, records steps.
- It records mouse and keyboard movements on the UI and this recording can be replayed to do the same steps again and again.
- This enables rapid automation. This component has played a very big role in the popularity of RPA.

Development studio

- The development studio is used by developers to create Robot configuration or train the Robots.
- Using the development studio, a set of instructions and decision-making logic is coded for Robots to execute.
- Some platforms provide flow-charting capabilities such as Visio, so it becomes very easy to plot steps in a process, whereas some other platforms require coding.
- In most studios, in order to do commercial development, developers need to have a fair amount of knowledge of programming,
  Example, loops, if else, variable assignment, and so on.

Extensions and plugins

- Most platforms offer many plugins and extensions to ease the development and running of bots.
- In many applications, such as Java SAP, it is not easy to individually identify controls of the UI through traditional techniques.
- RPA vendors have developed plugins and extensions to help with these issues.

Bot runner

- This is also referred to as the Robot, other components make it run.

Control center

- The objective of the control room is to provide Robot management capabilities.
- It monitors and controls a Robot's operation in a network.

- It can be used to start/stop Robots, make schedules for them, maintain and publish code, redeploy Robots to different tasks, and manage licenses and credentials.

2.2 RPA Platforms

- RPA vendor market has been showing continual and steady growth.
- While the largest market is the US, followed by the UK, the market in **Asia Pacific Countries**(**APAC**) is also showing considerable progress. Successful pilot projects and increased customer satisfaction among the early adopters of RPA will encourage new players to adopt this technology.
- There is growing demand for RPA, especially in industries that need large scale deployments.
- The major markets for RPA are banking and finance, healthcare and pharmaceuticals, telecom and media, and retail.

1.Automation Anywhere

Automation Anywhere helps to automate business processes for companies. They focus on RPA, cognitive data (machine learning and natural language processing), and business analytics. Their bots are capable of handling both structured as well as unstructured data.

The system has three basic components:

1. *A development client* for the creation of a bot
2. *A runtime environment* for the deployment of a bot
3. *A centralized command system* for handling multiple bots, analyzing their performance:

2.UiPath

- UiPath is an RPA technology vendor who designs and delivers software that helps automate businesses.
- The RPA platform consists of three parts:

->*UiPath Studio* to design the processes

->*UiPath Robot* to automate tasks designed in UiPath Studio

->*UiPath Orchestrator* to run and manage the processes

3.Blue Prism

- Blue Prism aims to provide automation that enterprises can use according to their needs.

- Blue Prism aims to do this by providing automation that is scalable, configurable, and centrally managed.
- It sells its software through its partners, some of which are Accenture, Capgemini, Deloitte, Digital Workforce Nordic, HPE, HCL, IBM, TCS, Tech Mahindra, Thoughtonomy, and Wipro

4. WorkFusion

- Work Fusion offers automation that is based on RPA and machine learning.
- It delivers software as a solution for automating high volume data.
- Work Fusion enables man and machine to work in tandem while managing, optimizing, or automating tasks.

5. Thoughtonomy

- Thoughtonomy delivers software that helps automate business and IT processes.
- It uses Blue Prism and other automation software and customizes it

6. KOFAX

- Kofax's RPA platform is capable of automating and delivering processes that are repetitive and rule-based.
- It uses Robots for extracting and consolidating information.
- The software platform consists of a management console to deploy and manage bots, Robot performance, and a monitoring system.
- This software can also group together high priority tasks that should be completed first by the Robot during times of high workload. Kofax's software, however, doesn't have machine learning.

	UiPath	Blue Prism	WorkFusion	Thoughtonomy	KOFAX
HQ	Bucharest, Romania	United Kingdom	New York, USA	London, UK	Irvine, California
Est		2001	2011	2013	
CEO	Daniel Dines	Alastair Bathgate	Max Yangkelivich, Andrew Volkov	Terry Walby	Paul Rooke
Key Clients	Atos, AXA, BBC, Capgemini, CenturyLink, Cognizant, Middlesea, OpusCapita, and SAP	BNY Mellon, RWE npower, and Telefonica O2	Thomson Reuters, Infogroup, Citi, and Standard Bank	Atos, Fujitsu, CGI, Unite BT, and Business Systems	Arrow Electronics, Delta Dental of Colorado, Pitt Ohio, Audi
Source of revenue by region	North America, Continental Europe, the UK, and APAC	More than half of its revenue source comes from the UK, followed by North America, Continental Europe, and APAC	North America provides more than 80% of Work Fusion's revenue,followed by Europe, APAC, and MEA	Around 70% of revenue comes solely from the UK. The rest comes from Continental Europe, North America, APAC,	North America accounts for almost half of its revenue, followed by Continental Europe, APAC, and LATAM (Latin America)
Source of revenue by industry	BFSI, healthcare, telecom and media, and retail	BFSI, health, and pharmaceuticals, retail and consumer, telecom and media, manufacturing, public sector, travel, and transportation	Around 90% of its revenue comes from the BFSI sector, followed by the retail and consumer sectors	A major part of its revenue comes from third party clients, followed by BFSI, public sector, telecom, healthcare, retail, and consumer sectors	BFSI,retail, consumer, travel, transportation, public sector, manufacturing, and healthcare

2.3 ABOUT Ui PATH

- UiPath is an RPA vendor that provides software to help organizations automate their business processes. The company aims to do away with repetitive and tedious tasks, allowing humans to engage in more creative and inspiring activities.
- UiPath was founded by Daniel Dines, who is the CEO. It has offices in London, Bucharest, Tokyo, Paris, Singapore, Melbourne, Hong Kong, and Bangalore. With clients spread across the world, from North America to the United Kingdom, Continental Europe to Asia Pacific countries, the company has shown remarkable growth in the last year, both in terms of revenue and its workforce.
- Today, its software is being widely used to automate business processes. However, the IT sector is also gradually embracing UiPath's software. Major clients of UiPath in the industry include BFSI, Telecom and media, healthcare, retail and consumer, and manufacturing.
- With UiPath automation software, one can configure software Robots to mimic human action on the user interface of computer systems.

The basic components of the UiPath RPA

. The components of the UiPath platform are UiPath Studio, UiPath Robot, and UiPath Orchestrator, see the following sections.

1. UiPath Studio

- UiPath Studio helps users with no coding skills to design Robotic processes in a visual interface.
- It is a flowchart-based modeling tool. Thus, automation is faster and more convenient.
- Multiple people can contribute to the same workflow.
- The presence of a visual signal that points out errors in the model, and a recorder that performs what the user executes, make modeling much easier.

2. UiPath Robot

- UiPath Robot runs the processes designed in UiPath Studio.

- It works in both attended (working only on human trigger) and unattended environments (self-trigger and work on their own).

The following are types of Robots:

Attended: It operates on the same workstation as a human to help the user accomplish daily tasks. It is usually triggered by user events. *You cannot start a process from Orchestrator on these type of Robots, and they cannot run under a locked screen.*

Unattended: It can run unattended in virtual environments and can automate any number of processes. In addition to the Attended Robot's capabilities, this Robot is responsible for remote execution, monitoring, scheduling, and providing support for work queues.

Free: It is similar to Unattended Robots, but can be used *only* for development and testing purposes, not in a production environment.

3.UiPath Orchestrator

- UiPath Orchestrator is a web-based platform that runs and manages Robots.
- It is capable of deploying multiple Robots, and monitoring and inspecting their activities.
- Orchestrator's main capabilities:
  -It helps in creating and maintaining the connection between Robots
  -It ensures the correct delivery of the packages to Robots
  -It helps in managing the queues
  -It helps in keeping track of the Robot identification
- It stores and indexes the logs to SQL or Elasticsearch
- Behind the scenes, Orchestrator Server uses:

-IIS Server

-SQL Server

-Elasticsearch

-Kibana

2.4 THE FUTURE OF AUTOMATION

- The buzzword today is the **Fourth Industrial Revolution**-the current age where technology is embedded within societies and even the human body-be it Robotics, 3D printing, nanotechnology, Internet of Things, or autonomous vehicles. This will fundamentally change the way we live, work, and interact with one another.

- Technological innovation has reached a stage where machines have now entered the realm of what was once considered exclusively human. For these reasons, there is a wide section of people who fear this age of Robots.

- There are various advantages of automation today; there are also fears surrounding its advancement, which are not completely unfounded. This time automation is capable of impacting a wide range of disciplines. Thus, unlike in the past where only blue collar jobs were at risk of being replaced by machines, this time even white collar jobs are believed to be at risk.
- While this is not untrue, reports suggest that only around 5% of the total jobs may be *totally* replaced by automation. For other jobs, automation will only replace a part of the job and not completely take over.
- There are, of course, those jobs in the 5% category that run the risk of being completely automated. These are the jobs that are routine, repetitive, and predictable. A few
  Examples: telemarketing, data entry operation, clerical work, retail sales, cashiers, toll booth operators, and fast food jobs.
- However, like in the past, people should be able to find a way to adapt to the changes. With each generation, humans become smarter, more adaptable to change, and also progressive.
- Also, with automation mostly taking over routine and tedious tasks, humans are provided the opportunity to make better use of their capabilities-be it reasoning, emotional intelligence, or their creativity.
- What we can do is not fret over the inevitable rather prepare for it. One way of doing so is to start changing the pattern of education. The next generation should be taught how to recognize and adapt to changes quickly. An important aspect of their education should be to *learn how to learn*.

2.5 RECORD AND PLAY

The facility of recording user steps on a computer and playing them back has made **Robotic Process Automation** (**RPA**) highly successful.

UiPath stack

There are three basic components in UiPath:

1. UiPath Studio
2. UiPath Robot
3. UiPath Orchestrator

The UiPath platform is available in two variations:

1. **Enterprise Edition**: This edition is suitable for large companies starting their RPA projects and looking to scale their Robot deployments in the future. It is integrated with UiPath Orchestrator (we will discuss UiPath Orchestrator later). This version can be updated by visiting the UiPath website and by downloading the newest version of the UiPath platform installer. Running the installer automatically replaces all the old files without modifying any of your settings.
2. **Community Edition**: This is suitable for individual developers and small organizations with fewer employees. The Community Edition is always up-to date, and it automatically updates itself as soon as a new version is available

- The Community Edition can be used to learn UiPath free of cost.

UiPath Studio

- UiPath Studio is the development environment of UiPath. It is the primary tool to develop UiPath Robots.
- It can be used to configure steps of a task or launch a full recorder to record a sequence of steps. The recording facility in the Studio is a game-changing feature for RPA tools.
- Its simplicity lets even nontechnical business users design/record steps of a process. This studio lets the user configure Robots, that is, develop steps to perform tasks visually.

- Most of the configuration and coding in UiPath is visual. By using the drag-drop facility from the toolbox, you may write a whole sequence of workflows to perform a set of tasks by Robots.
- These steps look like a data flow diagram and are very easy to understand. It is one of the simplest visual flow diagramming. The studio gives the same look and feel as a workflow. The designer.
- An activity or action includes clicking a button, writing and reading a file, and so on.

2.6 DOWNLOADING AND INSTALLING UIPATH STUDIO

UiPath Community Edition is free to use in academia, nonprofits, and small businesses

The UiPath Community Edition has the following features:

Auto update

No server integration

Community forum for support

Online self-learning

No complex installation required

Online activation is mandatory

To get your Community Edition of UiPath Studio, type the following link in your Browser: https://www.uipath.com/Community.

1. A **Community Edition** page opens. Click on **Get Community Edition**

2. On the next page, you must register yourself in order to download the Community Edition. So, use the correct details and remember them because the same email will be used to activate the software.

   ---Fill in the following details: **First Name***, **Last Name***, and **Email***. Filling in the **Twitter User** field is not mandatory, but it is good to provide it:

   ---Click on **REQUEST COMMUNITY EDITION**.

3. You will be directed to a page that requests you to check your email for downloading the link. Click on the link to download UiPath Studio.

   You may also directly download UiPath Studio. Just click on the word **here** in **download it**.

4. Once the download is complete, open the downloaded file, UiPathtsudioSetup.Exe
5. The installation will then begin. Once the installation is complete, a welcome message will be displayed. Click on the **Start Free** option.
6. Then, as requested, enter your **Email Address** once again and click on **Activate**. Please remember to use the same email ID that you used to download the software. This email ID will be bound to the computer. The activation will happen online. An offline activation option is not available for the Community Edition.
7. A message will then be displayed on the screen informing you of the successful installation. Close this window.

For more convenient use, you can pin it to your taskbar immediately; otherwise, you may have to unnecessarily search for UiPath.Exe in your computer every time you wish to use it.

Your UiPath Studio is now ready for use!

2.7 LEARNING Ui PATH STUDIO

- The **UiPath Studio** platform helps to design Robotic processes with a visual interface.
- Automation in UiPath Studio requires no or very little prior programming knowledge. It is a Flowchart-based modeling tool. Thus, automation is faster and more convenient.

Projects

The main types of project supported by UiPath Studio are as follows:

Sequence: This is suitable for simple actions or tasks. It enables you to go from one activity to another, without interfering with your project.

-It consists of various activities.

-Creating sequences is also useful for debugging purposes.

-One activity from a particular sequence can easily be tracked.

-The Basic type of project can be started using the **Blank** option in the start tab and then adding the sequence in the diagram from the toolbox.

Flowchart: This is suitable for dealing with more complex projects.

-It enables you to integrate decisions and connect activities.

To start this kind of project, choose the **Flowchart - Simple Process** option from the new project menu.

Assistant: This is suitable for developing attended or Front Office Robots: sometimes these Robots are called assistants. To start this kind of project, choose the **Assistant - Agent Process Improvement** option from the new project menu.

State machine: This is suitable for very large projects that use a finite number of states in their execution, triggered by a condition.

-To start this kind of project, choose the **Process - Transaction Business Process** option from the new project menu

- However, if you click on the **New** option in the DESIGN tab, you only get three options:

Sequence

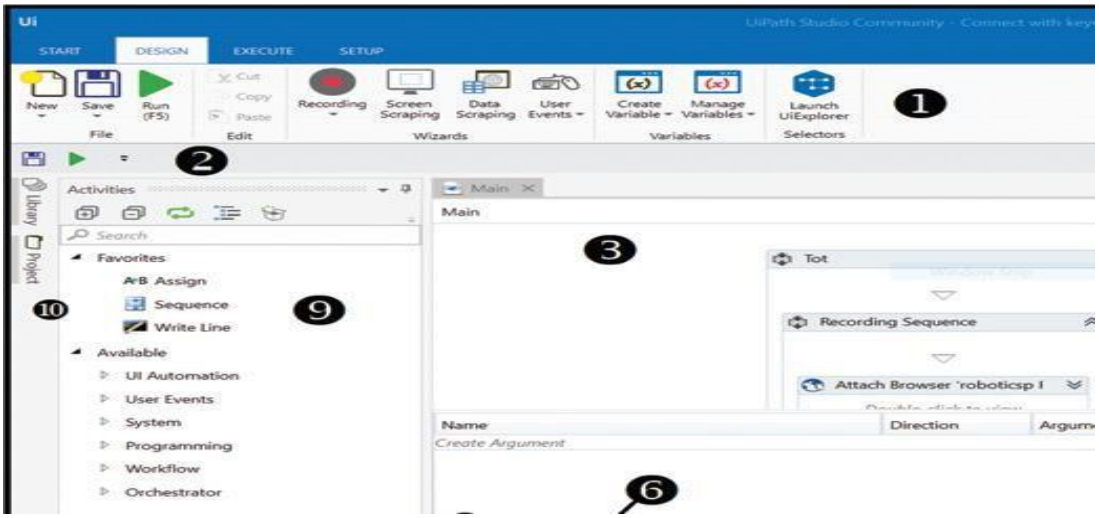
Flowchart

State Machine

The preceding options selected from the DESIGN tab's **New** menu become part of an existing project and are referred to as a diagram.

THE USER INTERFACE

- When you first open UiPath Studio, you are directed to the page.
- You can either open an old project or create a new one. Let us say we are making a new project.
- We click on **Blank** and name it. We will then be directed to a screen, which will display the following:



1. The Ribbon
2. Quick Access Toolbar
3. Designer panel
4. Properties panel
5. Outline panel
6. Arguments panel
7. Variable panel
8. Import panel
9. Activity panel
10. Library panel
11. Project panel
12. Output panel

1. The Ribbon

- This panel located at the top of the user interface and consists of four tabs:

1. **START**: This is used to start new projects or to open projects previously made.

2. **DESIGN**: This is to create new sequences, Flowcharts, or state machines, or to manage variables:

3. **EXECUTE**: This is used to run projects or to stop them, and also to debug Projects

4. **SETUP**: This panel is for deployment and configuration options; it has three tools available:

-Publish: This is used to publish a project or create a shortcut for it and schedule tasks

-Setup Extensions: This is used to install extensions for Chrome,
Firefox, Java, and Silver light

-Reset Settings: This is used to reset all settings to defaults:

2. The Quick Access Toolbar

- This panel gives the user a shortcut to the most used commands.
- One can also add new commands to this panel. This is located above the Ribbon on the user interface.
- The Quick Access Toolbar has been circled in the following screenshot and is indicated by the arrow:can be moved above or below the Ribbon. By default, there are two buttons available,**Save** and **Run**, which are also available in the **DESIGN** tab of the Ribbon.

3.Designer panel

- This is the panel where one defines the steps and activities of the projects.
- It is where a developer does most of the things to record activities or manually drop activities on the canvas.
- In UiPath, this is equivalent to the code windows of Microsoft Visual Studio. When we develop a Robot, this is the window where we will be organizing various activities in a flow or chain to accomplish a task.
- The project a user makes is clearly displayed on the Designer panel and the user has the option of making any changes to it.

4. Properties panel

- The panel located on the right-hand side of the user interface is for viewing the properties of the activities and for making any changes, if required.
- You need to select an activity first and then go to the **Properties** panel to view or change any of its properties

5. Activities panel

- Located on the left-hand side of the user interface, this panel contains all the activities that can be used in building the project.
- The activities can easily be used in making a project by simply dragging and dropping the required activity into the required location in the Designer panel.

6. Project panel

- With the **Project** panel, you can view the details of your current project and open it in a **Windows Explorer** window.
- It is located on the extreme left-hand side of the design panel,below the **Library** panel

7.Outline panel

- As the name suggests, this panel gives a basic outline of the project.
- The activities that make up the workflow are visible in this panel.
- Using this, you may see a high-level outline of the project and you can drill down to see deeper.
- This panel is especially helpful of large automation projects, where one may otherwise have a tough time going through it

8. Output panel

- This panel displays the output of the *log message* or *writes line* activities. It also displays the output during the debugging process.
- This panel also shows errors, warnings, information, and traces of the executed project. It is very helpful during debugging. The desired level of detail can be changed in **Execute | Options | Log activities**

9. Library panel

- With this panel, you can reuse automation snippets. It is located on the extreme left-hand side of the Designer panel:

10. Variable panel

- This allows the user to create variables and make changes to them. This is located below the Designer panel.
- In UiPath Studio, variables are used to store multiple types of data ranging from words, numbers, arrays, dates, times, and timetables.
- As the name suggests, the value of the variable can be changed.
- An important point to note is that variables can only be created if there is an activity in the Designer panel.
- To create new variables, you can go to the **DESIGN** tab on the Ribbon and click on **create variable**, and then choose the type of variable. Otherwise, one can simply go to the Variable panel located below the Designer panel and create a variable.

Argument

- While variables pass data from one activity to another in a project, arguments are used for passing data from one project to another.
- Like variables, they can be of various types-String, Integer, Boolean, Array, Generic, and so on.
- Since arguments are used to transfer data between different workflows, they also have an added property of *direction*. There are four types of direction:

In

Out

In/Out

Property

These depend on whether we are giving or receiving data to or from another workflow

2.8 TASK RECORDER

- The task recorder is the main reason for RPA's success.

- With the task recorder, we can create a basic framework for automation. The user's actions on the screen are recorded by the recorder and turned into a recording sequence in the current project.
- That's how Robots are able to mimic human actions.
- The recording is collection of execution steps that has to be taken, on the applications in the scope, in order to accomplish a task.
- These steps can be recorded one by one (manually) by pointing it on the screen or many steps in a go that is, automatically.

There are four types of recording in UiPath Studio:

Basic

Desktop

Web

Citrix

Basic recorder: Basic recorder is used to record activities on the desktop. This ype of recorder is used for single activities and simple workflows. The action here is self-contained and not contained in separate windows.

Desktop recorder: The desktop recorder, like the basic recorder, is used to record activities on the desktop. However, it is used to record and automate multiple actions and complex workflows. Each activity here is contained in an **Attach Window** component

-The **Attach Window** component is especially important to ensure that other windows of the same application do not interfere in the workflow.

Web recorder: The web recorder, as the name suggests, is used to record actions on web applications and browsers.

Citrix recorder: Citrix is used to record virtual machines, VNC, and Citrix environments. This recording allows only keyboard, text, and image automation.

- Some actions are recordable while others are not:

Recordable actions: Left-click on buttons, check boxes, drop-down lists, and other GUI elements. Text typing is also recordable.

Actions that cannot be recorded: Keyboard shortcuts, mouse hover, right-click.
Modifier keys such as *Ctrl* and *Alt* cannot be recorded.

- There are two types of recording:
- **Automatic recording**: This is for recording multiple actions in one go. This is a very good feature for preparing a solid foundation for automating a task. It can be invoked with the **Record** icon available in basic, desktop, and web recorders.
  Example, hotkeys, rightclick,double-click, and a few more.

- **Manual recording**: This type of recording is used to record each step one at a time and hence offers more control over the recording.
- Also, it can record all actions that cannot be recorded using automatic recording such as keyboard shortcuts, mouse hover, right-click, modifier keys, such as *Ctrl* and *Alt*, finding text from apps, and many other activities.
  - Citrix recorder can only record a single action (manual recording).

Shortcut keys:
***F2* key**: This pauses the recording for 3 seconds. The countdown menu is also shown on the screen.
Right-click: Exits the recording.
***Esc* key**: Exits the recording. If one presses the *Esc* key again, then the recording will be saved.

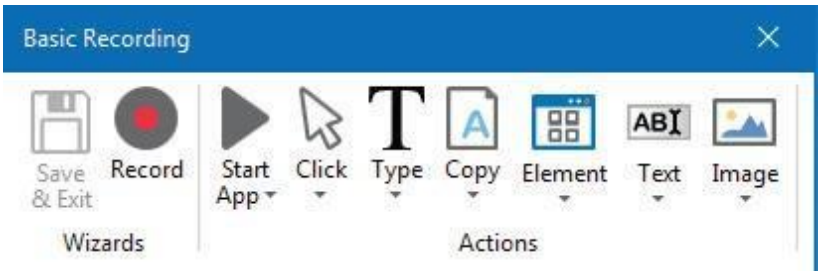
Recordings

The functions of these recordings. The operations that can be completed with the help of recording are as follows:

- Click (clicking a UI element: button, image, or icon)
- Type (typing any value into the available text field)
- Copy and paste

Basic Recorder

Recording. For example; **Start App**, **Click**, **Type**, **Copy**, and so on.



- **Start App**: This is used to start an application. When we left-click on this option, we are asked to point to an application that we want to open. When we are done, we can click on the **Save & Exit** option.
- **Click**: Another option is **Click**, which is used to click on a UI element. This feature is used as a mouse input. That is, it is used for clicking, checking, or selecting an item. When we click on this option, we are asked to indicate the location of the UI element we want to click. We can change the type of click to right-click or double-click in the **Click Type** property from the **Properties** panel.

- **Type**: Another option shown in the recording panel is Type. As the name suggests, it is used for typing something inside the indicated element. All you need to do is to indicate the area where you want to type. Then, you need to type your input in the popup that appears for typing
- After you are done typing, do not forget to press the *Enter* key. When the ***Enter* key** is pressed, the step is recorded.
- You can then click on **Save & Exit** to view the recording sequence.
- The recording sequence is shown in the following screenshot. You can change the text you have written (by changing the value of the **Type** in the block). You can write the desired text in double quotes (“ “), or you can simply use a variable to store the data
- There are UI three more options in the recording panel:

Element

Text

Image

Advanced UI interactions

Advanced UI interactions are input and output interactions. In other words, it refers to the types of input methods and output techniques that are used while automating.

Input methods

The input that we give in the form of text can be of three types:

1. Default
2. Simulate
3. Window message

-Default is the generated method, while the other two are available in the **Properties** panel..

-The other two methods work in the background. Out of these three methods, the simulate type is the fastest method and is mostly preferred because in the window message input type, it types only the lowercase characters.

Output methods

These are the methods we use for getting our output, which can be in the form of text or images. The available methods are:

Native

Full text

OCR

Native is, by default, the generated method to extract data from the window. When you indicate to any element, the scraping window appears, and here all of the options can be found.

In OCR, there are two types of **OCR engine**: One is Google OCR and the other is Microsoft OCR. We can choose whichever displays better results. Also, we can adjust the scale mentioned in the properties of the OCR.

Step-by-step examples using the recorder

We will illustrate two examples of using the UiPath recorder:

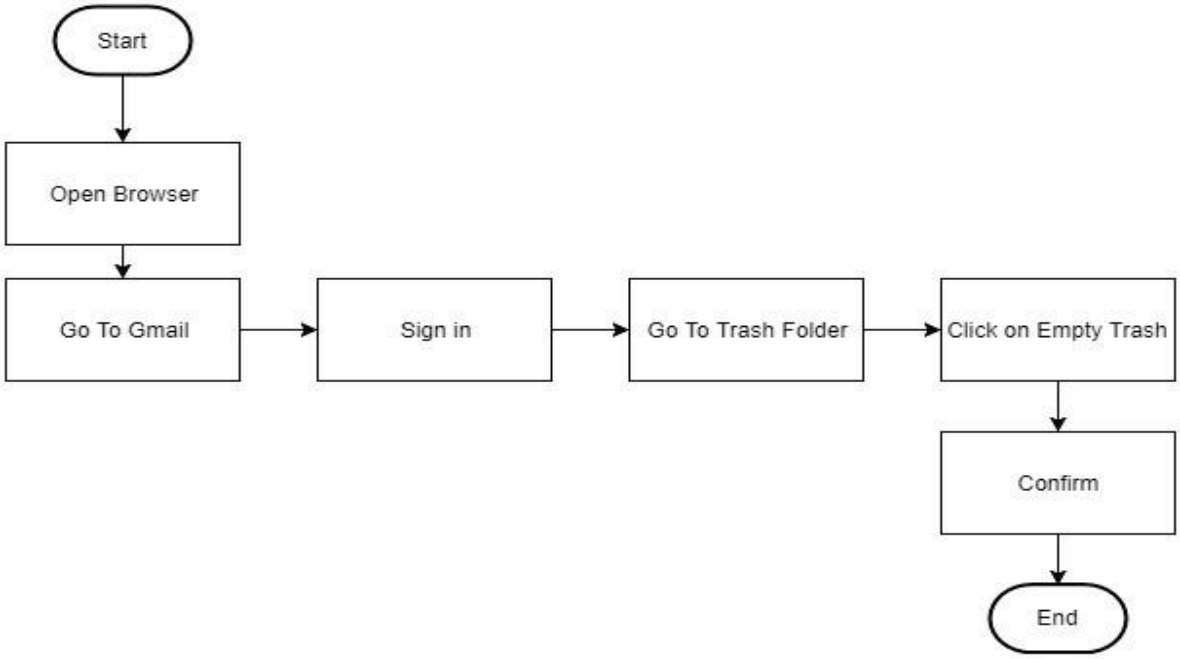
1. Emptying the trash folder in Gmail (**web-based application)**

2. Emptying Recycle Bin (**Windows based aplication**)

The first one is to show a recording of a web-based application, and the second is Windows based.

1. Emptying trash in Gmail

- This is an example of how we can empty a folder in Gmail with the help of a UiPath Robot, solely on the basis of recording.
- To do this, we are going to record all the actions that have to be performed to empty this Trash folder so that our Robot understands the sequence to be performed.
- The process flow of this simple activity in the following diagram:



Process flow for emptying Gmail trash

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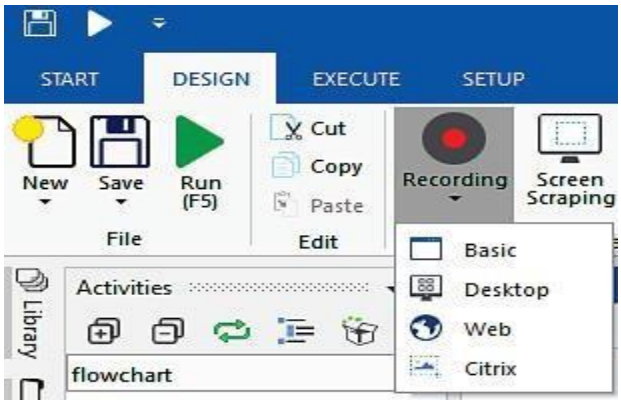
- First and foremost, we begin with a blank project in UiPath Studio and then choose **Web** recorder from the **Recording** drop-down list:

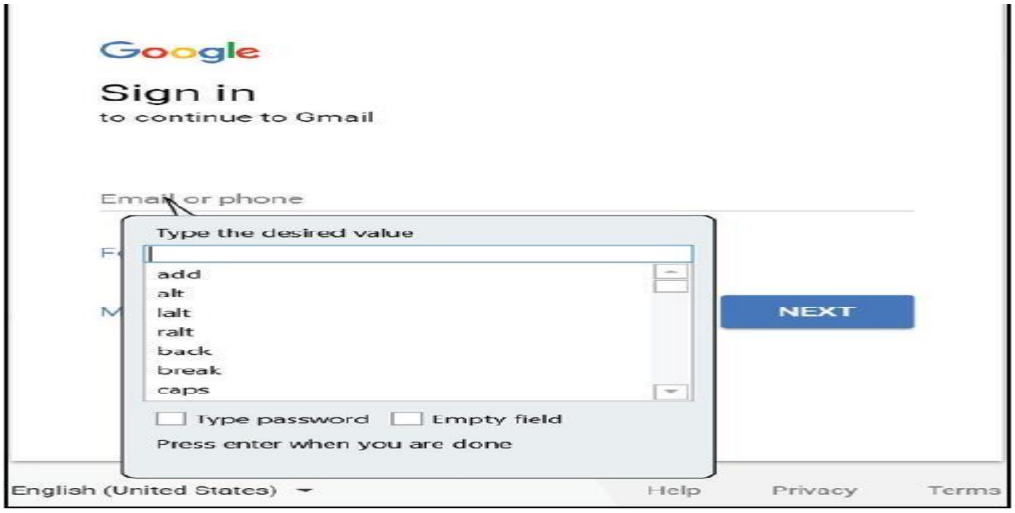


- To click on the **Recording** option and select the type of recording. We will use **Web** recording for this process since we are working on a website.
- Just click on the **Recording** icon at the top of the page. From the four types of recording that appear, choose **Web** recording. A **Web Recording** panel will appear, as shown in the above screenshot.
- Notice **Open Browser** between **Record** and **Click**; this is available with web recorder to record steps in browser-based applications.
- **Preparation**: Open your favourite browser, navigate to https://gmail.com, and keep this browser open.

The following are the six steps in our process flow:

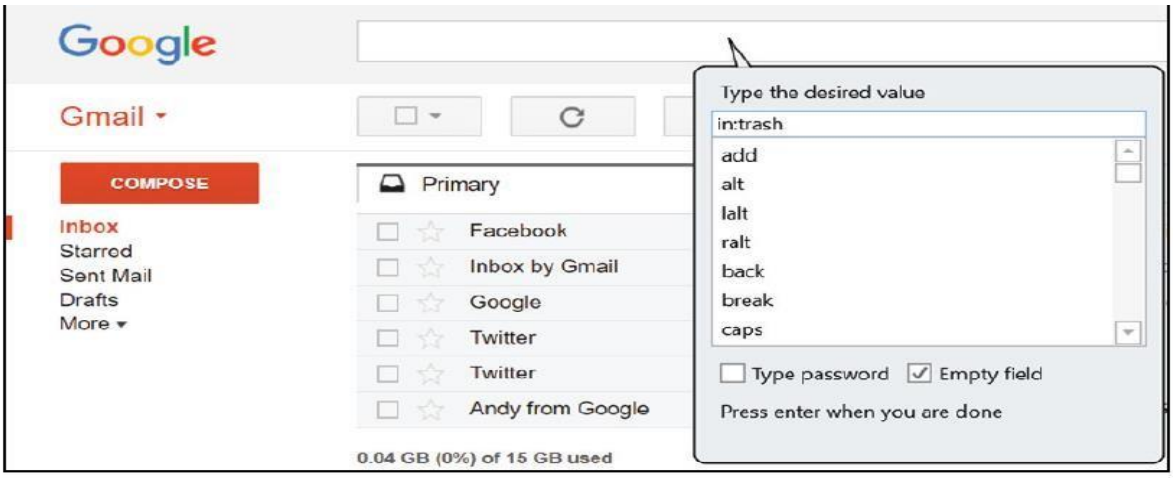
1. **Open Browser**: Although we have already opened Gmail in the browser, we did not record that step. Here, we will note that step in the recorder using the **Open Browser** button in the recorder. A drop-down menu will appear. Again, choose **Open Browser** from the drop-down menu. It will ask to highlight the browser, highlight the already opened browser and click on the top of the browser.
2. **Go to gmail.com**: You will be prompted to enter the **URL** of the website to navigate to. Type https://gmail.comor gmail.com and press **OK**:

3. **Sign In**: Start recording by clicking on the **Record** icon of the recording panel. Go to the already open Gmail and click on the Email or Phone field. UiPath will pop up a prompt for typing the email:



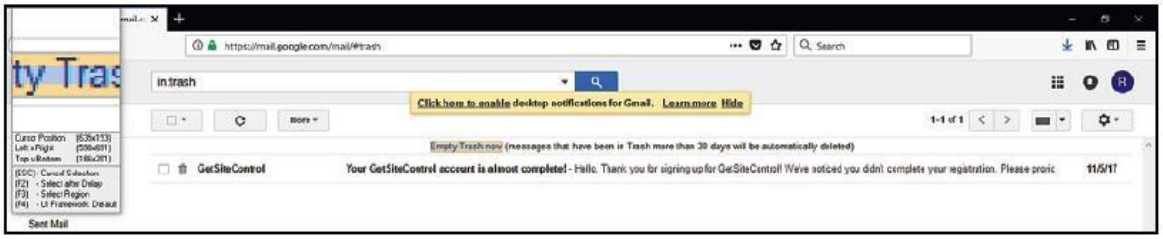
- Type Email in the box provided by the UiPath recorder and press *Enter*. The Gmail textbox will automatically fill up with your typed content. Click on the **NEXT** button of the Gmail interface; it will also get recorded.
- Now, you have recorded an entry in the password field. For simplicity, you may the password in the prompt provided by UiPath. Type your password in the text field of the popup that appears.
- Then, click **NEXT** to log in to your account. Clicking on the **NEXT** button will also get recorded.

4. **Locate Trash Folder**: In this step, we have to click on the search box of Gmail and type in:trash in the UiPath prompt and hit *Enter*:



- Now, click on the Search button beside the search box. It will also get recorded automatically and the Trash folder will appear.

5 **Click on Empty Trash now**: Once you are done with clicking on the Trash action, You can see a link showing **Empty Trash now**. Hover mouse on this link and it will get highlighted, click on it to delete all the messages in the Trash folder:

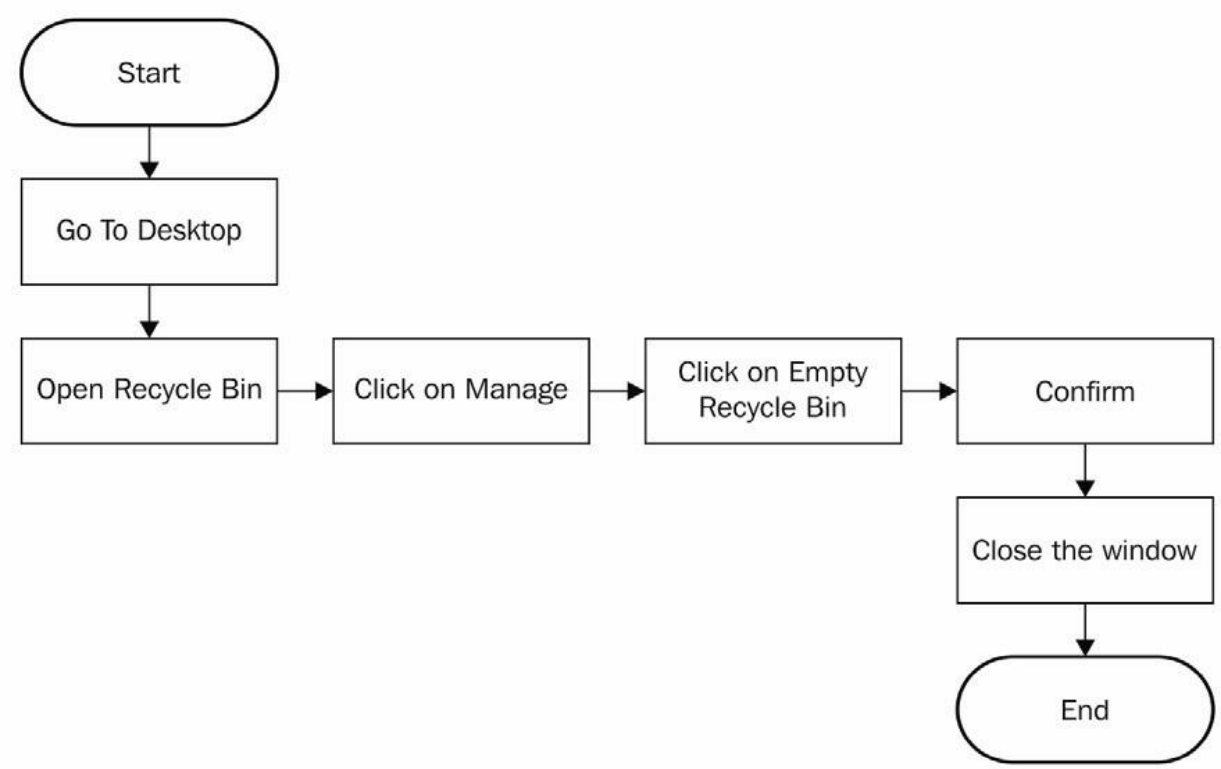


6 **Confirm**: When you click on **Empty Trash now**, a confirmation dialog will appear asking your permission for the action. Just confirm your action by clicking on the **OK** button.

- In the indicate anchor wizard, we have to indicate the adjacent button, that is, the **Cancel** button, so that the recorder will identify that the button is adjacent to **Cancel**.
- Now recording is complete, press *Esc* to get to the recording dialog. Click on the **Save & Exit** button.
- Then, in UiPath Studio, you can see a recording sequence in the Designer panel.
- Now run it by pressing the; *F5* key; it should perform the same task again. You have created your first Robot, which empties trash from your Gmail!

2. Emptying Recycle Bin

We are going to automate emptying the Recycle Bin. There are various steps that are involved. Let's map the process of how to empty the Recycle Bin:



This diagram is simpler and more detailed than in the Emptying trash in Gmail example; we need to do exactly the same steps in order to perform this task.

- Open UiPath Studio and choose a blank project.
- Since we are working in the recorder, and since we are working on the desktop and not a web application, we are required to choose the **desktop** recorder:

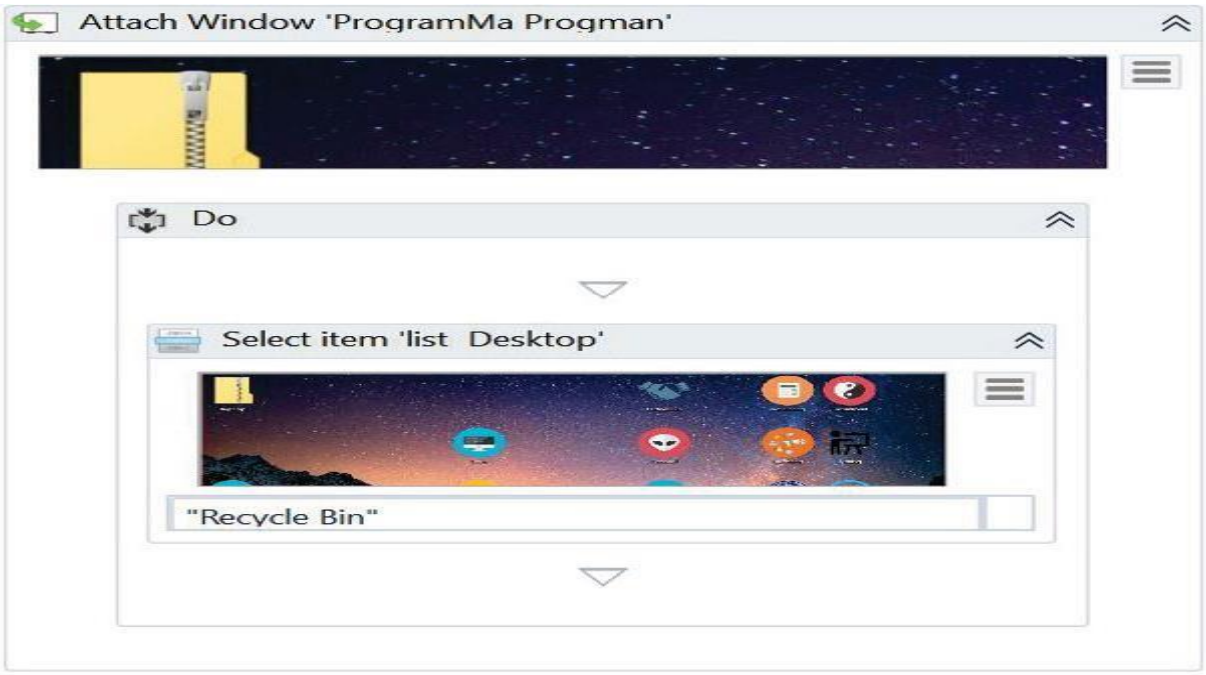
Start the recorder and simply perform the following steps:

1. Go to the desktop by pressing the *Windows + D* keys.
2. Open Recycle Bin by clicking on Recycle Bin and then pressing *Enter* key.
3. Click on the **Manage** tab of the Recycle Bin folder.
4. Click on the **Empty Recycle Bin** button.
5. Confirm by clicking on the **Yes** button in the dialog box.
6. Close the Recycle Bin folder by pressing the **cross** button.
7. Press the *Esc* key and **Save & Exit** the recorder.

Now your recording is ready to view, let's examine each step recorded:

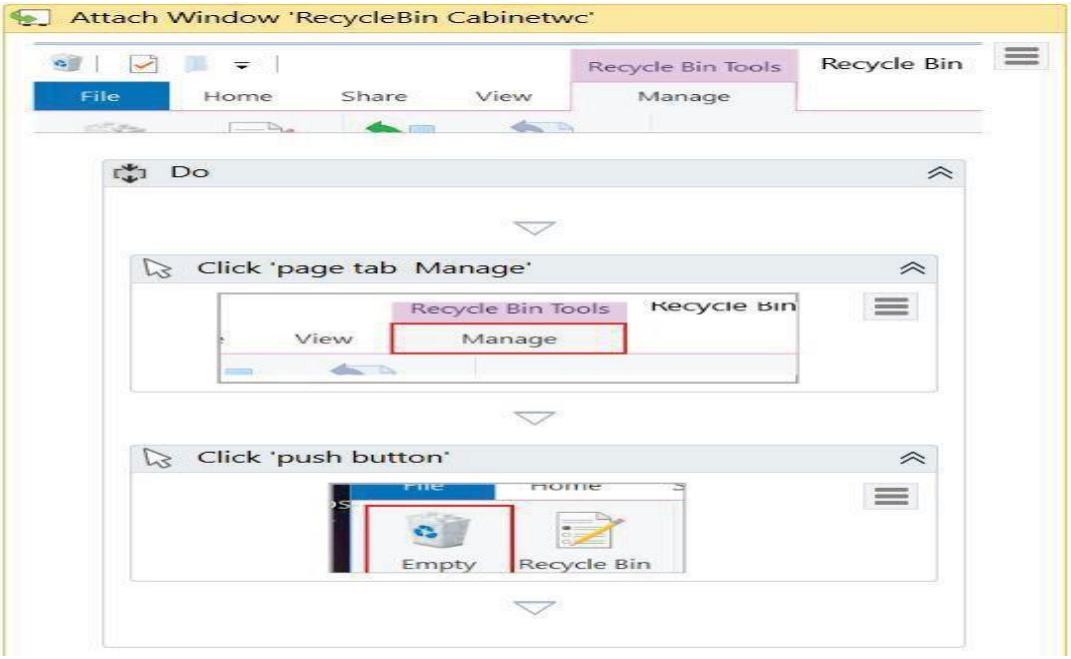
1. Go to the desktop by pressing *Windows + D* keys: This step is not recorded! Never mind, it is not needed. Please note that the recorded steps attach themselves to an application, and execute commands for that application, so the next step (Open Recycle Bin) will be executed on the desktop whether you are there or not.

2. Open Recycle Bin by clicking on Recycle Bin and then pressing the *Enter* key-We can see the recorded step in the following screenshot:

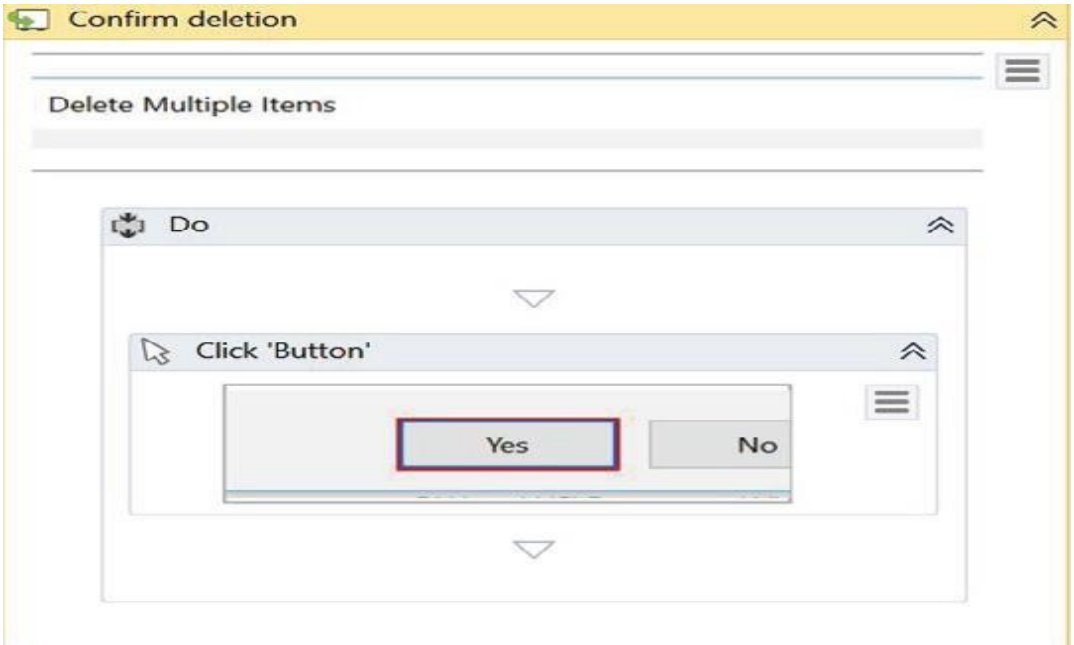


- selecting the Recycle Bin is recorded, not the *Enter* key. We should manually add that step. Search for Send hot key in the **Activities** window and insert it into the workflow just below the **Select item 'list Desktop'** step, as shown in the following screenshot:

- Click on the **Manage** tab of the Recycle Bin folder: This is recorded as it is and so is the fourth step, click on the **Empty Recycle Bin** button:



4. confirming by clicking on the **Yes** button on the dialog box is also recorded Smoothly:



In the last step, closing the Recycle Bin folder by pressing the **cross** button, you may have to indicate an anchor. Save it and press *F5* to run it. You see how easy it is to record steps taken on a computer and automate them.

Module-3

Sequence, Flowchart and Control Flow

3. Sequencing the workflow

Ui Path provides four types of projects:

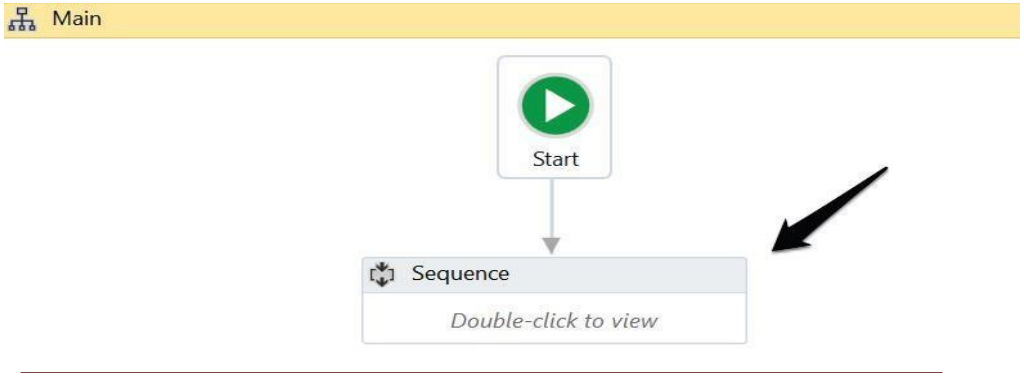
- Sequences
- Flowcharts
- User Events
- State Machines
  - A Flowchart and Sequence are mainly used for simple automation.
  - User Events are beneficial for implementing front office robots.
  - While State Machines are used for dealing with complex business processes.

3.1 What is a Sequence?

- A Sequence is a group of logical steps. Each step represents an action or a piece of work. A Sequence is used for processes that happen in linear succession, that is, one after the other.
- Among the three types of projects in UiPath, Sequences are the smallest.
- In the following example, we will make a simple project that asks for the name of the user and then displays his or her response:

1. Open Ui Path Studio and click on **Blank** to start a fresh project. Give it a meaningful name. On the Designer panel, drag and drop a **Flowchart** activity from the **Activities** panel.

2. Search for Sequence in the **Activities** panel and then drag and drop it into the **Flowchart**, as shown in the following screenshot:

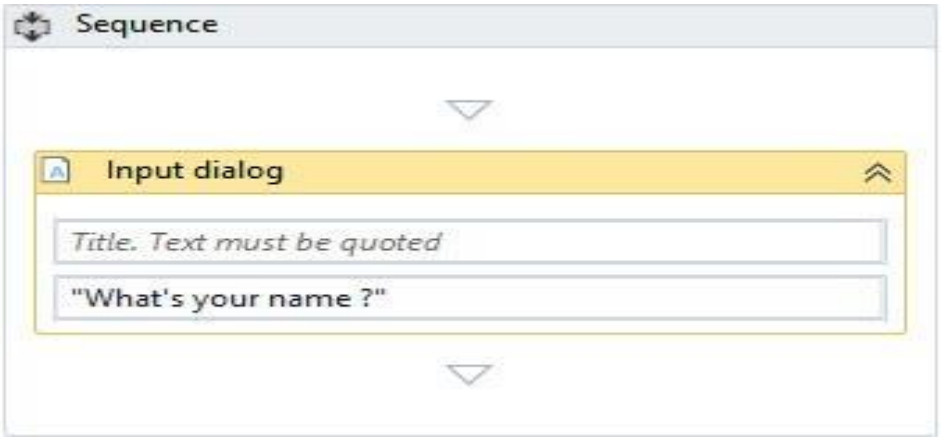


3. Double-click on the **Sequence**. We now have to add the steps that we want to perform. Consider each step as an action.

We can add many steps inside a **Sequence**. For the sake of simplicity, we will add two steps:

- Ask for the username in an **Input dialog**
- Display the username in a **Message box**

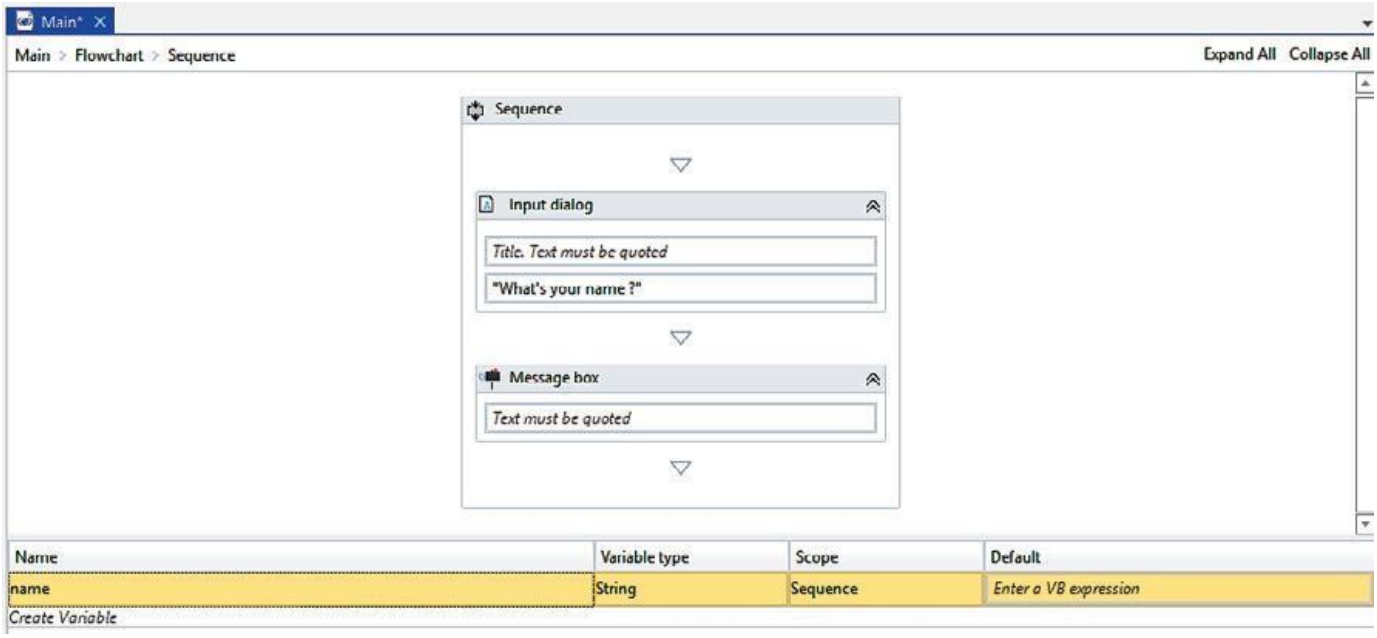
4. Search for Input dialog in the Search panel of the Activities panel. Drag and drop the Input dialog activity inside the Sequence (the Input dialog activity is a dialog box that appears with a message or a question; in response to which the user is required to put in his or her reply):



Write the appropriate message on the **Label** of this **Input dialog** to ask for the user's name. In our case, we have put in “What’s your name?”.

5. Drag and drop a **Message box** activity into the **Sequence**. (A **Message box**, as the name suggests, displays a given text. In this case, we will use it to display the text/reply that the user has given in the **Input dialog** box on being asked his/her name.)

6. Next, create a variable and give it the desired name. This variable will receive the text that the user has entered in the **Input dialog** box in response to our question, that is, the user's name:

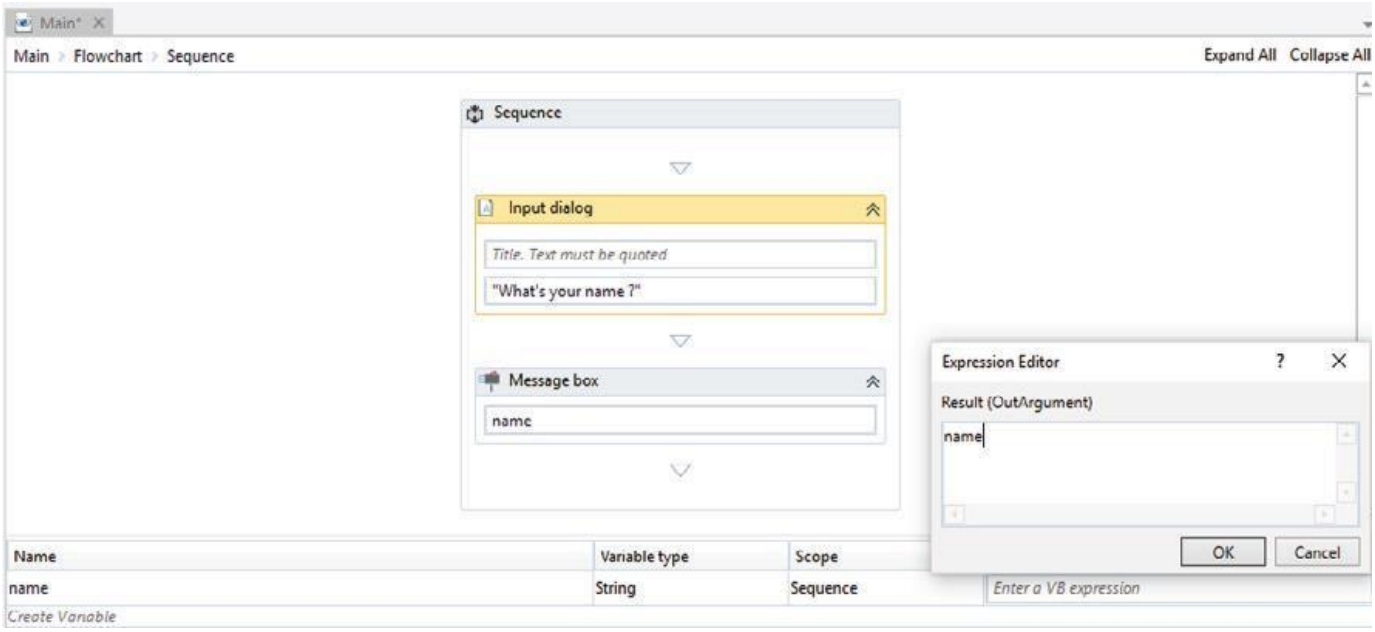


7. We now have to specify the **Result** property (in the **Properties** panel) of the **Input dialog** box.

On specifying the variable name there, it will receive the text that the user entered.

Click on the dotted icon that appears on the right side of the **Result** property.

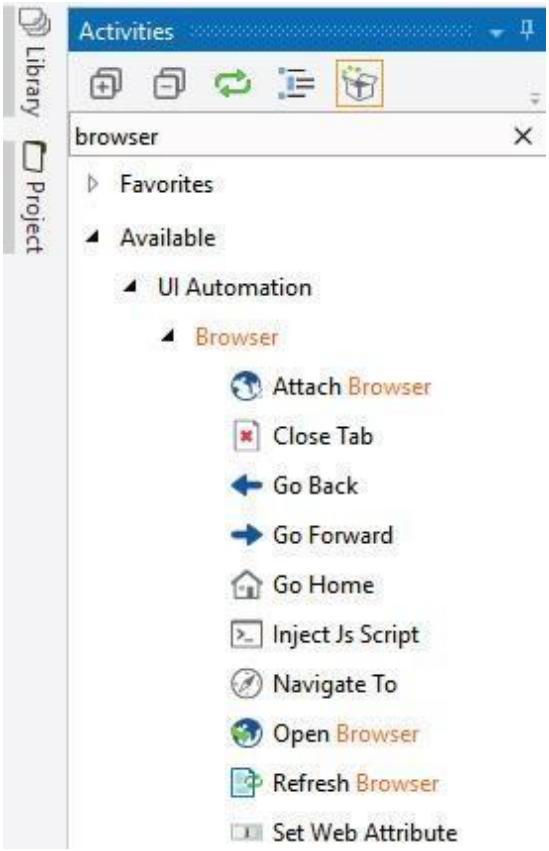
Now, specify the variable name:



8. Specify the variable name that we have created in the Text area of the **Message box** (the Text area of the **Message box** is used to input text that will be displayed in the **Message box**). We just need to connect the **Sequence** to the **Start** icon.
This can be done by right-clicking on the **Sequence** activity and choosing the **Set as Start node** option.
9. Hit the **Run** button and see the result.

3.2 Activities

- **Activity** represents the unit of an action. Each activity performs some action. When these activities combine together, it becomes a process.
- Every activity resides on the **Activities** panel of the main Designer panel. You can search for a particular activity and use it in your project.
- For example, when we search for **browser**, all the browser activities will appear in the **Activities** panel, as shown in the following screenshot:



3.2.1 **Using activities with workflows**

We have seen how we can easily search for a particular activity. Now, let us see how to use them in a workflow:
1. Search for **Flowchart** in the same way that we have searched for the browser activities in the **Activities** panel search bar. Drag and drop the **Flowchart** activity inside the Designer panel.

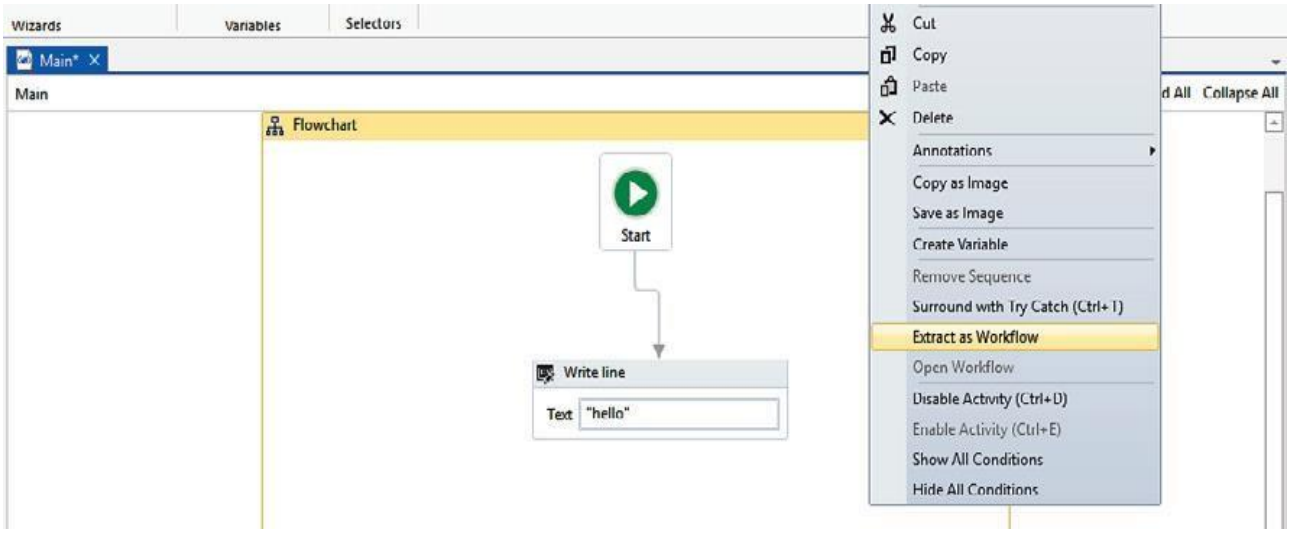
2. The **Flowchart** appears in the Designer panel and we have a given **Start** node. The **Start** node specifies where the execution begins.

3. We are ready to use different activities in our **Flowchart**. You can use any activity/activities inside the **Flowchart**. For the sake of simplicity, let us just use a **Write line** activity.

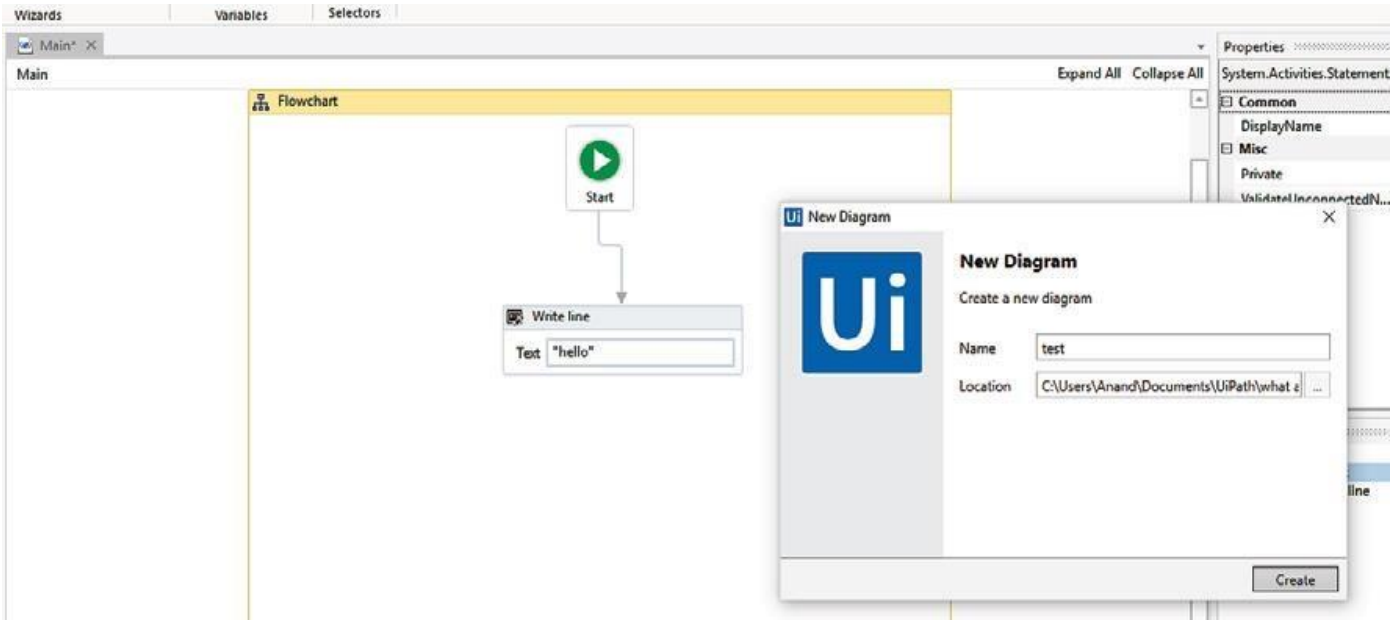
4. Drag and drop the **Write line** activity inside the **Flowchart**. Set its text property by providing a string value. Connect this **Write line** activity with the **Start** node by right-clicking on the **Write line** activity and selecting **Set as Start Node**.

Creating different workflows and combining them into a logical **Sequence** will enhance our code quality, maintainability, reliability, and readability.

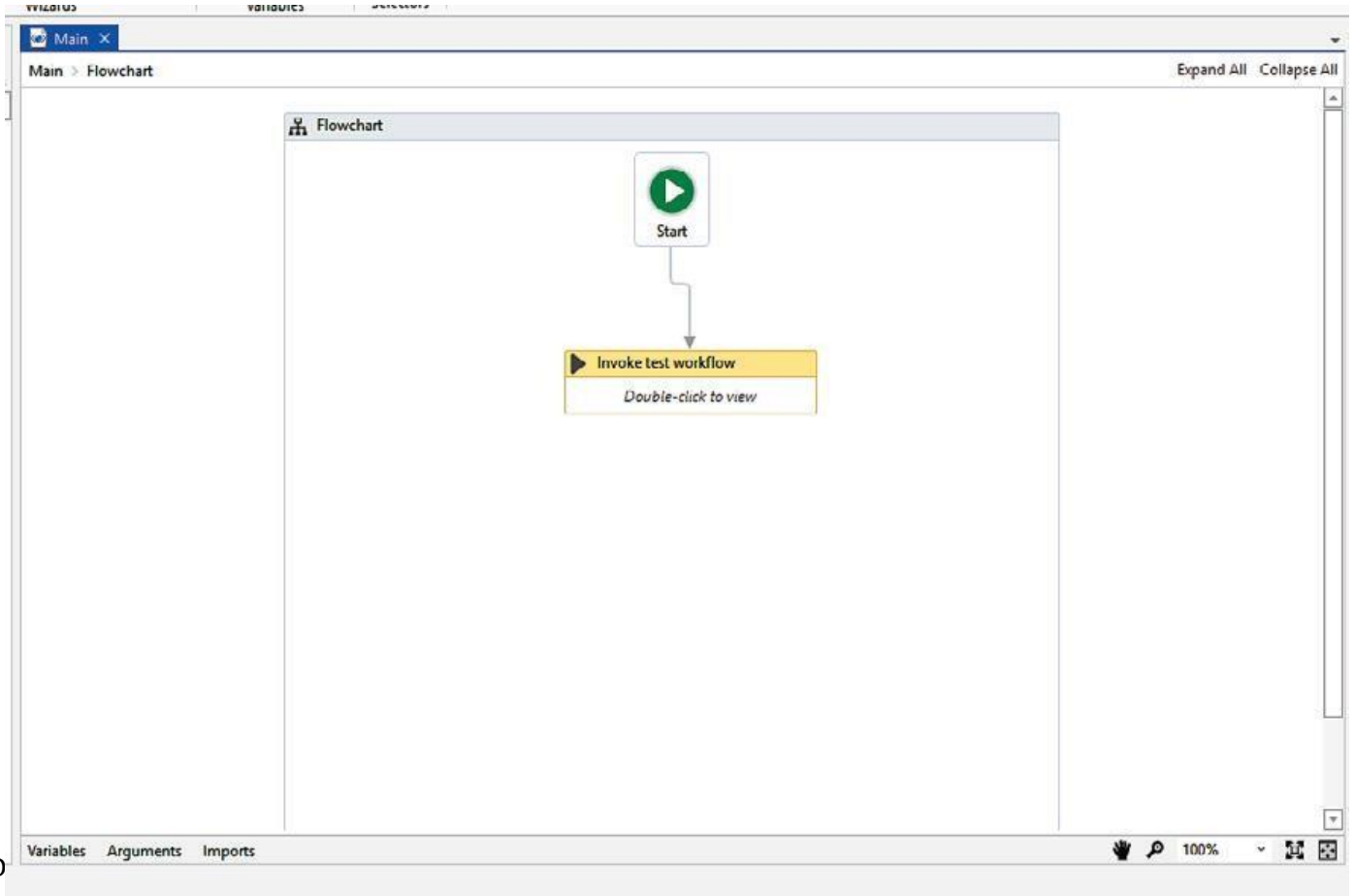
Right-click on the main Designer panel and choose **Extract as Workflow**:



A window will pop up asking for the name. Give it a meaningful name and click on **Create**. This will be the name of your workflow:



We have just used activities and extracted them in a workflow. If you check the main Designer panel, it looks like the following screenshot:



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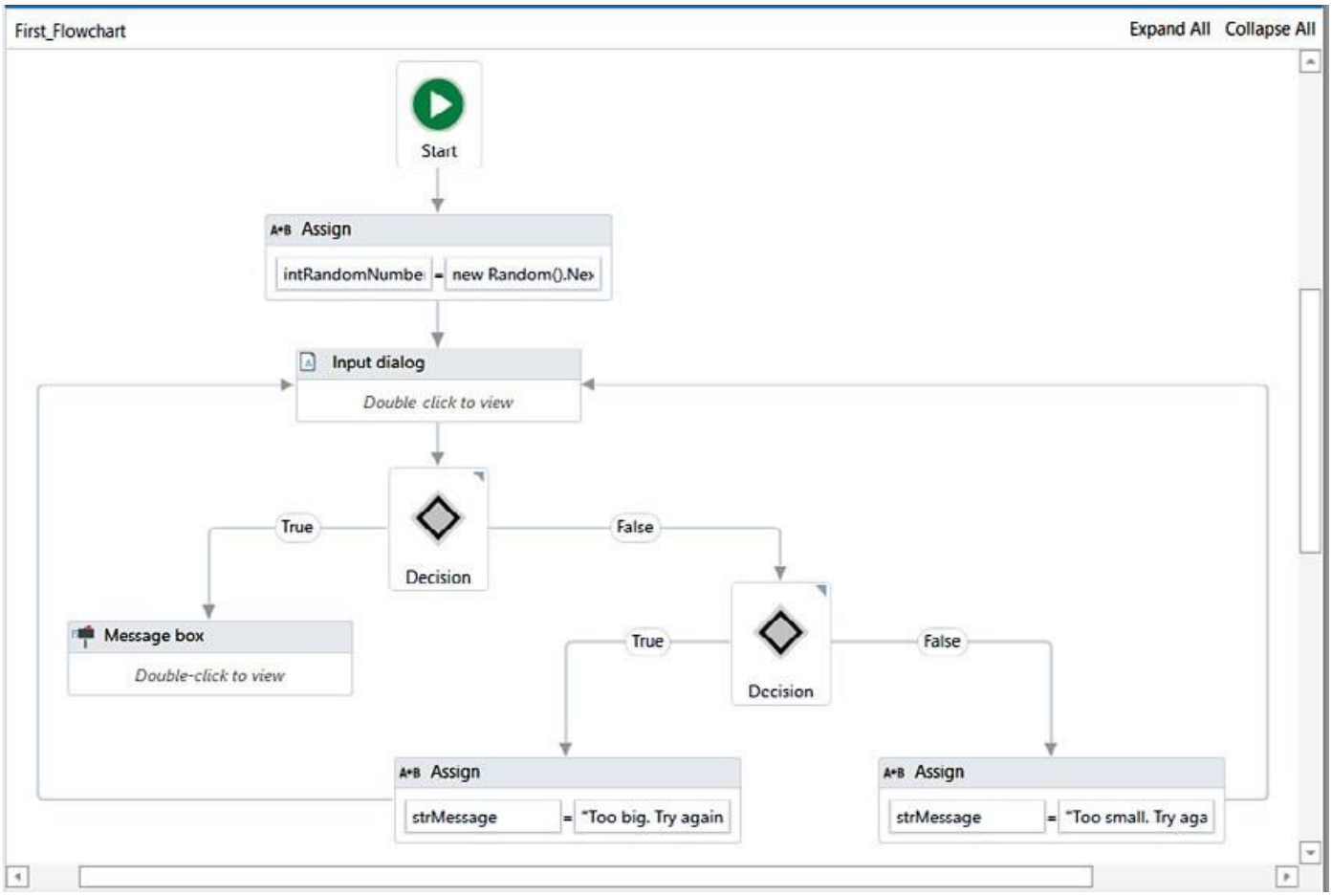
It automatically generates the **Invoke test Workflow** activity. Now, when we run the program, it will invoke the workflow that we have extracted (double-click on the **Invoke test workflow** activity to see which workflow it is going to invoke and where it is generated).

3.1.2 What Flowcharts are and when to use them

A Flowchart is generally used for complex business processes. It provides decision-making Facilities and can be used for both small and large projects. Here, we can add activities in Different ways:



A Flowchart provides multiple branching logical operators to make decisions. A Flowchart is able to run in reverse. Also, it can be used inside Sequences. A Flowchart facilitates reusability for distinct projects. Once we create it to use in a project, it can be used for a different but similar project.

A Flowchart's branches are set to true/false by default. However, its names can be manually changed from the **Properties** panel.

For example, enter two numbers and check whether their sum is less than 20.

Perform the following steps:

1. First, add a **Flowchart** from the **Activities** panel into the Designer panel.
2. Add a **Sequence** activity within the **Flowchart**.
3. Take two **Input dialog** activities (for entering the numbers to be added) inside the **Sequence** activity.
4. Create the variables *x* and *y* to save the values.
5. Next, add a **Message box** activity to perform a mathematical operation. In our case, the sum of the two numbers is less than 20:

$x + y < 20$

6. Now, add a **Flow Decision** activity to check the mathematical operation.
7. If true, the **Flow Decision** will flow toward the true branch. Otherwise, it will flow towards the false branch.

3.3 Control flow, various types of loops, and decision making

Control flow refers to the order or the particular manner in which actions are performed in an automation. UiPath provides numerous activities for performing the decision-making process.
These activities, present in the **Activities** panel, are put into the workflow either using the double-click method or the drag and drop method.

Different types of control flow activities are as follows:

- The Assign activity
- The Delay activity
- The Break activity
- The While activity
- The Do While activity
- The For each activity
- The If activity
- The Switch activity

3.3.1 The Assign activity

- The **Assign** activity is used to designate a value to the variable.
- The Assign activity can be used for different purposes, such as incrementing the value of a variable in a loop, or using the results of a sum, difference, multiplication, or division of variables and assigning it to another variable.

3.3.2 The Delay activity

- The **Delay** activity, as the name suggests, is used to delay or slow down an automation by pausing it for a defined period of time.
- The workflow continues after the specified period of time. It is in the hh:mm:ss format.
- This activity plays a significant role when we need a waiting period during automation, perhaps say, a waiting period required for a particular application to open.

Example: To better understand how the **Delay** activity works; let us see an example of an automation that writes two messages to the **Output** panel with a delay of 50 seconds. Perform the following steps:

1. First, create a new **Flowchart**.

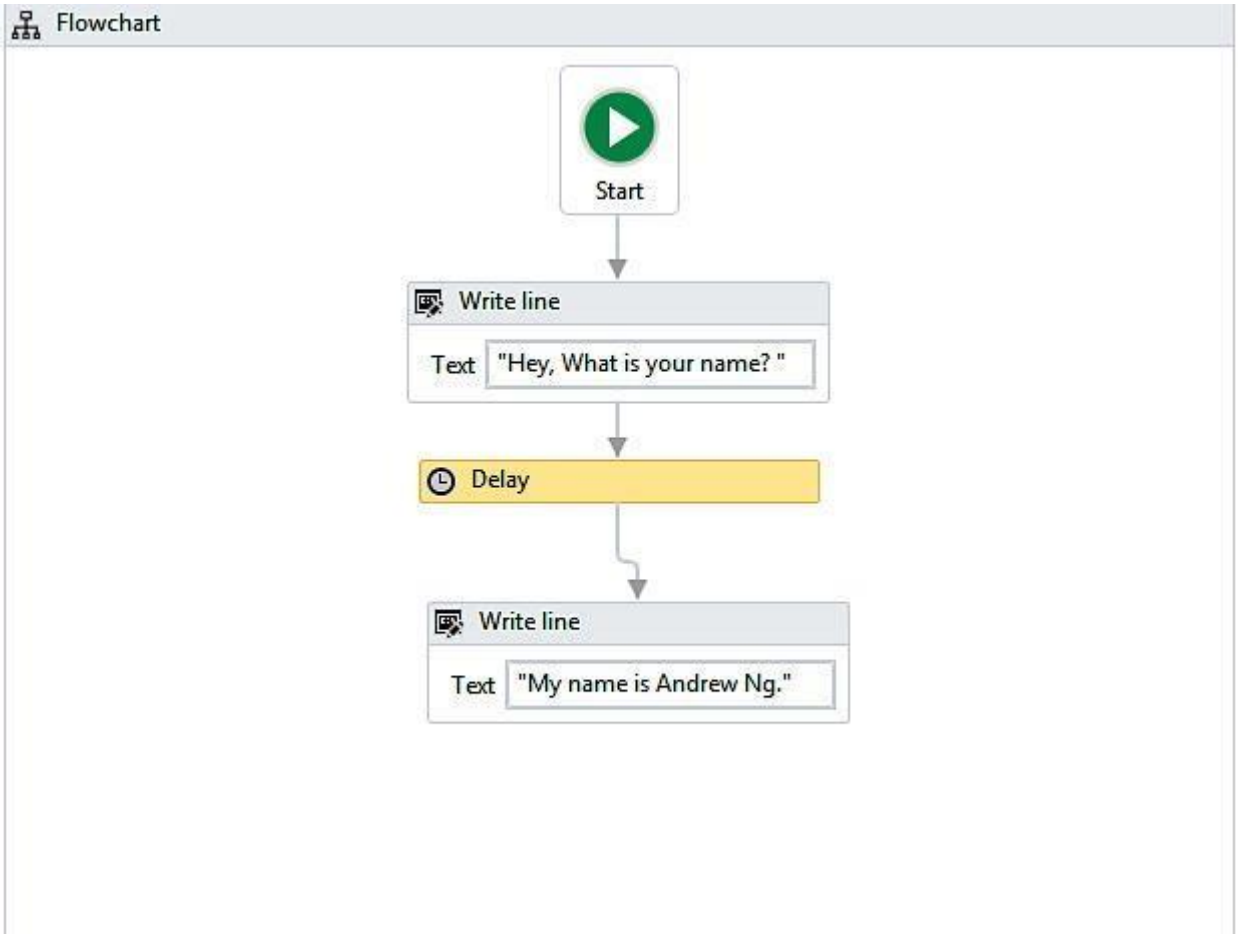
2. Add a **Write line** activity from the **Activities** panel and connect it to the **Start** node.

3. Select the **Write line** activity. Now, type the following text into the **Text** box: "Hey, what is your name".

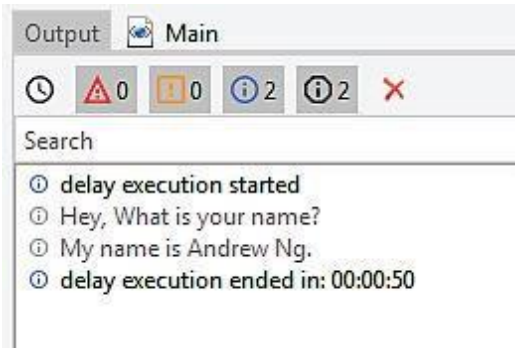
4. Next, add a **Delay** activity and connect it to the **Write line** activity.

5. Select the **Delay** activity and go to the **Properties** panel. In the **Duration** field, set 00:00:50. This is a 50-second delay between the two logged messages.

6. Take another **Write line** activity and connect it to the **Delay** activity. In the **Text** field, write "My name is Andrew Ng,":



7. After clicking on the **Run** button, the **Output** panel shows the message that delays it by 50 seconds:



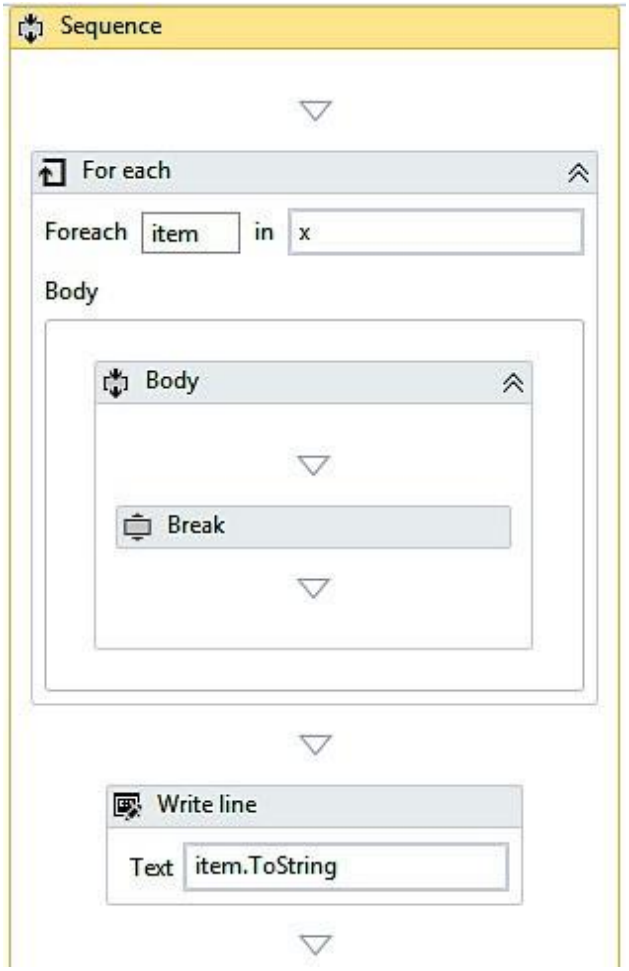
3.3.3 The Break activity

- The **Break** activity is used to break/stop the loop at a particular point, and then continue to the next activity according to the requirement.
- It cannot be used for any other activity apart from the For each activity.
- It is useful when we want to break the loop to continue to the next activity in the For each activity.

In this example, we will use the Break activity to execute only one iteration. Perform the following steps:

1. Add a **Sequence** activity to the Designer panel.

2. Next, add a **For each** activity inside the **Sequence** (as mentioned in the preceding section, to use the **Break** activity, we need the **For each** activity):



3. Create two variables; an integer variable named Item, and an array integer variable named X. Then, set them to the text field.

4. Now, assign a default value to the integer variable X.
5. Add a **Break** activity inside the body of the loop.

6. Under the **For Each** activity, add a **Write line** activity.

7. In the **Write line** activity, type Item to string in the text field.

8. When we click the **Run** button, it will display one element, as shown in the following screenshot. This is due to the **Break** activity, which has stopped execution after the first iteration:

A loop can simply be created by connecting the end of the workflow to the point where we want the workflow to resume. The While, Do while, and For each activities mentioned among the various control flow activities are examples of loops.

3.3.4 The While activity

- The While activity is used in automation to execute a statement or process based on a certain condition. If found true, the loop is executed; that is, the process is executed repeatedly.
- The project only exits from the loop when the condition does not hold true. This Activity is useful while iterating through an array of elements.

In the example, we will see how an integer variable will increase from 5 to 50 in increments of 5.Perform the following steps:

1. On a **Blank** project, add a **Sequence** activity.

2. Now, create an integer type variable X. Set its default value to 5.

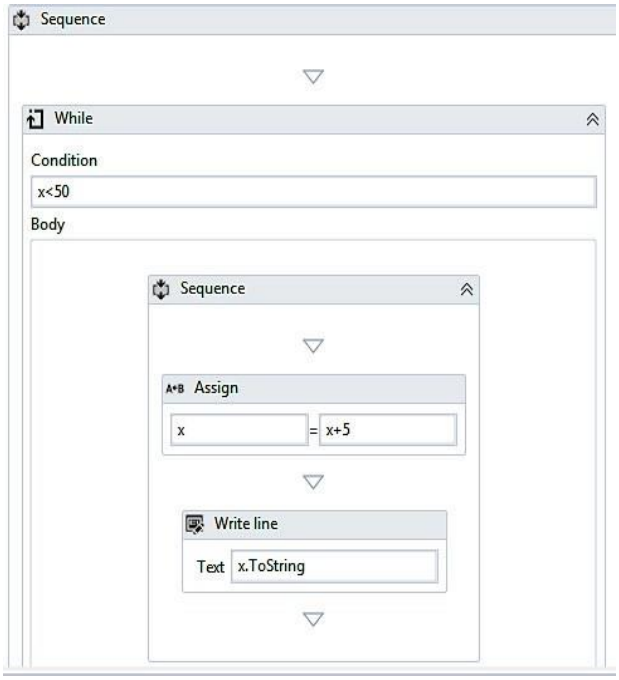
3. Next, add a **While** activity to the **Sequence**.

4. In the condition field, set X<5.

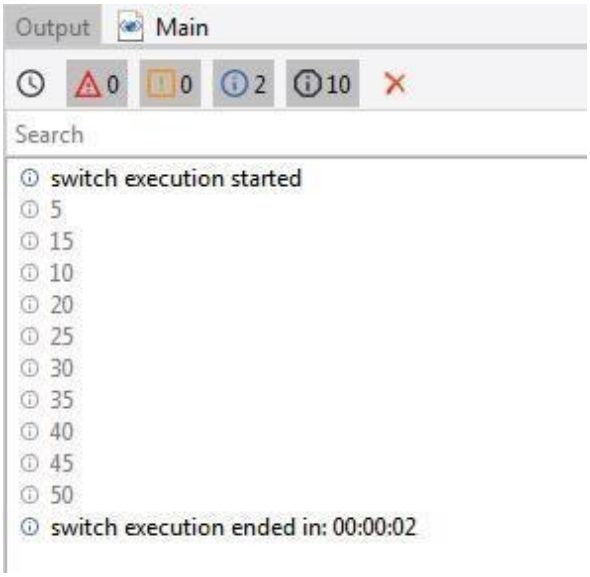
5. Add an **Assign** activity to the body section of the **While** loop.

6. Now, go to the **Properties** panel of the **Assign** activity and type in the text field Integer variable for value field integer X+5.

7. Drag and drop a **Write line** activity and specify the variable name X and apply Tostring method on this variable:



8. Now, click the Run button. The output will display in the Output panel, as shown in the following screenshot:



3.3.5 The Do while activity

- The Do while activity is used in automation when it is required to execute a statement based on the fulfillment of a certain condition.
- While activity executes a statement, then checks whether the condition is fulfilled.
- If the condition is not fulfilled, it exits the loop.

example to understand how the Do while activity works in automation. Take an integer variable. Starting with this variable, we shall generate all multiples of 2, less than 20.

Perform the following steps:

1. Add a Sequence to the Designer panel.

2. Add a Do while activity from the Activities panel.

3. In the body section of the Do while activity, add an Assign activity.

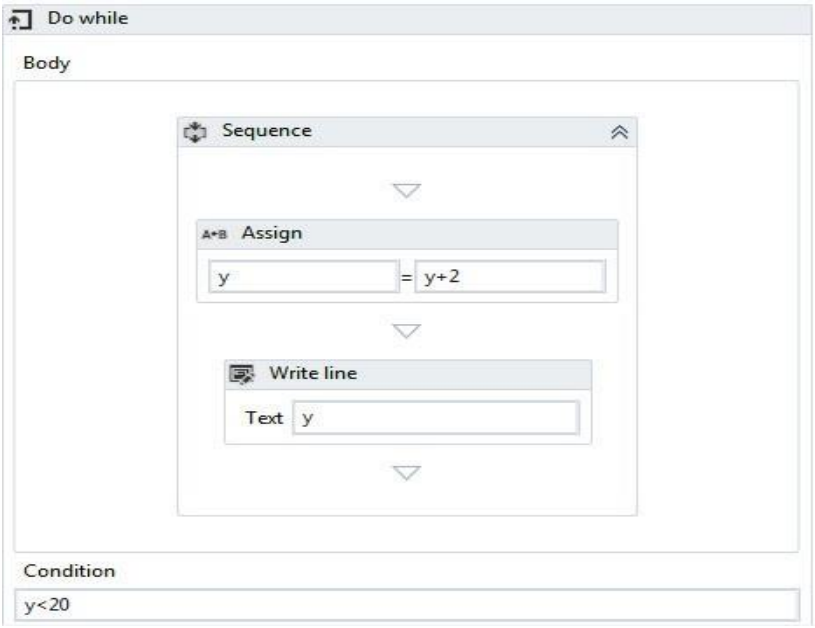
4. Now, select the Assign activity. Go to the Properties panel and create an integer variable y. Set its default value to 2.

5. Set y+2 in the value section of the Assign activity to increment the result each time by 2 until the loop is executed.

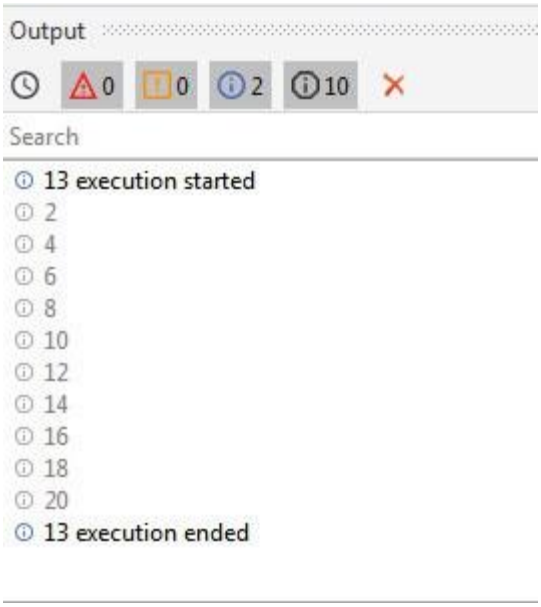
6. Add a Write line activity inside the Assign activity.

7. In the text field of the Write line activity, type y.

8. In the condition section, set the condition y<20. The loop will continue until the condition holds true:



9. On clicking the Run button, the output displayed will be as follows:



3.3.6 The For each activity

- The For each activity works by iterating each element from the collection of items or list of elements, one at a time.
- In the process, it will execute all the actions that are available inside the body. Thus, it iterates through the data and processes each piece of information separately.

Example, we shall use the For each activity to go through a collection of even numbers and display each element one at a time.

Perform the following steps:

1. Start with a **Blank** project in UiPath.

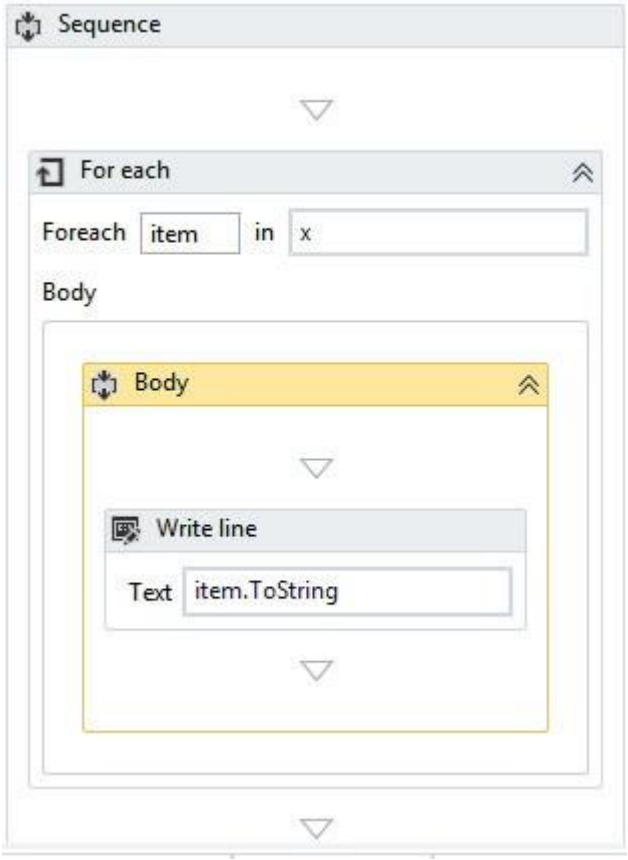
2. Add a **Sequence** activity to the Designer panel.

3. Next, add a **For each** activity within the **Sequence** and create an integer type array variable, X.

3. In the default value of the variable, put in ({2,4,6,8,10,12,14,16,18,20}).

4. Add a **Write line** activity to the Designer Panel (this activity is used to display the results).

6. In the **Text** field of the **Write line** activity, type item. To string to display the output:



7. Now, run the program. You will see that each number of the array is displayed one by one because of the use of the For each activity:

The If activity and the Switch activity are the Control flow's decision-making activities.

3.3.7 The If activity

- The If activity consists of a statement with two conditions: true or false.
- If the statement is true, then the first condition is executed; if not, the second condition is executed.
- This is useful when we have to take decisions on the basis of statements.

example that checks whether the sum of any two numbers is less than 6.
Perform the following steps:

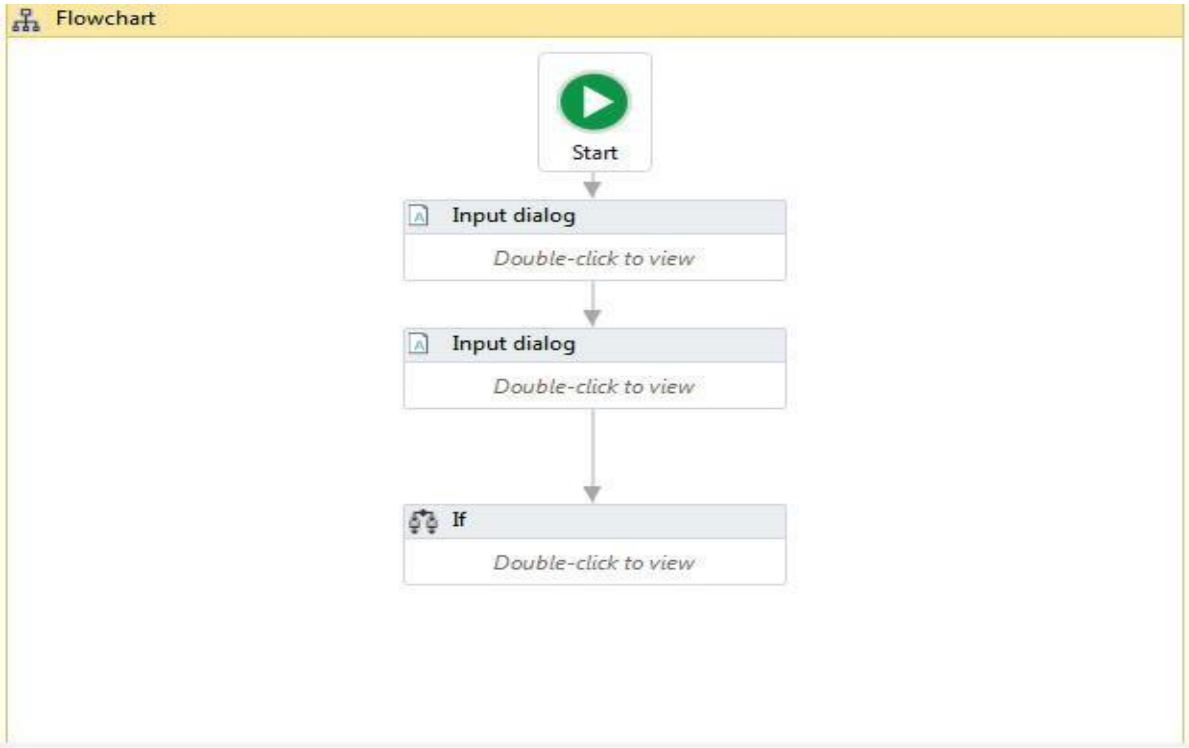
1. Add a **Flowchart** from the **Activities** panel.

2. Add two **Input dialog** activities. Create two integer variables, *x* and *y*.

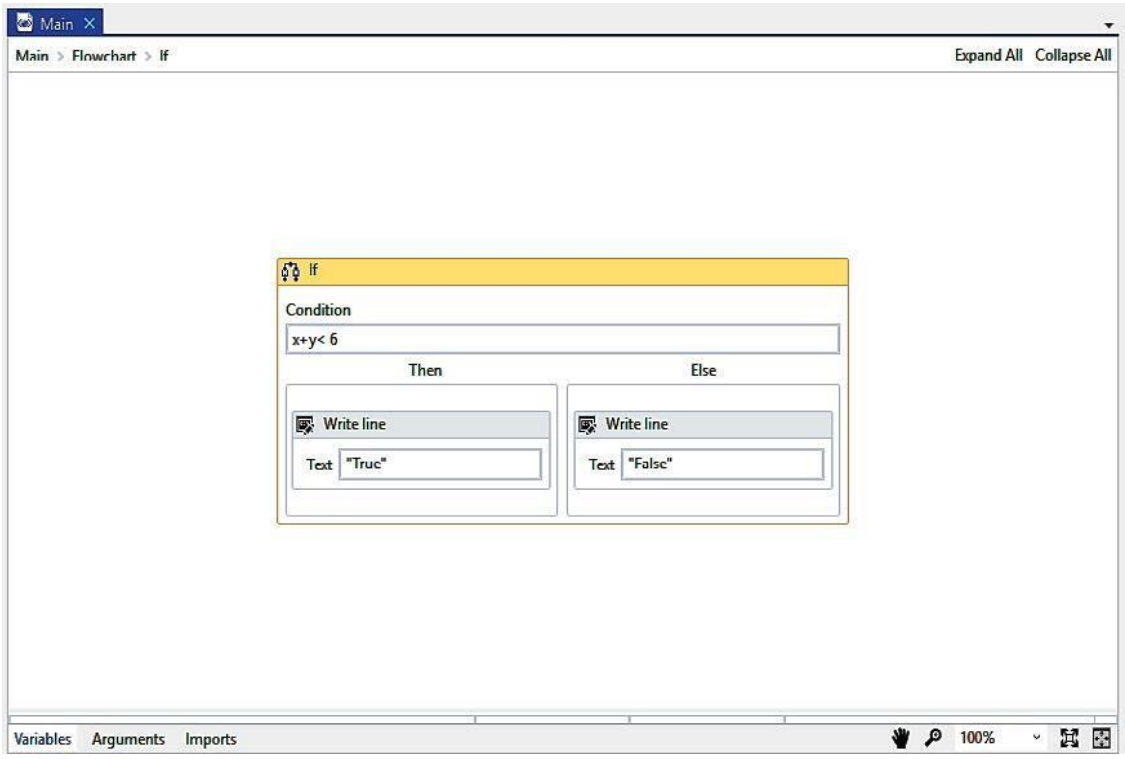
3. In the **Properties** panel, change the label name and title name of both the **Input dialog** activities.

4. Now, specify these name of these two variables in the **Result** property of both the **Input dialog** activities.

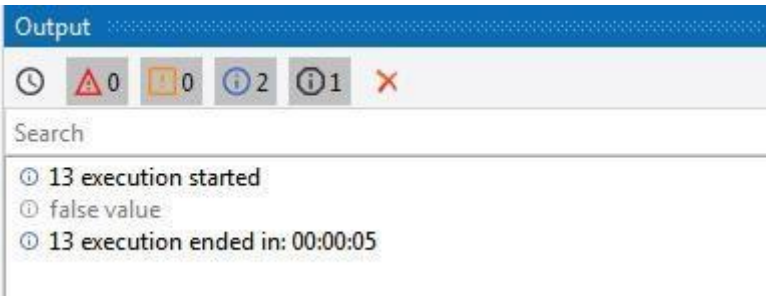
5. Now add the **If** activity to the Designer panel.



6. In the condition part, X+Y<6 check whether it is true or false. Add two Write line activities and type “True” in one and “False” in the other:



7. Click the **Run** button to check the output. If the condition holds true then it will show the true value; otherwise, it will show the false value, as shown in the second screenshot (in our case, we put in the values of *x* and *y* as x and y, respectively, thus getting a sum of 13, which is not less than 6; hence, the output shows it as false value):



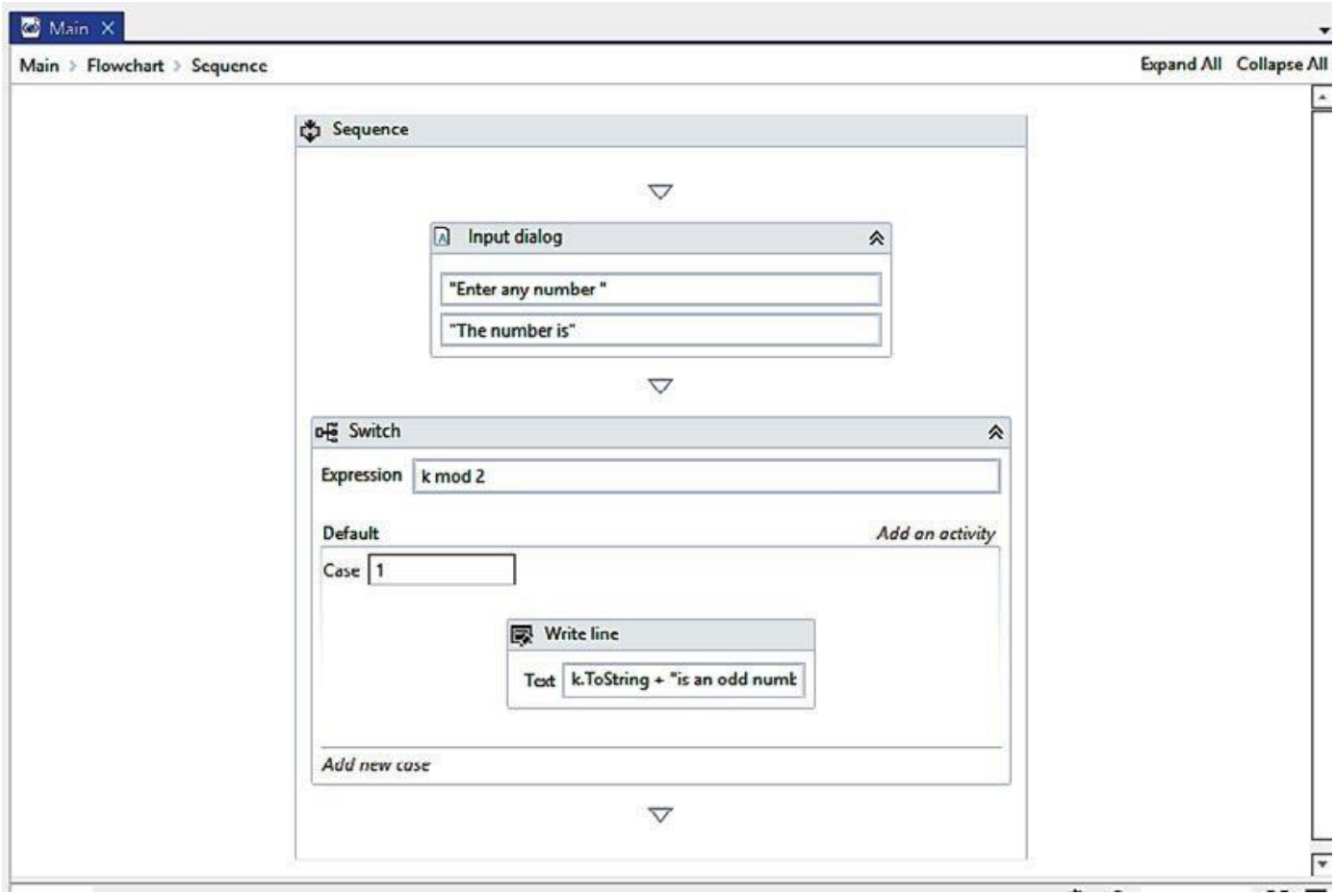
3.3.8 The Switch activity

- The **Switch** activity can be used to make a choice.
- When we have various options available and want to execute one option, we frequently usethe Switch activity.
- By default, the Switch activity takes an integer argument. If we want to take a desired argument, then we can change it from the Properties panel, from the Type Argument list.
- The Switch activity is very useful in the categorization of data according to one's ownChoice.

- Example where we have to check whether a given number is odd or even.
- We know that all odd numbers, when divided by 2, leave a remainder of 1.
- On the other hand, even numbers, on being divided by 2, leave a remainder of 0.
- Hence, we will have two cases getting a remainder of 1 or 0.

Perform the following steps:

1. Add a **Sequence** activity.
2. Add an **Input dialog** activity inside the **Sequence**.
3. Now, create an integer type variable k.
4. Specify the newly created variable's name in the **Result** property inside the **Properties** panel.
5. Add the **Switch** activity under the **Input dialog** activity.
6. In the **Expression** field, set k mode 2 to check whether the number is divisible by 2 or not.
7. Add a **Write line** activity to the **Default** section and type the k. To string + "is an even number" in the text field.



3.4 Step-by-step example using Sequence and Flowchart

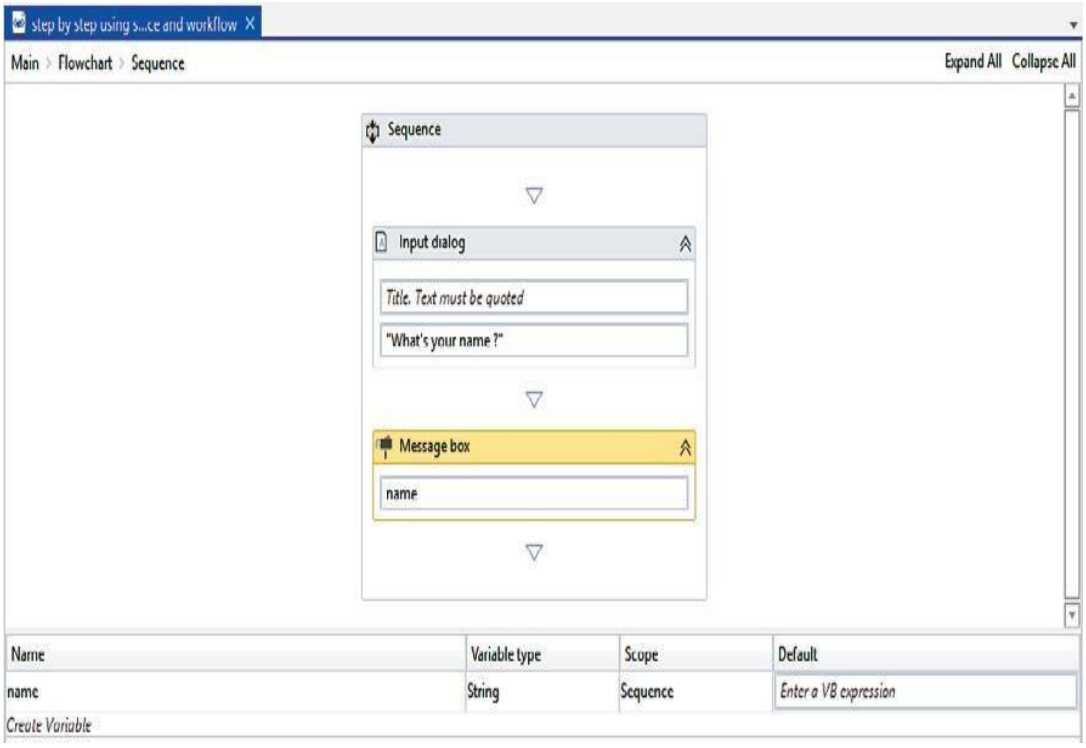
- A Sequence and a Flowchart are similar concepts.
- They are both used to contain logical steps or actions.

3.4.1 How to use a Sequence

- There may be different Sequences doing their jobs. We can easily put similar Sequences into a workflow; each workflow represents a task.
- It is very easy to test a separate workflow alone.
- Perform the following steps:

1. Drag and drop a **Flowchart** onto the Designer panel. Drag and drop a **Sequence** activity. Connect the **Sequence** activity with the **Start** node.
2. Double click on the **Sequence** activity. Drag and drop an **Input dialog** activity and a **Message box** activity. Specify a message in the **label** property of the **Input dialog** activity.
3. Create a variable of type **String**. Give it a name. Also, specify this newly created

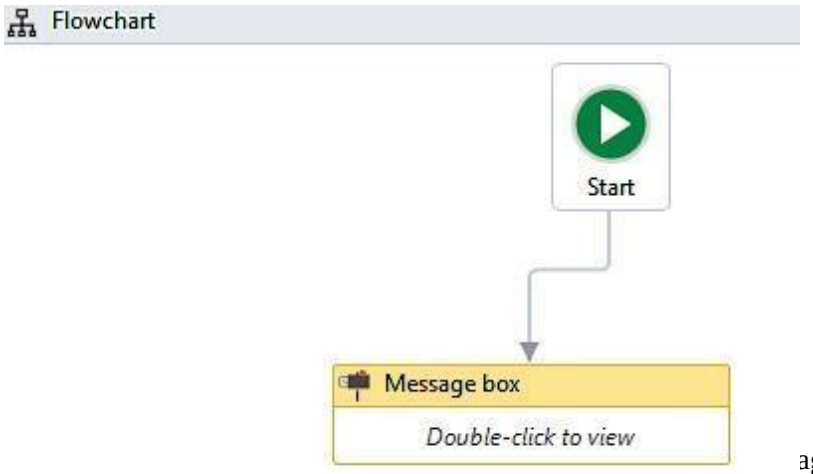
variable's name in the content property of the **Message box** activity:
Hit the **Run** button or press *F5* to see the result.



- We can see clearly that we have used two activities inside the **Sequence** that are logically related (one for inputting the name and the other for popping it up). Here, the **Sequence** contains two activities.

3.4.2 How to use a Flowchart

- A **Flowchart** is a container. It can contain activities inside it.
- Let us drag and drop a **Message box** activity inside the **Flowchart**. Double click on the
- **Message box** and type "Hello World!" in the area where the text is to be quoted. Press *F5* to see the result):



- So, when the program has only a few steps, we can use activities directly inside the **Flowchart**.
- However, it becomes more complex when we have a large number of steps. That is why it is necessary to arrange the related activities into Sequences and then group the Sequences into a **Flowchart**.
- Example to see how to use Sequences in the **Flowchart**.
  Perform the following steps:

1. Drag and drop two **Flowchart** activities on the main **Flowchart**. Rename them as Send mail and Message.

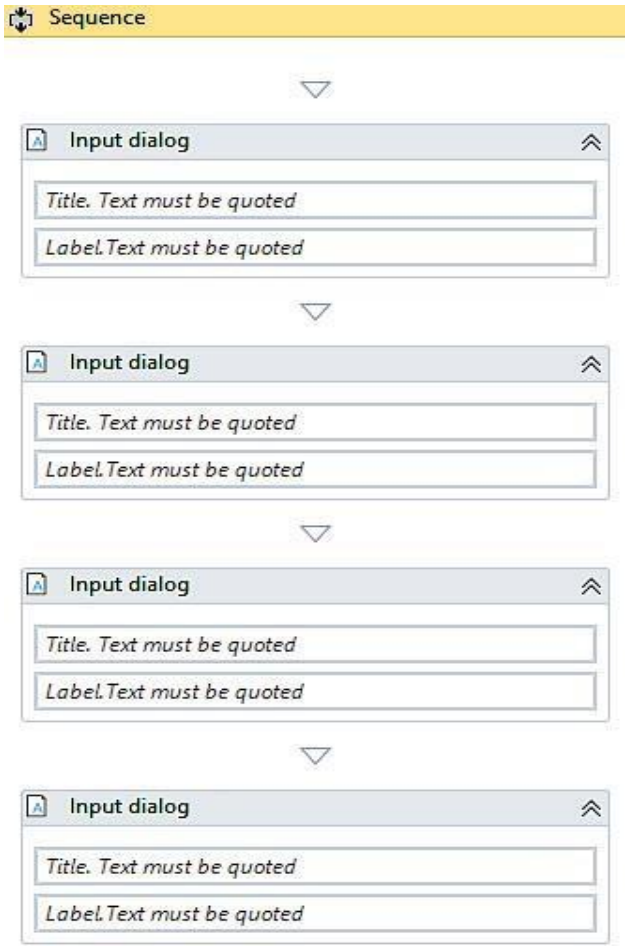
- We have two different workflows.
  - The **Send Mail** workflow will send the mail to an email address.
  - The **Message** workflow has the message body of that email and will ask the user for a name, message, sender, and receiver.

2. We have to implement the desired steps in both workflows. For that, we are using a **Sequence** inside the **Flowchart**.

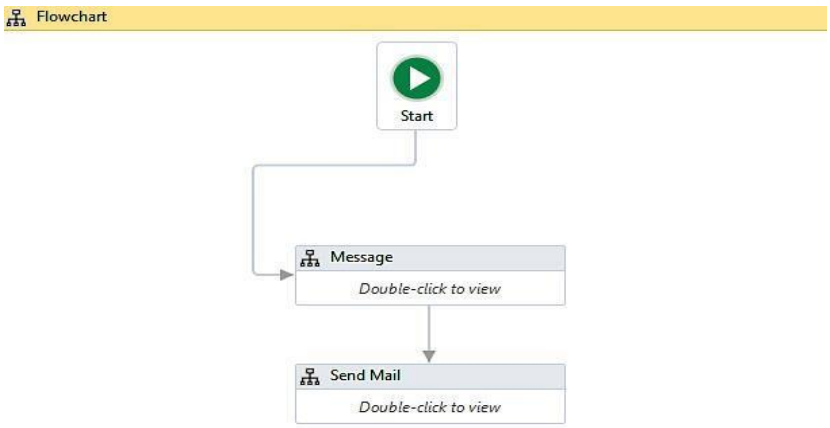
- Double click on the **Flowchart**. Drag and drop a **Sequence** activity inside both Flowcharts.
- Connect the **Sequence** to the **Start** node by right-clicking on the **Sequence** and selecting the **Set as Start node** option.

3. Double click on the **Sequence** in the **Message** Flowchart.

- Drag and drop four **Input dialog** activities for the name, message, sender, and receiver.



4. Double click on the **Send Mail Flowchart**. Double click on the **Sequence**. You can drag and drop the email activities here.
5. That's it. Now, go to the main Flowchart. Connect the Message Flowchart to the Start node. Also, connect the Send Mail activity to the Message Flowchart:



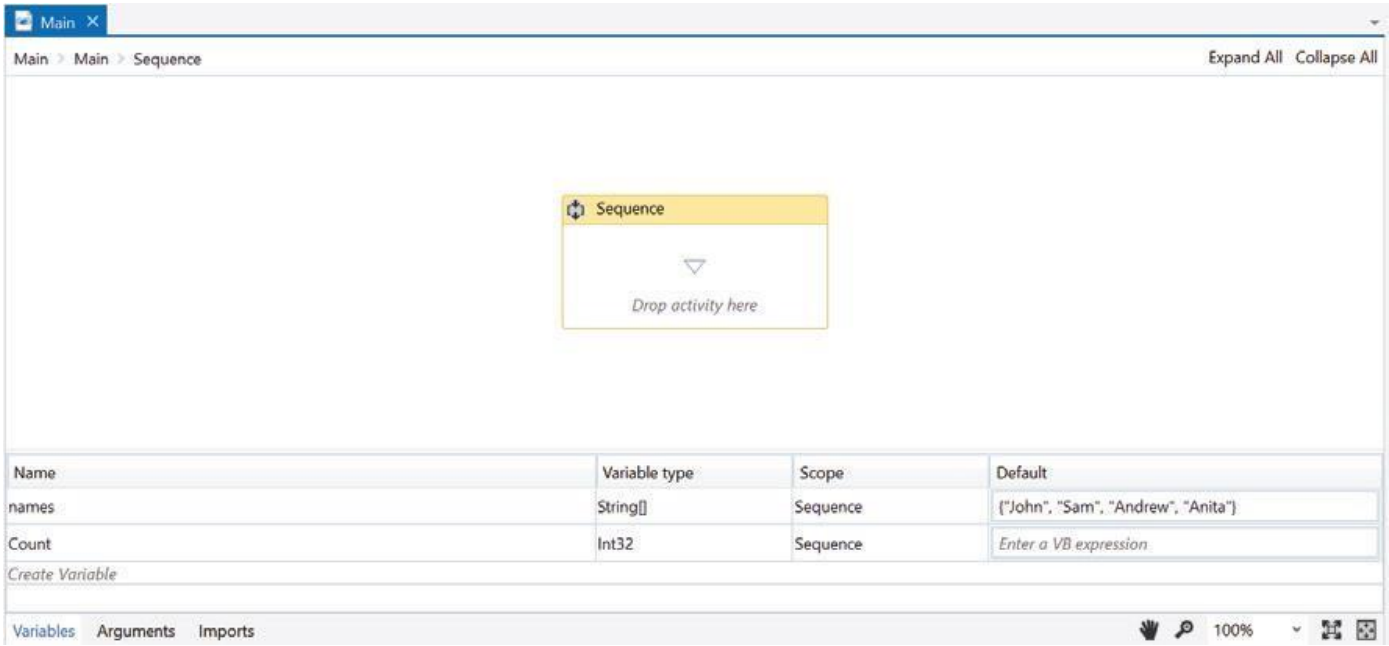
6. Run the program and visualize it.

3.4.3 Step-by-step example using Sequence and Control flow

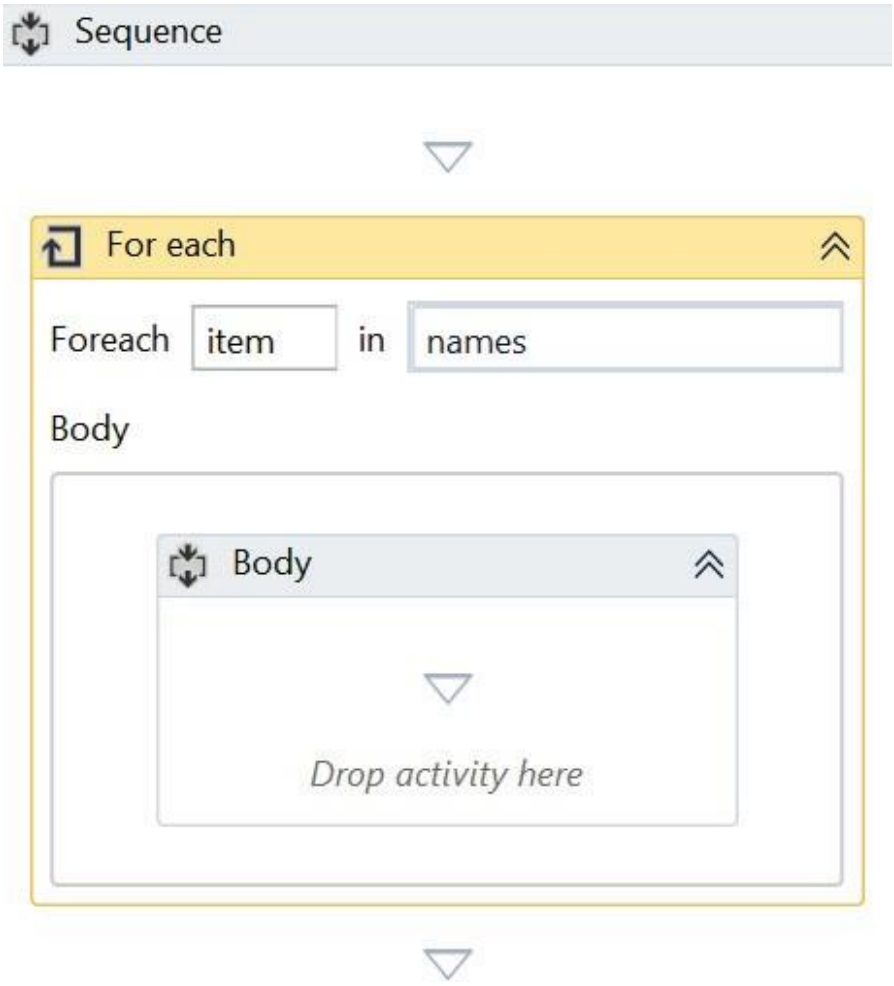
- Consider an array of names. Say we have to find out how many of them start with the letter *a*.
- We will then create an automation where the number of names starting with *a* is counted and the result is displayed.

- Perform the following steps:

1. Drag and drop a **Flowchart** activity from the **Activities** panel.
2. Drag and drop a **Sequence** activity inside the **Flowchart**. Connect the **Sequence** to the **Start** node by right-clicking on the **Sequence** activity and selecting the **Set as Start node** option.
3. Double click on the **Sequence** activity. Create a variable. Give it a name (in our case, we will create an array of type string and name the variable as *name*). Set the variable type to **Array of [T]**. When asked for the type of array, select **String**. Also, initialize the array in the **Default** section of the variable by giving it a default values. For example, *{"john", "sam", "Andrew", "Anitha"}*.
4. Create a variable of type integer **Count** for storing the result. Set the variable type to **Int32**:

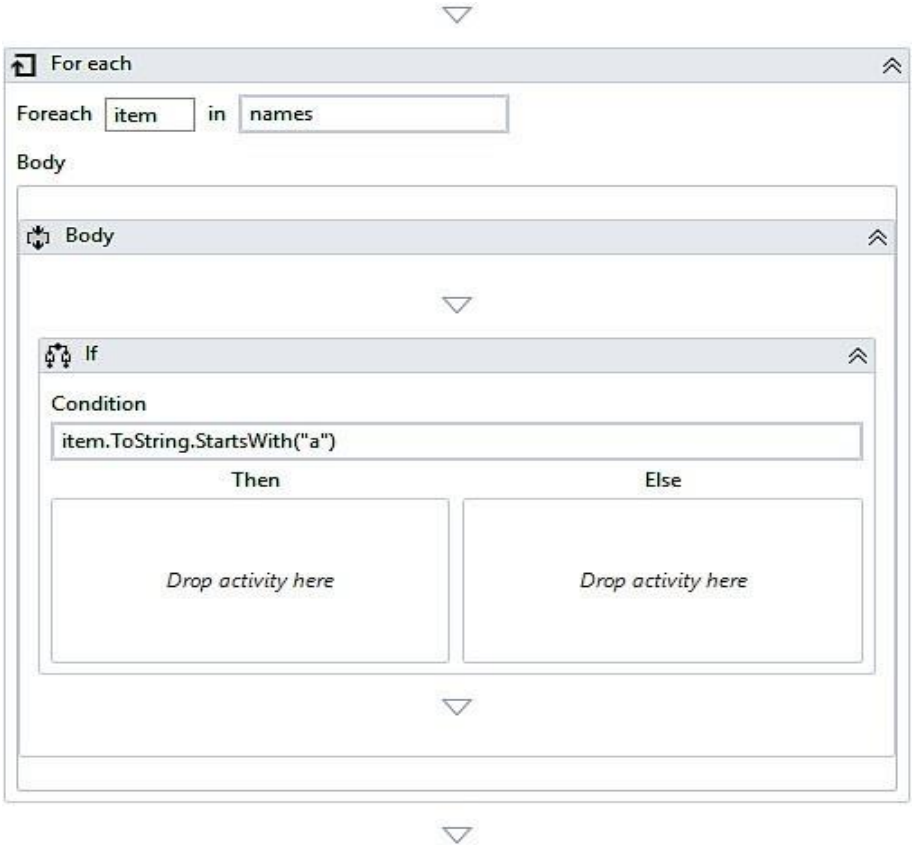


5.Drag and drop a **For each** activity inside the **Sequence**. Also, specify the array name in the expression box of the **For each** activity. The **For each** activity is used to iterate over the array. It will pick up one name from the array each time until it reaches the end:


Sequence
For each
Foreach
item
in
names
Body
Body
Drop activity here

6.Drag and drop the **If** activity from the **Activities** panel and place it inside the **For each** activity at the location where ***Drop activity here*** is mentioned.

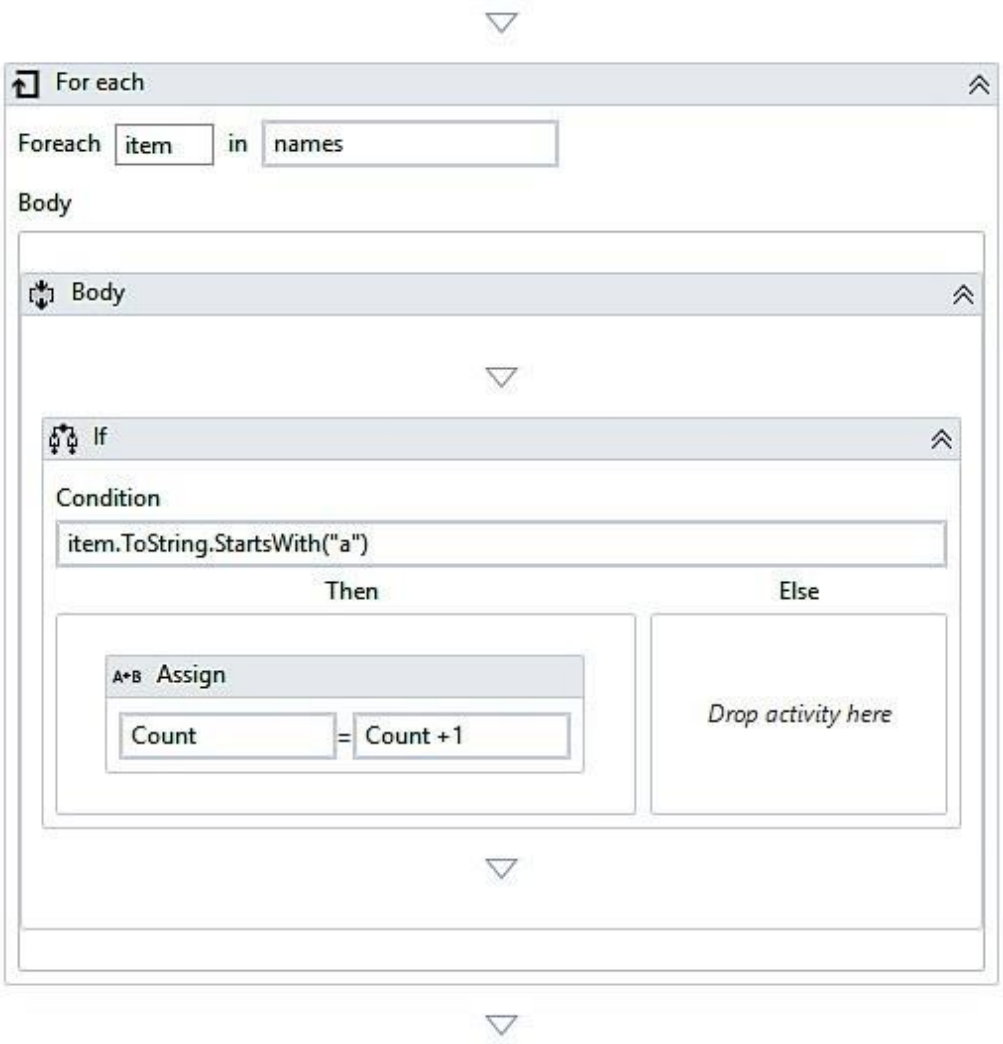
- Specify the condition in the expression box of the **If** activity. The **If** activity is used to check for a particular condition/expression.
- If that expression is satisfied, the **Then** block will be executed. Otherwise, the **Else** block will be executed.
- We have specified the expression as *Item.Tostring.Startswith('a').* This expression specifies the name present in the item variable starts with the letter 'a'.
- The **For each** activity iterates over the array, picks up one name at a time,
- and stores it as a variable, *item*:



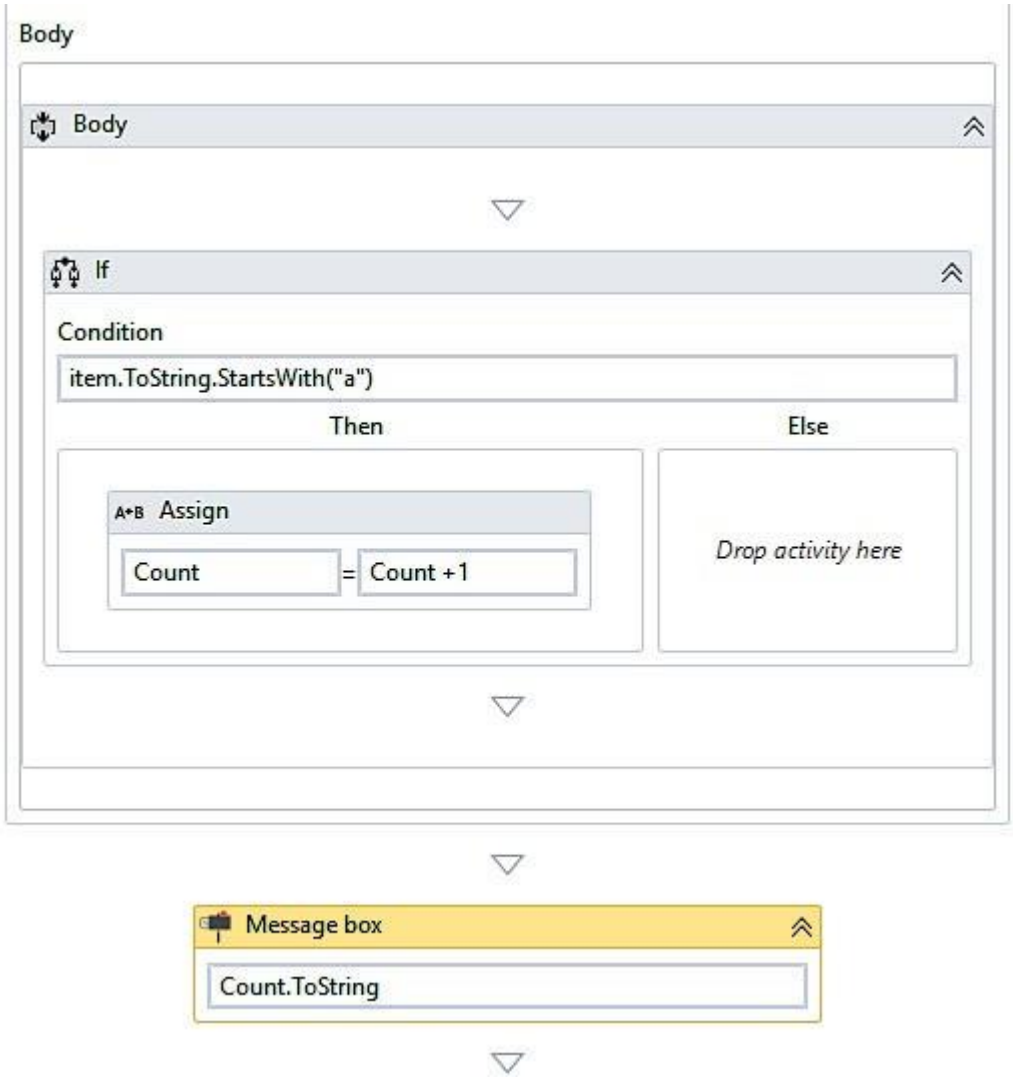
7. Now, we are going to use the *count* variable and increment it each time a name from an array starts with the letter *a*.

- we have to use the **A+B Assign** activity. Drag and drop the **A+B Assign** activity inside the **If** activity.

- Set the **To** property to *count*(variable name) and the **Value** property to *Count+1*(to increment its value) of the **A+B Assign** activity:



8.Just drag and drop a **Message box** activity inside the **Sequence** activity. Specify the count variable in the expression box of the **Message box** activity. But remember, the variable that we have created is of type **Int32**, so, it cannot be used with the **Message box** activity without converting it to a string. To convert it to a string, we have the *'.tostring'* method available in UiPath Studio. Just apply it to the variable and select *'.tostring*:



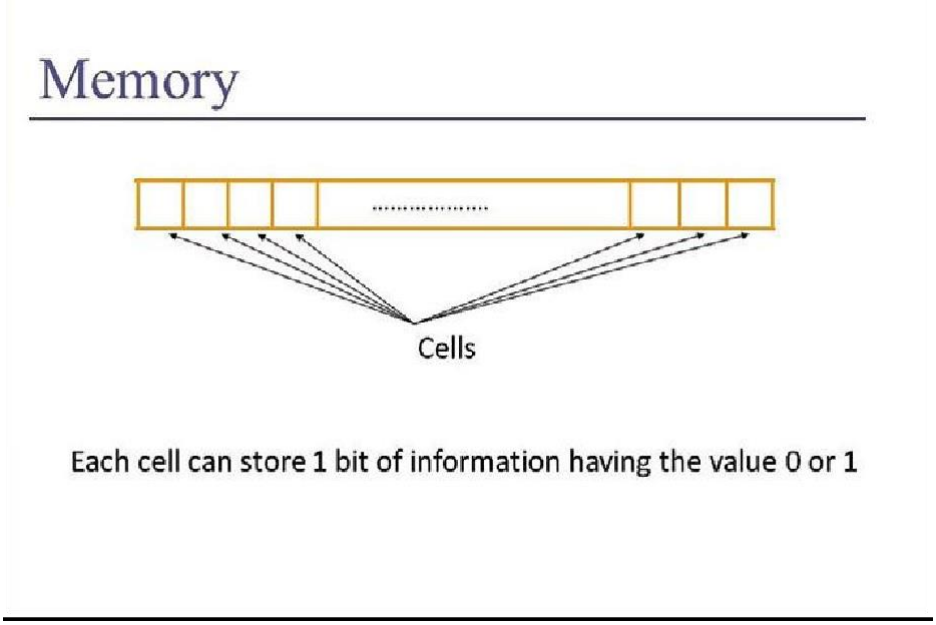
Hit the **Run** button or press *F5* and see the result.

4. Data Manipulation

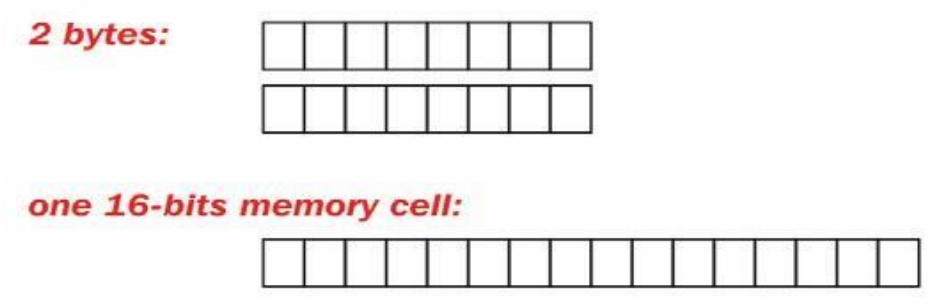
Data manipulation is the process of changing data whether it is adding, removing, or updating it.

4.1 Variables and scope

- Before discussing variables, let us take a look at Memory and its structure:



- Memory consists of millions of memory Cells and each memory cell stores data in the form of 0s and 1s (binary digits).
- Each cell has a unique address, and by using this address, the cell can be accessed.

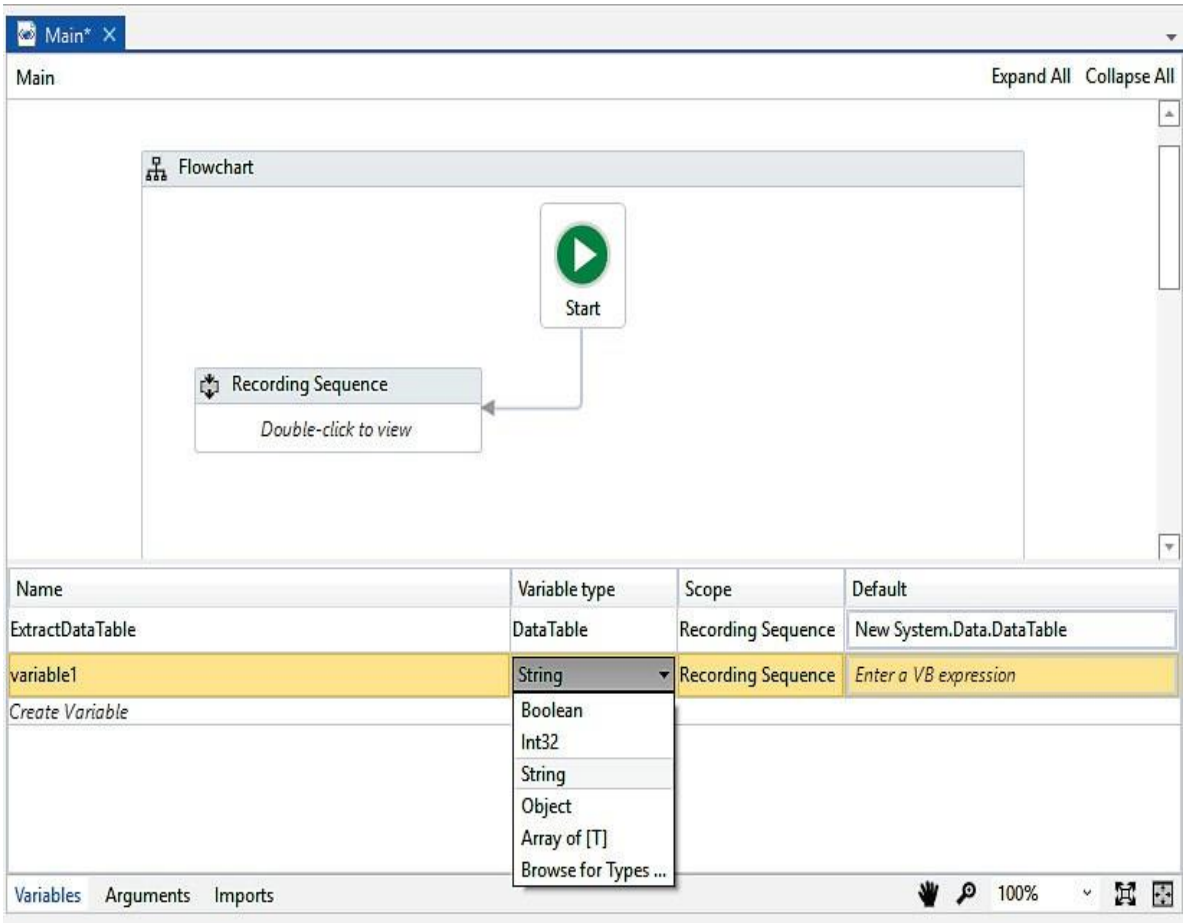


- When data is stored in memory, its content gets split into further smaller forms (binary digits). As shown in the preceding diagram, **2 bytes** of data consists of several memory cells.
- A **variable** is the name that is given to a particular chunk of memory cells or simply a block of memory and is used to hold data.
- A variable is used to store data. Data is present around us in different Types-it can be an mp3 file, text file, string, numbers, and so on.
- A particular type of variable can hold only that type of data.
- If there is a mismatch between the data and the variable type, then an error occurs.

- The following table shows the type a of variable available with UiPath:

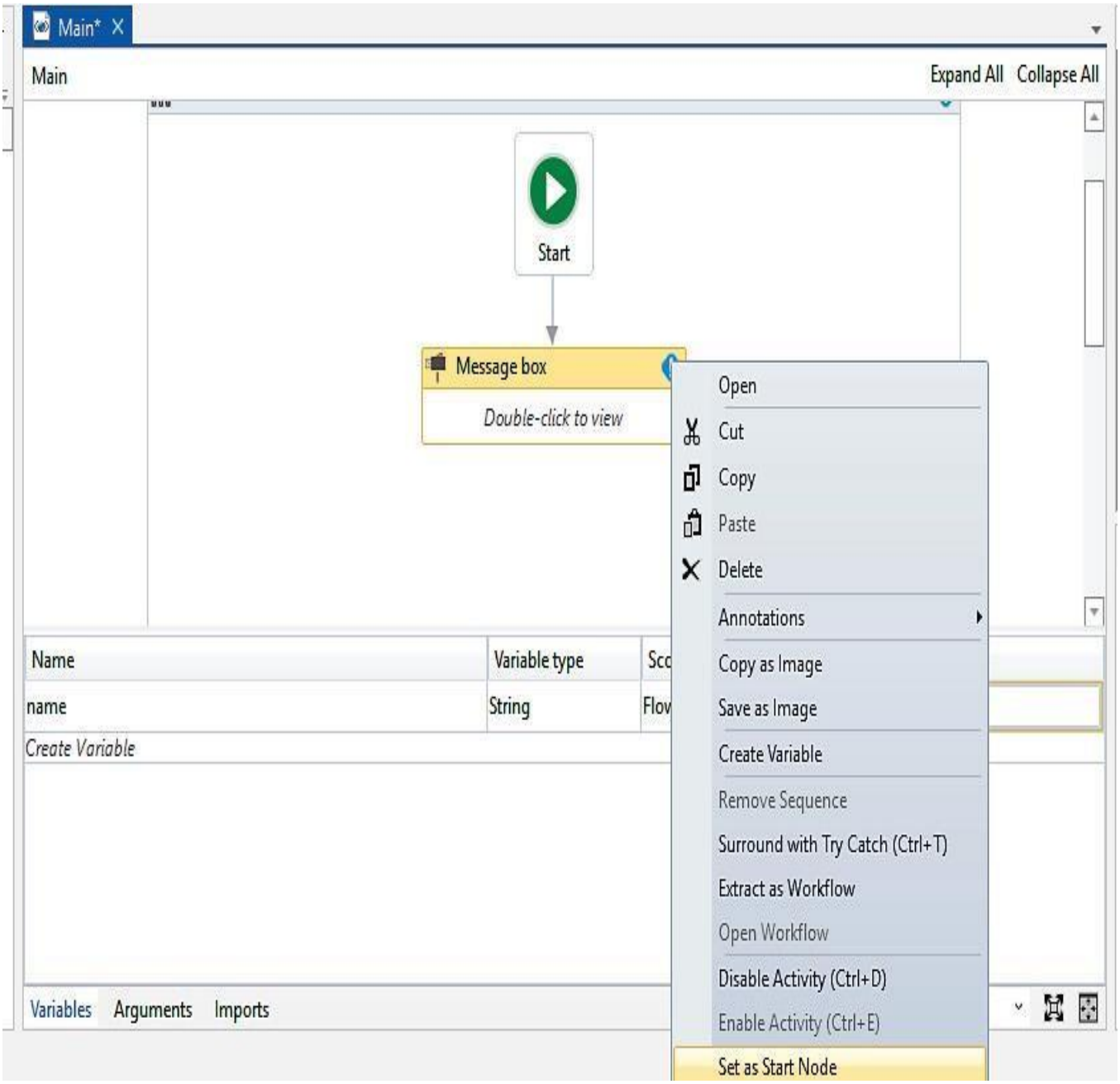
Type	Content
Integer	Whole numbers
String	Text of any kind: "The Quick Fox @4598"
Boolean	True or false
Generic	Anything

- In UiPath, we can declare a variable in the **Variables** section. Just give it a meaningful name and select the appropriate type from the drop-down list.
- We can also specify the scope of a variable. The **Scope** is the region under which the data has its effect or availability.
- You can choose the **Scope** of the variable according to your requirements; try to limit it as far as possible.

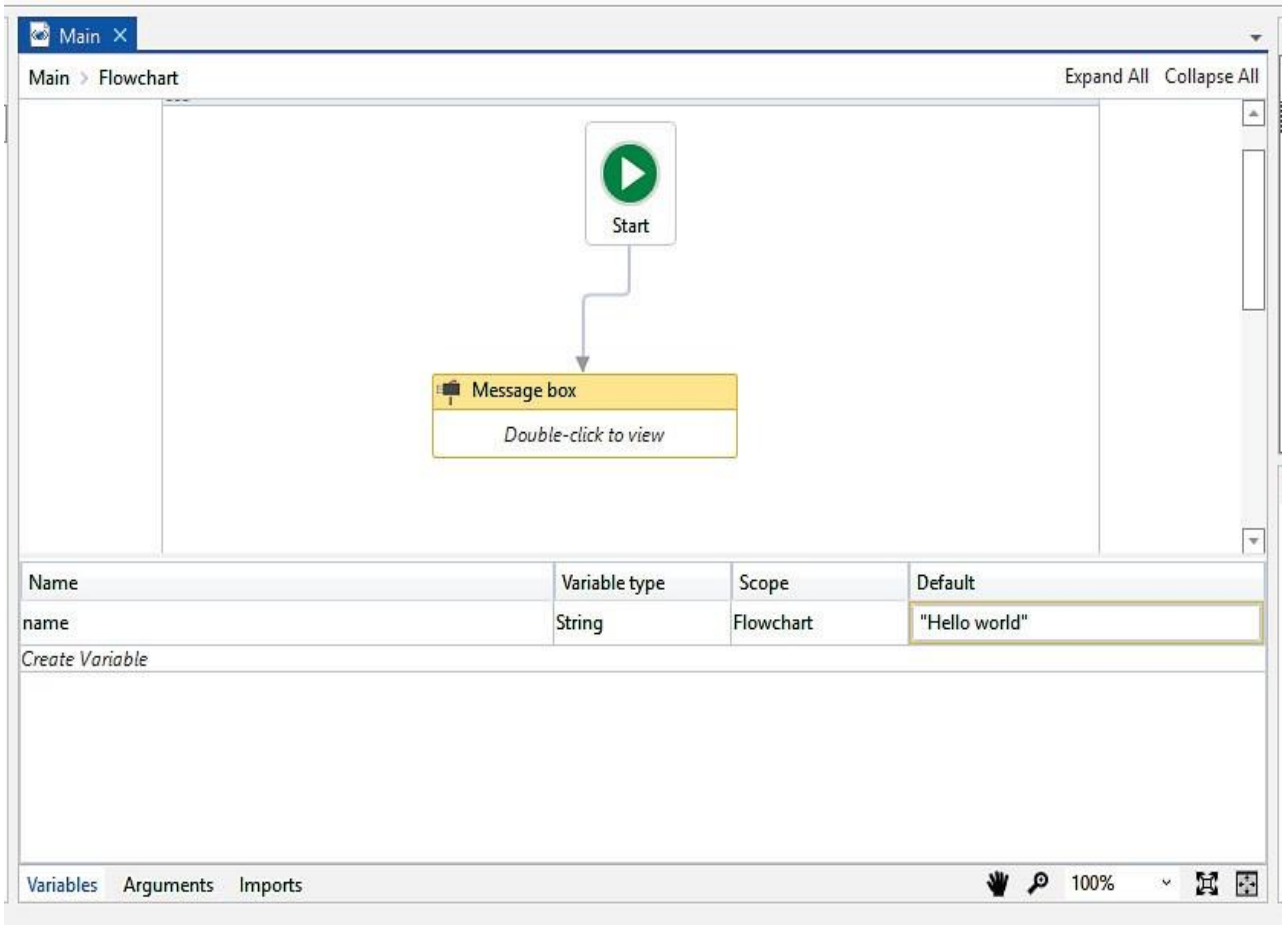


- Let us take an example of creating a variable and then displaying a **Message box** using that variable:

1. We have declared a variable as *name* in the **Variables** section and set its **Default** value to *"Hello World"*. By default, the type of the variable is **String** (we can change its type according to our needs).
2. Search *for Message box* in the **Activities** panel. Drag and drop that **Message box** template into a **Flowchart**.
3. Right-click on the message template and select **Set as Start node**:



4. Double-click on the **Message box** template and specify the variable name that we Created earlier. At this stage, we are ready to run our application by simply clicking on the **Run** button:



A dialogue box will pop up with the "Hello World" text displayed on it.

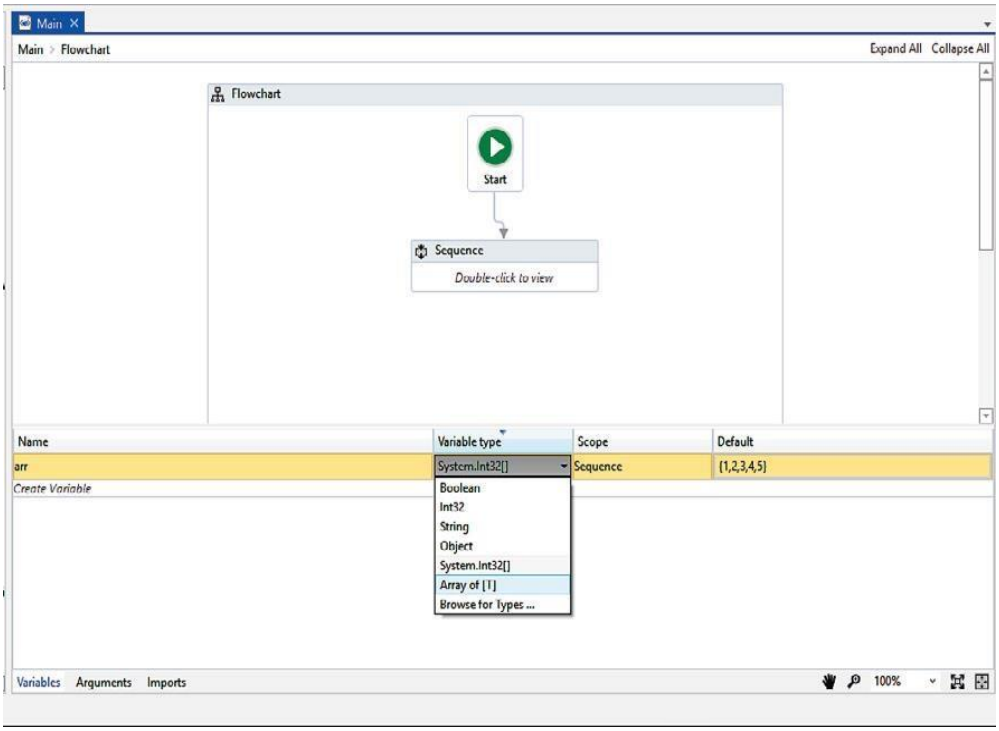
4.2 Collections

- There are different types of variables. Variables can be classified into three categories:
  - **Scalar:** These are variables that can only hold a single data point of a particular data type, for example; Character, Integer, Double, and so on.
  - **Collections:** These are variables that can hold one or more data point of a particular data type. For example; array, list, dictionary, and so on.
  - **Tables:** These are a tabular form of the data structure which consists of rows and columns.
- In a collection, we can store one or more data points, but all the data must be the same.
- In this example, we are going to take an array of integers, initialize it, and then iterate through all the elements of the array:

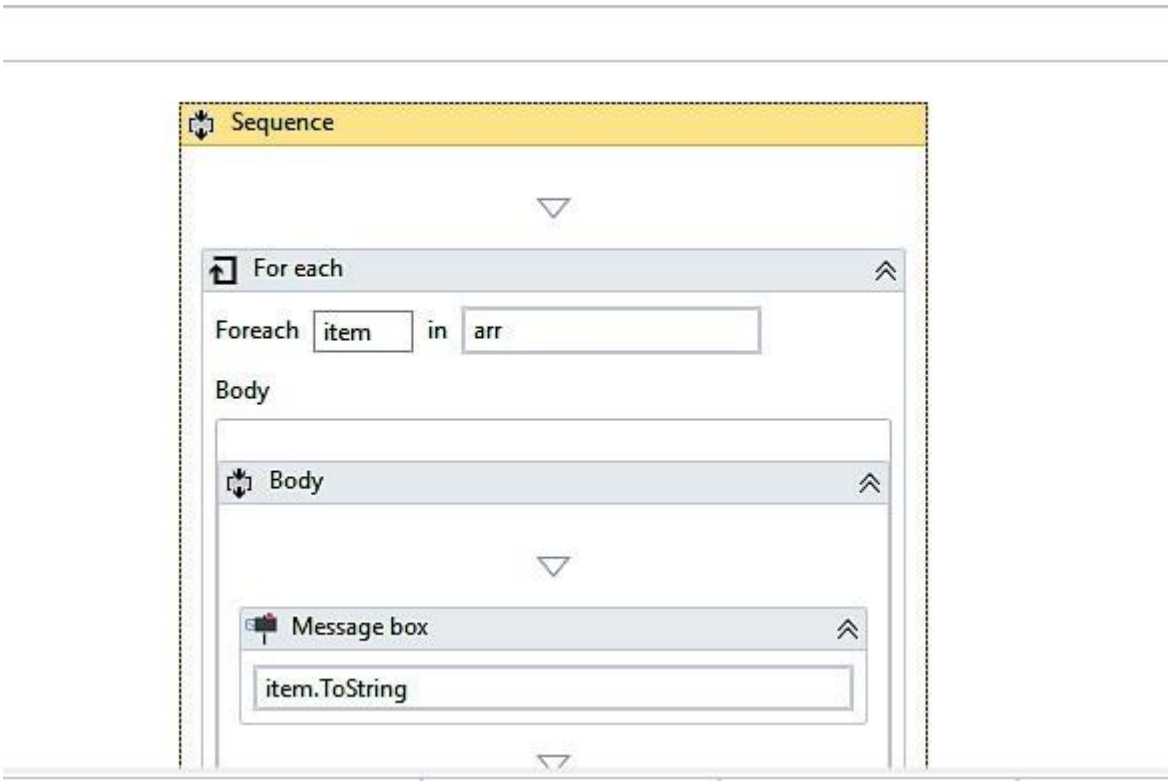
1. Drag and drop a **Flowchart** activity onto the main Designer panel, and drag and drop a **Sequence** activity inside the **Flowchart**. Set the sequence as **Start** node.

2. Create a variable in the **Variables** panel and give it a meaningful name (in this example, we have created a variable named ***arr***, which is an array of integers). Choose the data type as an array of integers.

3. We have initialized the array as {1, 2, 3, 4, 5} in the **Default** section. You can initialize it with the **int32** data type:



4. Drag and drop a **For each** activity from the **Activities** panel inside the **Sequence**, and drag and drop a **Message box** activity inside the **For each** activity.
5. Specify the array name in the expression text box of the **For each** activity.
6. Specify the *item* variable that is auto-generated by the **For each** activity, inside the **Message box** activity. But hold on, we have to convert the *item* variable into the **String** type because the **Message box** activity is expecting the string data type in the text box. Just press the dot (.) along with the *item* variable and choose the **ToString** method:

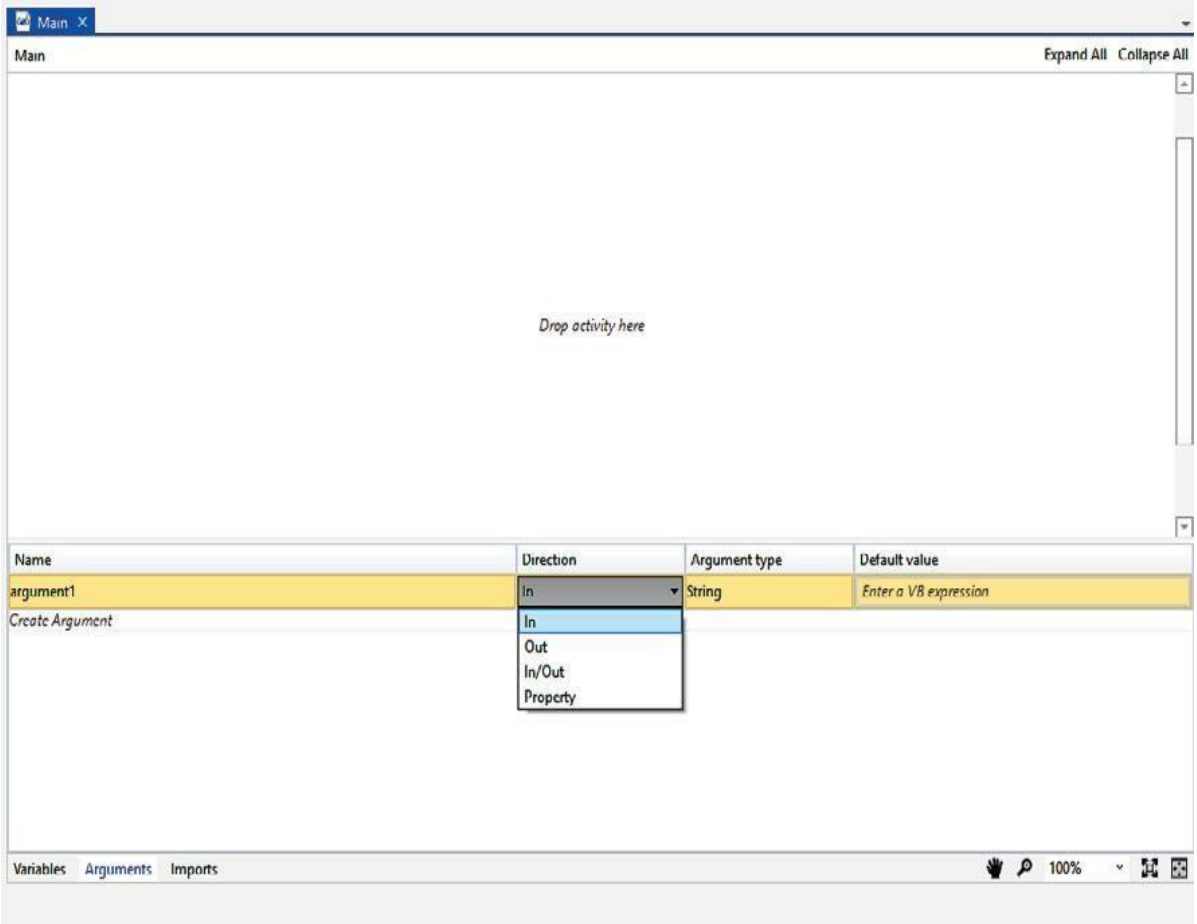


Hit the **Run** button to see the result. All the values will pop up at once.

4.3 Arguments - Purpose and use

- An Argument is simply a variable that can store a value.
- You can create an argument in the Argument section of the main Designer panel. variable and is used to pass values between different workflows.
- Suppose we have a big project to build; we break down the project into different workflows because smaller workflows can be easily tested separately.
- It is very easy to build smaller workflows and combine them, thus turning them into the real solution of the project.
- These Arguments are used for interacting with different workflows by exchanging data between them.
- That is why the direction property is associated with Arguments.
- We can choose the direction on the basis of our requirement either giving the value to some workflow or receiving the value from another workflow.
- We can easily create arguments in the **Arguments** panel. We can also specify the direction:

  - **In**: When we have to receive the value from another workflow.
  - **Out**: This is the current value if we have to send the value to a workflow.
  - **In/Out**: This specifies both; it can take or receive the value.
  - **Property**: This specifies that it is not being used currently:



4.4 Data table usage with examples

- A data table is a tabular form of data structure. It contains rows and each row has columns,
- for example:

Student name	Roll number	Class
Andrew Jose	1	3
Jorge Martinez	2	3
Stephen Cripps	3	2

- The preceding illustration is an example of a data table that has three rows and three columns.
- For example, you have to build a table dynamically. You can use a data table as your preferred choice.
- A data table is also extensively used to store tabular data structures. In data scraping, data tables are widely used.
- Data scraping is a method in which we can dynamically create tabular data records of search items on the web.
- We shall build two projects in which we will use a data table:
  - Building a data table.

- Building a data table using data scraping (dynamically).

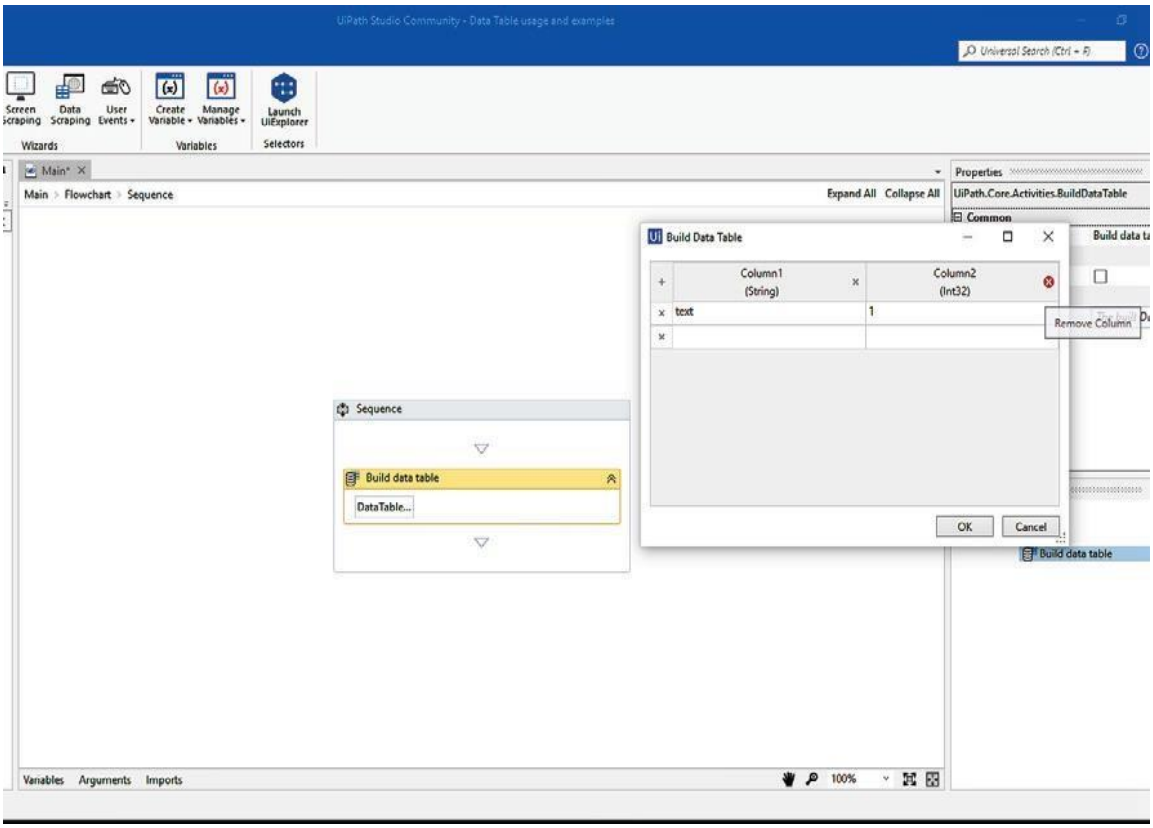
4.4.1 Building a data table

- Create an empty project. Give it a proper name:

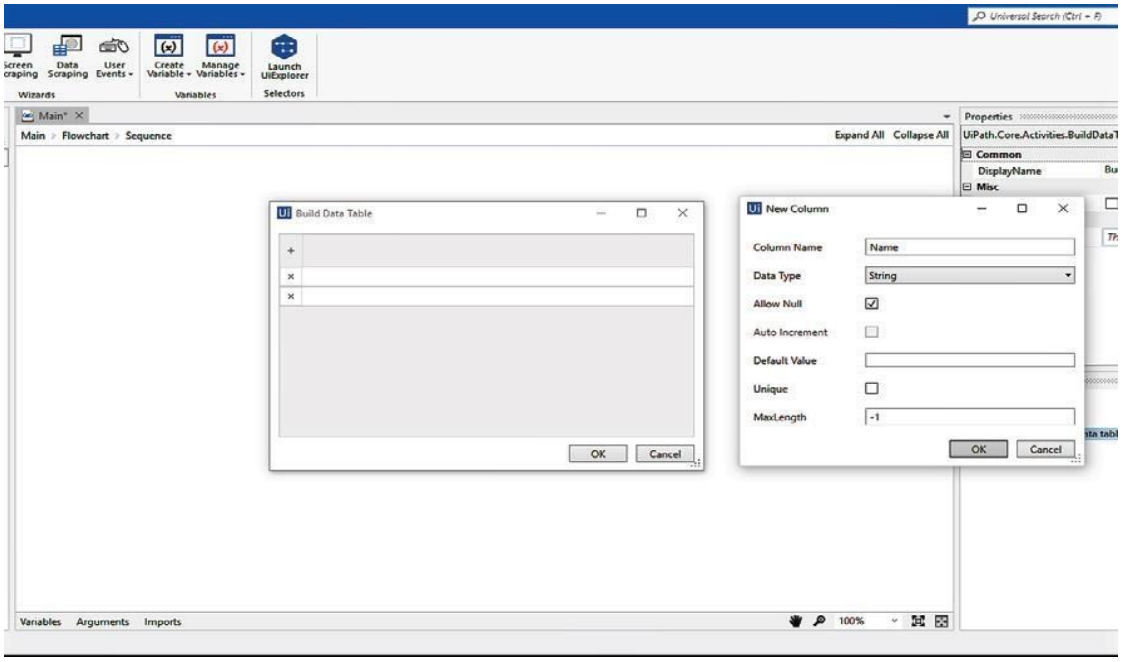
1. Drag and drop a **Flowchart** activity on the Designer panel. Also, drag and drop a **Sequence** activity and set it as the **Start** node.

2. Double click on the **Sequence** and drag and drop the **Build Data Table** activity inside the **Sequence** activity.

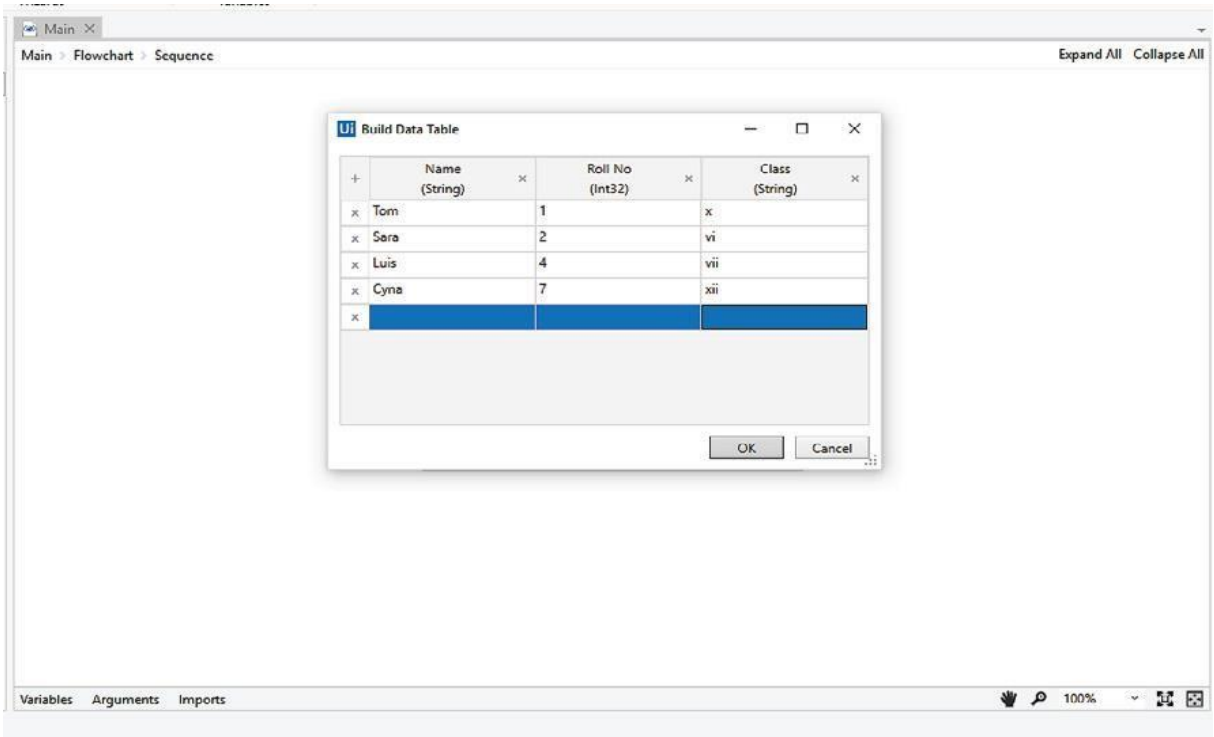
3. Click on the **Data Table** button. A pop-up window will appear on the screen. Remove both the columns (auto generated by the **Build Data Table** activity) by clicking on the Remove Column icon:



4. Now, we will add three columns by simply clicking on the + symbol. Specify the Column names and select the appropriate data types from the drop-down list. Click on the **OK** button. We will add column *Name* of **String** Data Type, ROLL_NO of **Int32** type and finally Class of string type:



Now enter some random values just to insert the data into the rows:

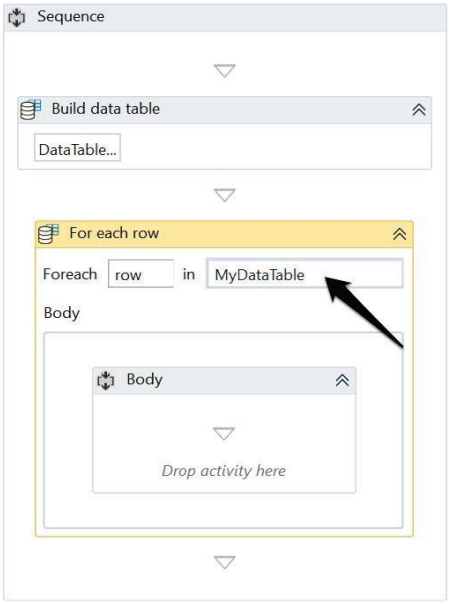


Click on the **OK** button and our data table is ready. We have to iterate over the data table's rows to make sure everything works correctly.

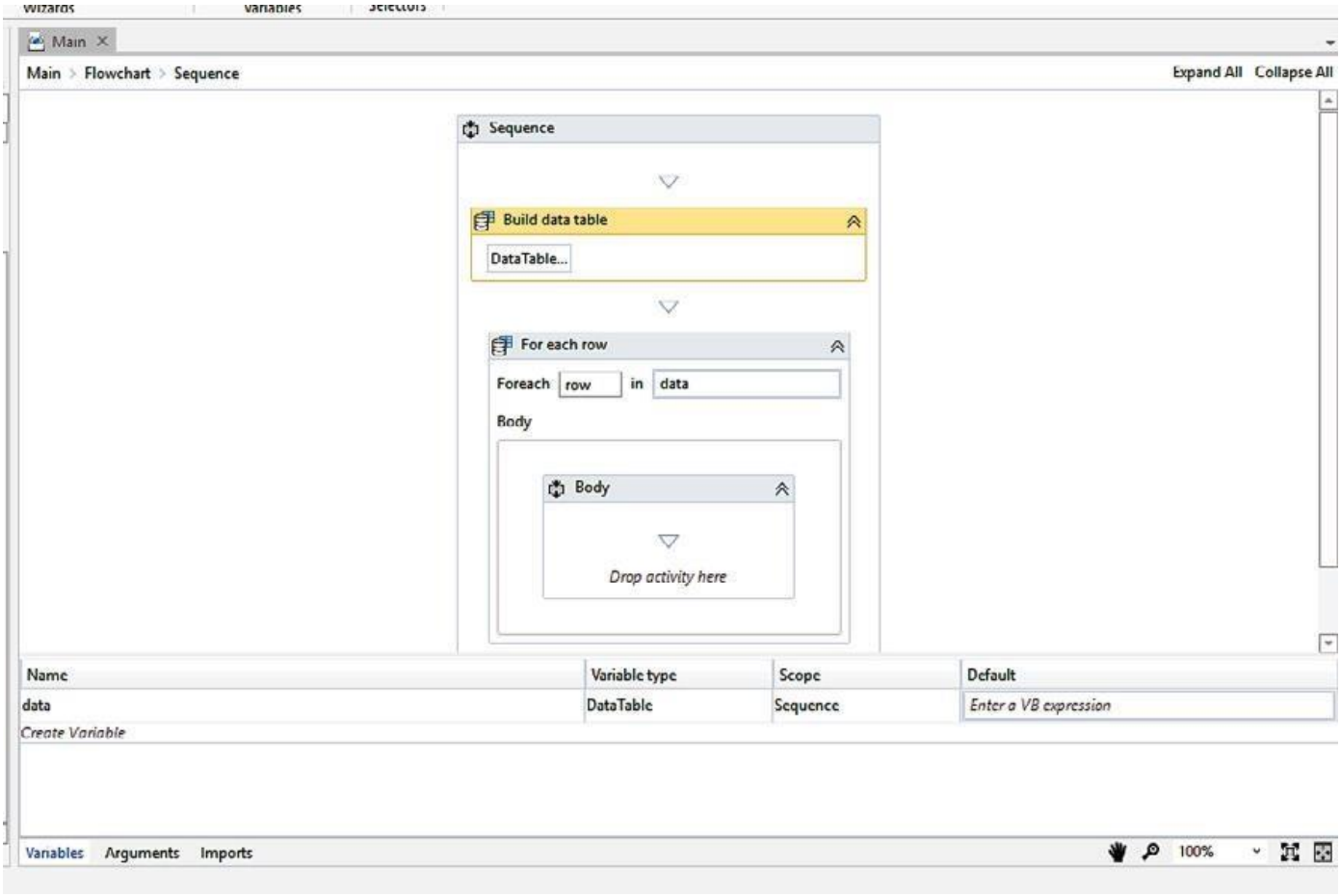
5. In order to store the Data Table created by **Build Data Table** activity, we have to create a data table variable MyDataTable of **Data Table** type and in order to store

the result of the data table that we have dynamically built. Also, specify assign the **Output** property of the **Build Data Table** activity with this variable. Specify the data table variable's name there.

6. After our data table is ready, we will iterate the data table's rows to make sure everything works correctly. Drag and drop the **For each row** activity from the **Activities** panel inside the **Sequence** activity. Specify the data table variable's name (MyDataTable) in the expression text box of the **For each row** activity:



6. Drag and drop the **For each row** activity from the **Activities** panel inside the **Sequence** activity. Specify the data table variable's name in the expression text box of the **For each row** activity:


Wizards
Variables
Selectors
Main
Main > Flowchart > Sequence
Expand All
Collapse All
Sequence
Build data table
DataTable...
For each row
Foreach
row
in
data
Body
Body
Drop activity here
Name
Variable type
Scope
Default
data
DataTable
Sequence
Enter a VB expression
Create Variable
Variables
Arguments
Imports
100%

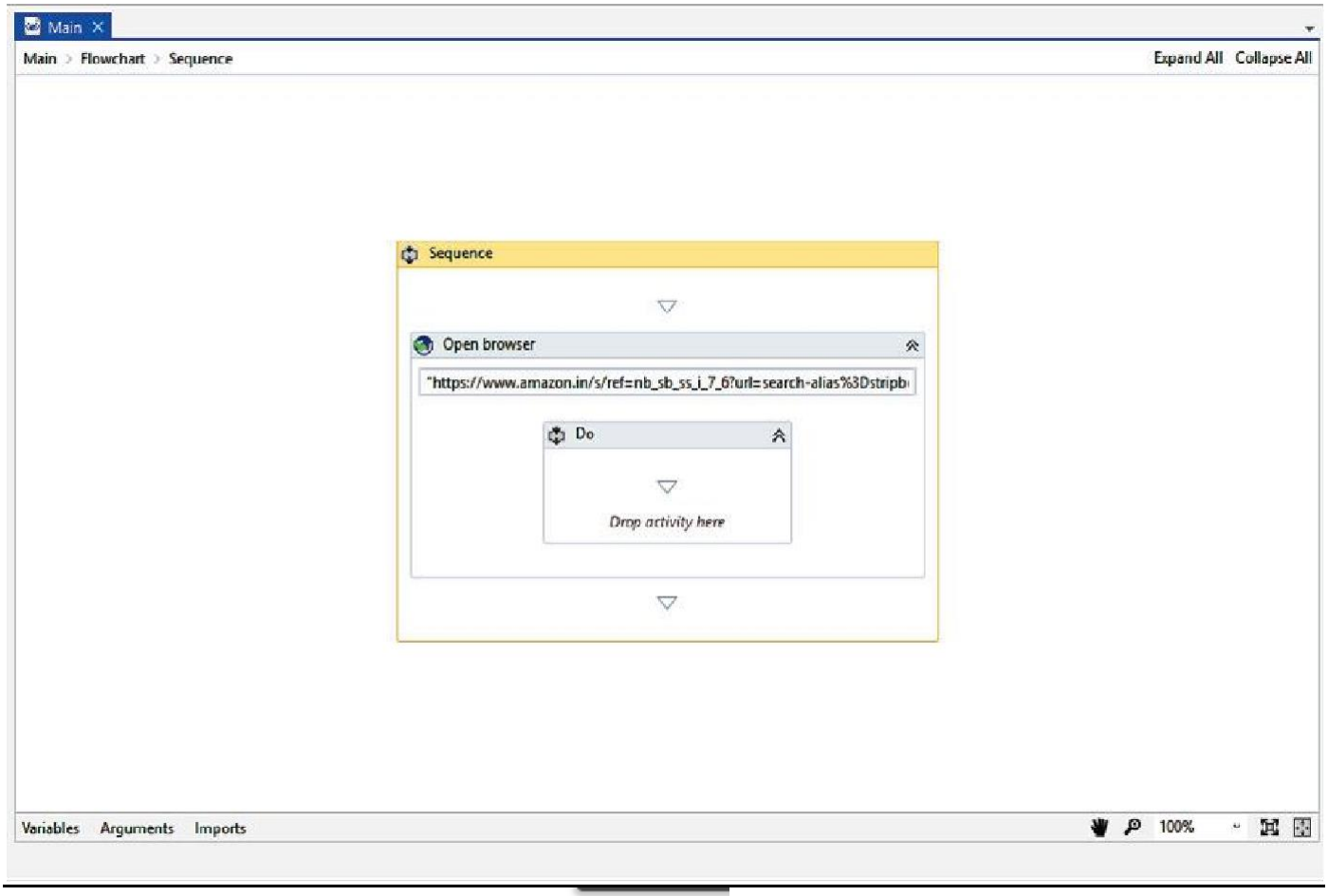
4.4.2 Building a data table using data scraping(dynamically)

Using data scraping, we can build the data table at runtime. Let us consider an example of extracting data from Amazon's website. Perform the following steps:

1. Drag and drop the **Flowchart** activity from the **Activities** panel, and drag and drop the **Sequence** activity inside the **Flowchart** activity.

2. Double-click on the **Sequence** activity.

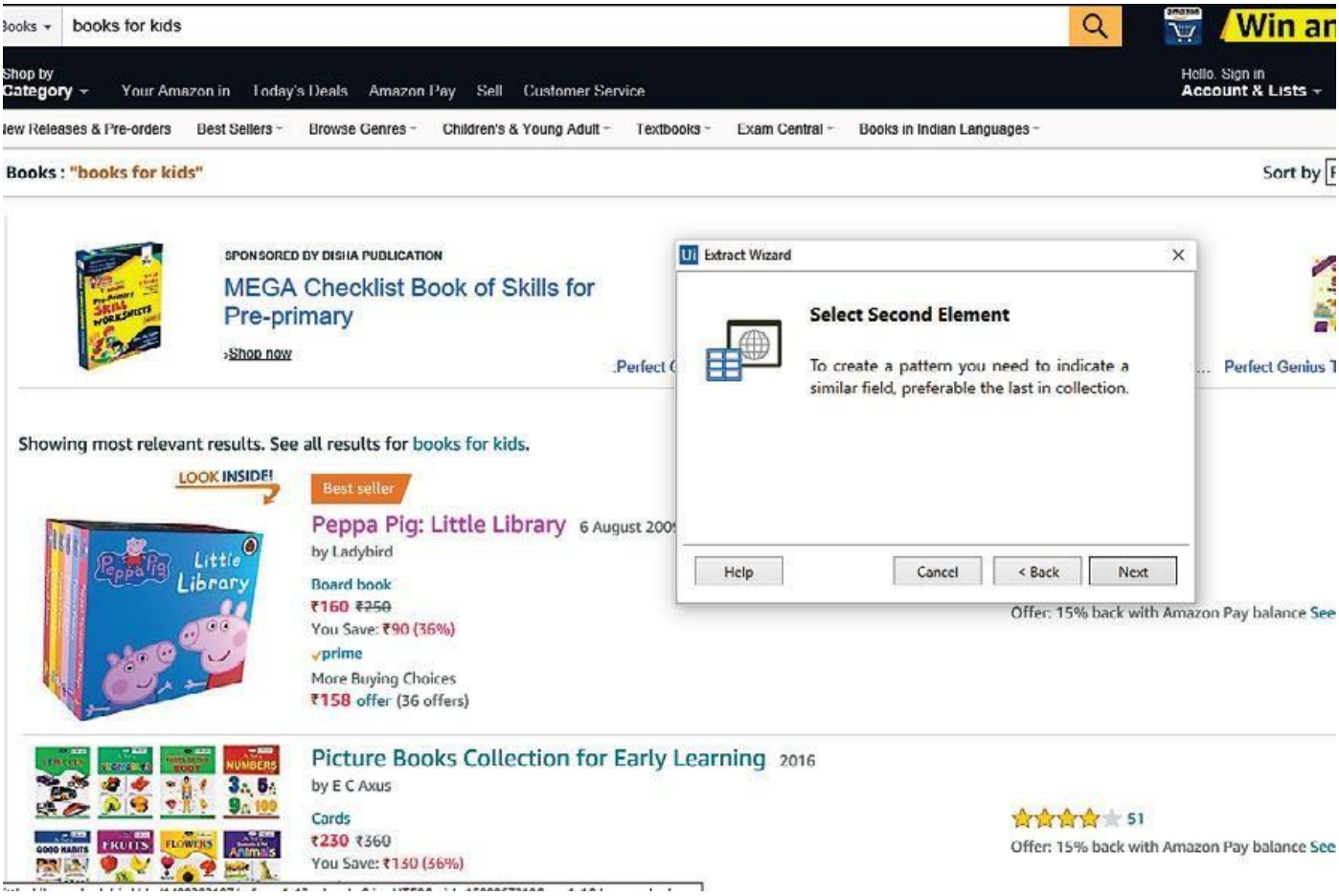
3. Drag and drop the **Open Browser** activity inside the **Sequence** activity. Specify the URL in the text box:



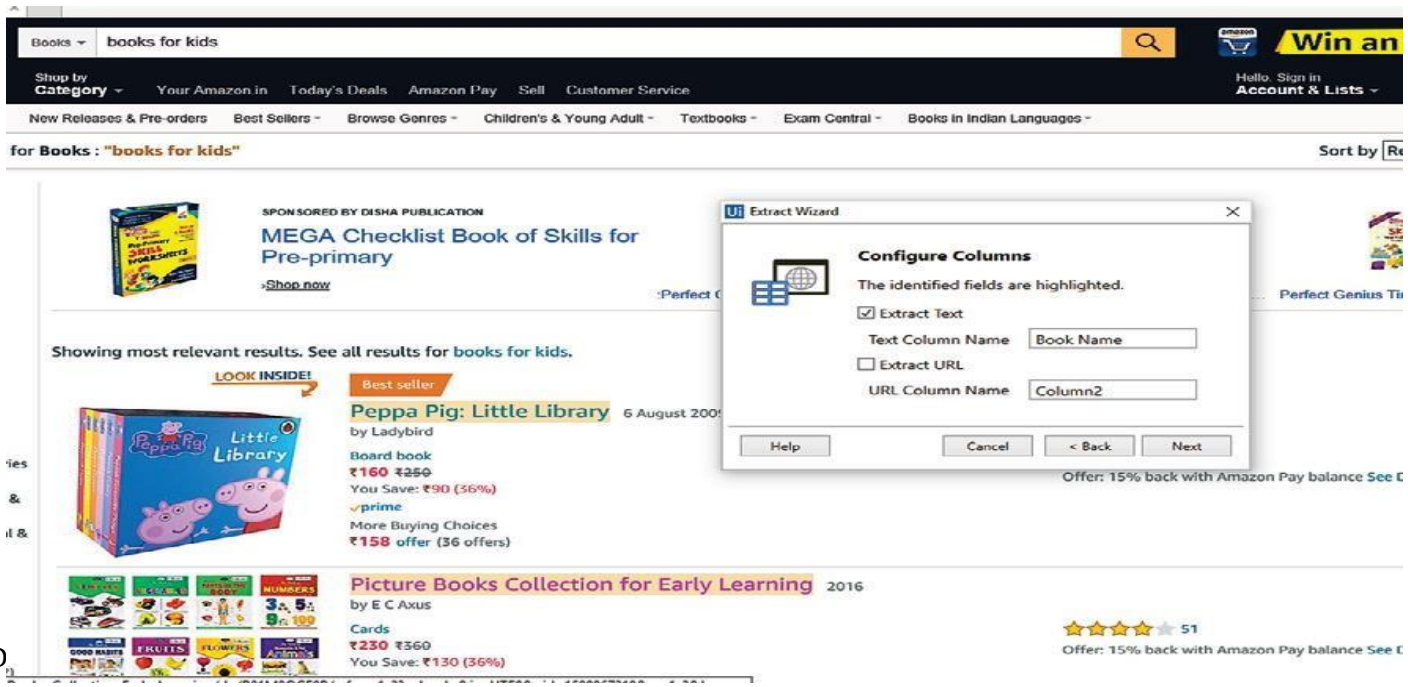
(URL: https://www.amazon.in/s/ref=nb_sb_ss_i_7_6?url=search-alias%3Dstripbooksfield-keywords=books-for-kidsprefix=books-%2Cstripbooks%2C322crid=2OWJE9AMZYS06)

4. Click on the **Data Scraping** icon on the top left corner of UiPath Studio. A Window will pop up. Click on the **Next** button.

5. Now, there will be a pointer pointing to the UI elements of the web page. Click on the name of the book:



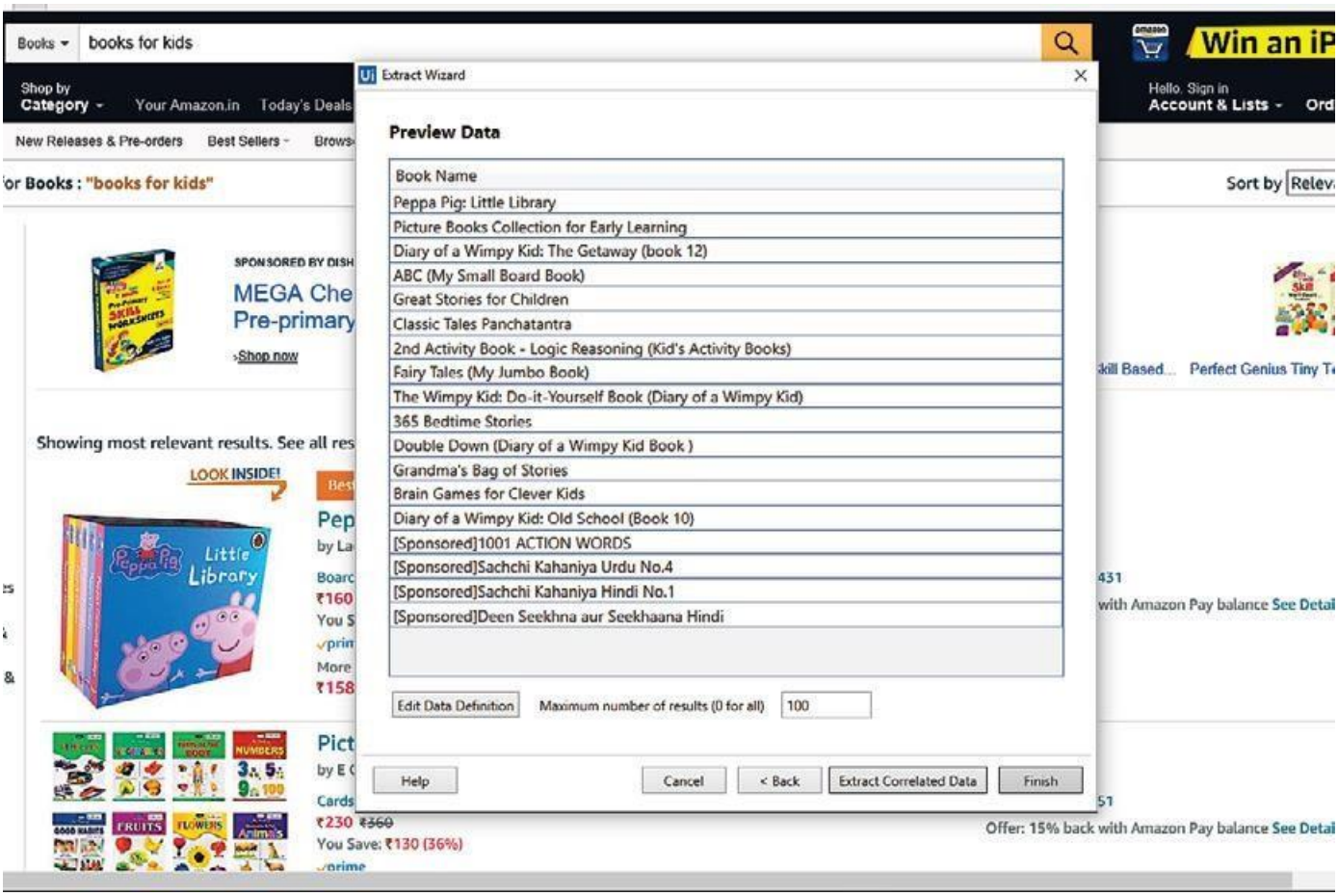
It will ask you to point to a second similar element on the web page:



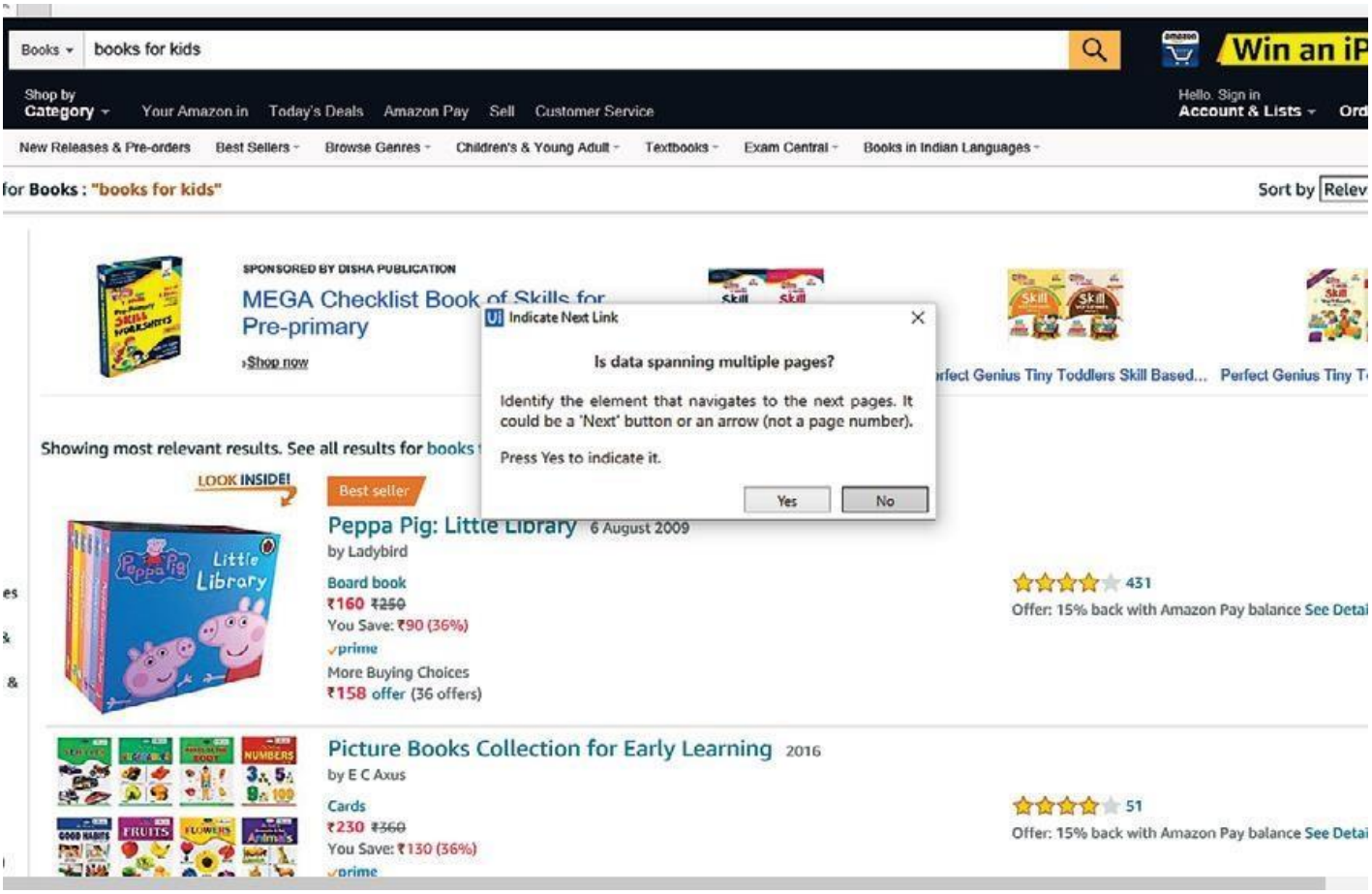
D

6. Point to a second similar element on that web page. Specify the name that you want to give for that extracted data column. (It will become the column name of the extracted data). Click on the **Next** button.
7. A list of names will appear in a separate window.

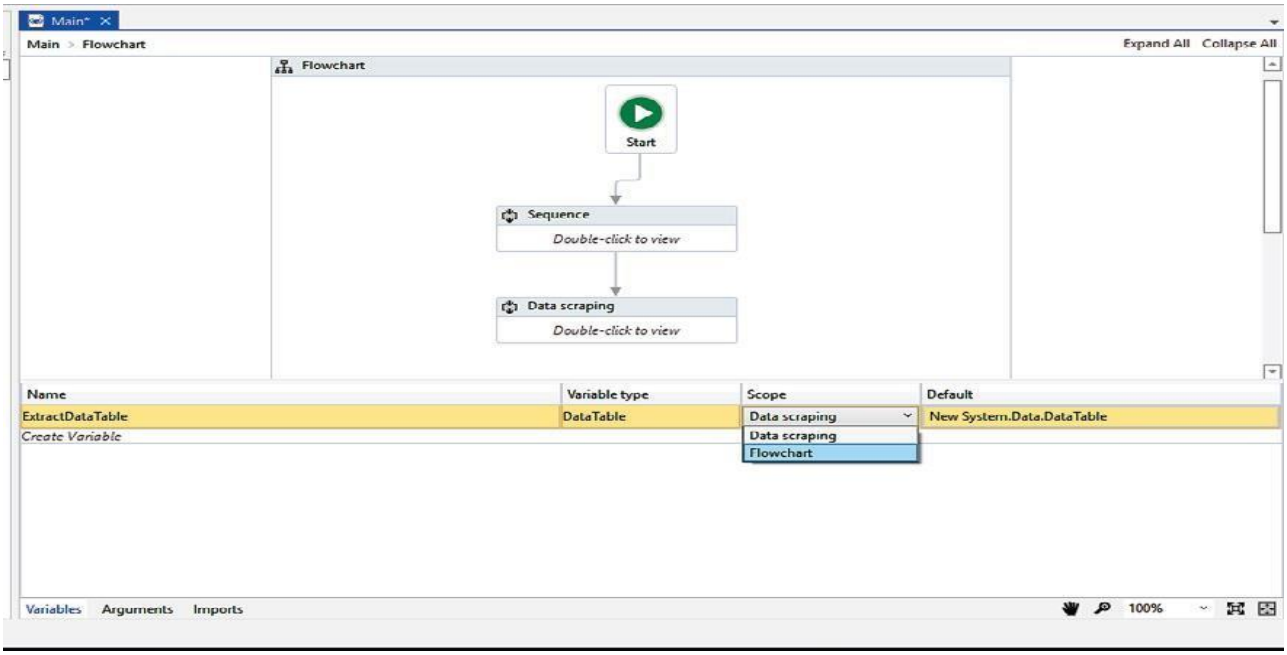
If you want to extract more information, then click on the **Extract correlated data** button and repeat the same process once again (just as we extracted the name of the book from Amazon's website). Otherwise, click on the **Finish** Button:



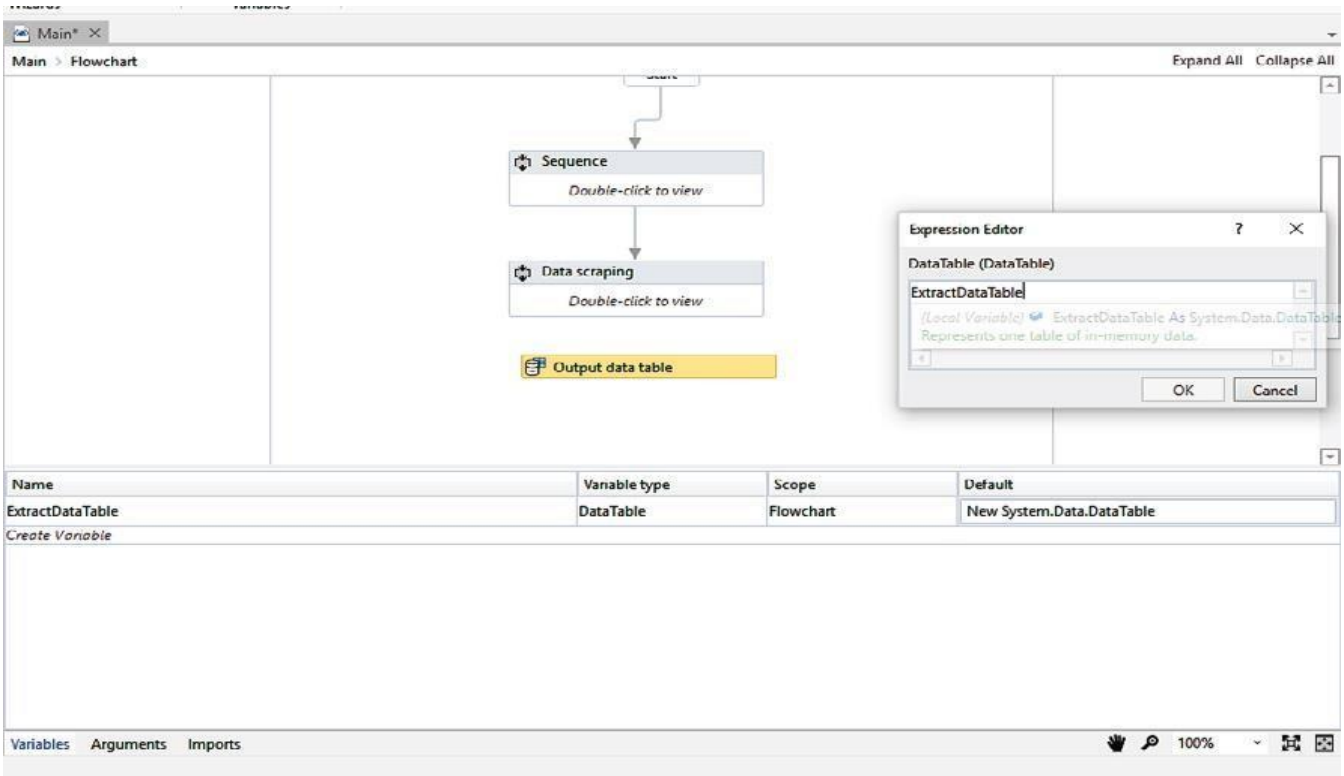
8. It will ask you to locate the next page's button/link. If you want to extract more information about the product and it spans across multiple pages, then click on the **Yes** button and point to the next page's button/link. Then, click on it. If you want to extract only the current page's data, click on the **No** button, (you can also specify the number of rows that you want to extract data from: By default it is 100):



9. Data scraping generates a data table. (In this case, *ExtractedDataTable* is generated.) Change the scope of *ExtractedDataTable* to the **Flowchart** so that it is accessible within the **Flowchart** activity:

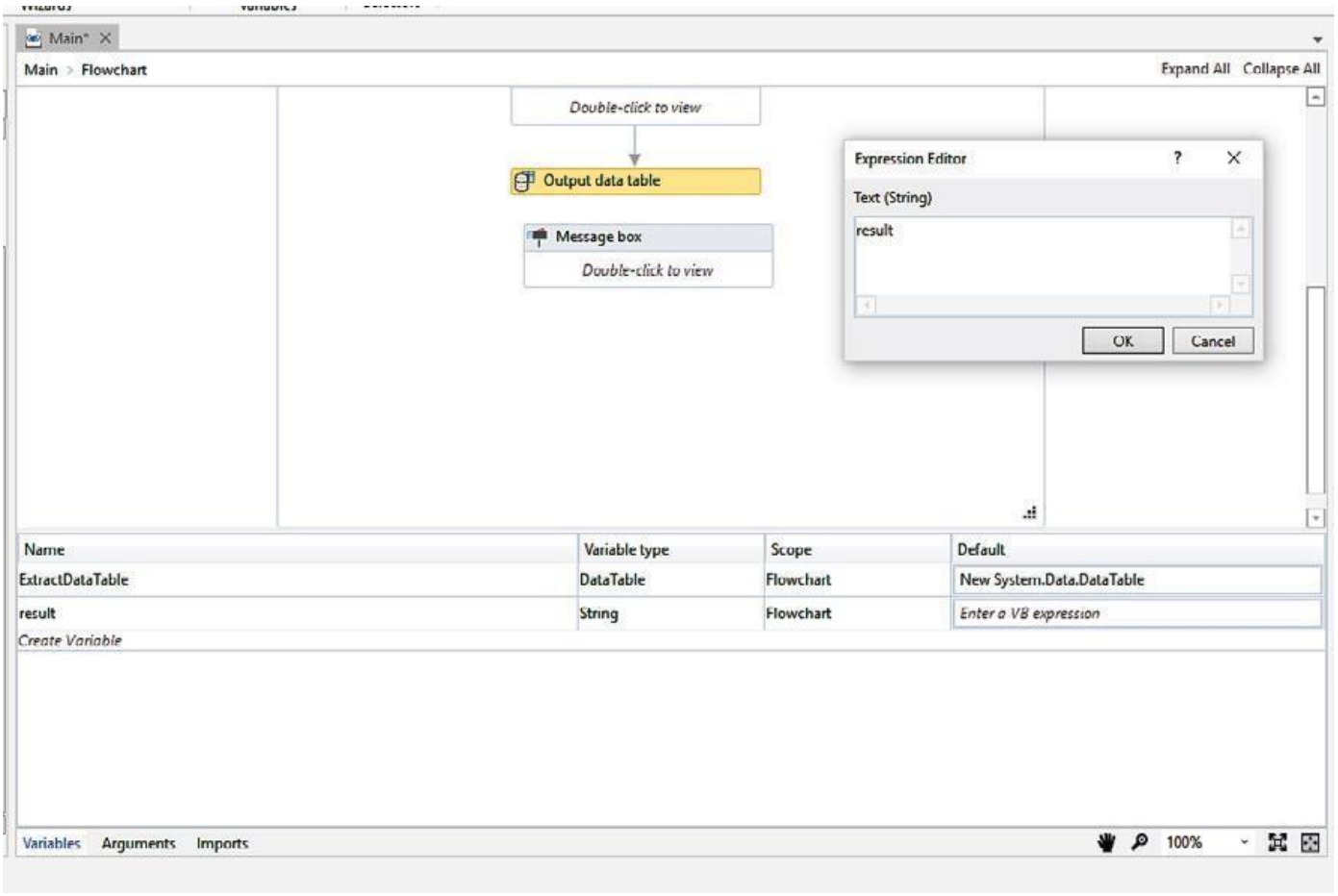


10. Drag and drop the **Output data table** activity on the **Flowchart**. Set the **Output** property of the **Output data table** activity as: *ExtractedDataTable*:



11. Connect the **Output data table** activity to the **Data Scraping** activity. Drag and drop the **Message box** activity on the Designer window. Also create a string variable to receive the text from the **Output data table** activity (in our case, we have created a *result* variable).

Specify the text property of the **Output data table** activity as the *result* variable to receive the text from the **Output data table**:



12. Connect the Message box activity to the Output data table activity. Double-click on the Message box and specify the text property as the *result* variable (the Variable that you created to receive the text from the Output data table activity).

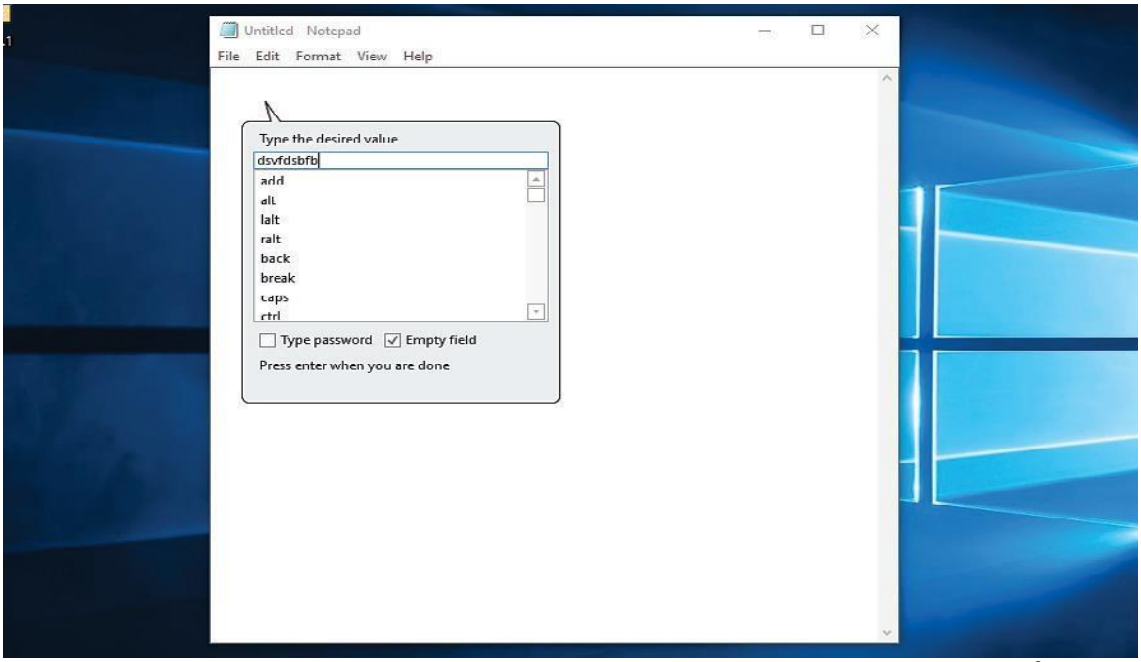
13. Hit the Run button and see the result.

4.5 Clipboard Management

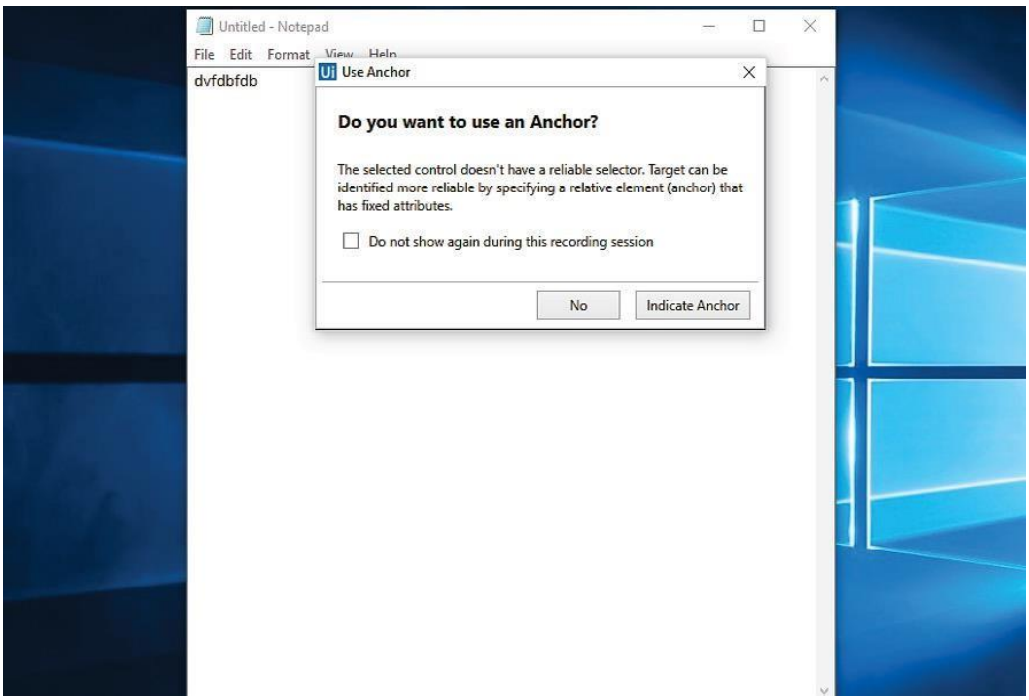
- Clipboard management involves managing the activities of the clipboard.
- Example, getting text from the clipboard, copying selected text from the clipboard, and so on.
- In this example, we will use Notepad. We will open Notepad, write some data into it, and Then copy the data to the clipboard. We will then extract the data from the clipboard:
  1. Drag and drop a **Flowchart** activity from the **Activities** panel.
  2. Click on the **Recording** icon on the top of UiPath Studio.
  A drop-down menu will appear with the options, **Basic**, **Desktop**, **Web**, and **Citrix**, indicating the different types of recording. Select **Desktop** and click on **Record**.
  3. Click on **Notepad** to open it. A Notepad window will pop up:

4. Click on the text area of Notepad. Type into the dialog box and check the empty field. (Checking the empty field will erase all existing data in Notepad before writing any new data.) Press *Enter*.

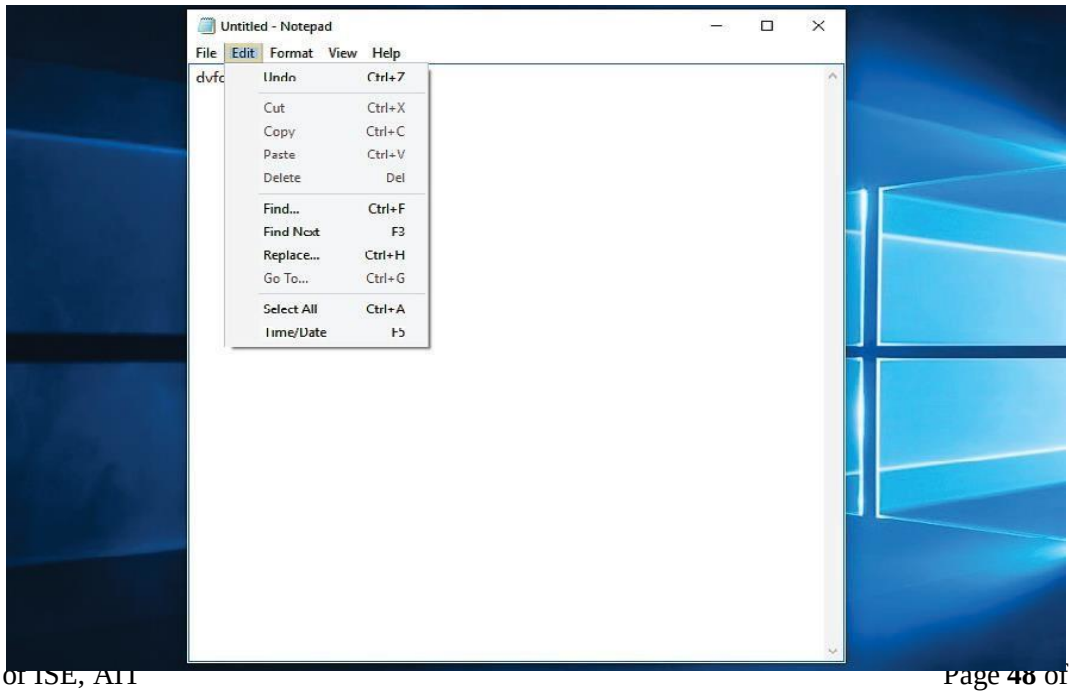
Data will be written on the Notepad text area:



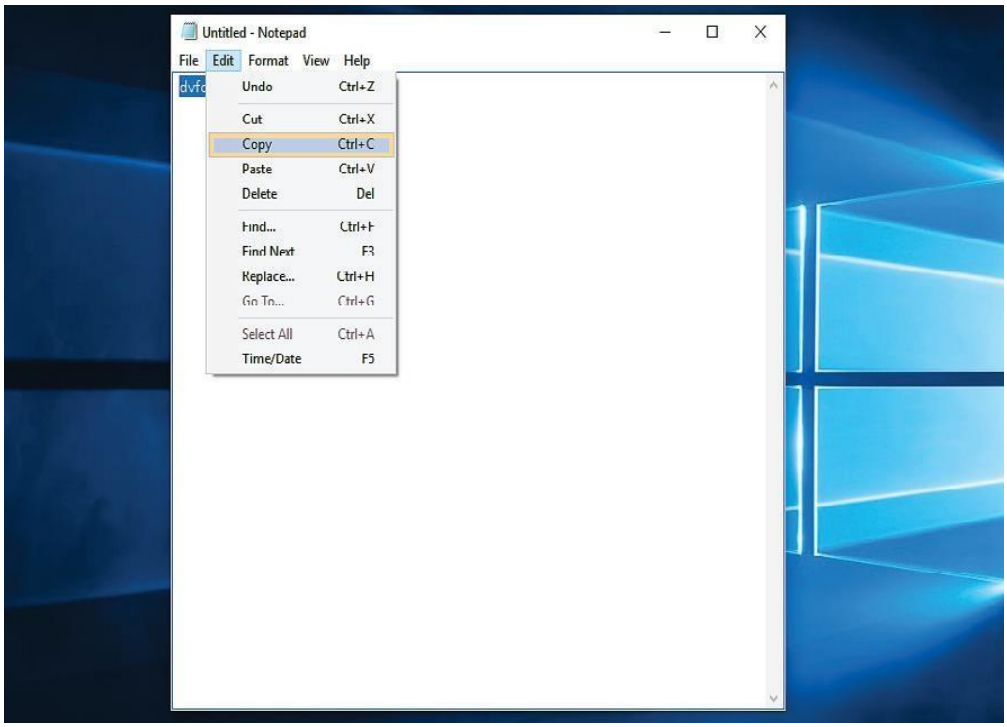
5. Click on the **Edit** button. A pop-up window will appear asking you whether you want to use an anchor. (An anchor is a relative element of the current {focused} element.) As you can see clearly, the anchor element of the **Edit** button can be the **File** or **Format** button. In this case, we have chosen the **Format** button:



6. Then, it will automatically start recognizing the **Edit** button. Choose the **Select all** option from the drop-down list:



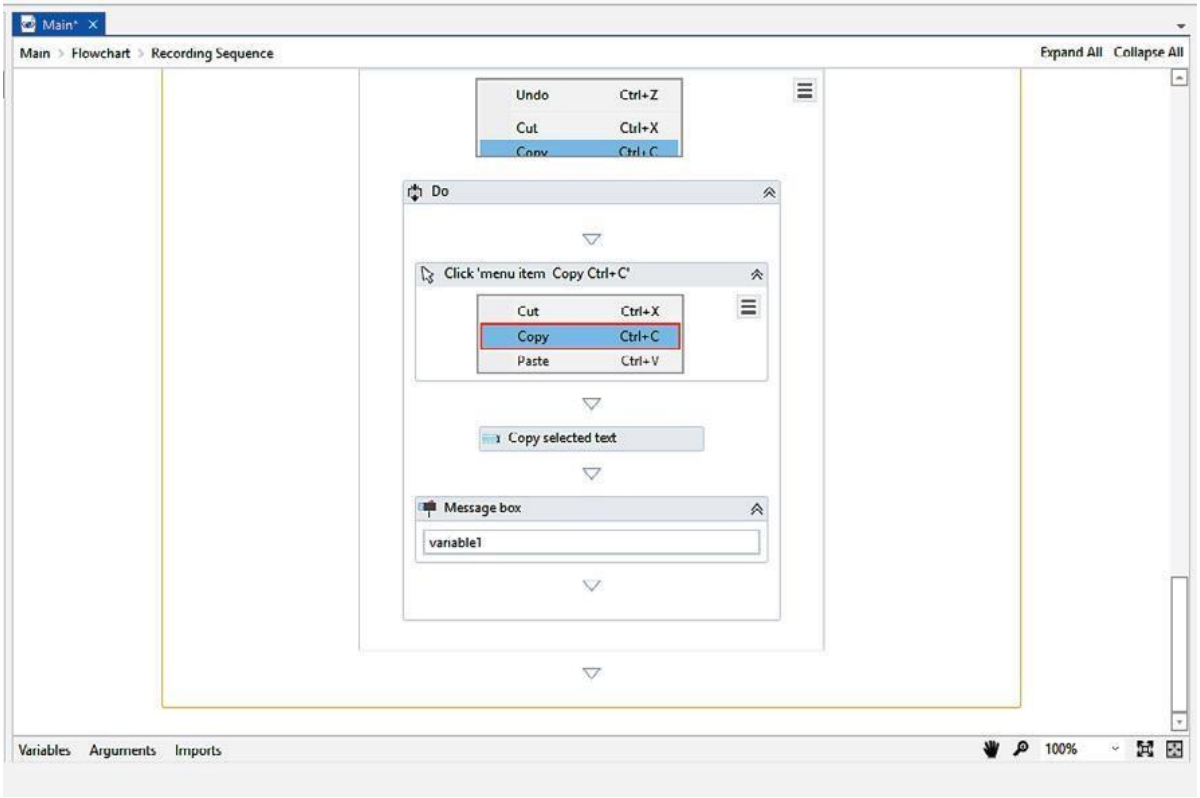
7. Once again, click on the **Edit** button. It will again ask you to indicate the anchor element. Indicate the anchor button and the **Edit** button will be highlighted, giving you a drop-down box. Select the **Copy** option:



This copied text is now stored in the clipboard.

- We can use the **Get from clipboard**, and **Copy selected text** activities to copy the text that is stored in the clipboard.
- We will use the **Copy selected text** activity.

8. Double-click on the **Recording sequence** that is generated by the recording. Scroll down and drag and drop the **Copy selected text** and **Message box** Activities inside the **Recording sequence**:



9. Create a variable of type **String** to store the output value of **Copy selected text**.
   - This variable will receive the required text from the clipboard with the **Copy Selected text** activity. Now, specify the newly created variable in the **Output** Property of the **Copy selected text** activity.
   - This will be the required selected text that we have copied into the clipboard.

10. Specify the string variable in the text property of the **Message box** activity.

11. Hit the **Run** button to see the result.

4.6 File operation with step-by-step example

In this module, we are going to operate on Excel file. The following are the methods that are frequently used with an Excel file:

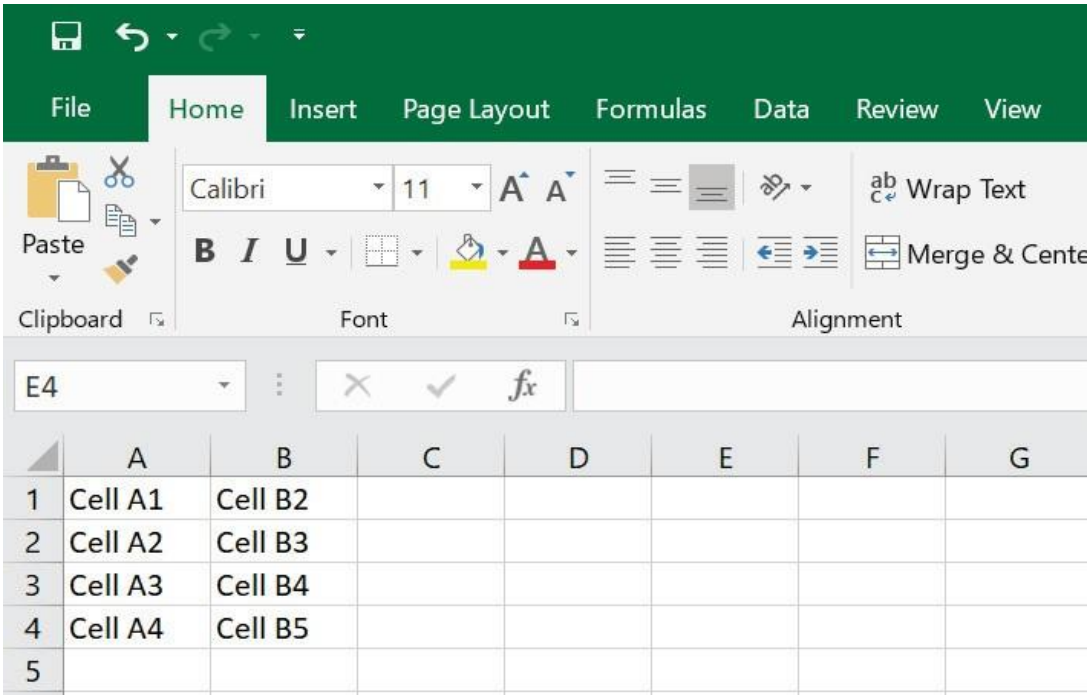
- Read cell
- Write cell
- Read range
- Write range
- Append range

Once you get familiar with these methods, it will become very easy for you to use other

methods too.

4.6.1 Read cell

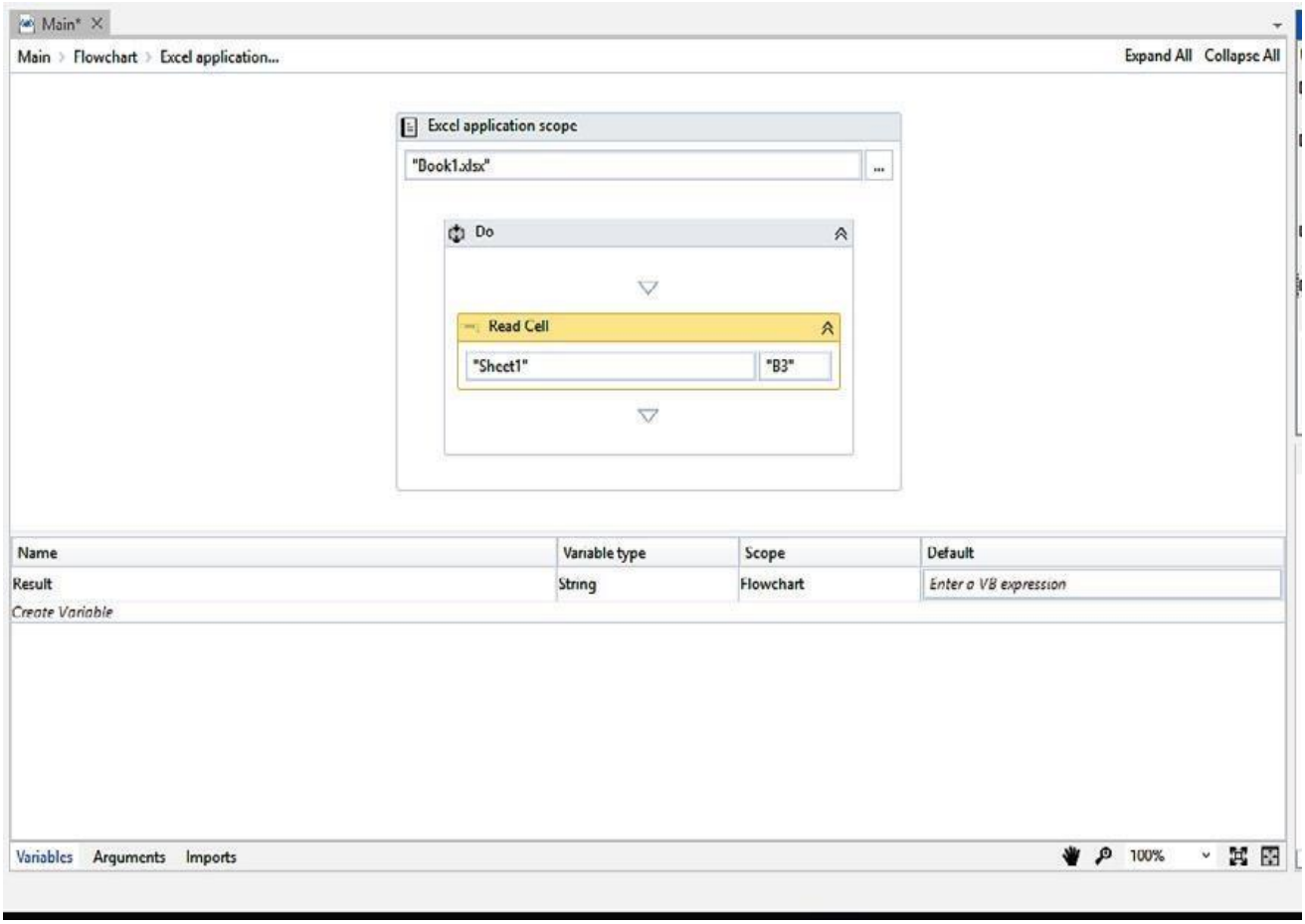
- This is used to read the value of a cell from an Excel file.



Suppose we have to read the value of the **B3** cell:

1. Drag and drop a **Flowchart** activity on the main Designer panel. Also, drag and drop an **Excel application scope** inside the **Flowchart**. Connect it to the **Start** node. Double click on Excel application scope.
2. Drag and drop the **Read Cell** activity inside the **Excel application scope** activity. Specify the range value in the cell text box of the **Read Cell** activity.

- Create a variable of type string to hold the result produced by the **Read Cell** activity.
- In our case, we have created a *Result* variable.
- Specify the **Output** property of the **Read Cell** activity by providing the variable's name that we have created:



3. Drag and drop a **Message box** activity inside the **Excel application scope** activity and specify the string variable's name (which we created earlier) in the expression box of the **Message box** activity.

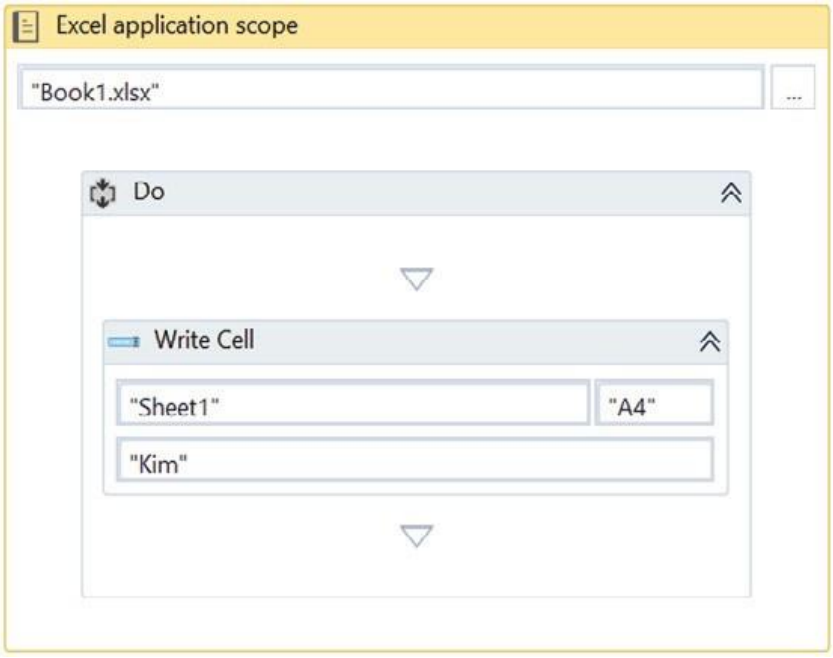
That's it. Press *F5* to see the result.

4.6.2 Write cell

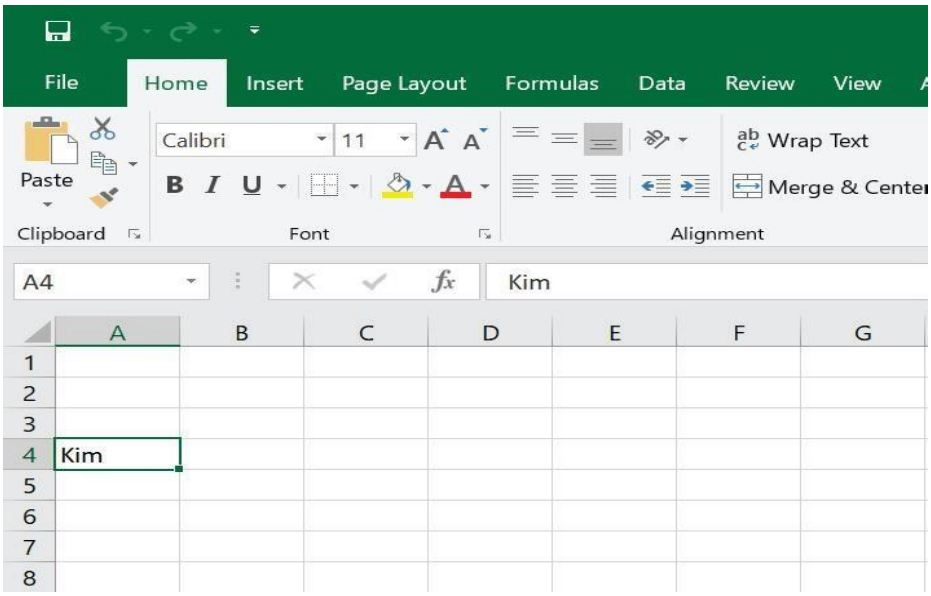
This activity is used to write a value in a cell of an Excel file:

1. Drag and drop a Flowchart activity on the main Designer panel. Also, drag and drop an Excel application scope inside the Flowchart activity. Connect it to the Start node.

2. Drag and drop a Write Cell activity inside the Excel application scope. Specify the cell value in which we want to write in the Range property of the Write Cell activity. Also, specify the value of the Value property:



Press *F5* and see the result. Open the Excel file to see the changes:



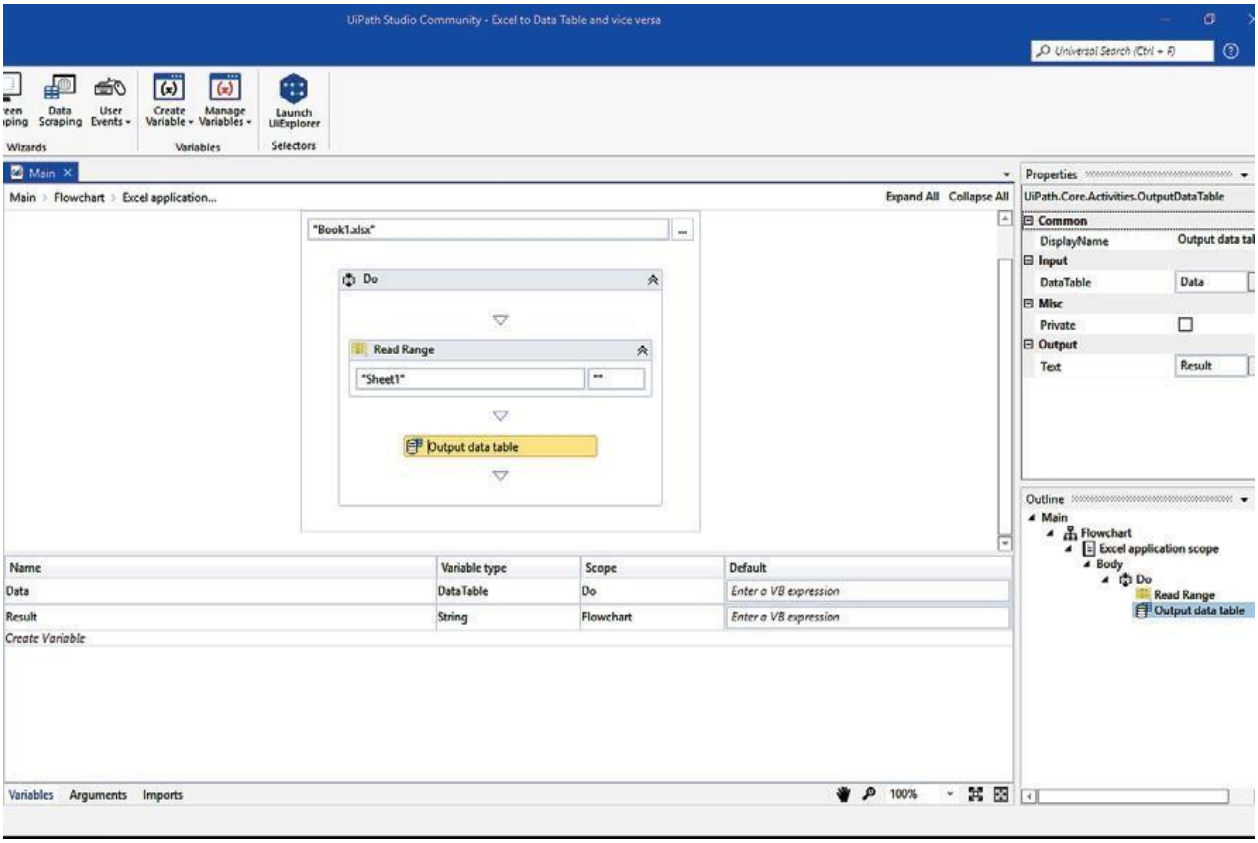
4.6.3 Read range

This is used to read the value up to the specified range. If the range parameter is not specified, it will read the entire Excel file:

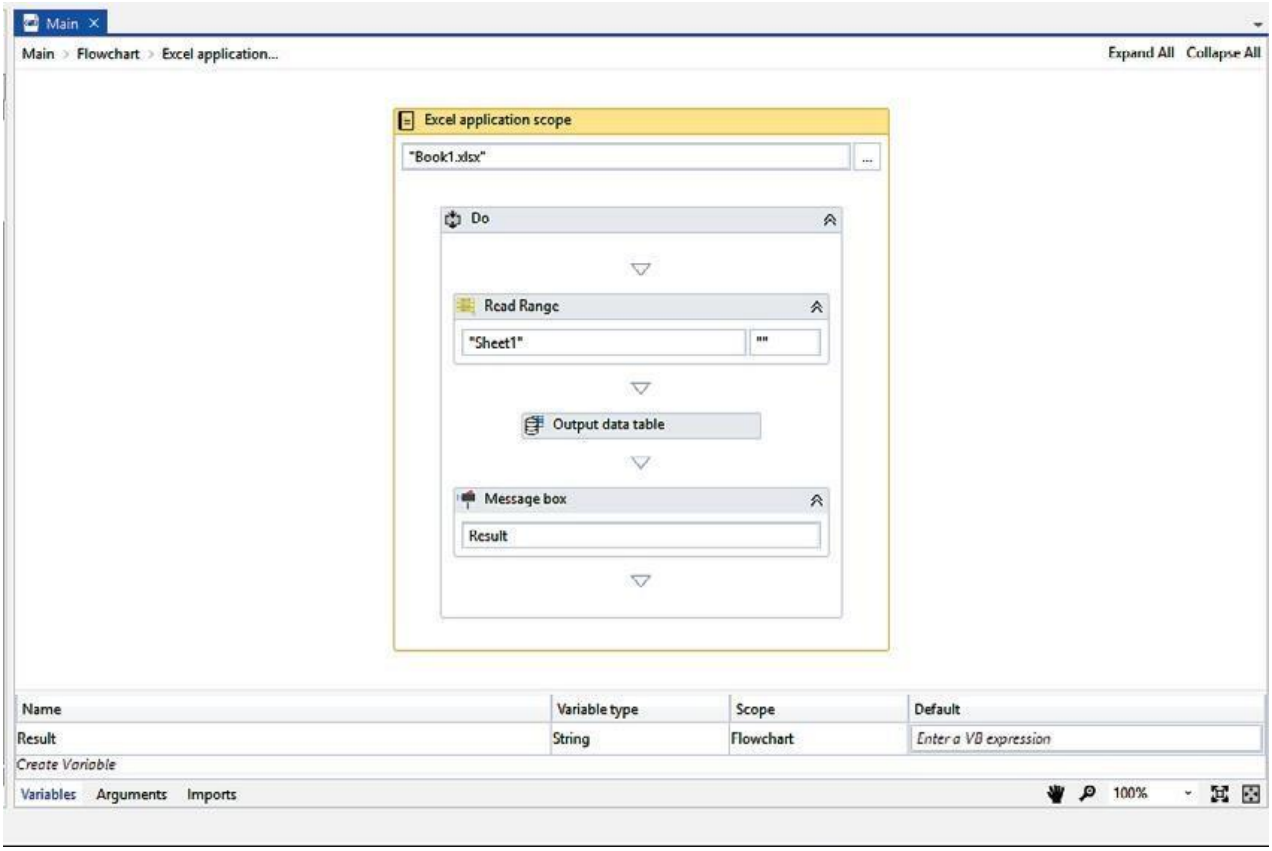
1. Drag and drop a **Flowchart** activity on the main Designer panel. Also, drag and drop an **Excel application scope** inside the **Flowchart** activity. Connect it to the **Start** node.

2. Drag and drop a **Read Range** activity inside the **Excel application scope** activity.
The **Read Range** activity produces a data table. We have to receive this data table in order to Consume it. We need to create a data table variable and specify it in the **Output** property of the **Read Range** activity.

3. Drag and drop an **Output Data Table** activity inside the **Excel application scope** activity. Now, we have to specify two properties of the **Output Data Table** activity: **Data Table** property and text property. The **Data Table** property of the **Output Data Table** activity is used to convert the data table into a string format. The text property is used to supply its value in a string format. We have to receive this value in order to consume it. For this, let us create a variable of type string. Give it a meaningful name (in our case, it is **Result**):



4. Drag and drop a **Message box** activity inside the **Excel application scope** activity. Also, specify the string variable's name that we created earlier inside the **Message box** activity:



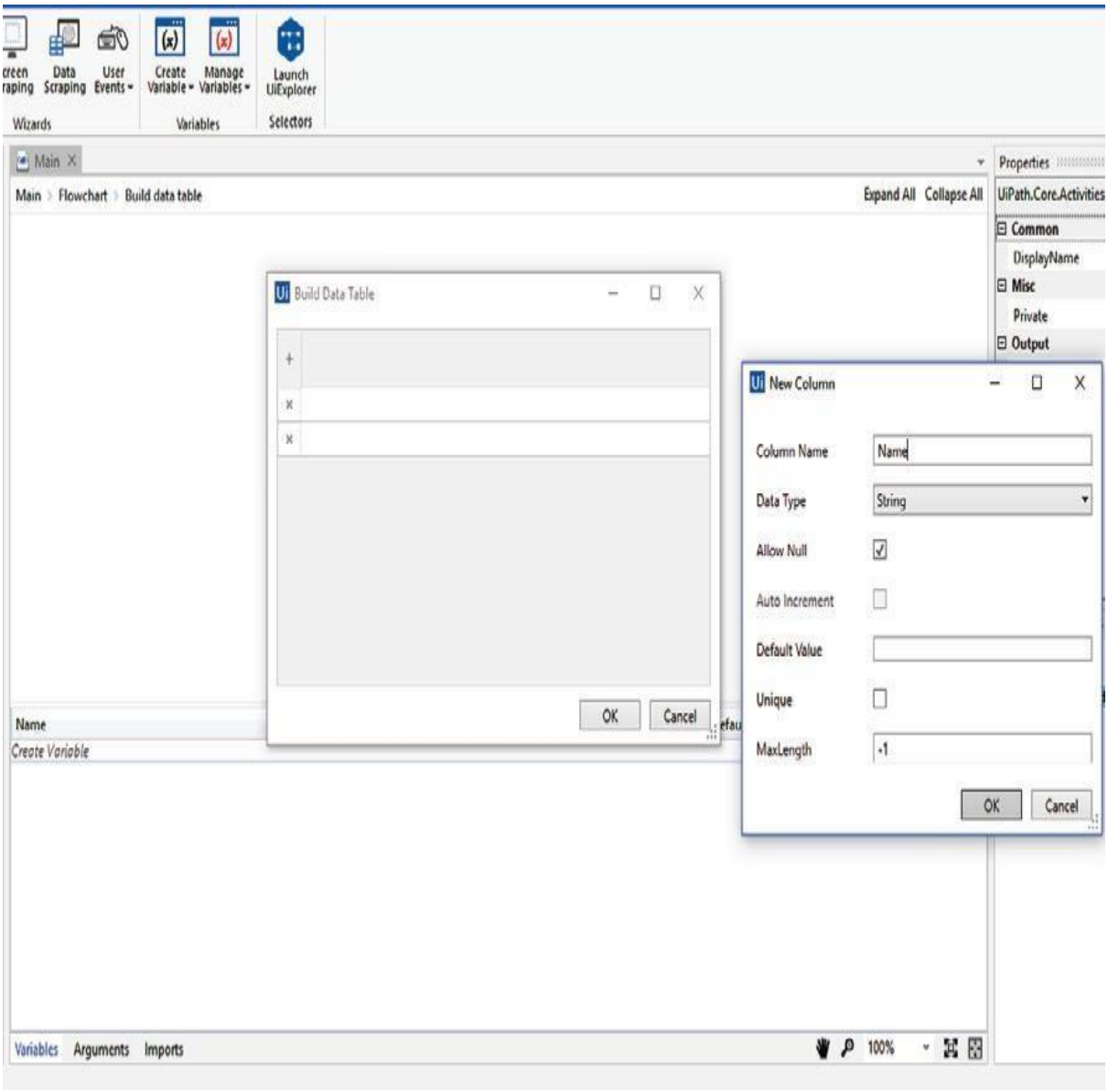
That's it. Press *F5* to see the result. A window will pop up displaying your Excel file data.

4.6.4 Write range

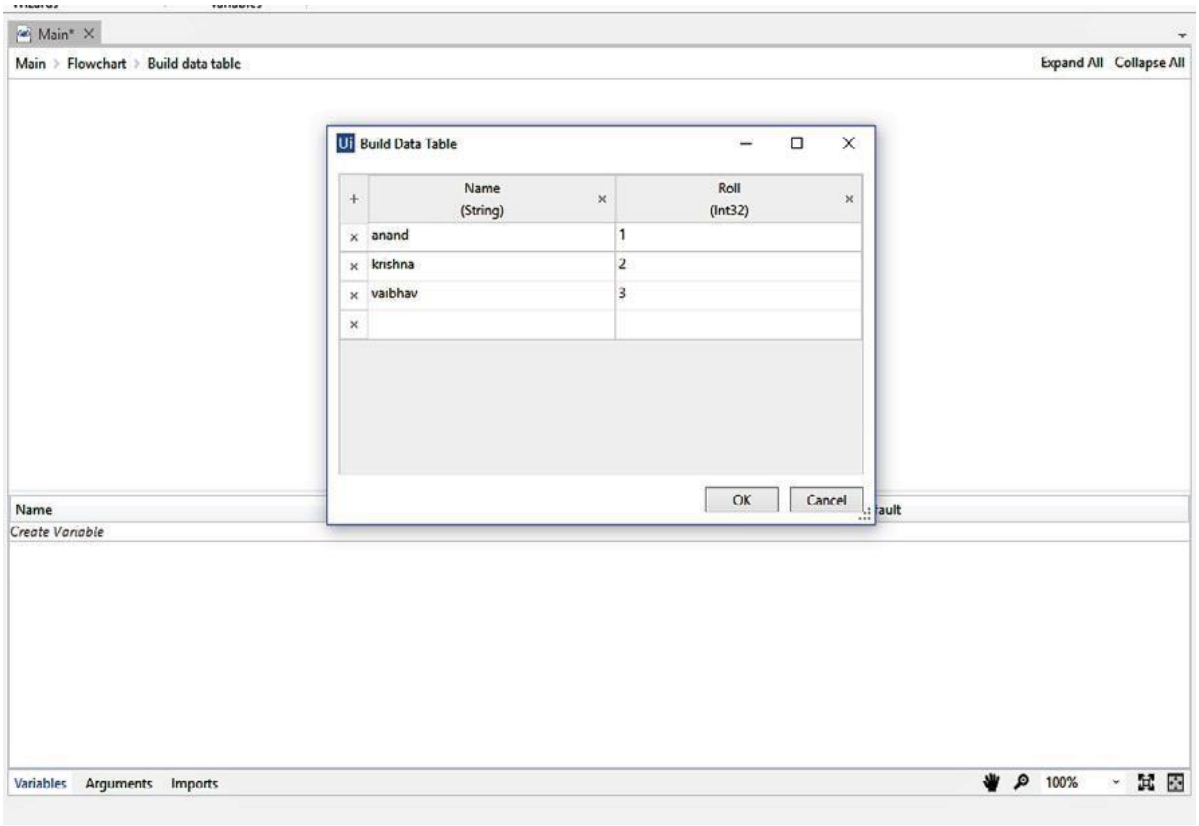
- This is used to write a collection of rows into the Excel sheet. It writes to the Excel file in the form of a data table. Hence, we have to supply a data table:

1. Drag and drop a **Build data table** activity from the **Activities** panel.

- Double-click on this activity.
- A window will pop up.
- You will notice that two columns have been generated automatically. Delete these two columns.
- Add your column by clicking on the + icon and specify the column name.
- You can also select your preferred data type.
- You are free to add any number of columns:

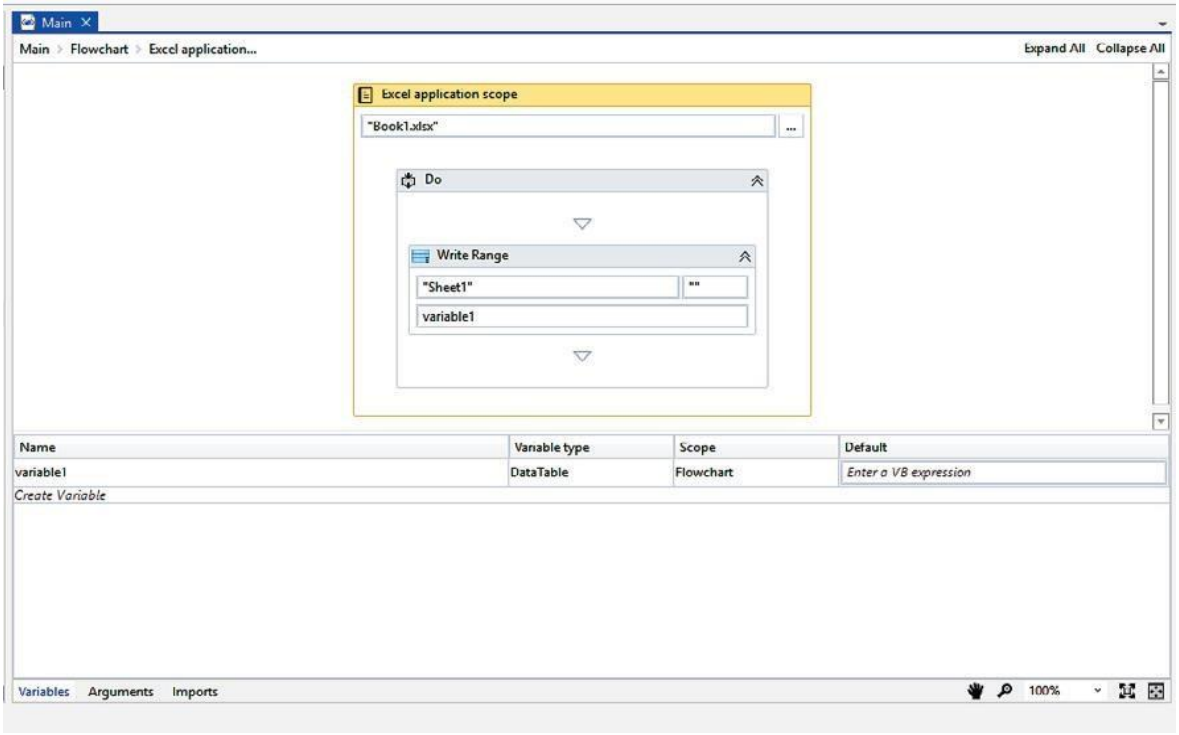

Data Scraping
User Events
Create Variable
Manage Variables
Launch UiExplorer
Wizards
Variables
Selectors
Main
Main > Flowchart > Build data table
Expand All
Collapse All
Properties
UiPath.Core.Activities
Common
DisplayName
Misc
Private
Output
Build Data Table
OK
Cancel
New Column
Column Name
Name
Data Type
String
Allow Null
Auto Increment
Default Value
Unique
MaxLength
-1
OK
Cancel
Name
Create Variable
Variables
Arguments
Imports
100%

2. In this project, we are adding two columns.
   - The procedure for adding the second column is almost the same.
   - You just have to specify a name and its preferred data type.
   - We have added one more column (Roll) and set the data type to **Int32** for the data table.
   - We have also initialized this data table by providing some values in its rows.
   - Create a variable of type data table. Give it a meaningful name.
   - Specify this data table name in the **Data table** property of the **Build data table** activity.
   - We have to supply this variable in order to get the data table that we have built:



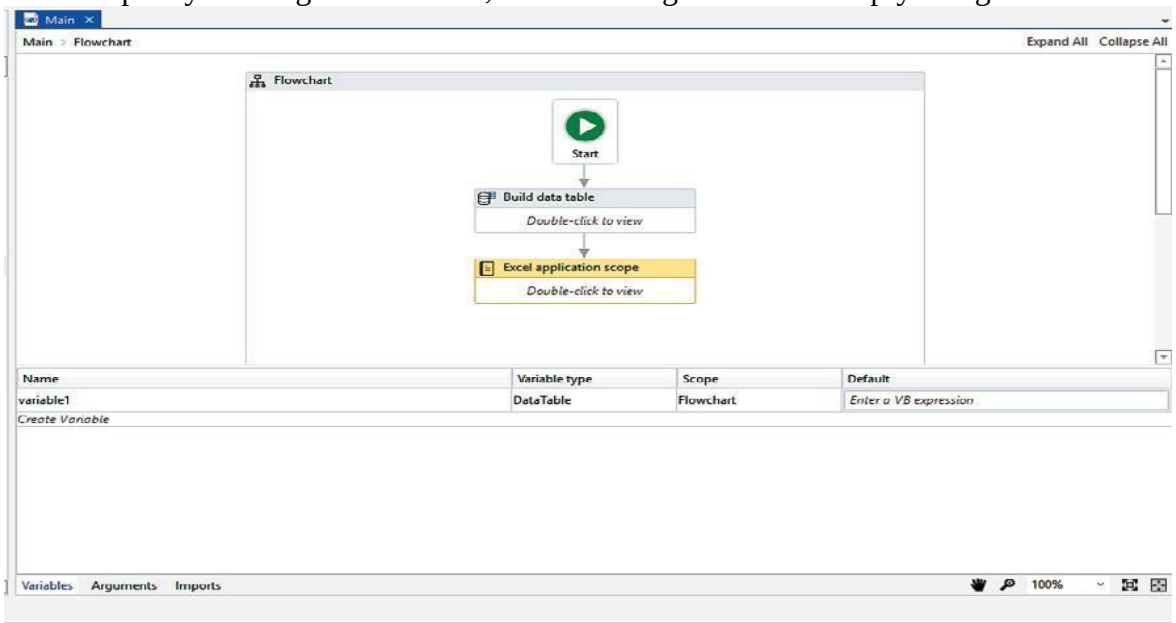
Our data table has been built successfully.

3. Drag and drop an **Excel application scope** inside the main Designer panel.
   - You can either specify the Excel sheet path or manually select it.
   - Connect this activity to the **Build Data Table** activity.
   - Inside the **Excel application scope** activity, just drag and drop the **Write Range** activity:



4. Specify the data table variable name that we created earlier and set it as a **Data table** property inside the **Write Range** activity.

- We can also specify the range. In this case, we have assigned it as an empty string:



That's it. Hit the **Run** button or press *F5* to see the result.

4.6.5 Append range

- This is used to add more data into an existing Excel file. The data will be appended to the end.

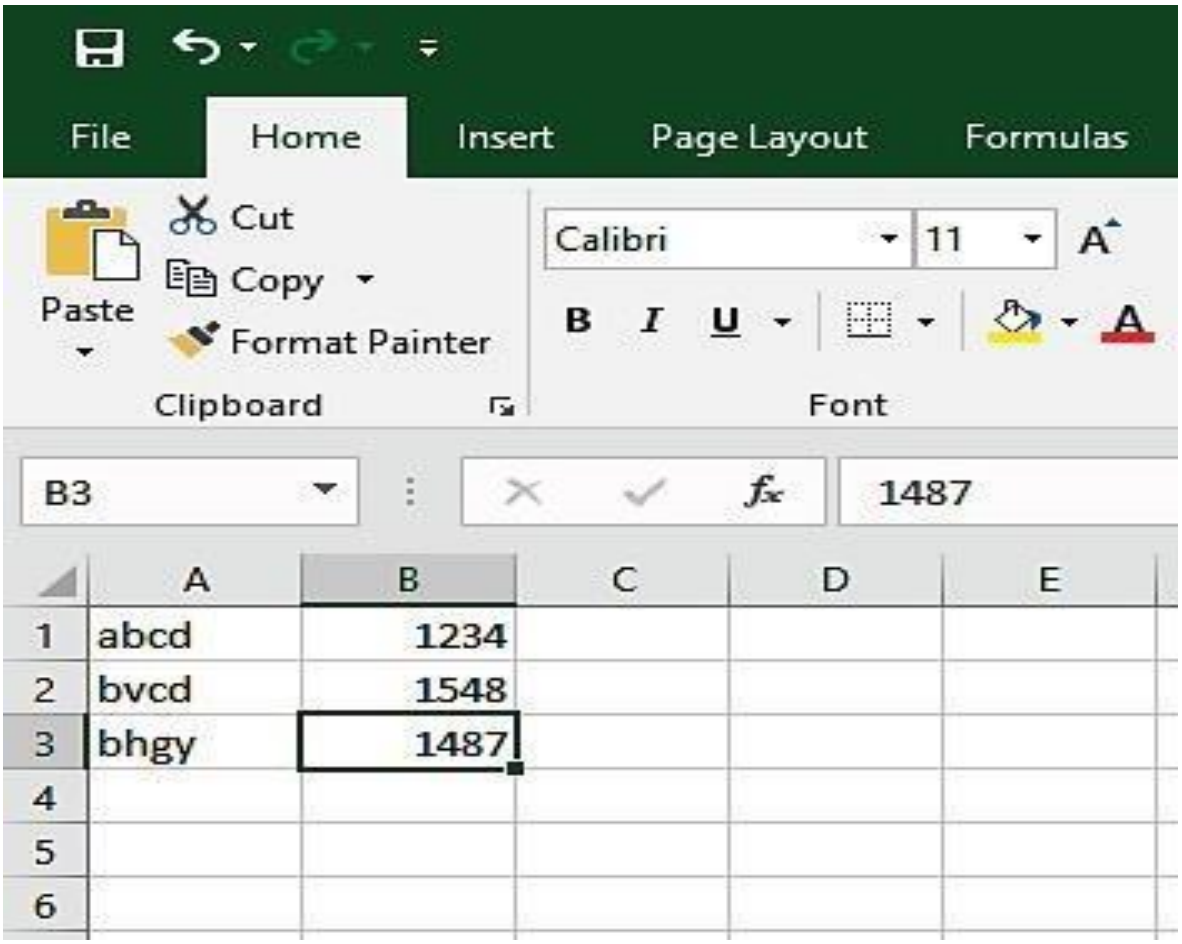
1. Drag and drop the **Flowchart** activity on the main Designer window. Also, drag and drop the **Excel application scope** inside the **Flowchart** activity.

- Connect it to the Start node.

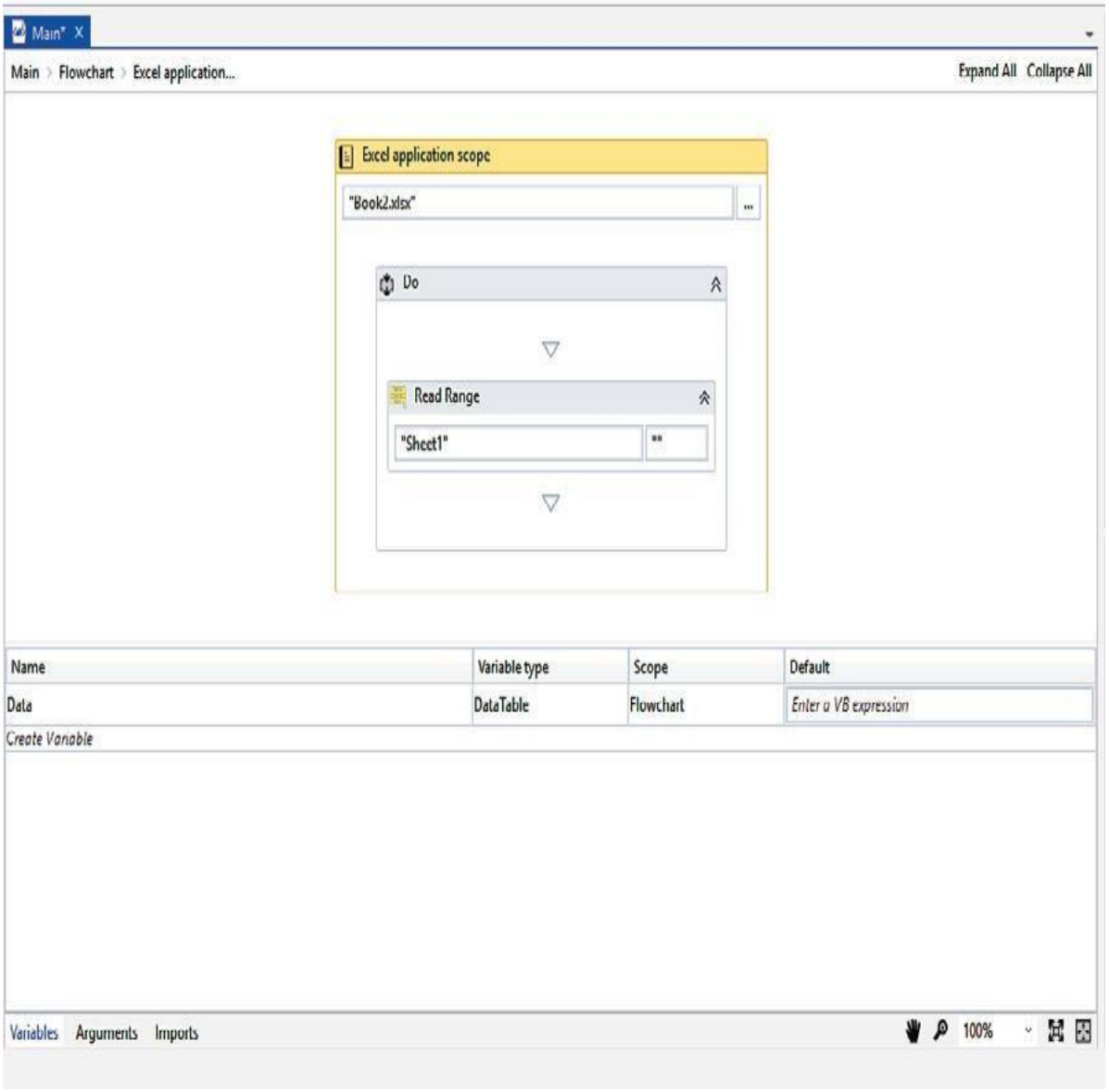
The **Append Range** activity requires a data table.

- In this program, we are going to use another sample Excel file, which has some raw data. Then, we will read this Excel file and append the data to another Excel file.

- First, we have to read its contents:

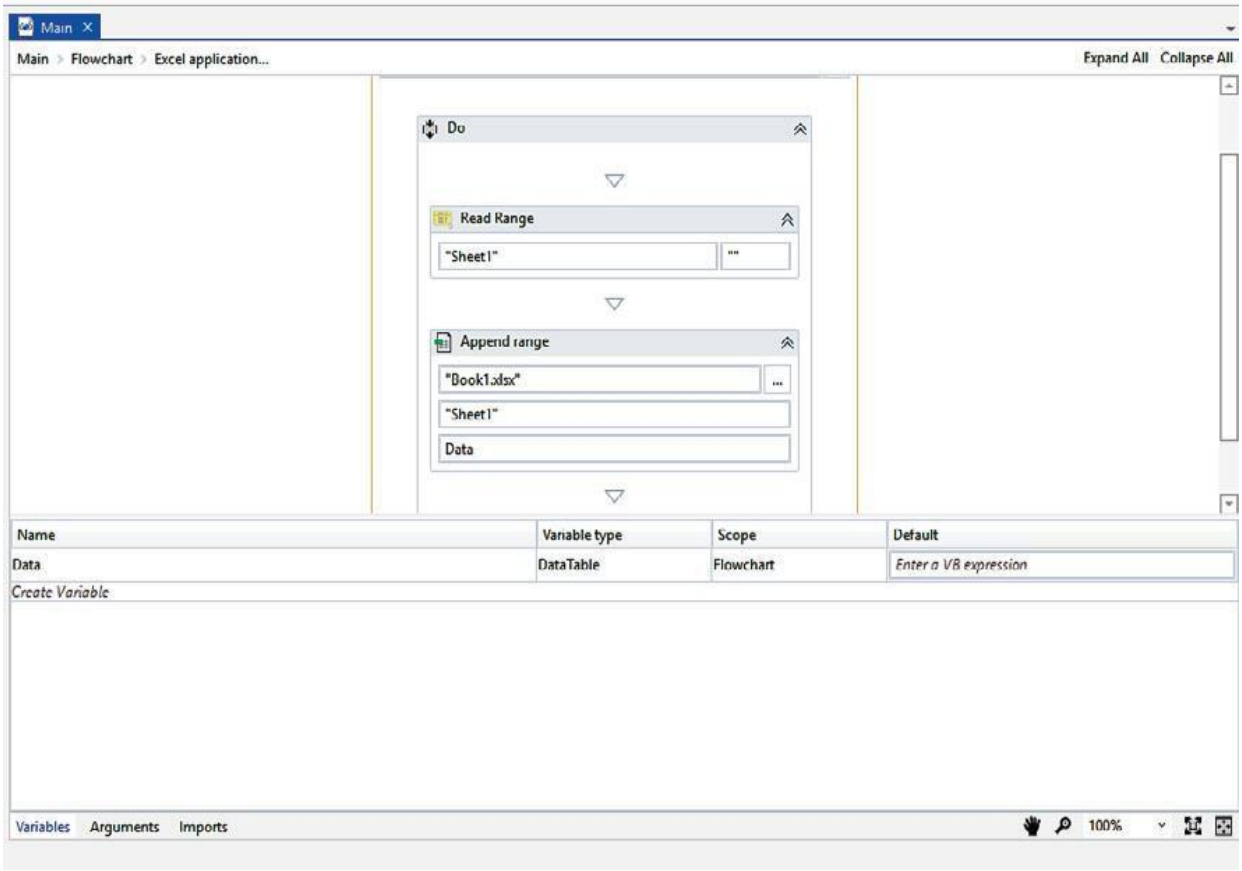


2. Drag and drop the **Read Range** activity inside the **Excel application scope** activity.
   - The **Read Range** activity produces a data table.
   - We have to receive this data table in order to consume it. Create a data table variable and specify it in the **Output** property of the **Read Range** activity:

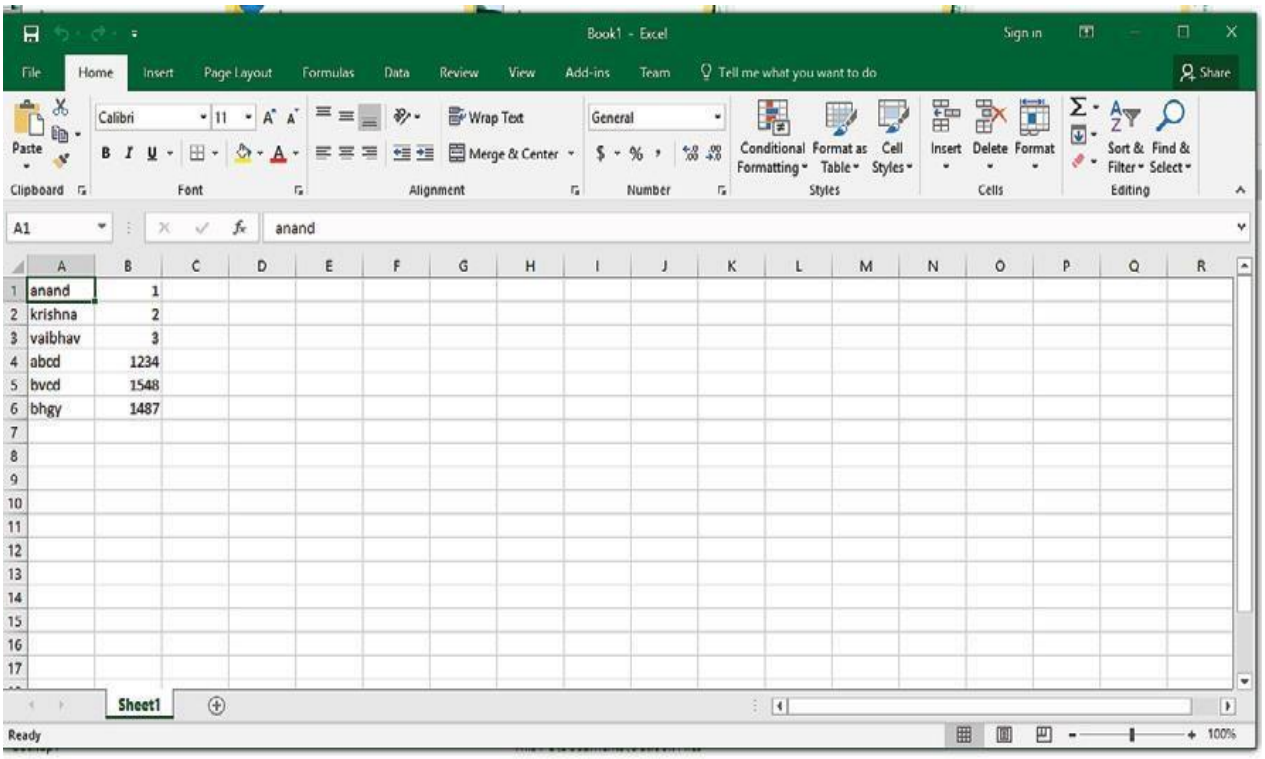


3. Drag and drop the **Append Range** activity inside the **Excel application scope** activity.

- Specify the Excel file path in the **Append Range** activity (in which we want to append the data).
- Also, specify the data table (which is generated by the **Read Range** activity):



That's it. Press *F5* to see the result:



We can clearly see that the data has been appended successfully to the Excel sheet.

4.7 CSV/Excel to data table and vice versa (with a step-by-step example)

We will see how to extract data from an Excel file into a data table and vice versa. We will achieve this by:

- Reading an Excel file and creating a data table using data from the Excel file
- Creating a data table and then writing all its data to an Excel file.

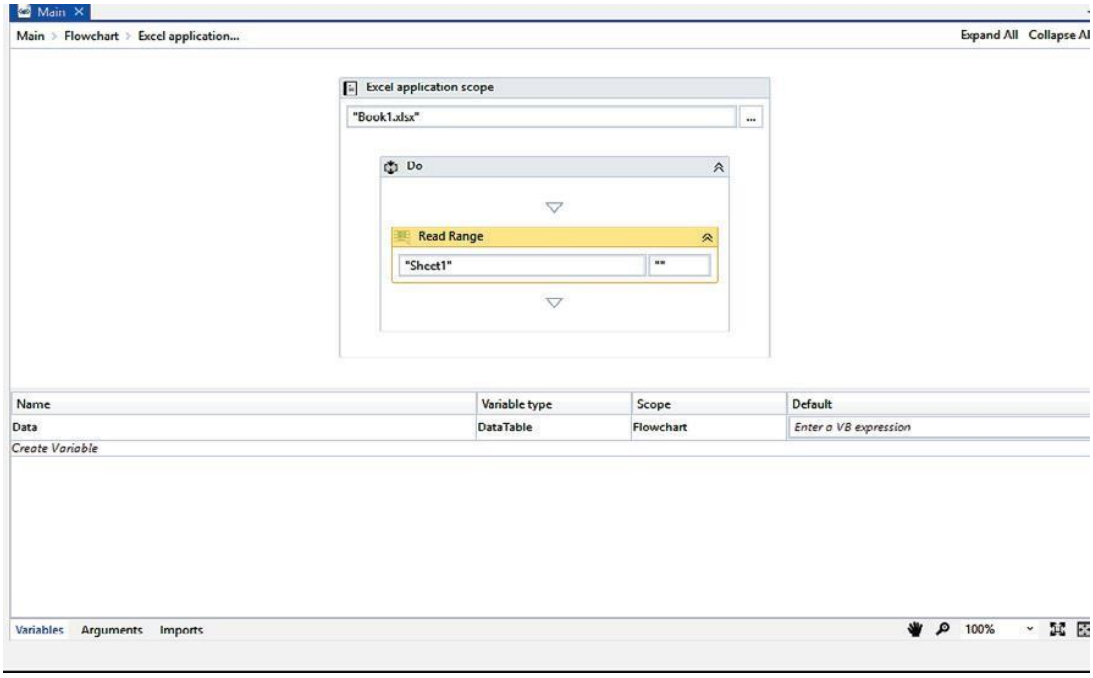
4.7.1 Reading an Excel file and creating a data table by using data from the Excel file

- We have an existing Excel file and we are going to use it in our project:

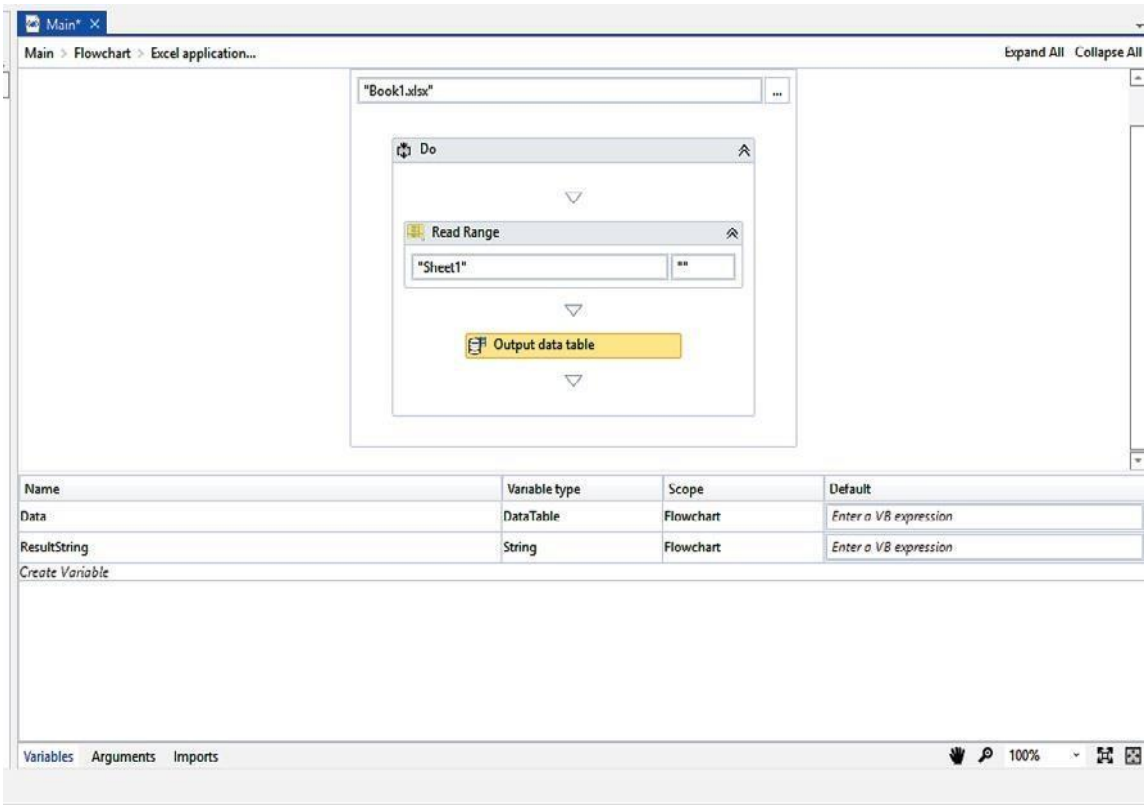
1. Drag and drop the **Flowchart** activity on the main Designer window. Also, drag and drop the **Excel application scope** inside the **Flowchart**.

2. Double-click on the **Excel application scope**. You have to specify the path of your workbook/Excel file. Drag and drop the **Read Range** activity from the **Activities** panel inside the **Excel application scope**.

- The **Read Range** activity will read the entire Excel sheet. We also have the option of specifying our range. Create a variable of type data table and specify it in the **Output** property of the **Read Range** activity. This variable will receive the data table produced by the **Read Range** activity:



3. Drag and drop the **Output Data Table** activity inside the **Excel application scope** activity.
   - Now, we have to specify two properties of the **Output Data Table** activity:
   - the **Data Table** property and the text property. The **Data Table** property of the **Output Data Table** activity is used to convert the **Data Table** into string format.
   - The text property is used to supply its value in a string format. We have to receive this value in order to consume it. For this, let us create a variable of type string.
   - Give it a meaningful name:



4. Drag and drop a **Message box** activity inside the **Excel application scope** activity.

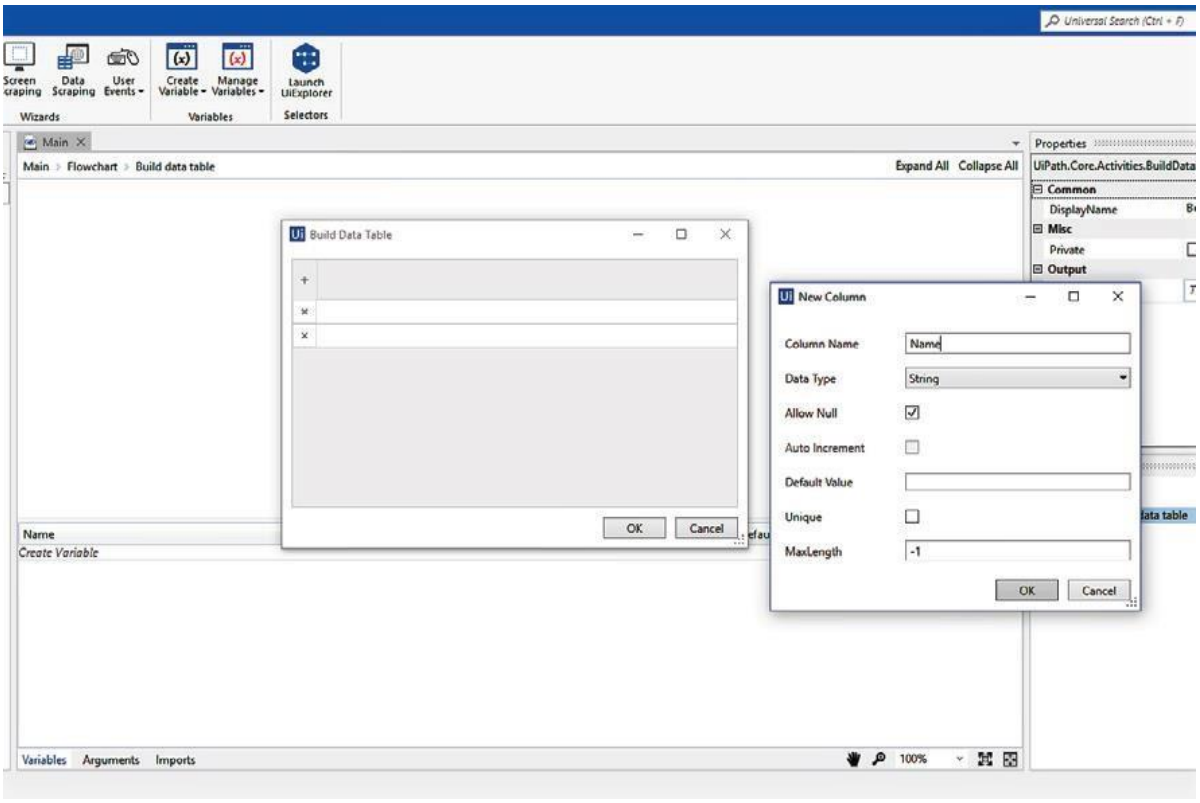
- Also, specify the string variable's name that we created earlier inside the **Message box** activity.

That's it. Press *F5* to see the result. A window displaying the Excel file data will pop up.

4.7.2 Creating a data table and then writing all its data to an Excel file

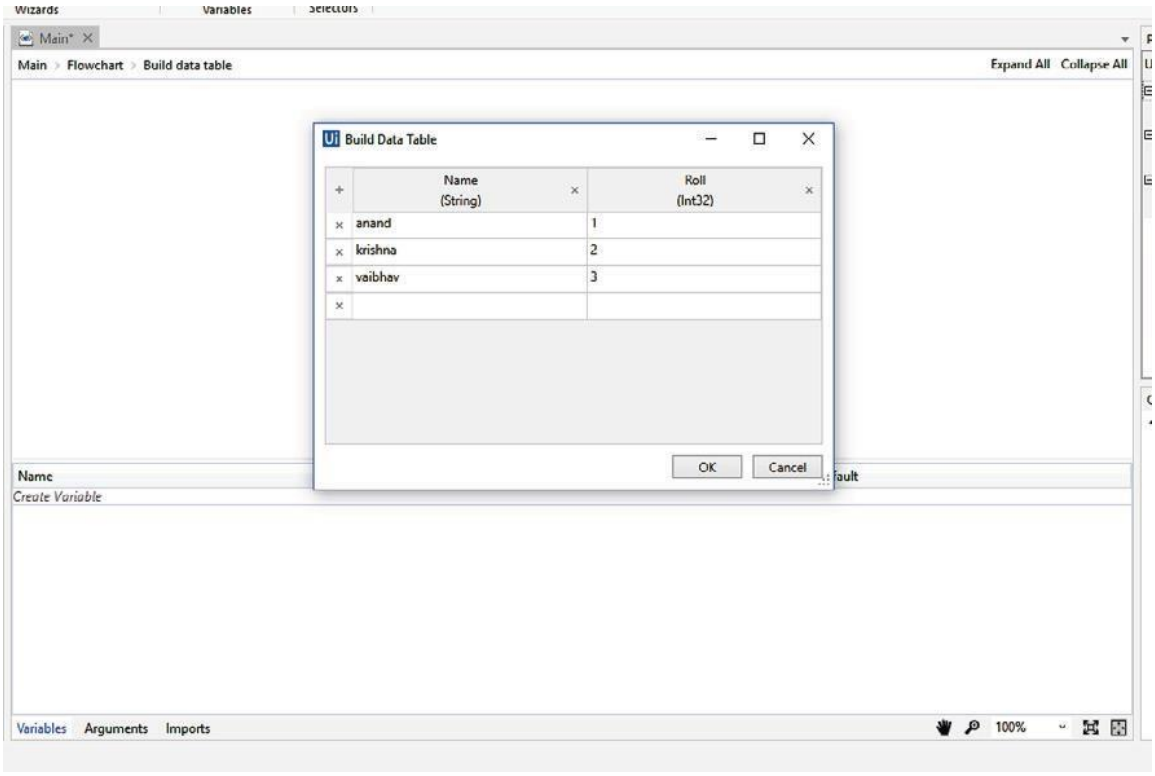
we will build a data table dynamically and then write all its data to an Excel file:

1. Drag and drop a Build data table activity from the Activities panel. Double-click on this activity. A window will pop up. Two columns have been generated automatically; delete these two columns. Add your column by clicking on the + icon and specify the column name. You can also select your preferred data type. You are free to add any number of columns:



In this project, we are adding two columns. The procedure for adding the second column is almost the same. You just have to specify a name and its preferred data type. We have added one more column (Roll) and set the data type to **Int32** in the data table. We have also initialized this data table by giving some values to its rows.

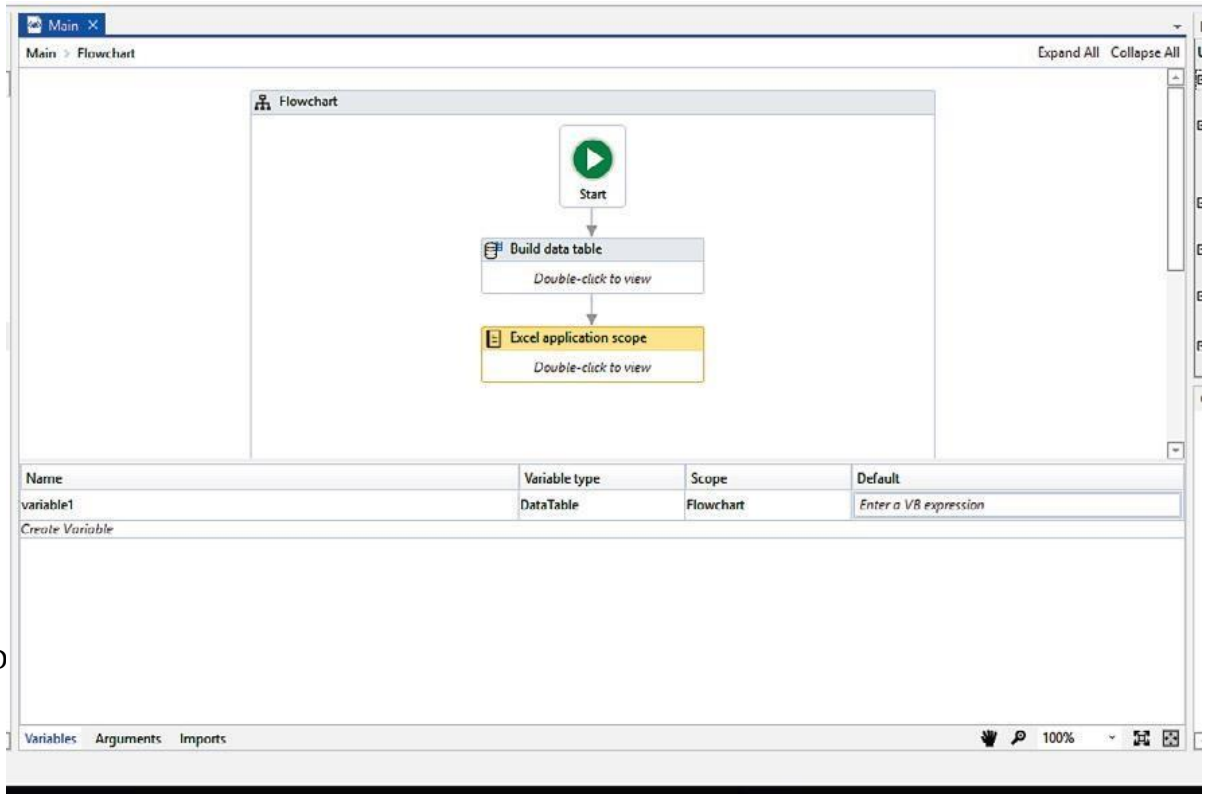
Create a variable of type **Data Table**. Give it a meaningful name. Specify this data table's name in the **Data Table** property of the **Build data table** activity. We have to supply this variable in order to get the data table that we have built:



Our data table has been built successfully.

2. Drag and drop the **Excel application scope** inside the main Designer window.

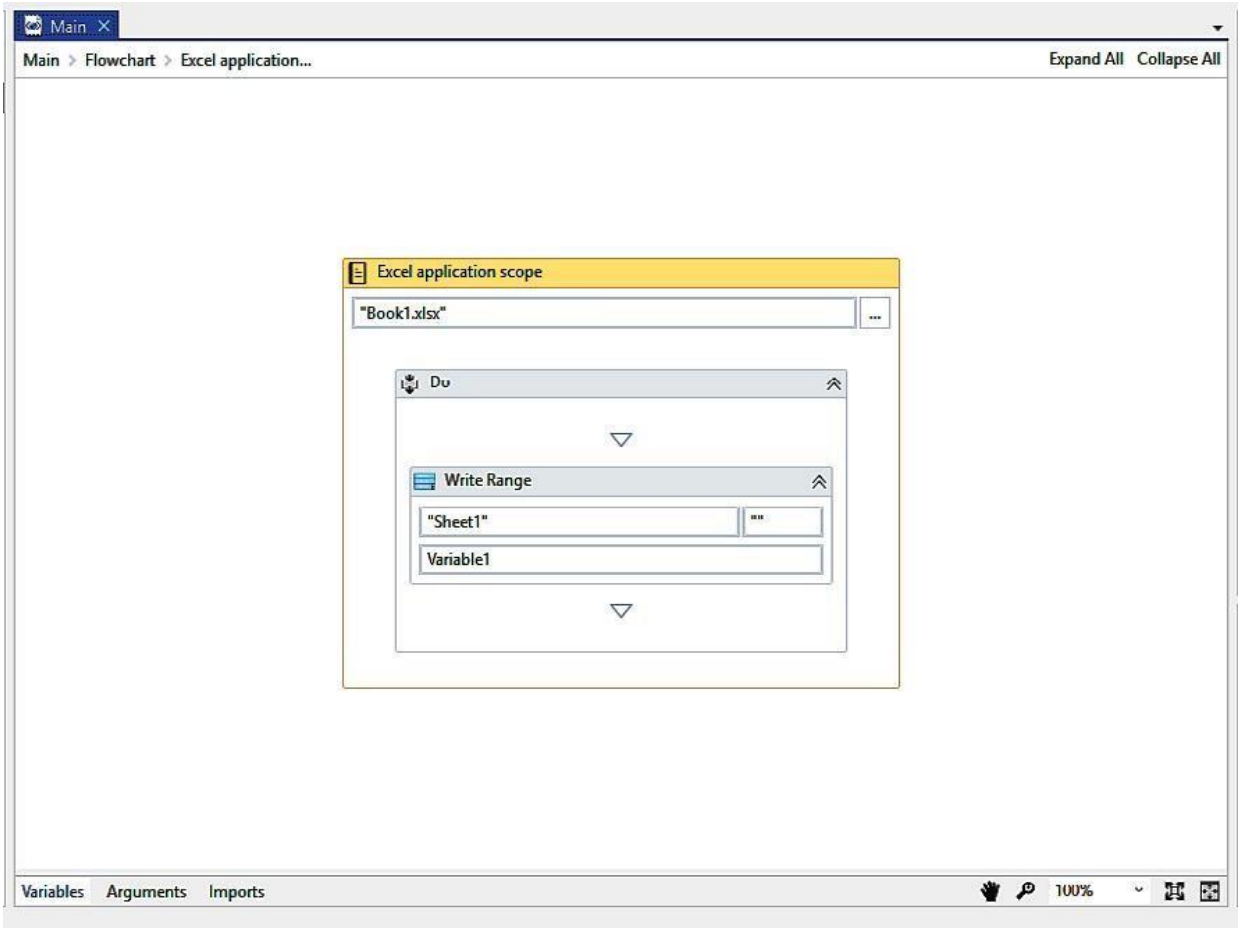
Specify the Excel sheet's path or manually select it. Connect this activity to the **Build Data table** activity:



3. Inside the **Excel application scope** activity, drag and drop the **Write Range** activity.

Specify the data table variable name that we created earlier and set it as a **Data table** property inside the **Write Range** activity.

We can also specify the range. In this case, we have assigned it as an empty string:



4. That's it. Hit the **Run** button or press *F5* to see the result.

Module 4

Chapter 5: Taking Control of the Controls

Introduction

In this chapter we will learn how we can interact with the controls in the UI. Sometimes, you may need to click on a particular button or extract information from a textbox. Either we take some action on a control, or we read/write. We will go into detail on how to do this accurately.

Extraction is a primary feature of RPA, enabling UI automation. Behind the scenes, many technologies are at work on the seamless extraction of information from the UI. When typical RPA techniques are not successful, OCR technology is used to extract information. We will learn about using OCR and other techniques in the following topics:
a.Screen Scraping
b.When to use OCR
c.Types of OCR available
d.How to use OCR

5.1 Finding and attaching windows

→we are going to use the Attach Window activity.

→The Attach Window activity can be found in the **Activities** panel.

→This activity is generally used to attach an already opened window.

→It is also auto-generated when we record actions using the Basic or Desktop recorder.

Implementing the Attach Window activity

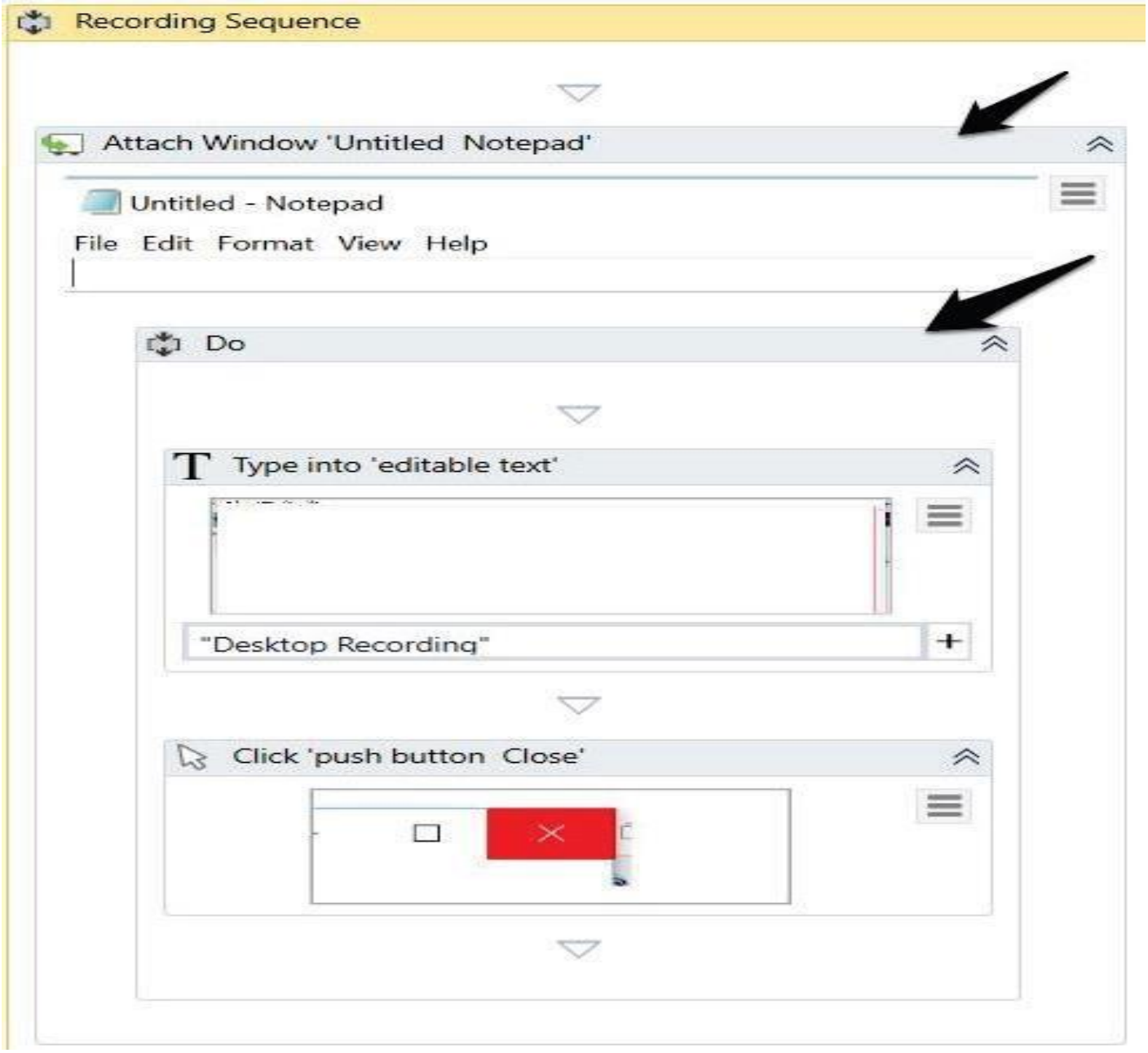
In this example, we shall use the **Attach Window** activity manually. Here, we are going to attach a Notepad window and then write some text into it:

1. Create a blank project and give it a meaningful name.
2. → Drag and drop a **Flowchart** activity on the Designer panel.
   →Also, drag and drop a **Click** activity inside the Designer panel.
   →Set this **Click** activity as the **Start** node.

3. Double-click on the **Click** activity and then click on **Indicate on screen**. Locate the Notepad icon.
4. Drag and drop the **Attach Window** activity on the main Designer panel. Connect the **Attach Window** activity to the **Click** activity.

5. Double-click on the **Attach Window** activity. Click on **Click Window on Screen** and indicate the Notepad window. The Notepad window is now attached to the previous activity:

6.→For the sake of completeness, we are going to add a **Type into** activity.
→Just drag and drop the **Type into** activity, inside the **Attach Window** activity.
→ Click on the **Indicate element inside window** and
→Locate the Notepad window where you want to write the text.
→ Write the text in the Text property of the **Type into** the activity.
7. Hit the **Run** button.


Recording Sequence
Attach Window 'Untitled Notepad'
Untitled - Notepad
File Edit Format View Help
Do
Type into 'editable text'
"Desktop Recording"
Click 'push button Close'

5.2 Finding the control

→There are many activities which can be used to find controls on screen/ applications.
→These activities are used to find or wait for an UI element.

Following are the activities that help in finding the controls:

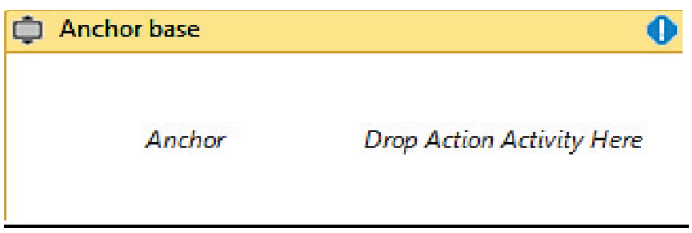
- Anchor base
- Element Exists
- Element scope
- Find children
- Find element
- Find relative element
- Get ancestor
- Indicate on screen

5.2.1 Anchor base

→This control is used for locating the UI element by looking at the UI element next to it.
→This activity is used when we have no control over the selector.
→That means when we do not have a reliable selector, then we should use the **Anchor base** control to locate the UI element

We can use the **Anchor base** control as explained in the following section:
1. →Drag and drop a **Flowchart** activity on the Designer panel of a blank project.
   →Also, drag and drop an **Anchor base** control from the **Activities** panel.
   → Connect the **Anchor base** control with **Start**.
2. Double-click on the **Anchor base** control:
3. There are two activities that we have to supply to the **Anchor base** control:
Anchor and action activities.
4. Drag and drop the **Anchor base** activity (for example; **Find Element** activity) in the **Anchor** field and **Action** activity (for example; **Type into**) in the **Drop Action Activity Here** field of the **Anchor base** control.

The **Anchor base** activity will find the relative element nearby the element on which you want to perform the Action, and the Action activity will perform the appropriate action that you have specified.



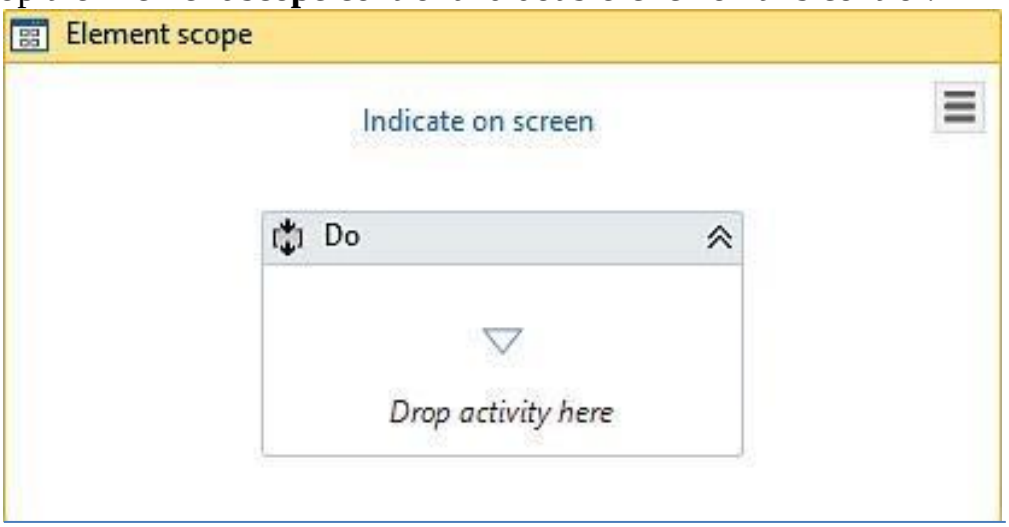
5.2.2 Element Exists

→This control is used to check the availability of the UI element.
→It checks if the UI element Exists or not. It also returns a Boolean result if the UI Element Exists, then it returns true: otherwise, it returns false.
→You can use this control to check for the UI element. In fact, it is good practice to use this control for UI elements whose availability is not confirmed or those that change frequently.

- Just drag and drop the **Element Exists** control from the **Activities** panel.
- Double-click on it. You can see there is an **Indicate on screen** option.
- Click on it to indicate the UI element.
- It returns a Boolean result, which you can retrieve later from the Exists property.
- You just have to supply a Boolean variable in the **Exists** property in the **Properties** panel.
-

5.2.3 Element scope

→This control is used to attach a UI element and perform multiple actions on it. You can use a
→bunch of actions within a single UI element.
→Drag and drop the **Element scope** control and double-click on this control:



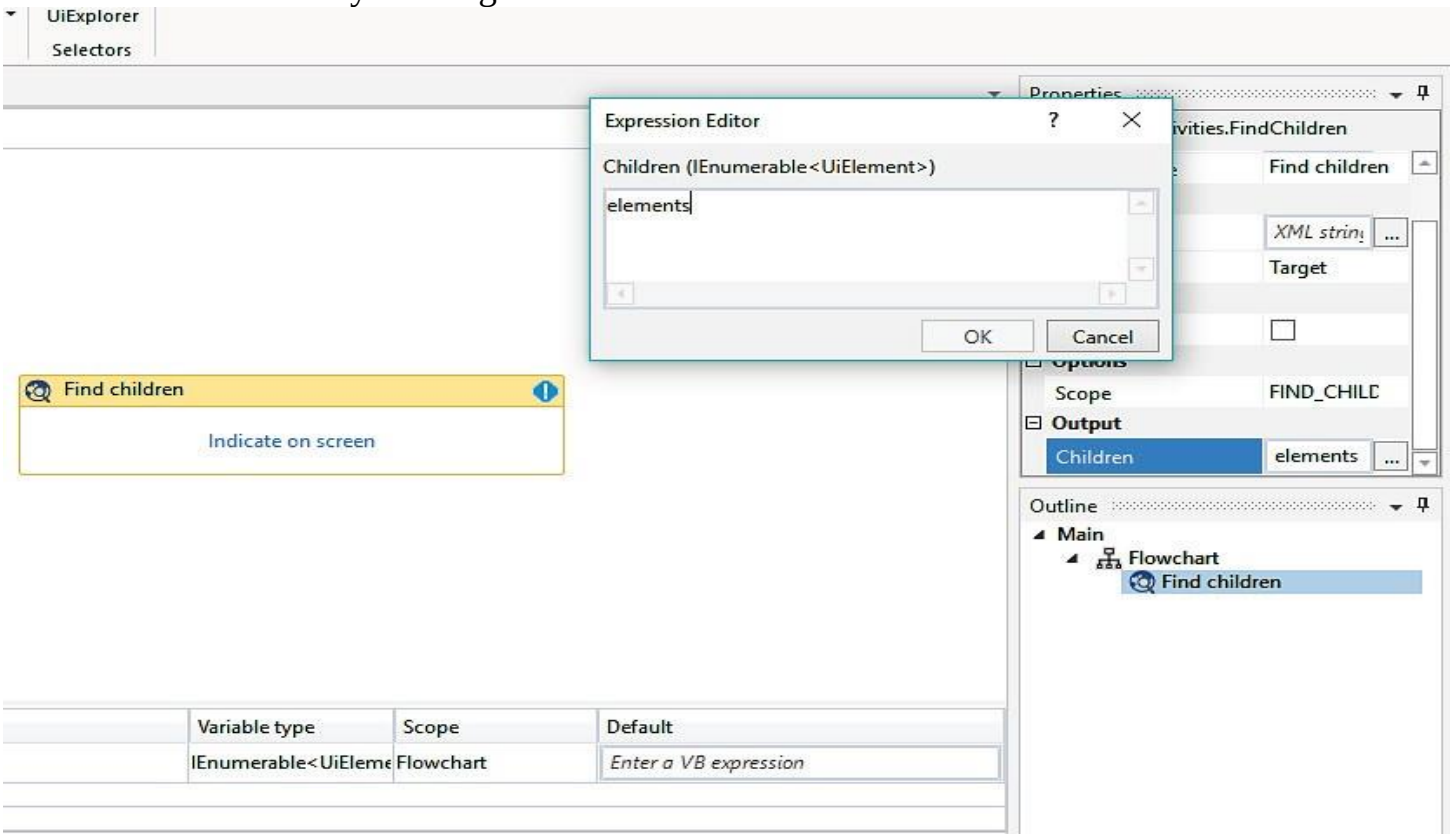
You can clearly see that you have to indicate the UI element by clicking on **Indicate on screen** and specifying all the actions that you want to perform in the **Do** sequence. You can add many activities inside the **Do** sequence.

5.2.4 Find children

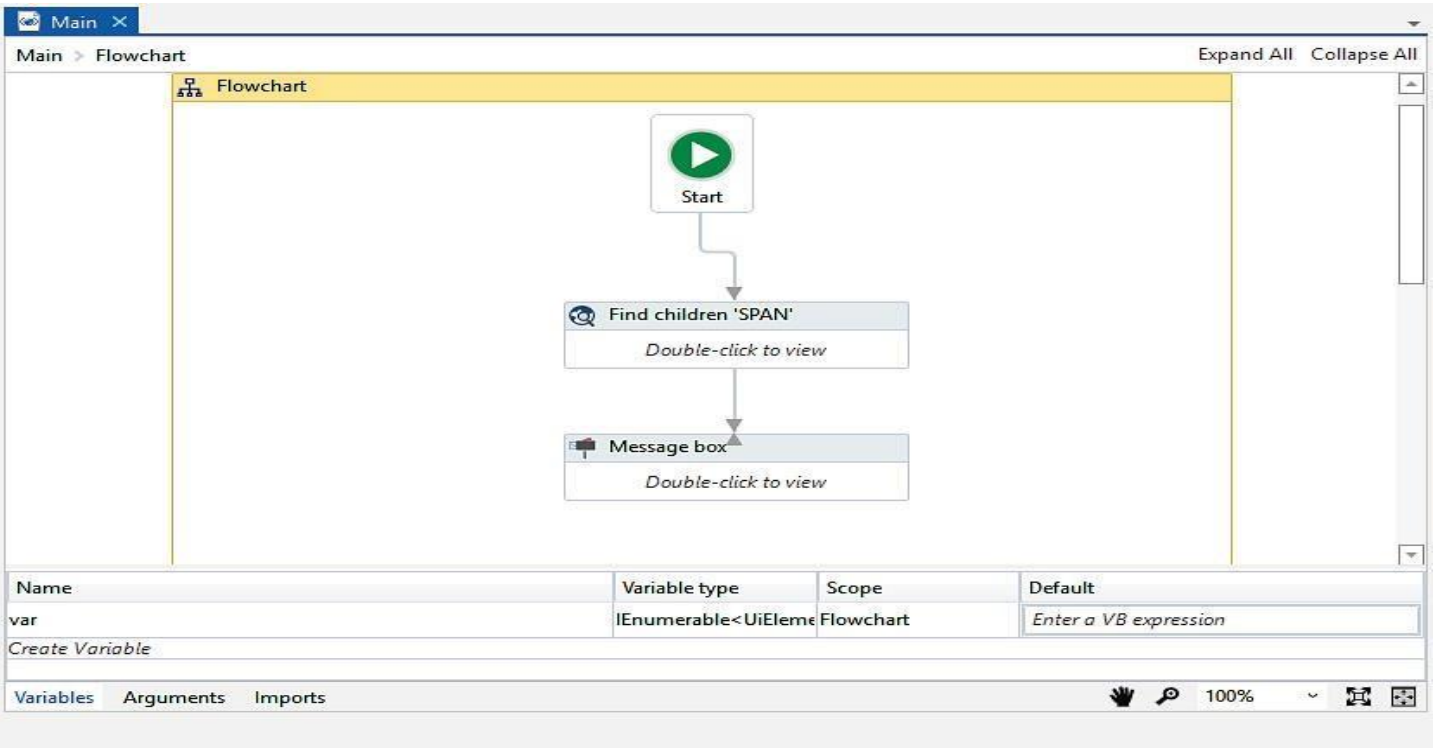
→This control is used to find all the children UI elements of a specified UI element.
→It also retrieves a collection of children UI elements.
→You can use a loop to inspect all the children UI elements or set up some filter criteria to

filter out the UI elements.
→Drag and drop the **Find children** control from the **Activities** panel.

→Double-click on it to indicate the UI element that you want to specify.
→You can indicate it by clicking on **Indicate on screen**:



You have to supply a variable of type IEnumerable<UIElements> in the children property, as mentioned in the preceding screenshot. This variable is then used for retrieving the UI elements:



De

Find element

→This control is used to find a particular UI element.
→It waits for that UI element to appear on the screen and returns it back.
→You can use this control in the same way that you used the other controls.
→Just drag and drop this control, and indicate the UI element by clicking on **Indicate on screen**.
→You can specify the variable of type UI element in the Found element property of the Find Element control to receive the UI element as output.

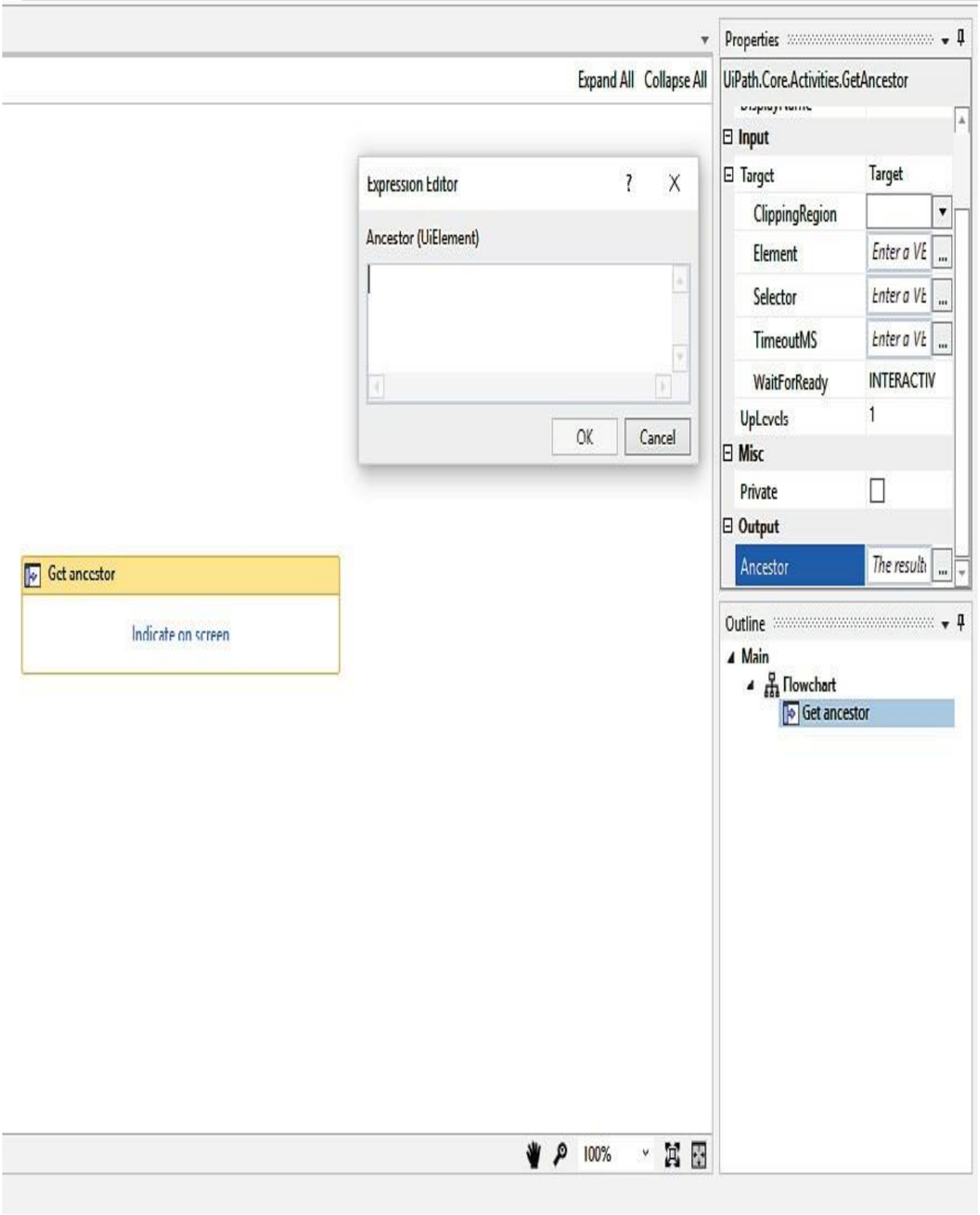
5.2.5 Find relative element

→This control is similar to the Find element control.
→ The only difference is that it uses the relative fixed UI element to recognize the UI element properly.
→This control can be used in scenarios where a reliable selector is not present.
→Just drag and drop this control, and indicate the UI element by clicking on **Indicate on screen**.
→You can also look for its selector property after indicating the UI element for better analysis.

5.2.6 Get ancestor

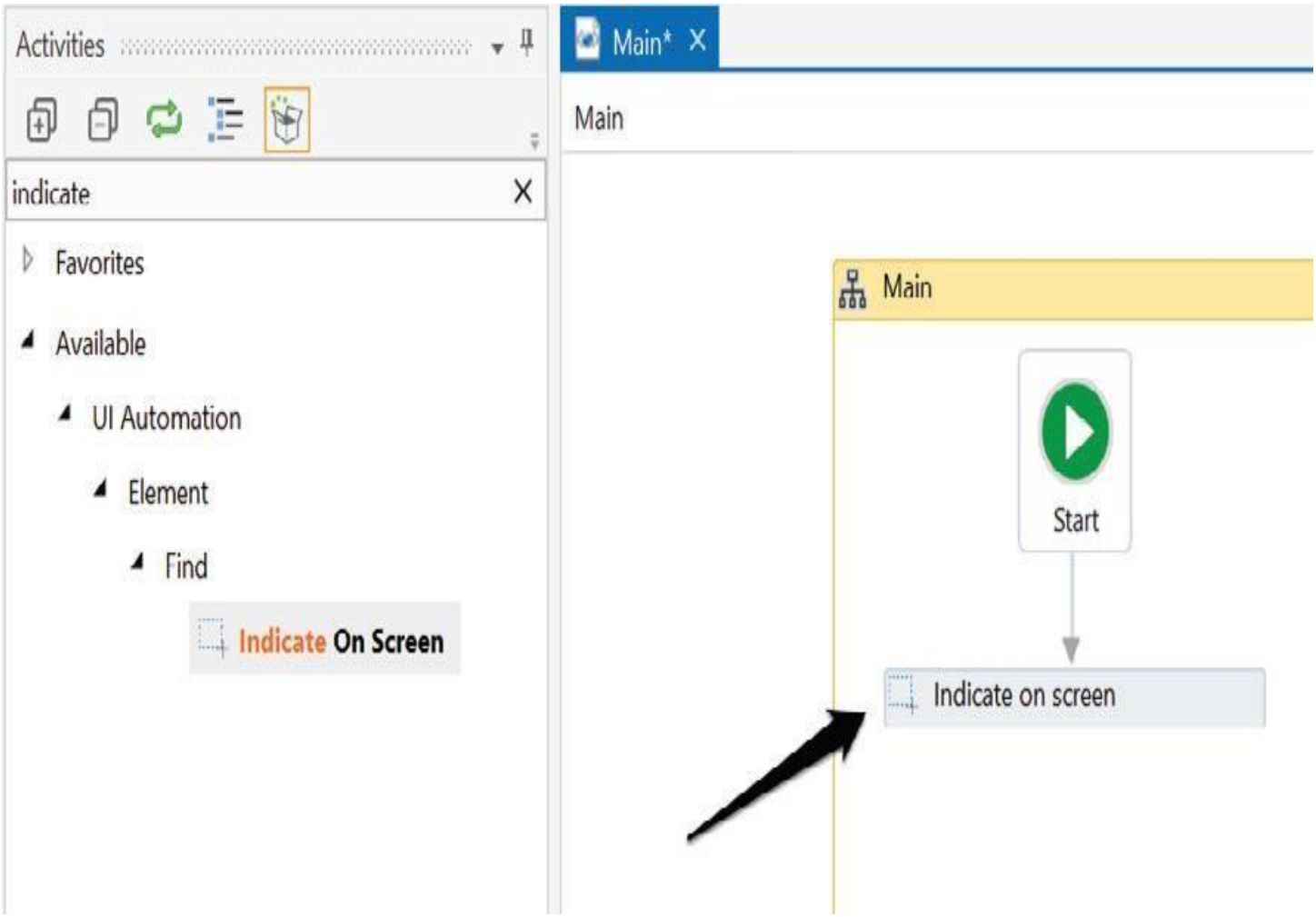
→This control is used to retrieve the ancestor of the specified UI element.
→You have to supply a variable to receive the ancestor element as output.
→You can specify the variable name in the **Ancestor** property of the **Get ancestor** control.
→After receiving the ancestor element, you can retrieve its attributes, properties, and so on for further analysis:

Refer below Screen shot
→Just drag and drop this control and indicate the UI element by clicking on **Indicate on screen**.



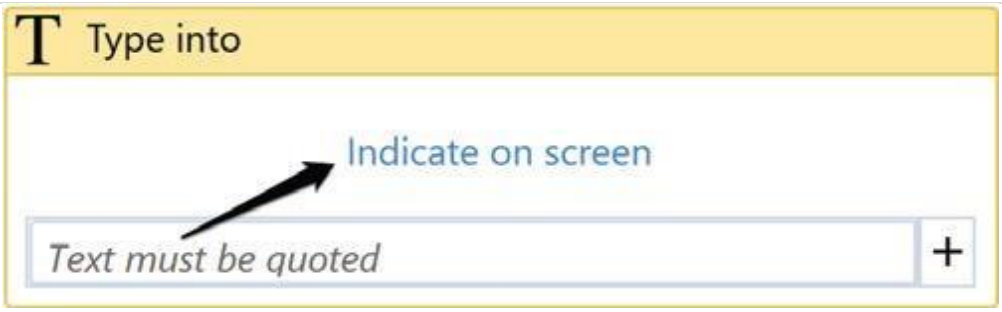
5.2.7 Indicate on screen

→This control is used to indicate and select the UI element or region at runtime.
→It gives flexibility to indicate and select the UI element or region while running the workflow.
→You just have to drag and drop this control in your project:



Note

→Do not confuse this with **Indicate on screen** written inside any activity like **Type into**.
→In previous examples, we have used **Indicate on screen** inside various controls (as shown in the following screenshot).
→This button is used to locate the region or UI element before the execution of the workflow, while the **Indicate on screen** control executes its process after the execution of the workflow:



5.3 Techniques for waiting for a control

There are three techniques through which we can wait for a control.
They are:
5.3.1. Wait Element Vanish
5.3.2. Wait Image Vanish
5.3.3. Wait attribute

5.3.1 Wait Element Vanish

→This activity is used to wait for a certain element to disappear from the screen.
→ Let us see an example where the **Wait Element Vanish** activity is in use:
1. Create a **Blank** project and give it a meaningful name.
2. → Drag and drop a **Flowchart** activity on the Designer panel.
   → Also, drag and drop the **Wait Element Vanish** activity on the Designer panel.
   →Set this activity as the **Start** node.
3. Double-click on the **Wait Element Vanish** activity, then indicate on the screen which element needs to vanish.

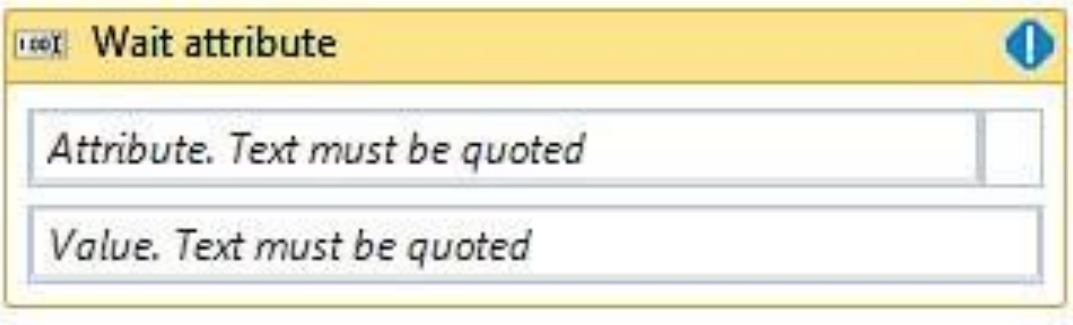
5.3.2 Wait Image Vanish

→The **Wait Image Vanish** activity is similar to the **Wait Element Vanish** activity.
→This activity is used to wait for an image to disappear from the UI element.
→The only difference between the **Wait Element Vanish** and the **Wait Image Vanish** activities is that the former is used to wait for an element to disappear, while the latter is used to wait for an image to disappear.

5.3.3 Wait attribute

→This activity is used to wait for the value of the specified element attribute to be equal to a string.
→We have to specify the string explicitly:
1. Drag and drop a **Flowchart** activity on the Designer panel. Next, drag and drop the **Wait attribute** on the Designer panel. Now, right-click on the **Wait attribute** activity and set it as the **Start** node.

2. Double-click on the **Wait attribute** activity. We have to specify three values: attribute, element, and text property. We also have to specify the element on which we have to supply the value:



Hit the **Run** button and see the result.

5.4 Act on controls - mouse and keyboard activities

While working in UiPath Studio, we have to work with various types of controls, such as Find control, mouse control, keyboard control, and so on, to automate tasks.

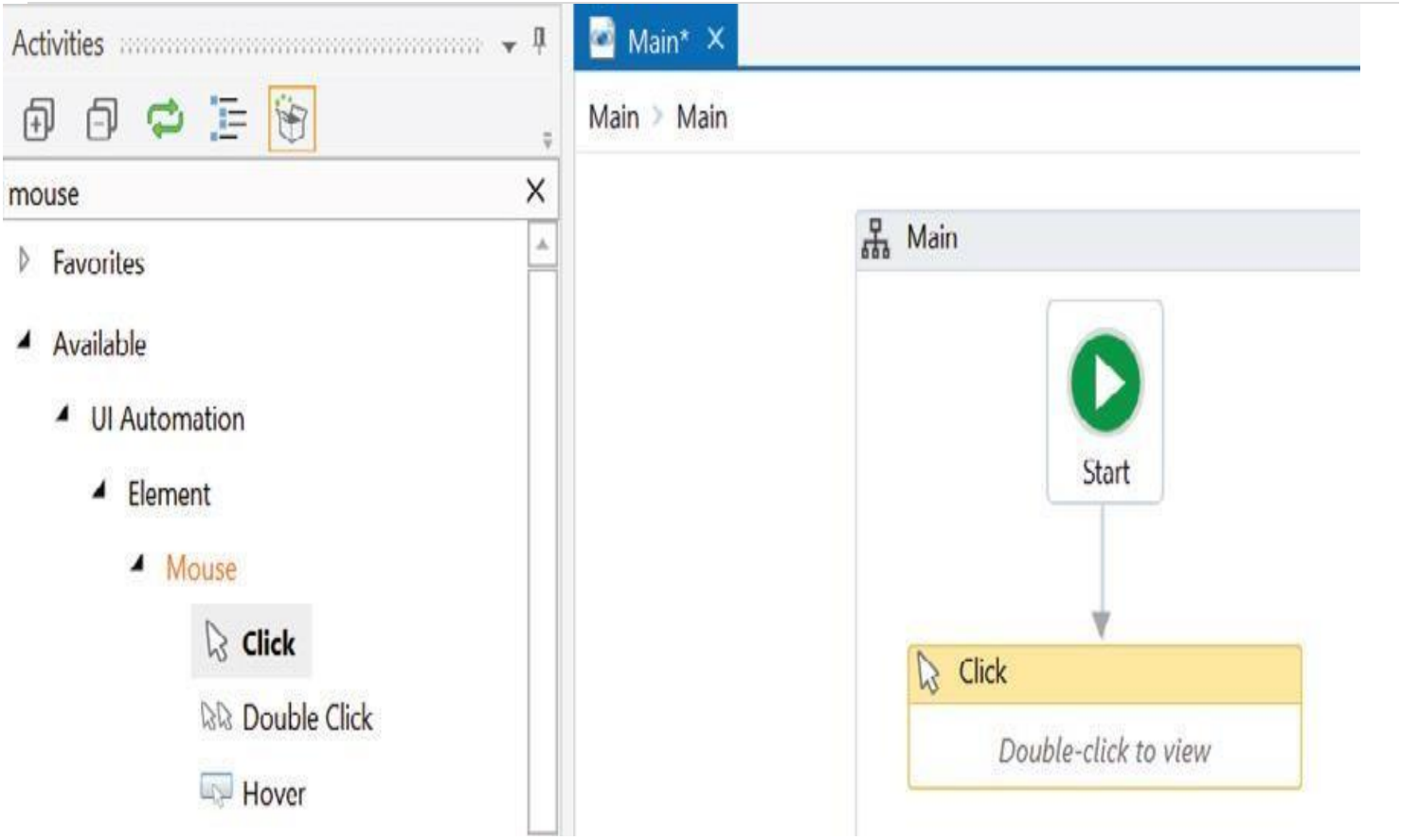
In this section, we are going to implement the mouse and keyboard activities.

5.4.1 Mouse activities

Those activities that involve interaction with the mouse fall under the category of mouse activities.
There are **three mouse activities** in UiPath Studio:
a. Click activity
b. Double-click activity
c. Hover activity

a.The Click activity

→When we have to click on a UI element on the screen, we generally use the Click activity.
→It is very easy to use the **Click** activity, as illustrated by the following example:
1. Drag and drop a **Flowchart** on the Designer panel. Search for mouse in the search bar of the **Activities** panel. Drag and drop the **Click** activity. Right-click on the **Click** activity and select **Set as Start Node**.
2. Double-click on the **Click** activity. Click on **Indicate on screen** and indicate the UI element you want to click on:



Hit the **Run** button to the see the result.

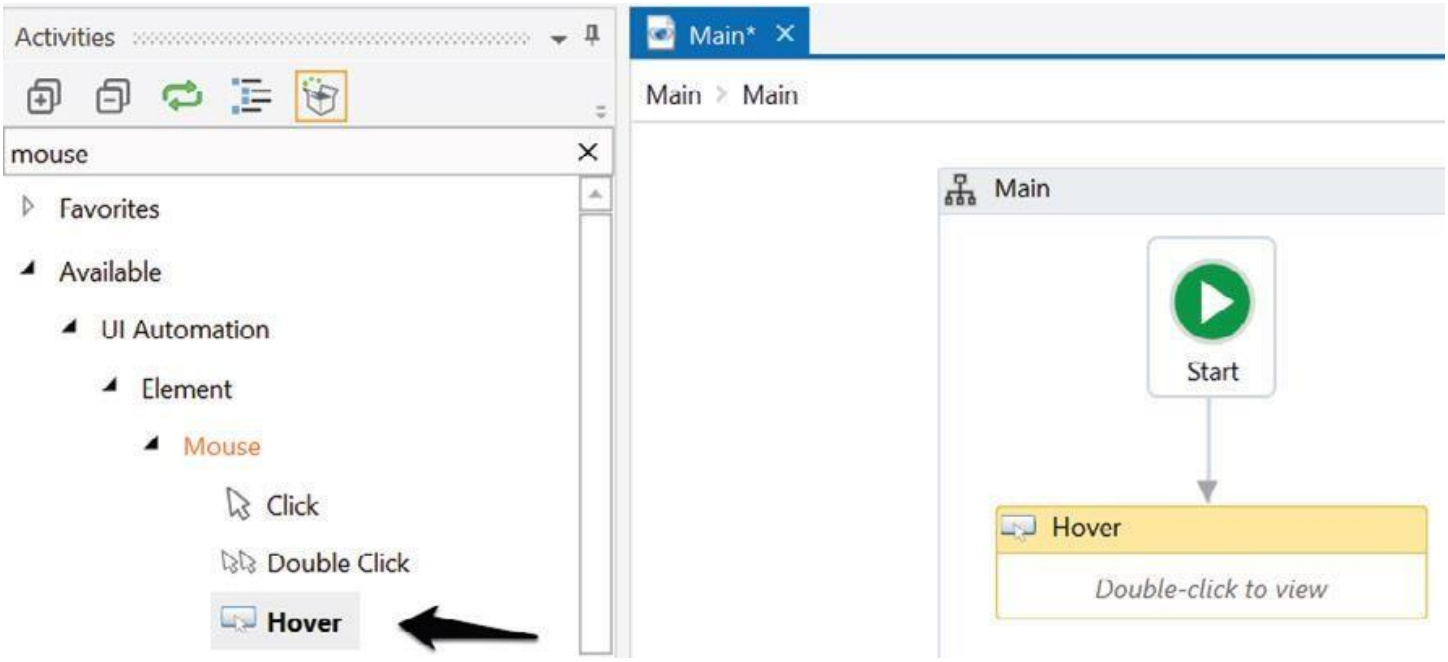
b. The Double-click activity

→We have already seen the Click activity.
→The **Double Click** activity is similar to the Click activity.
→ It just performs the double-click action.
→Using the Double click activity in your project is almost the same as click.
→You have to use the Double click activity instead of the Click activity and indicate the UI element, as we have done in the previous example.

c. The Hover activity

The **Hover** activity is used to hover over a UI element. Sometimes, we have to hover over a UI to perform an action. The Hover activity can be used in this case:

1. →Drag and drop a **Flowchart** on the Designer panel. Search for mouse in the search bar of the **Activities** panel.
   →Drag and drop the **Hover** activity.
   → Right-click on the **Hover** activity and select **Set as Start Node**:



2 . Double-click on the **Hover** activity. Click on **Indicate on screen** to indicate the UI element you want to hover on. That's it. We are done.

Hit the **Run** Button to see the result.

5.4.2 Keyboard activities

While automating tasks, we have to deal with keyboard activities a lot of a time. Keyboard activities generally involve an interaction with a keyboard.

In UiPath Studio, the following are keyboard activities:

a.Send hotkey
b.Type into
c.Type secure text

a. Send hotkey

→This activity is used to send keystrokes from the keyboard as an input to the screen.
→ Let us use an example. In the following example, we will use the **Send hotkey** activity to scroll the Flipkart main
page:
1. Drag and drop a **Flowchart** on the Designer panel. Search for keyboard in the search bar of the **Activities** panel. Drag and drop a **Send hotkey** activity. Rightclick on the **Send hotkey** activity and select **Set as Start Node**.
2. Double-click on the **Send hotkey** activity. Click on the **Indicate on screen** and indicate the required page (in our case, https://www.flipcart.com). You can assign any key by marking the checkboxes. You can also specify the key by
selecting a key from the drop-down list. In our example, we have chosen the **down** key:

Hit the **Run** button to see the results.

b. Type into activity

→This activity is used to type the text into the UI element.
→It also supports special keys.
→The **Type into** activity is quite similar to the **Send hotkey** activity.
→We have to send the keystrokes along with the special keys. Special keys are optional:

→You can use this activity by simply dragging and dropping the **Type into** activity, and specifying the keystrokes and the special keys by clicking on the + icon and choosing the key from the drop-down list (if you wish to send special keys also).

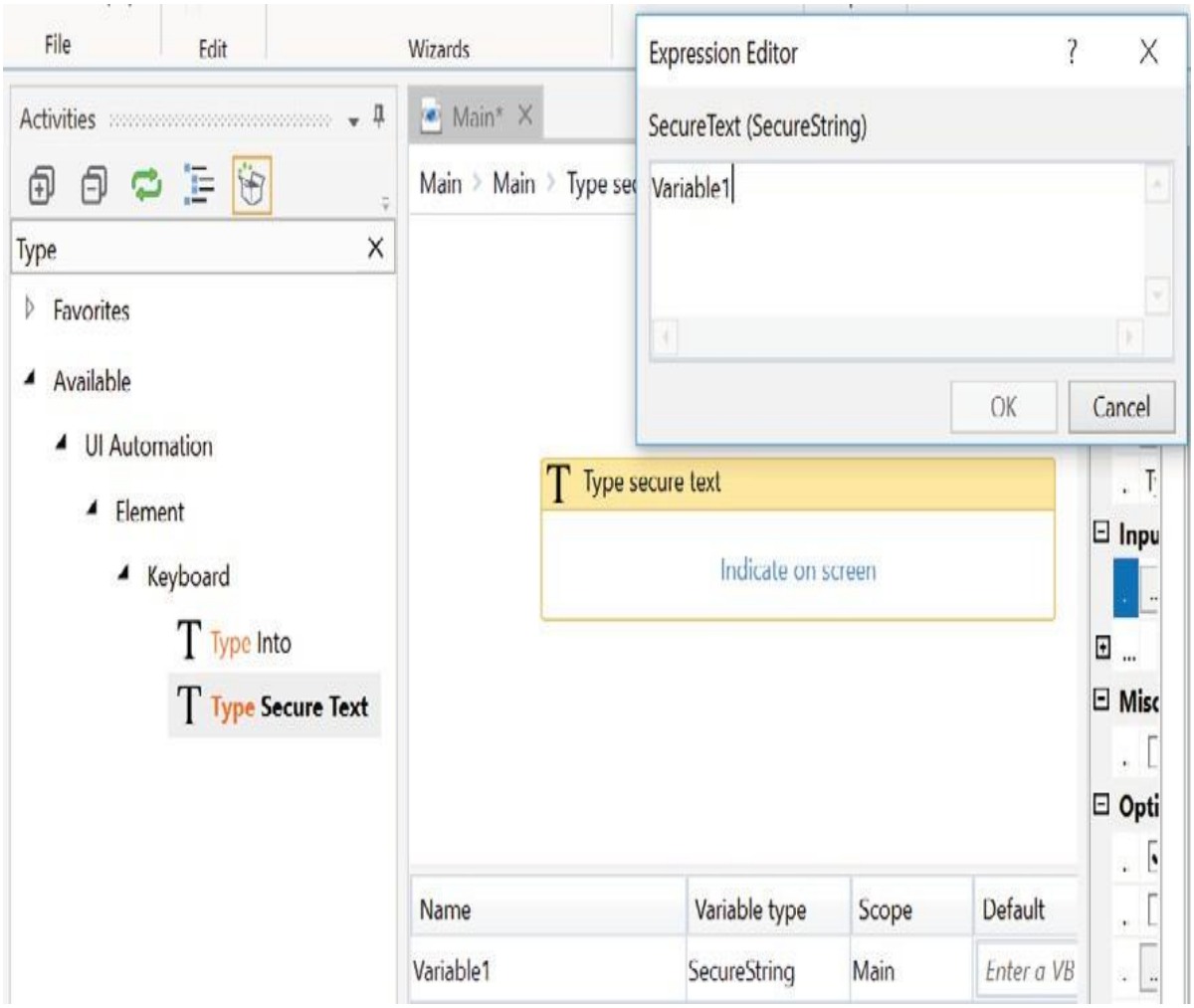
→You also have to **Indicate on screen** the area where you want the text to be typed.

c. Type secure text

→This activity is used to send secure text to the UI element. It sends the string in a secure way:

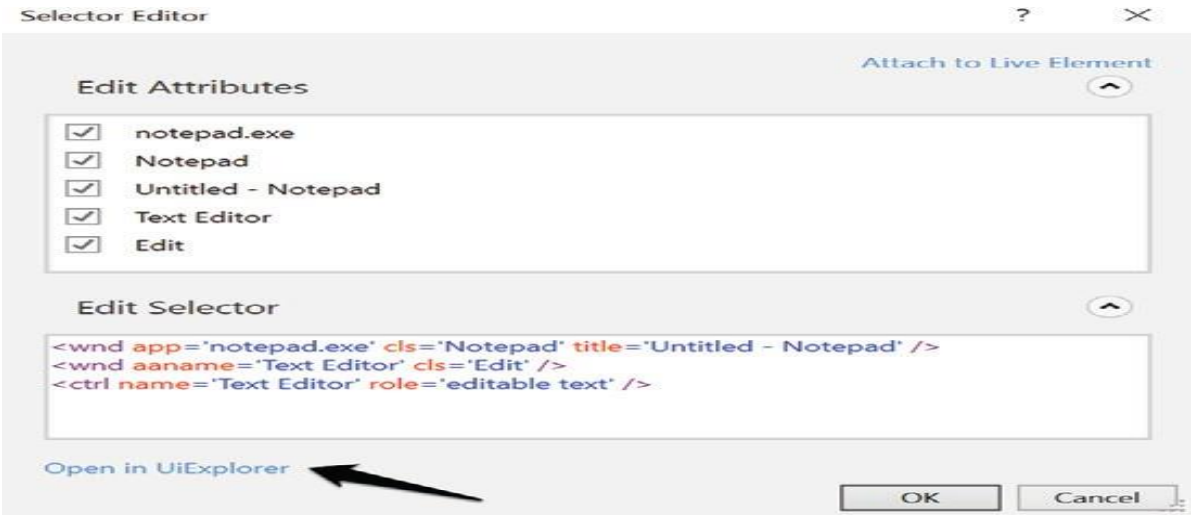
1. Drag and drop a **Flowchart** on the Designer panel. Search for keyboard in the search bar of the **Activities** panel. Drag and drop the **Type secure text** activity. Right-click on the **Type secure text** activity and select **Set as Start Node**.

2. Create a variable of type **SecureString**. Now, double-click on the **Type secure text** activity and specify the variable's name in the **SecureText** property of the **Type SecureText** activity. You also have to indicate on the screen by clicking on **Indicate on screen**:

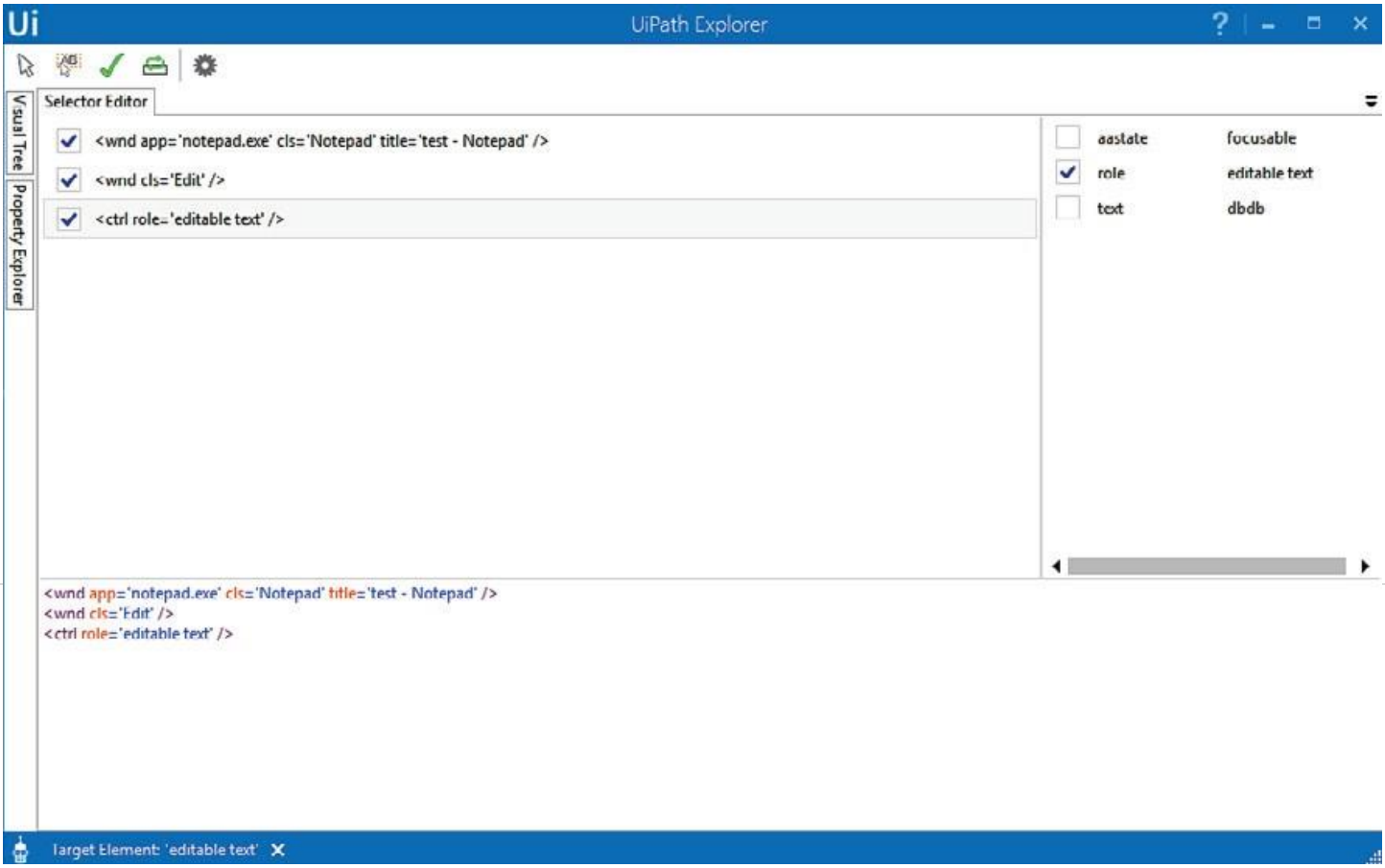


5.5 Working with UiExplorer

→UiExplorer is a more advanced version of the selector.
→It is a tool that gives us the flexibility to customize the selector.
→Let us try to understand the concept of UiExplorer with an example.
→ In this example, we are going to type some text into a Notepad window.
→ It is very easy to automate this task.
→You just have to use the **Type into** activity and **Indicate on screen** the area to be typed into and provide the text to be typed.
→Suppose you have opened a Notepad window, written some text into it, and then saved this file.
→ If you want to write some text into it again, then UiPath Studio gives you an error.
→There is nothing wrong with the implementation.
→What actually happens is that when you write some text in Notepad, UiPath Studio recognizes the file, app, type, title, and class, and saves this information for future recognition.
→You have saved the file by providing a name. Hence, the title has been changed by the system (as the name of the Notepad window has changed).
→When you made the second attempt to write some text, UiPath Studio failed to recognize that instance of the Notepad window.
→We can correct it by using UiExplorer. We have automated the task of writing some text in the Notepad window. →Double-click on the **Type into** activity.
→Click on the right side of the **Selector** property, expand **Target** property to find **Selector** property. A window will pop up. Click on the **Open in UiExplorer** button:



→A window will pop up. You can see the **Selector Editor** window. Analyze all the text
→written there. You will notice the title: **Untitled-Notepad**.
→You just have to edit this title. Just specify **test-Notepad** between the quotes:



→The problem was when you opened the Notepad window, UiPath Studio saved the title attribute as **Untitled-Notepad**.
→You saved the file and its title changed to **test-Notepad**.
→When you tried to write some text next time, it did not recognize the title as it had been changed from **Untitled-Notepad** to **test-Notepad**.
→You just have to edit the title attribute to remove the error.
→UiExplorer is used to customize the selector and to view attributes and their associated values. View it carefully and inspect the attribute that should be changed.

5.6 Handling events

An event occurs when some action is performed. There are different types of events:
5.6.1 Element triggering event
5.6.2 Image triggering event
5.6.3 System triggering event

5.6.1 Element triggering events

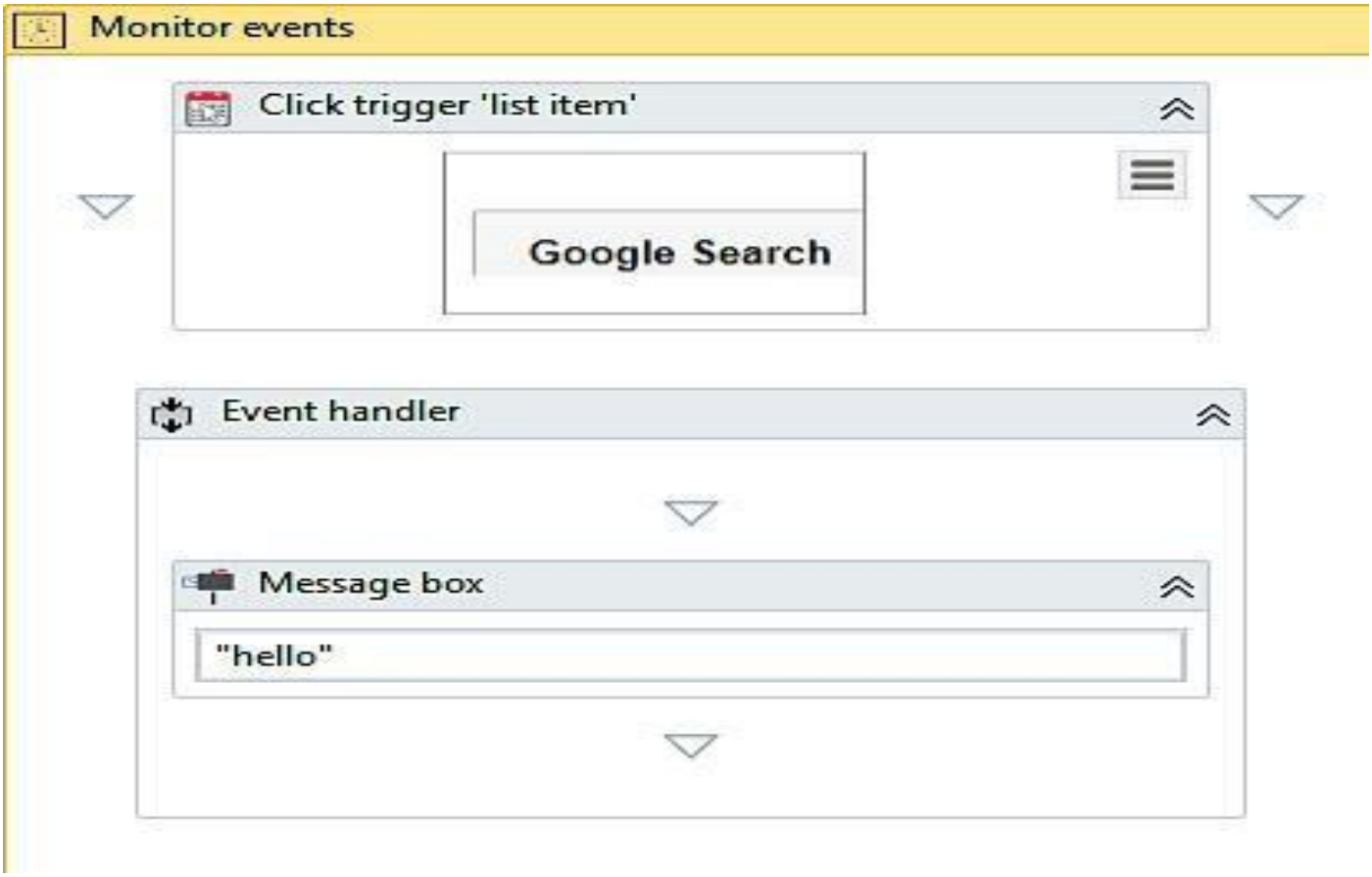
This type of event deals with clicking and keypress events.

a. Click Trigger
b. Key Press Trigger

a. Click trigger

→This event occurs when a specified UI element is clicked.
→Before using the Click trigger, we have to use the **Monitor events** activity.
→ Without **Monitor events**, the Click trigger cannot be used.
→Double-click on **Monitor events**. Drag and drop the Click trigger inside **Monitor events**.
→Also, drag and drop the activity in the **Event handler** section of **Monitor events**.
→ In this case, we have used the **Message box** activity and also specified the string value.
→Inside the Click trigger, you have to indicate the UI element that you want to click on:

When the Click action is performed on the specified button, then the event handler will be called and the activities inside the event handler will be executed.

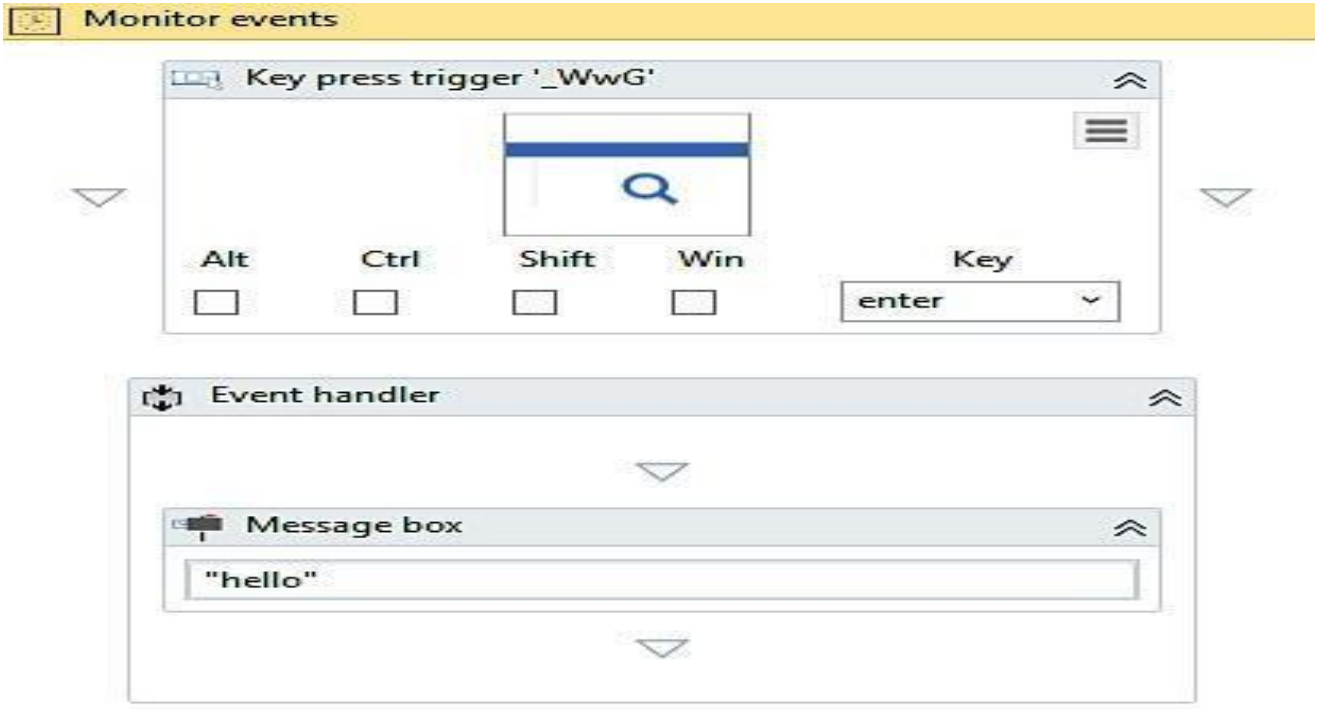


b.Key press trigger

→This event is similar to the Click trigger. A Key press trigger event occurs when keystrokes have been performed on some particular UI element. It calls the **Event handler** when it is triggered.

→While using **Key press trigger** event you have to specify the key or combination of keys.

→Indicate the UI element on which you want to perform the action:



When the keys are pressed on the specified UI element, the event handler will be called.

5.6.2 Image triggering events

→The Click image trigger is an image tiriggering event.
→Click image trigger, as the name suggests, is used for when we click an image.
→You just have to use the Click image trigger event inside the Monitor event and indicate the image.
→Upon clicking the indicted image in the Click image trigger event, the event handler will be called.

5.6.3 System triggering events

The following are System triggering events:
a. Hotkey trigger
b. Mouse trigger
c. System trigger

Hotkey trigger

→This event is raised when special keys are pressed. As we have already looked at triggering events, you can use the Hotkey trigger event on your own.
→You have to use this event inside the Monitor event.

→Specify the special key or combination of keys. Also, provide the event handler that will be called when the event occurs.

a. Mouse trigger

→This event is fired when the mouse button is pressed.

→Use this event inside the Monitor event and specify the Mouse button:

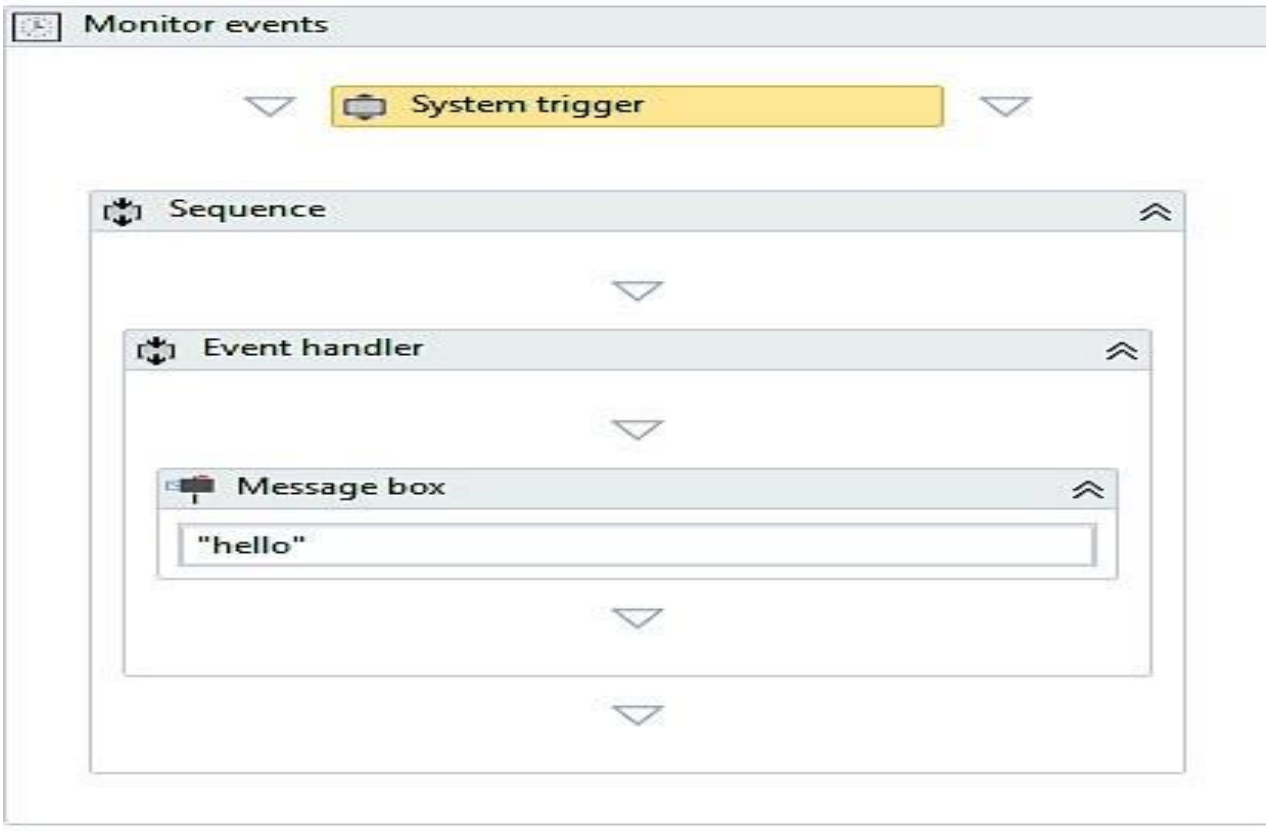
→ Either the left mouse button, middle mouse button, or the right mouse button.

b. System trigger

→This event is used when you have to use all of the keyboard events, all of the mouse events, or both.

→In the following screenshot, we have dragged and dropped the **System trigger** event into **Monitor events**.

→You can specify the trigger input property:



5.6 Revisit recorder

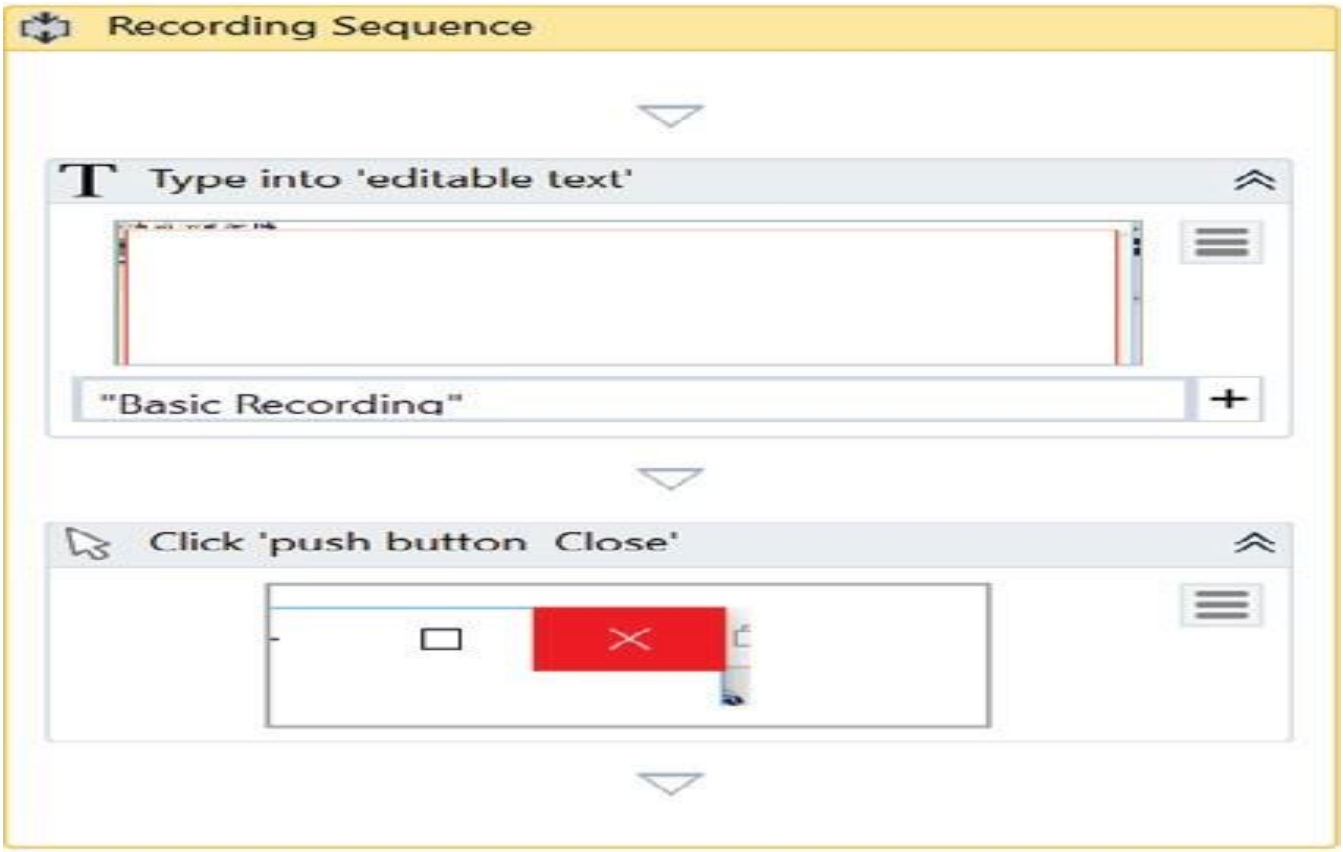
You have already learned about Task recording in chapter 2, *Record and Play*. In this section,

we will explore recording a bit more. As we discussed earlier, there are four types of recording in UiPath Studio:
5.6.1 Basic recording
5.6.2 Desktop recording
5.6.3 Web recording
5.6.4 Citrix recording

5.6.1 Basic recording

→This is used to record the actions of applications that have a single window.
→Basic Recording uses a full Selector. It works better for applications performing a single action.
→ It is not suitable for applications with multiple windows.

→There are two types of selectors, partial selectors and full selectors.
→ A Full selector has all the attribute to recognize a control or application. The Basic recording uses full selectors.



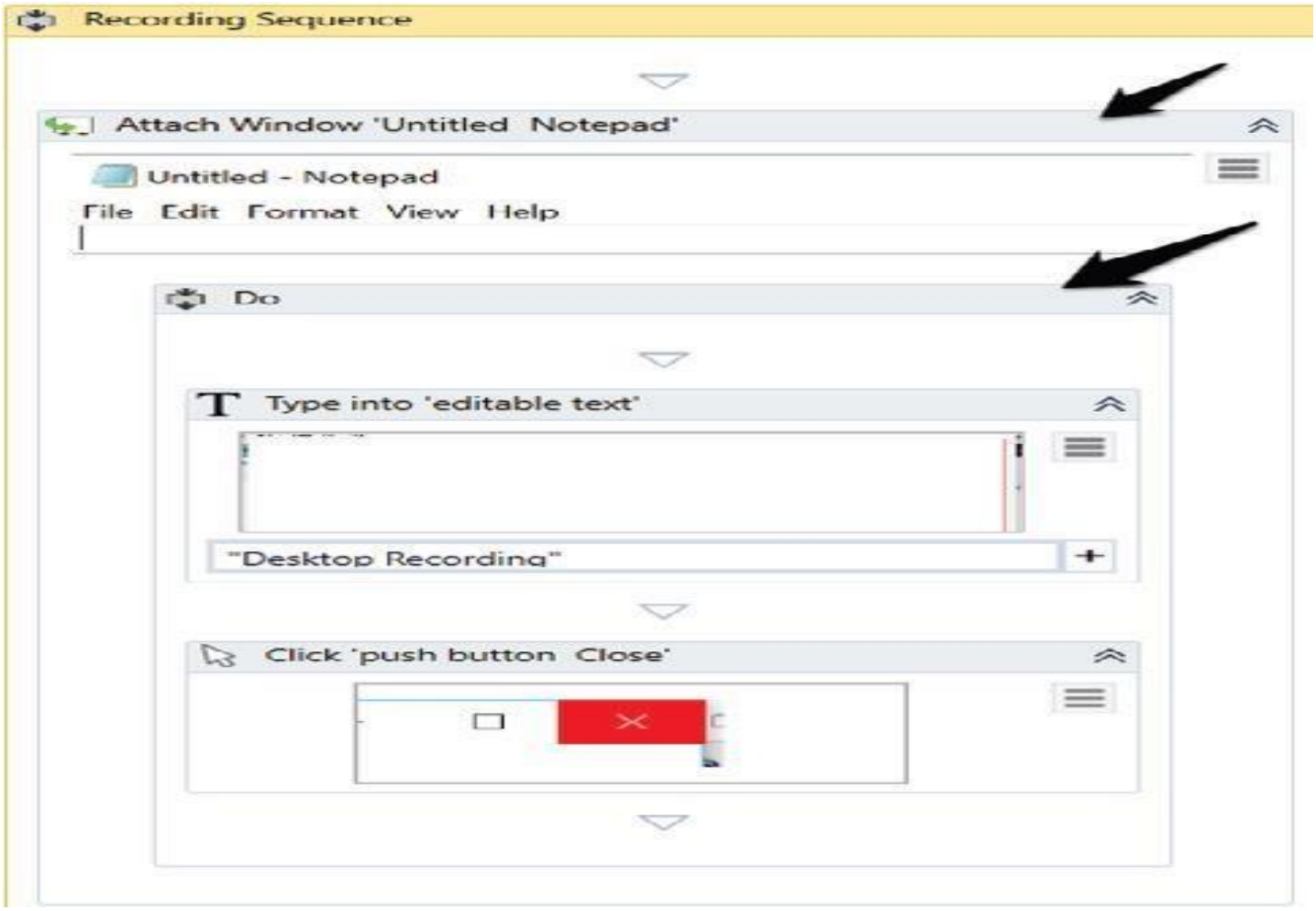
→Please note that, in the preceding image that there are different activities but those activities

are not wrapped inside containers, it is generated by Basic recorder.→ Basic recording generates different activities and places them directly in the sequence withfull selector.
→You have already seen how to automate tasks using the Basic recorder; now, let us cover other recorders.

5.6.2 Desktop recording

→This is similar to Basic recording with the added advantage of working with multiple actions.
→It is most suitable for automating Desktop applications.
→Desktop recorder generates Partial selectors.
→ The Partial selectors, have a hierarchical structure.
→ They are split into parent child views for recognizing the UI element properly.

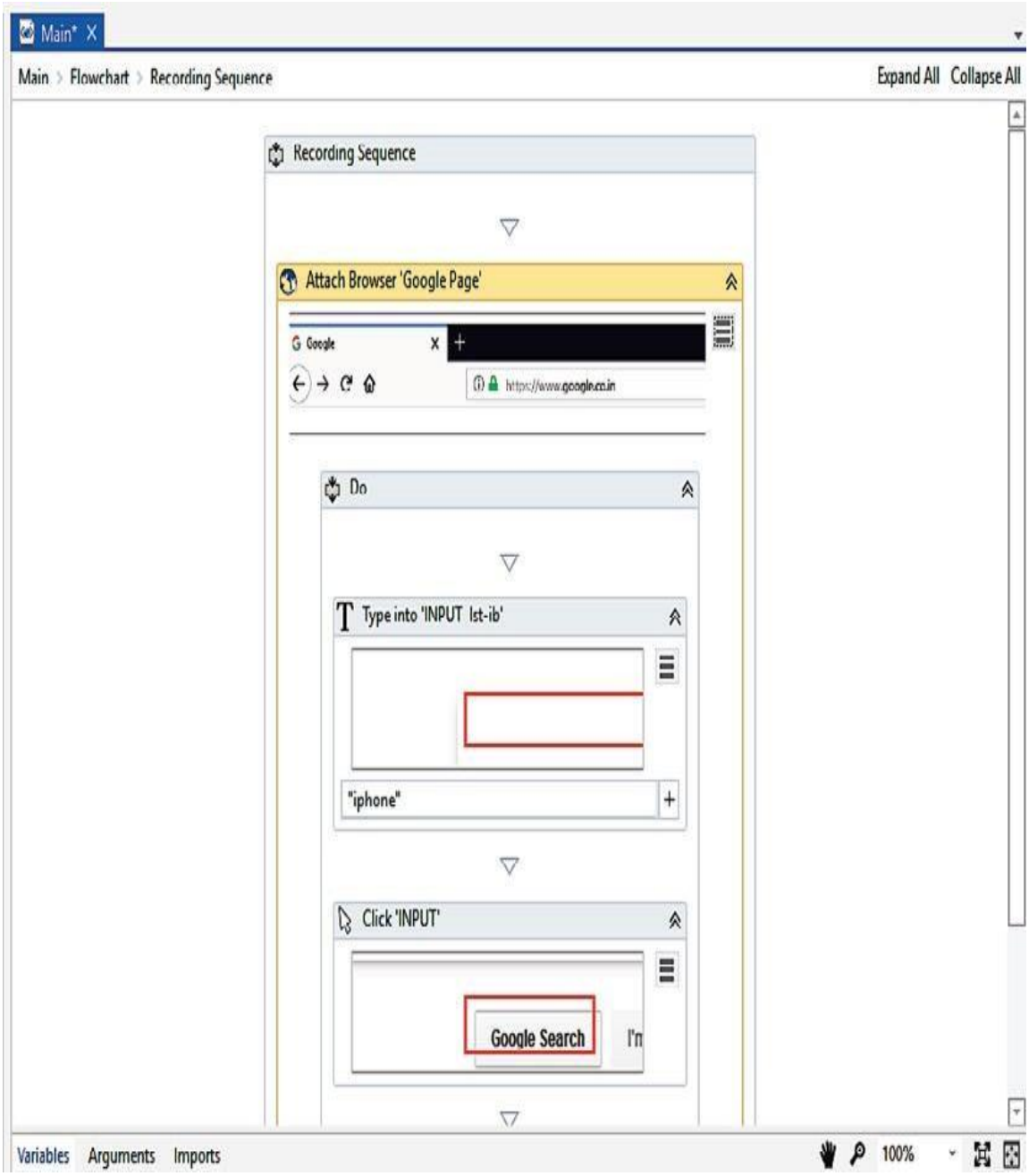
Please note in the preceding image there is a **Attach Window** activities and other activities are nested under it. This flow is generated **Desktop** recorder:



5.6.3 Web recording

→Web Recording can be done by using the Web recorder.
→For recording web actions, the UiPath extension for that browser should be installed.
→Otherwise, you will not able to automate tasks or actions using Web recording.
→You just have to click on the Setup icon and then click on Setup Extensions.
→ Now, choose your browser and click on it.
→The UiPath extension will be added to your specified browser.
→Web Recording is similar to Desktop Recording. You just have to record the actions and save it.

- Create a **Blank** project.
- Drag and drop a **Flowchart** activity.
- Now, click on the **Recording** icon and choose **Web** recording.
- You can record your actions on the web on your own and then save it.
- In our case, we have opened a web page using Google Chrome and logged in to https://www.google.com.
- Then, we started the recording by clicking on the Record button of the web recorder.
- Next, we typed some text in the search bar of Google and performed the Click activity.
- Then, we pressed the *Esc* key to exit the recording and clicked on the **Save and Exit** button.
- Now, a recording sequence is generated in our Designer panel.
- Connect this sequence to the **Start** node.
- Hit the **Run** button to see the result. In the following screenshot, you can see the sequence generated by the Web recorder:



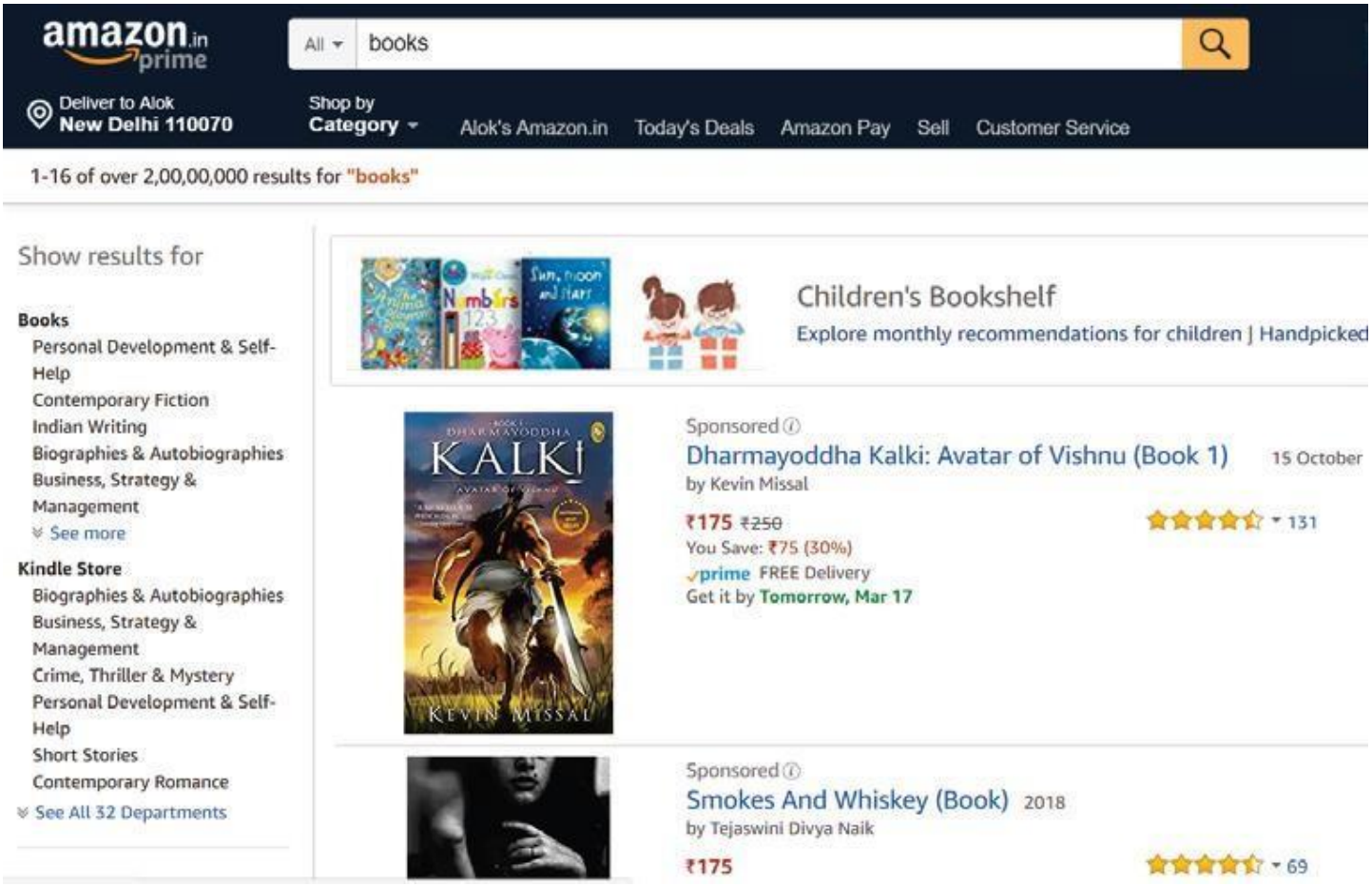
Before running the UiPath workflow, make sure you are on the Google homepage.

We have seen Web recording and it is very easy. There is also another option to extract information from websites.
We can easily extract information from websites using data scraping.

Suppose we want to extract data from Amazon's website. Say we want to search for books on Amazon and extract the search results.

Extracting data from websites becomes very easy with data scraping:

1. Create a blank project and give it a meaningful name. Click **Create**.
2. Log on to Amazon's website and search for books. A detailed list of books is listed on your screen:



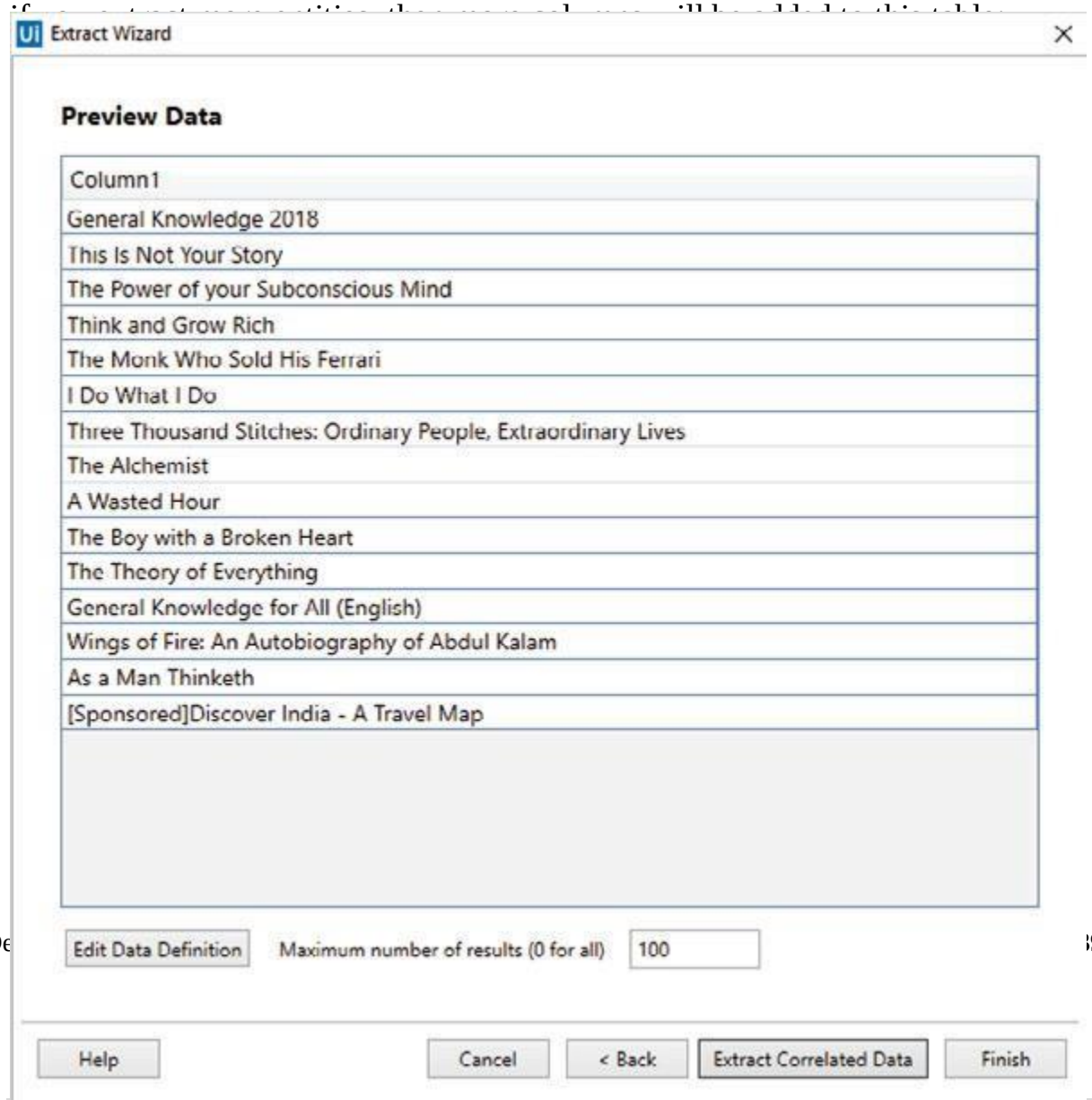
3. Drag and drop a **Flowchart** activity on the Designer panel. Now, click on the **Data Scraping** icon. A window will pop up.

4. Click on the **Next** button.

5. You have to indicate the first book's entities. Entities can be name, price, author, and so on. It

is your choice.
6. Lets's, indicate the book's name. After that, it will ask for the next book's entities. Indicate the second book entity as well. Click on **Next**.

7. This means you have to indicate the second book's entities: however, the entities will be the same. If you choose name as the first book's entity then you have to be specific and choose name as the second book's entity. You should not choose name as the first book's entity and then choose price as the second book's
entity.
8. Again, a window will pop up asking you to configure the columns. You can also extract the URL. If you want to do this, check the **Extract URL** checkbox.
9. You can specify the column name as well. Click on the **Next** button.
10. As you can see, all the book names are extracted to a window. If you want to extract more columns or more entities, then click on **Extract Correlated Data** and you have to again indicate another entity of the book to extract more columns, as we have done previously. After that, all the data will be extracted and will be added to this table. Here, we have one column but



11. Click on the **Finish** button. If the results of your query span multiple pages, it will ask you to indicate the page navigation link on the website (Next button of the website that we used to navigate to another/next page). If the results of your query span multiple pages, click on the **Yes** button and indicate the link, otherwise click on the **No** button.
12. We have clicked on the **No** button. A data scraping sequence is generated in our **Flowchart**. It will also generate a data table. You can retrieve the information from the data table.

5.6.4 Citrix

→When dealing with the Remote Desktop connection, methods such as Basic Recording and Desktop Recording cannot be used.
→In an RDP environment, images will be sent from one desktop to another, and will be mapped by analyzing the position of the pointer of the mouse button.
→ Hence, basic and desktop recording cannot be used, as these recording techniques fail to interact with the images.
→In a Citrix environment, we have the **Click Text** and **Click Image** activities, using which we can work with images with ease. You can clearly see the activities that are listed in a Citrix Recording:

1. Click Image
2. Click Text
3. Type
4. Select & Copy
5. Screen Scraping
6. Element
7. Text
8. Image

All these activities are used extensively in a Citrix environment.

You can use these activities as you have used Basic Recording or Desktop Recording: the only difference is that you have to indicate a point on the screen, or you have to indicate an anchor element as you have used in previous sections.

5.7 Screen Scraping

→Screen Scraping is a method of extracting data from documents, websites, and PDFs.
→It is a very powerful method for extracting text. We can extract text using the Screen Scraper wizard.
→**The Screen Scraper wizard has three scraping methods:**
a.Full Text

b.Native
c.OCR

We shall elaborate on each of these methods one by one. One should have a clear understanding of these methods in order to know when to use which method. There will be situations when we have to choose the best method for our needs:

a. Full text:

→ The Full text activity is used to extract information from various types of documents and websites.
→ It has a 100% accuracy rate. It is the fastest method among all three methods. It even works in the background.
→It is also capable of extracting hidden text. However, it is not suitable for Citrix environments.

b. Native:
→This is similar to the Full text method but has some differences.
→ It has a slower speed than the Full text method. It has a 100% accuracy rate, like the Full text method.
→It does not work in the background.
→ It has an advantage over the Full text method in that it is also capable of extracting the text's position.
→ It cannot extract hidden text. It also does not work with a Citrix environment.

c. OCR:
→This method is used when the previous two methods fail to extract information.
→It uses the two OCR engines: Microsoft OCR and Google OCR.
→ It has also a scale property: you can choose the scale level as per your need.
→ Changing the scale property will give the best results:

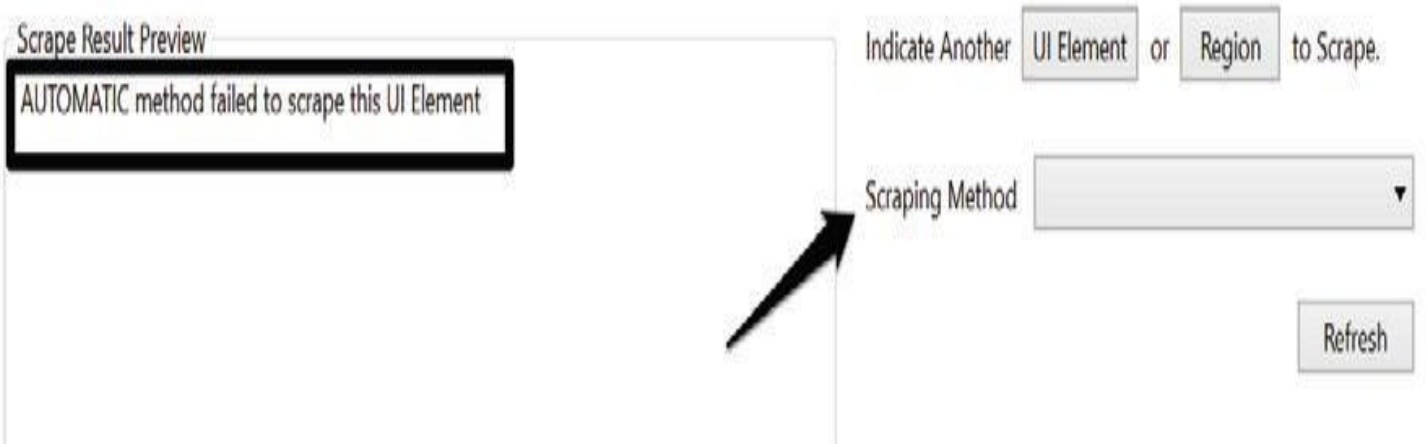
Capability Method	Speed	Accuracy	Background Execution	Extract text position	Extract hidden text	Support for Citrix
Full Text	10/10	100%	yes	No	Yes	No
Native	8/10	100%	No	Yes	No	No

OCR	3/10	98%	No	Yes	No	yes

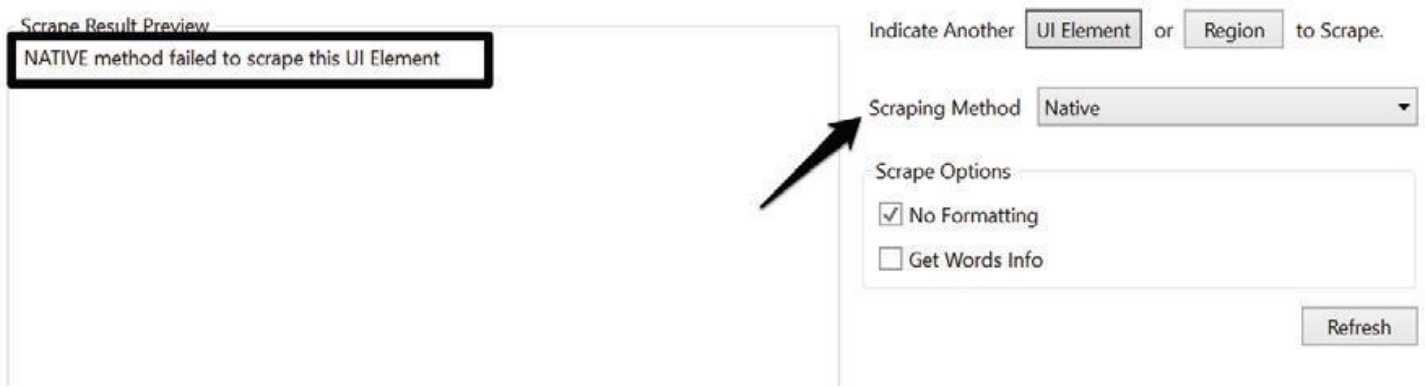
Let us consider an example of extracting text from the UiPath website's main page:
1. Create a **Blank** project and give it a meaningful name.
2. Log on to the UiPath website by logging in to httpps://www.uipath.com in your browser.

3. →Drag and drop a **Flowchart** activity on the Designer panel.
→Click on the **Screen Scraping** icon and locate the area from which you want to extract the information.
→Just choose an area on the UiPath website.
→A window will pop up**b**stating that the **AUTOMATIC method failed to scrape this UI Element**.

By default, the **Screen Scraper Wizard** chooses the best scraping method to extract data, but it failed to do so in our case:

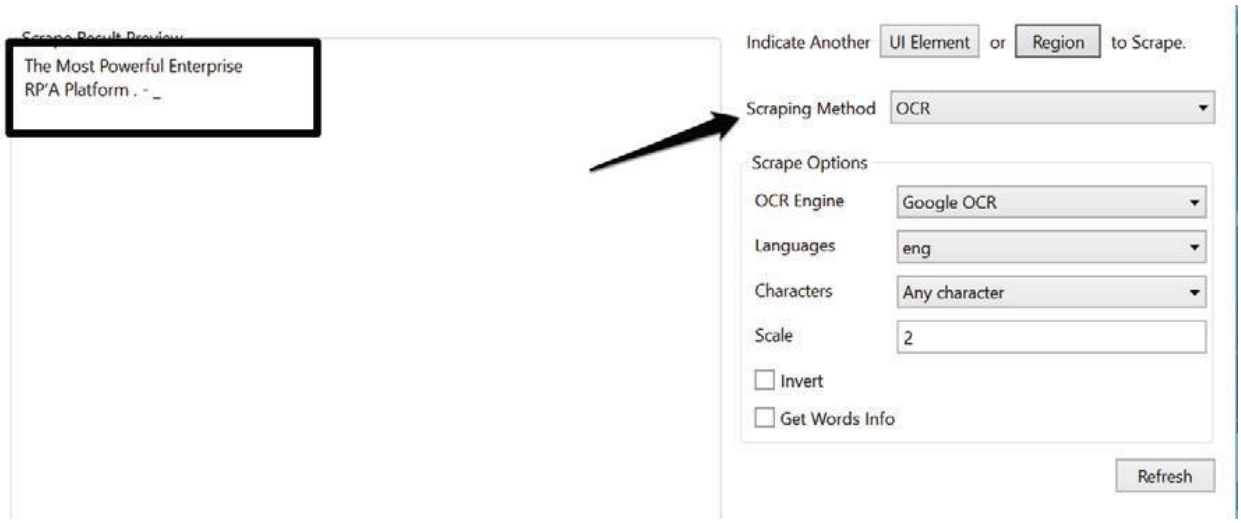


4. Try choosing another method. We shall choose the Full text method. This too will fail. Next, choose the Native method. This will also fail, as you can see in the following screenshot:



De

5. This time, choose the OCR Scraping method. You can clearly see the extracted text:



5.8 When to use OCR

→There are some scenarios where normal activities such as **Get Text** and **Click Text** activities fail to extract the text or perform an action.
→This is when OCR comes in, giving us the flexibility to perform actions when existing activities fail to do their job.
→**OCR stands for Optical Character Recognition**.
→ It is a text recognition technique that transforms printed documents that are scanned into electronic formats.
→OCR is used mainly for images, scanned documents, PDFs, and so on, to extract information or perform actions. →Extracting information or data from images, scanned documents, or PDFs is a very tedious job.
→ Normal activities are not recommended for extracting these types of inputs.
→OCR uses a different method and approach to extract the information.

There are two OCRs available in UiPath Studio:
1. Microsoft OCR
2. Google OCR

→**Microsoft's OCR is known as MODI, and Google's OCR is called Tesseract.**

→OCR is not limited to only these two types of OCR.
→ You are free to use another type of OCR.

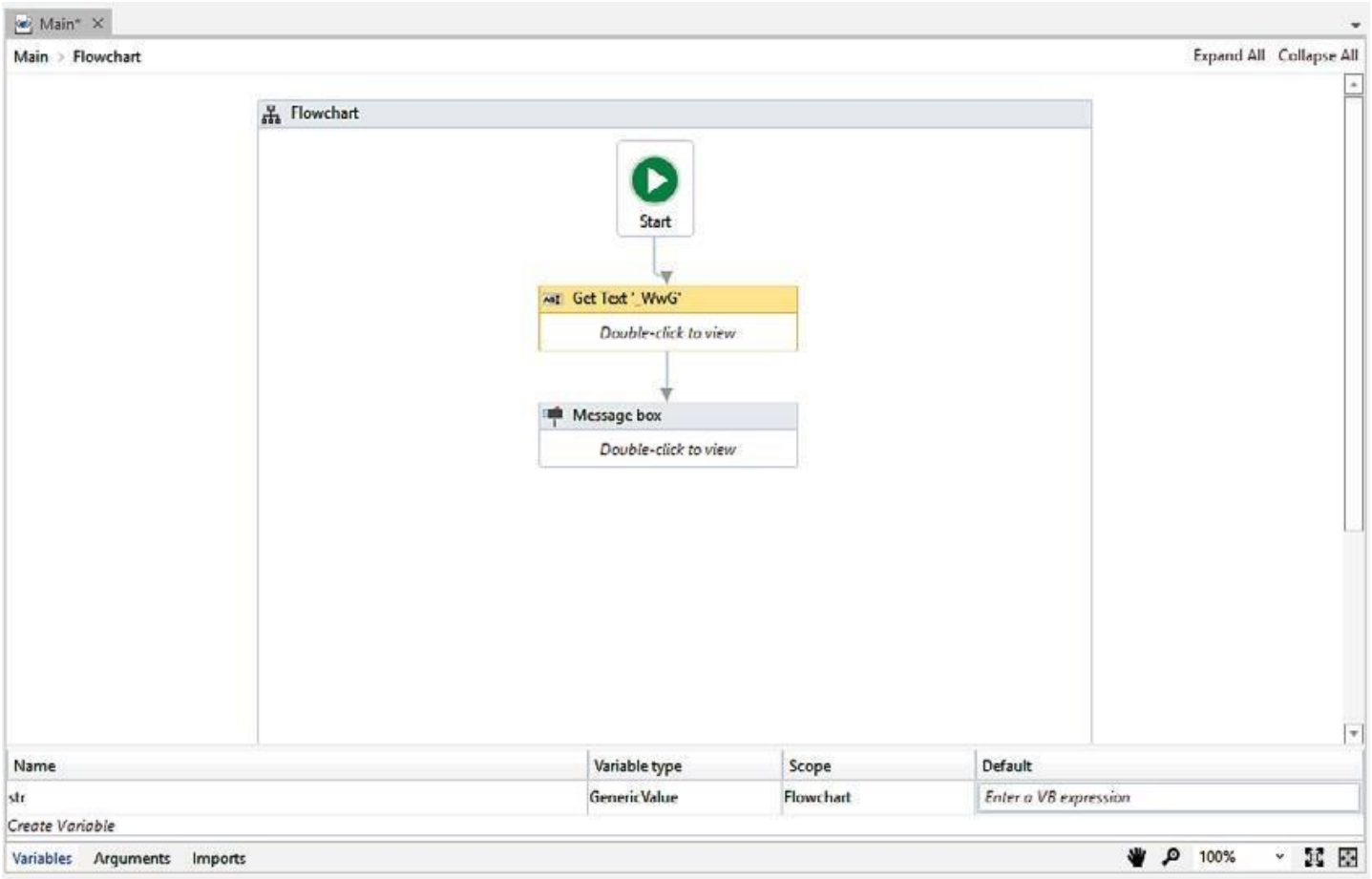
Let's see an example of when we should use OCR. Consider we are going to extract some text from a Word document by using the **Get Text** activity:

1.Create a **Blank** project and give it a meaningful name.

2. →Drag and drop a **Flowchart** activity on the Designer panel.
→ Also, drag and drop a **Get Text** activity inside the Designer panel.
→ Now right-click on the **Get Text** activity and choose **Set as Start Node**.

3.→Double-click on the **Get Text** activity.
→Click on **Indicate on screen**.
→ Now indicate the text from which you want to extract information.
→You have to supply the output value for receiving the text from the **Get text** activity.
→Create a **GenericValue** type of variable and specify the variable name str.

4. Drag and drop a **Message box** activity. Connect it to the **Get Text** activity. Double-click on the **Message box** activity and specify the variable's name (str) that you created earlier:



Hit the **Run** button to see the result. You can clearly see in this example that using the **Get Text** activity does not extract, text properly.

This is where OCR enters the picture. In the next section, we will see the extraction of text using OCR.

5.9 Types of OCR available

There are two OCRs available in our UiPath Studio:
1. Microsoft OCR
2. Google OCR

However, we are free to import other OCR engines into our project.

Both the Microsoft and Google OCR engines have their own advantages and disadvantages.

The advantages of Google OCR include the following:

- Multiple language support can be added in Google OCR
- Suitable for extracting the text from a small area
- It has full support for color inversion
- It can filter only allowed characters

The advantages of Microsoft OCR include the following:

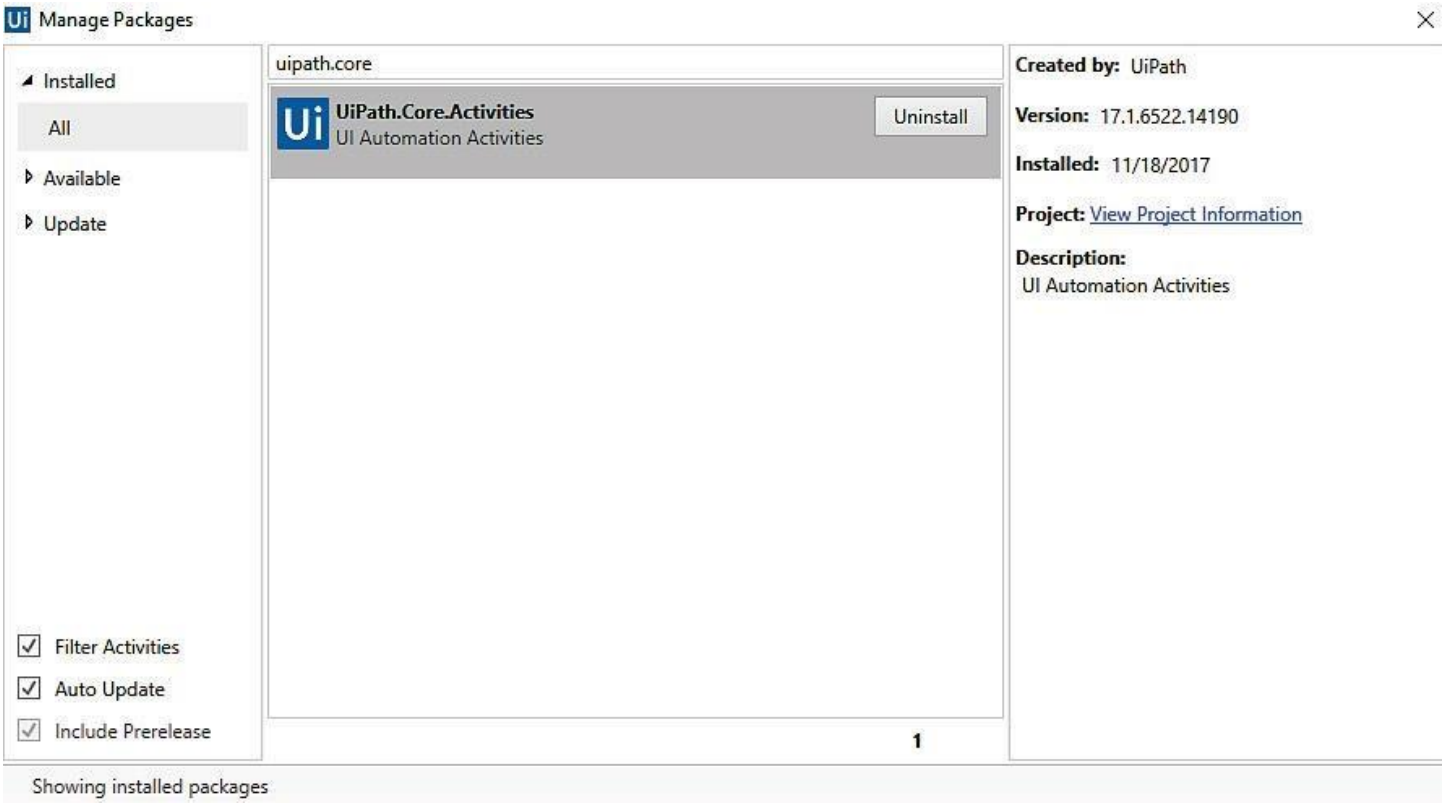
- Multiple languages are supported by default
- It is suitable for extracting text from a large area

OCR is not 100% accurate. It is useful for extracting text that other methods cannot successfully do. It works with all applications, including Citrix.

Microsoft and Google's OCRs are not the optimum for every situation. Sometimes, we have to look for more advanced OCRs to recognize more sophisticated text, such as handwritten documents and so on.

There is another OCR available in UiPath Studio, known as the **Abbyy OCR Engine**. You can find this OCR engine in the **Activities** panel by searching for OCR

. If you cannot find this OCR listed in the **Activities** panel, you need to install the Uipath.Core.Activities package:

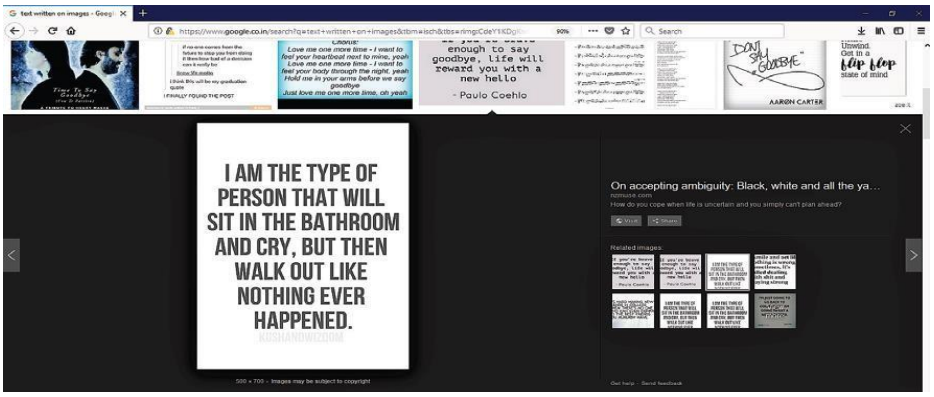


In the previous screenshot, the package has already been installed, which is why there is an **Uninstall** button on the right-hand side of Uipath.Core.Activities.

5.10 How to use OCR

In this section, we are going to see how we can use OCR. Suppose we have an image and we have to extract the text in it. In such a scenario, OCR becomes very handy.

In the following example, we are going to use a random Google image with some text in it, as follows:

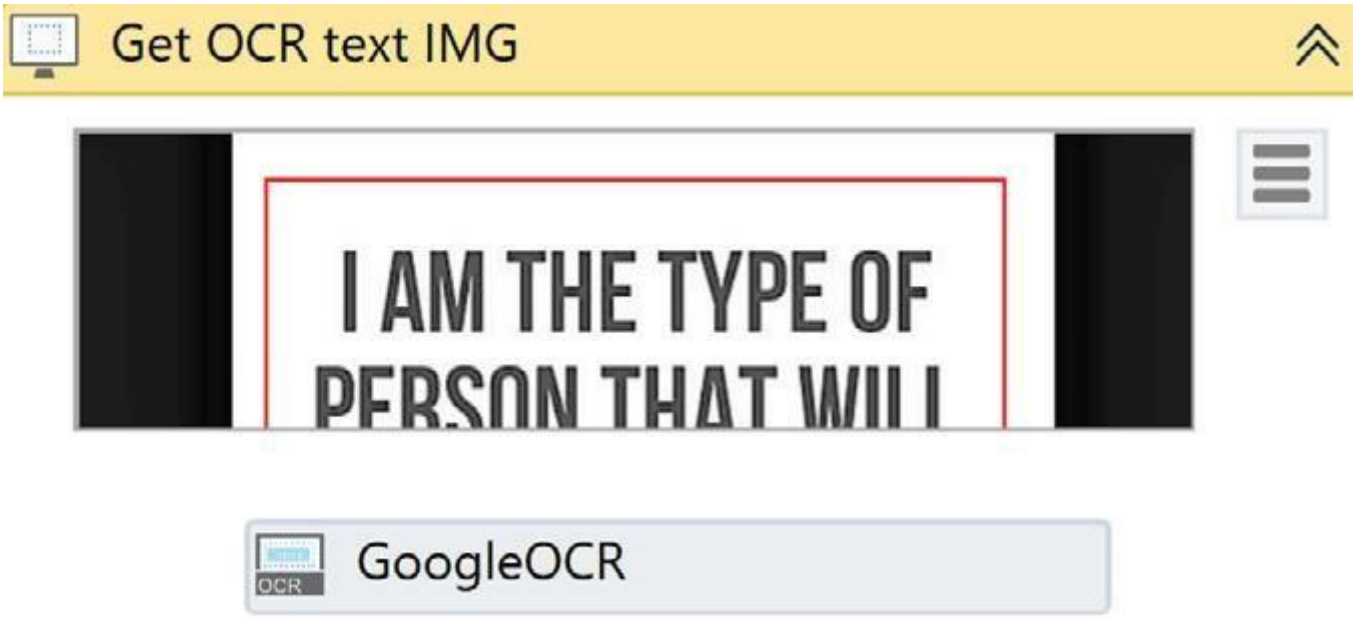


To extract text from the previous image, perform the following steps:

1. →Open UiPath Studio and click on a **Blank** project. Give it a meaningful name.
   → On the Designer panel, drag and drop a **Flowchart** activity.

2. →Next, drag and drop a **Get OCR Text** activity from the **Activities** panel and set it as the start node.
   →Double-click on it and click on the **Indicate on screen** option.
   →Choose the specific area from which you want to extract the text from the image.
   →In our case, we are using an image that we have searched for on Google.

3. →Now, click on the **Text** property of the **Get OCR Text** activity.
   →A window will pop up as shown in the following screenshot.
   →Right-click inside the window and choose **Create Variable**.
   → Give it a meaningful name, press *Enter*, and click on the **OK** button.
   → A variable will be created with that name:



4. → Drag and drop the **Message box** activity.
   →Connect it to the Get OCR with textactivity.
   →Double-click on the **Message box** activity and
   → specify the variable name that you have created earlier in the expression box.
   → (In our case, it is the result variable).

   Press *F5* to see the result.

5.11 Avoiding typical failure points

There are many scenarios where the normal implementation would fail. We are going to discuss these failure points and will see how to tackle them.

In this section, we will work with the following entities to tackle failure points:
a. Selectors
b. Scope of the variable
c. Delay
d. Element Exists
e. Try/ Catch
f. toString method

a. Selectors

→Sometimes, it is tedious to deal with selectors while working with them.
→This is because a selector has attributes, title, and class properties.

→ When we select a UI element using the selector, it stores all these properties.
→ Different instances of an application may have different properties of a UI element.

→The problem with selectors is when you select a UI element, it captures its properties.
→These properties will differ when we select the UI element of a different instance of an application with the selector.
→ Hence, the property will differ and the selector will fail to recognize the same UI element of another instance of the application.

We can easily fix this problem by using wildcard characters or by attaching it to a live element. Two wildcard characters are available with UiPath:

1. The question mark symbol,?, which replaces one character
2. The asterisk symbol, that is,* , which replaces a number of characters

We have to simply replace the variables (the name that changes continuously) with wildcard characters.

We can also use the **Attach to live element** option from the selector property window and indicate the element again. It automatically detects the variable properties and fixes them for us.

b. Scope of the variable

→Sometimes we create a variable inside a Sequence or Do activity.
→ In doing so, the scope of the variable is limited to only that activity.
→When we try to access a variable from outside its scope, it cannot be accessed.
→ We have to change the scope of the variable.

c. Delay activity

→In some situations, we have to wait for a particular action.
→For example, when opening the Outlook application, it needs to connect to the server (for synchronization).
→When it is opened, it takes some time (the UI element is not stable at this stage).
→In the meantime, the robot's activity is waiting for the UI element to be stable so that it can perform the action. →After waiting for some time, if the UI element is not stable, it results in an error because the activity cannot find the UI element.
→ Thus, we have to add a Delay activity to ensure that the UI element is stable for action.
→Specify the time for the delay in the expression text box of the Delay activity.
→This activity will delay the process for the specified period of time.

d. Element Exists

→This activity is used to ensure that the required Element Exists.
→It is used to ensure that the element we are looking for exists in this context.
→This is a good way of checking whether the activity exists or not.

e. Try/Catch

→This is an exception handling mechanism used to tackle exceptions.
→Put all suspicious activities inside the try block. If an error occurs, it can be detected by the catch block.

f. toString

→Sometimes, we forget to use the toString method with variables and we end up with an error.
→For example, when outputting an integer variable inside the **Message box**, we have to apply the toString method.

Module 5
Exception Handling, Debugging, and Logging

Introduction

Sometimes, automation program may fail to execute. To deal with such cases, we use exception handling activities.
In this chapter, we start with the various types of exception handling method available in UiPath, the exceptions that you may encounter, and how to deal with them. We will also learn about logging. An important topic covered in this chapter is debugging to check whether workflows are working properly or not and to rectify any errors.

5.1 Exception handling

→Exception handling is a way to handle exceptions for a process that the program or the procedure has failed to execute. For handling exceptions in a program, the best practice considered is to use the **Try catch** activity.

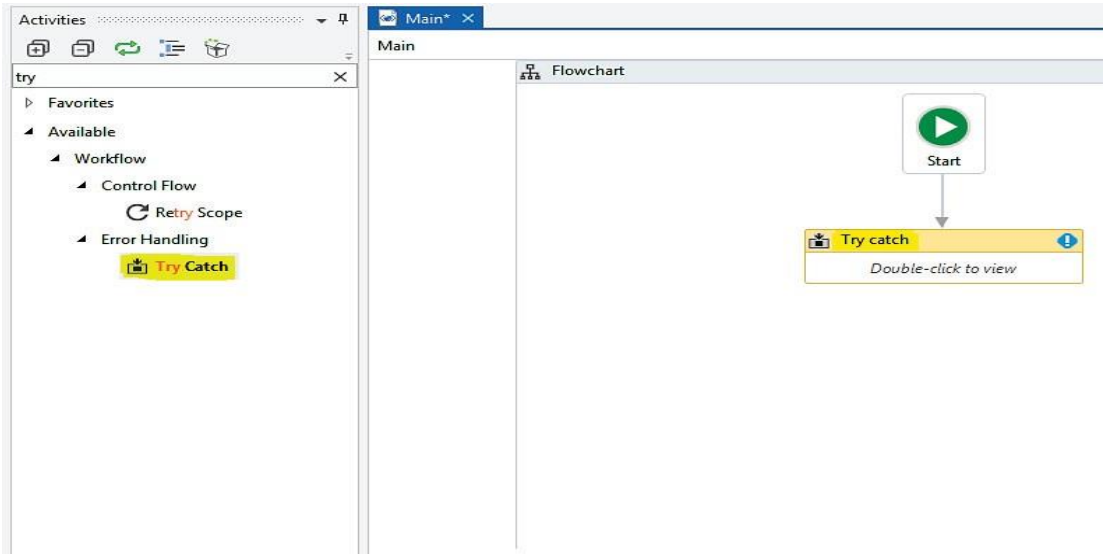
→The **Try catch** activity can be found in the Activities panel. By dragging and dropping the **Try catch** activity into the workspace, we can handle exceptions.

→ For handling errors in the Try catch block, we can divide the whole process into four parts just to make it simpler:

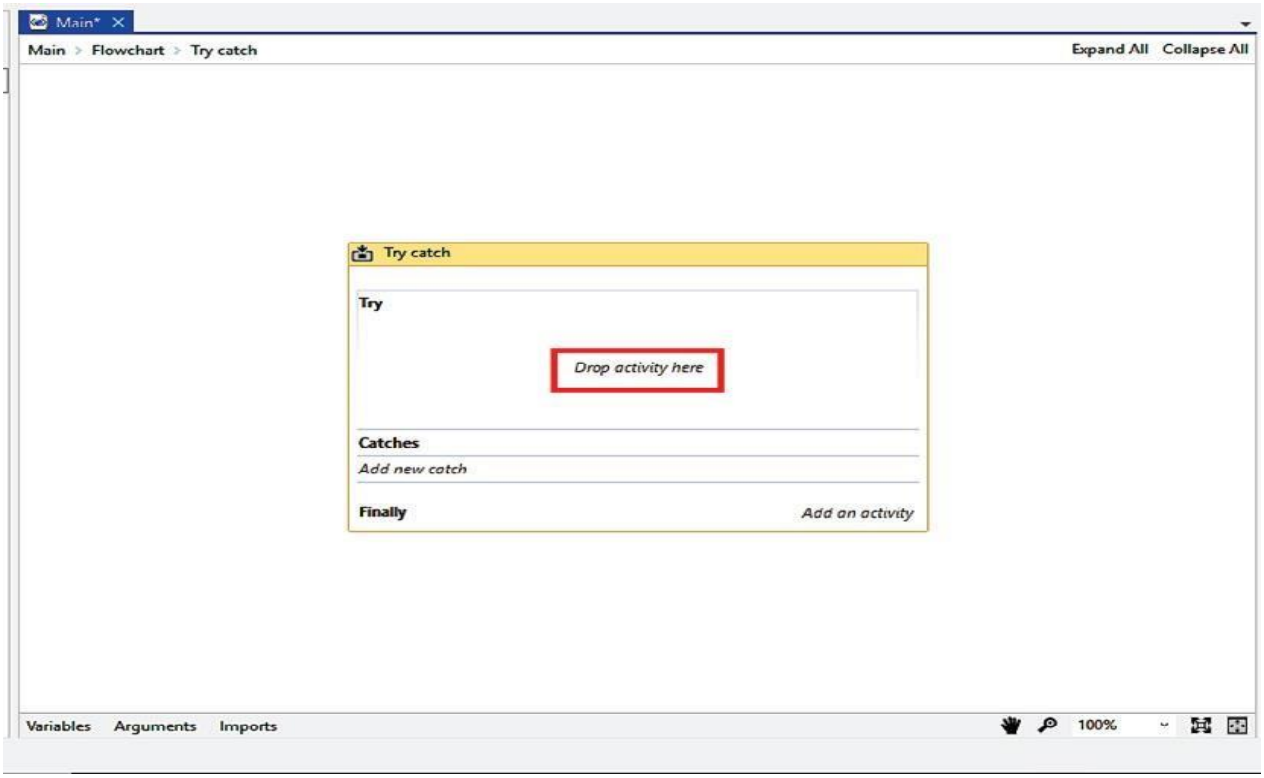
(i)Drag and drop the Try catch activity
(ii)Try block
(iii) Catch block
(iv)Finally block

Let's build a Try catch block to handle exceptions, in following steps:

(i) **Drag and drop the Try catch activity**: Create a blank project. Drag and drop the **Flowchart** activity into the Designer panel. Search for the **Try catch** activity in the **Activities** panel and drag it into the **Flowchart**. Set it as the **Start** node:

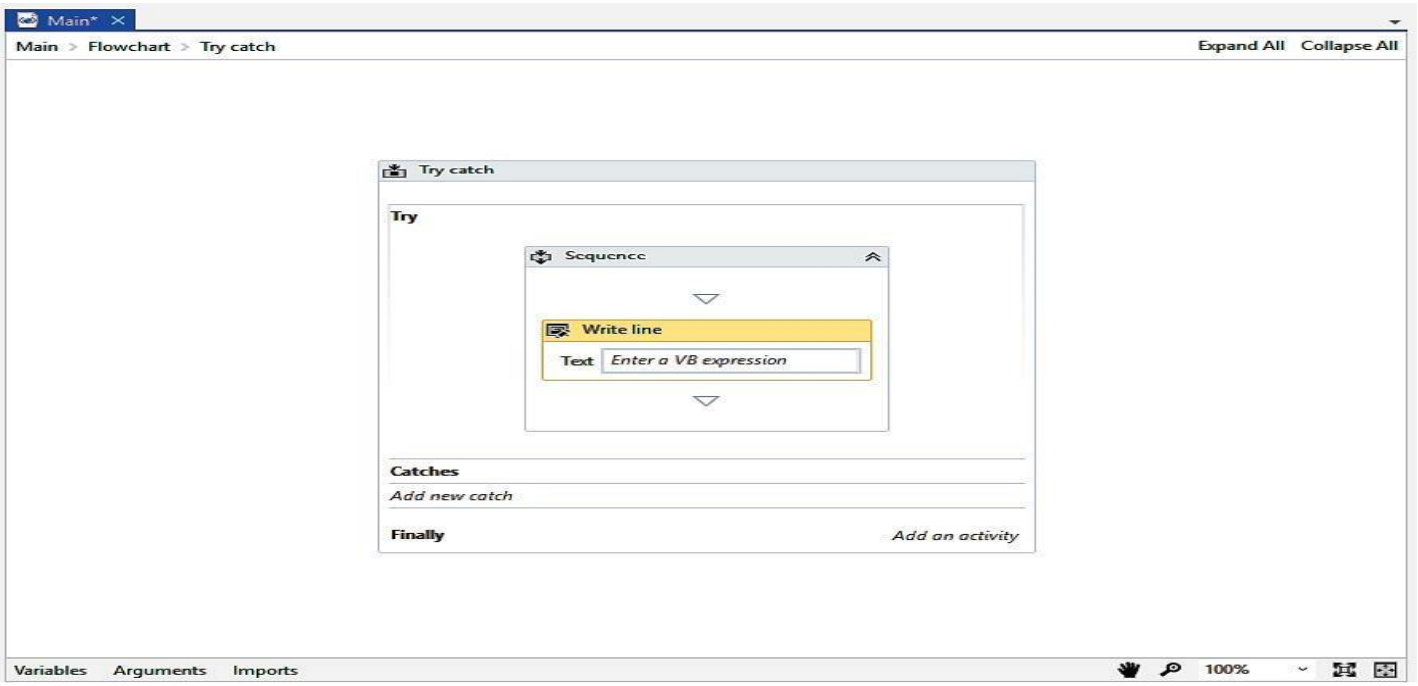


(ii) **Try:** When we double-click on the **Try catch** activity, dragged and dropped inside the workspace, space for the **Try** activity appears, as shown in the following screenshot:

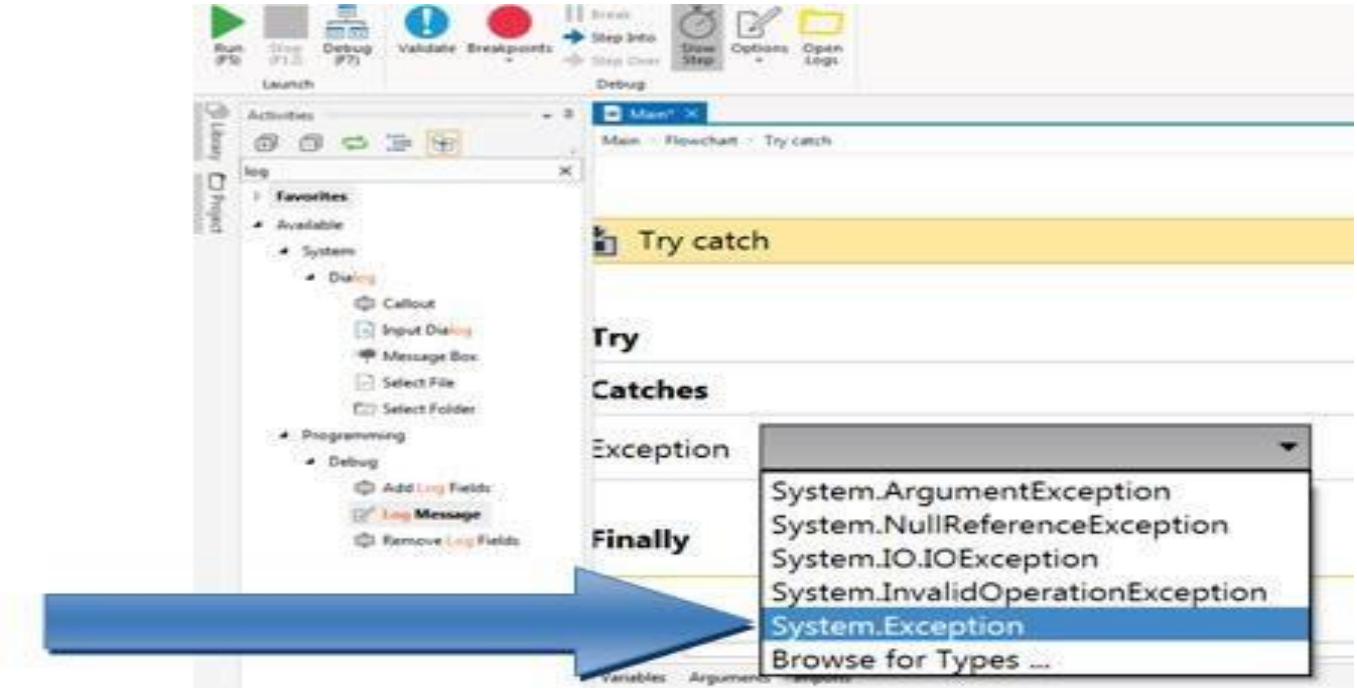


Inside the **Try** block, we have to drop the activity we want to perform.

Drop a **Write line** activity to test the working of **Try Catch** block, as shown in the following screenshot:

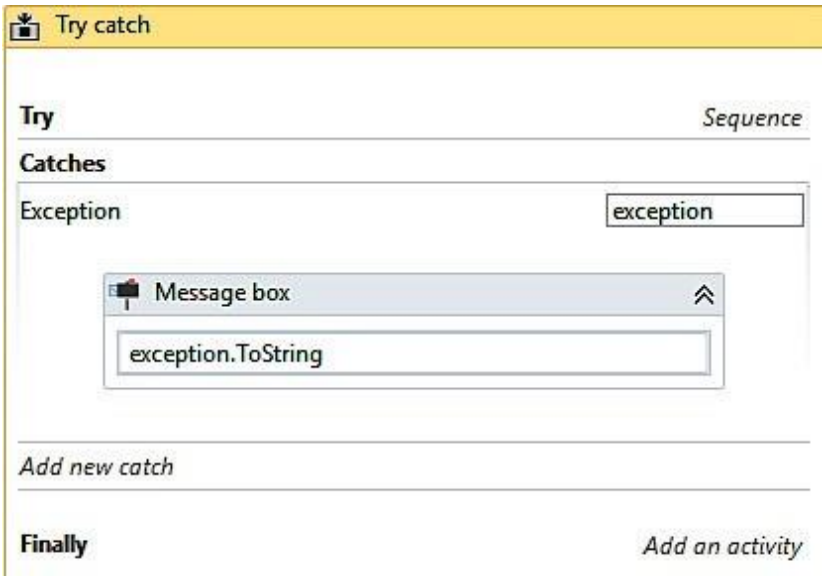


(iii) **Catches:** Inside the **Catches** activity, first we have to click on **Add new Catch** and then click on **Add Exception** option, from which we have to select the type of exception. In most cases, **System.Exception** is preferred. The following screenshot shows the types of exception. There are many more exceptions which can be viewed by clicking on the **Browse for Types** option:



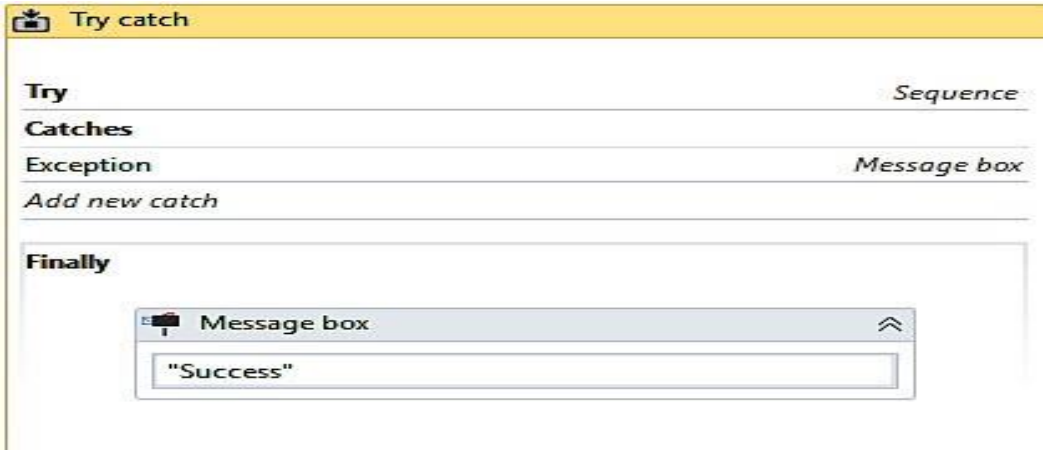
Exceptions can be viewed when clicked on the Browse on Types option

Say the execution fails: for example, the **Click** activity is unable to be executed because of the unavailability of a UI element. In such a case, we can use the **Catches** block in order to either view the error that has occurred or for an alternative method to be used if that particular error occurs. As shown in the following screenshot, we will drop the activity in the **Catches** block. To print a message, we use a **Message box**:



When we click on **Add new catch**, we are asked to select the type of exception. We have selected **System.Exception**. Now inside the exception block, we have dropped a **Message box** activity. Entering exception.ToString will display the error that occurred during execution.

(iv) **Finally**: When we have defined the exception for our sequence, the **Finally** block will always work, regardless of whether the execution was successful or not. Suppose we want to display a message to the user notifying that the process is complete. To make sure that the whole **Try catch** activity is executed, we will just drop a **Message box** activity in the area provided in the **Finally** block, as shown in the following screenshot:



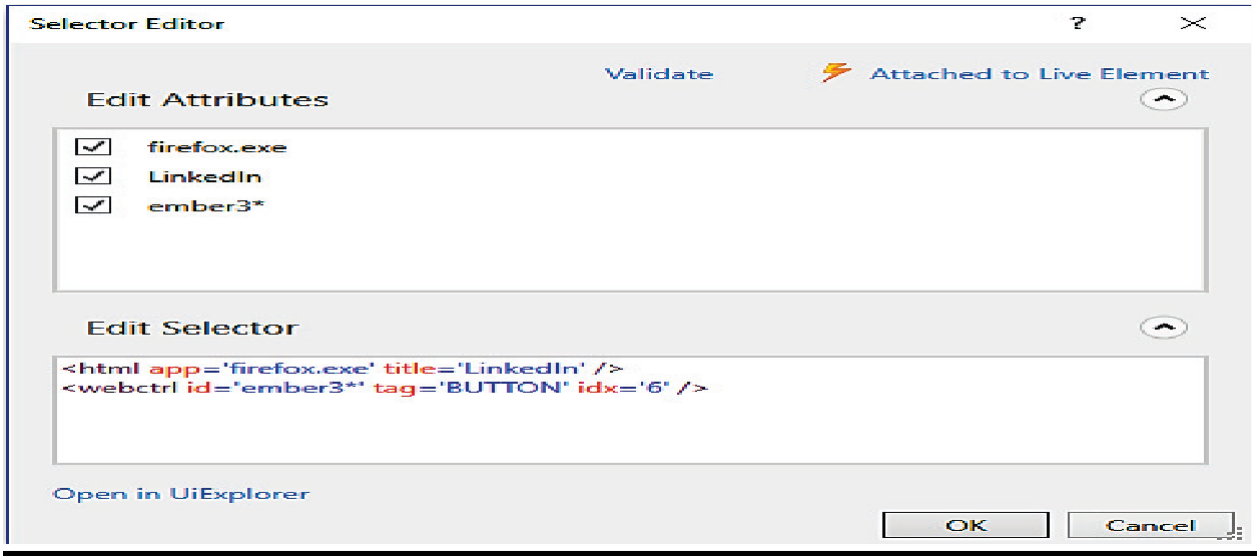
5.2 Common exceptions and ways to handle them

Implementing exception handling enables the robot to work in every possible situation and tackle any exception that may arise. There are some common exceptions that we usually face while working on UiPath.

(i) Unavailability of UI element
(ii) Handling runtime exceptions
(iii) Orbit reference not set to the instant of an object
(iv) Index was outside the bounds of an array. Index out of the range
(v) Image not found in the provided timeout
(vi) Click Generic error - cannot use UI CONTROL API on this UI node please use UI Hardware ELEMENTS method
(vii) Logging and taking screenshots

(i) Unavailability of UI element

→When working on UiPath, especially on the web, we may encounter this type of error.
→This is because the UI element was not found due to the dynamic behavior of the web page.
→To handle this exception, we have to make changes in the selector attributes or we have to add new attributes to the selector so that the UI element can be easily found.
→For example, if we have a variable which is dynamically changing, we can use a wildcard so that it can be easily found by the robot. As shown in the following screenshot, we can edit the dynamic attribute of the selector using wildcard characters (in our case, *). Another way is to attach it to the live element:

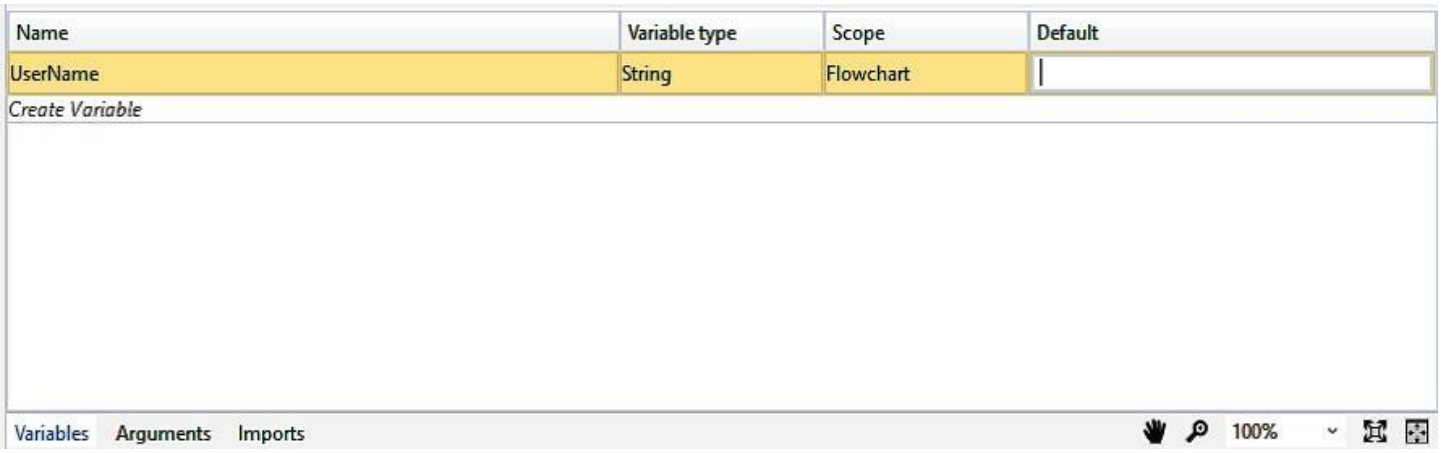


(ii) Handling runtime exceptions

→We may encounter runtime errors while working in UiPath.
→To rectify these errors, one of the best practices is to use the Try catch activity, which can be used to handle exceptions at runtime.
→By keeping an alternative inside the catch block, we can also overcome the error which we encountered before.
→So placing your sequence or workflow inside the Try catch activity will help you handle runtime exceptions.

(iii) Orbit reference not set to the instant of an object

→This type of error usually occurs when the default value required for some variable is not provided.
→ In that case, we are required to give a default value to the required variable, as shown in the following screenshot.
→In the empty area indicated in the following screenshot, just type the default value of the variable in order to overcome this error:



(iv) Index was outside the bounds of an array. Index out of the range

→This error occurs when we try to iterate array elements by an index which is out of range.
→This happens when we are not aware of the size of the array and we just randomly type the index to access the element.
→To resolve this, we must check the size of the indexes of the array or the collective list.

(v) Image not found in the provided timeout

→This type of exception is thrown because the image was not found.
→ This may be due to a change of environment, such as resolution or theme settings.
→ In this case, using some a selector attribute or indicating an anchor will work well:

As shown in the preceding screenshot, when we cannot identify the image properly, **Indicate Anchor** will help us indicate the UI element nearby so that the recorder can identify the correct image.

(vi) Click Generic error - cannot use UI CONTROL API on this UI node please use UI HardwareELEMENTS method

This type of error occurs when the environment in which we are trying to use the Click activity does not support Simulate or Send message activity (used by us to click the UI element).
Sometimes, either **SimulateClick** or the **SendWindowMessages** may be checked. In both cases, when an exception is thrown we just have to uncheck the appropriate box.

(vii) Logging and taking screenshots

UiPath has a multi-process architecture that offers to execute each workflow separately in the executor. Executors are managed by UI robots. So, if any executor stops working, then the entire process will not be affected.

5.3 Client Logging and Server Logging

5.3.1 Client logging

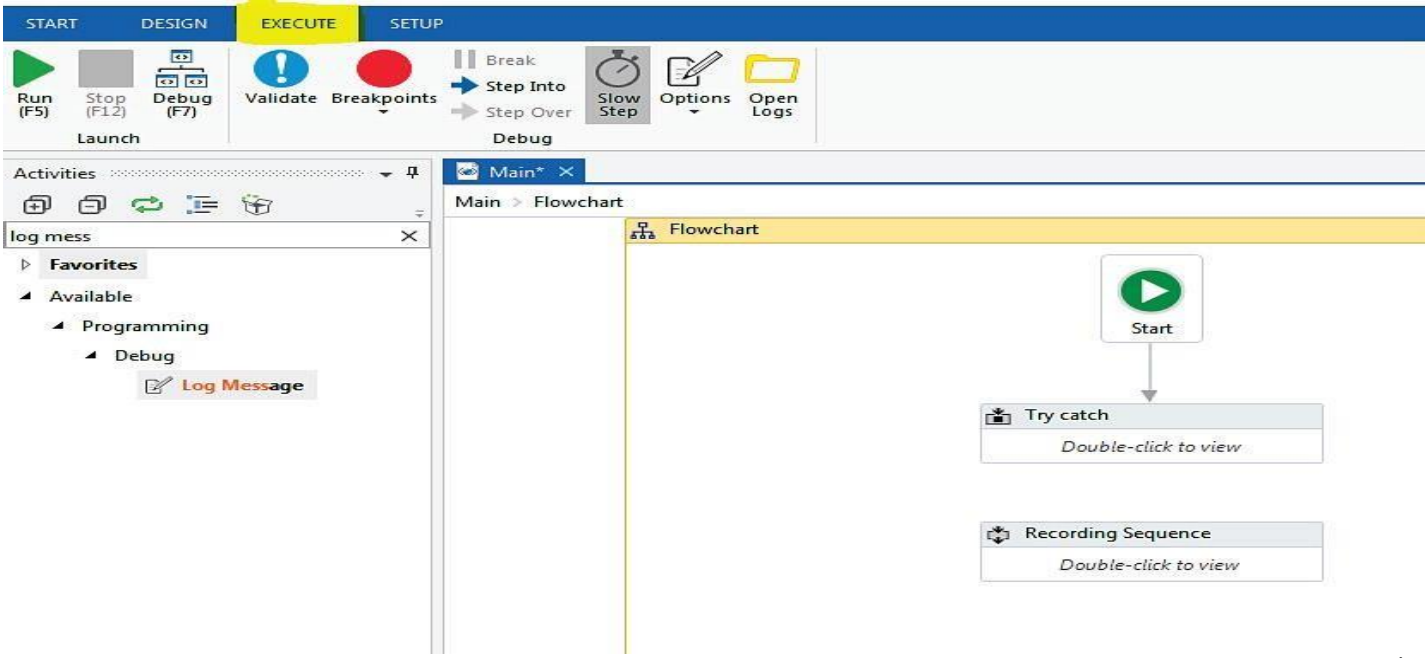
- Client logs basically enable a server to record connections.
- These logs can be used by content providers in various scenarios, such as to generate billing, to trace media server usage, or to deliver suitable quality content depending on the speed of the client's server.
- For client logging in UiPath, we have an NLog configuration file which makes it easy and flexible to integrate with databases, servers, or any other NLog targets.
- Logging can be configured with this NLog.cofig file.
- UiPath Studio, Robot, and workflow execution generate log messages on the client side:
- Messages which are produced by the workflow execution are logged with the execution logging source.
  →Messages produced by UiPath Studio are logged as Studio Source and those produced by UiPath Robot are logged as Robot logging Source.
  →We can also access these logs from UiPath Studio.
- We can access the stored logs by clicking on **Open Logs** in the **EXECUTE** option.
- By default, these Logs are saved in % Local App %\Uipath\Logs:
- The automatic logging mechanism for all errors generated, including values of variables and arguments, may be enabled in the UiRobot.exe config file, which is present in C:\Users\Username\AppData\Local\UiPath\app-17.1.6435, by setting the Log parameter from 0 to 1 inside the <Switches>section.
- We have two activities that can be used for logging and these are the Log message and **WriteLine** activities.

5.3.2 Server logging

If you have configured the UiPath server, then all logs generated by the execution are also sent to the server. You can take a screenshot anytime by pressing *Ctrl + PrtScrn*.

5.4 Debugging techniques

- There are various techniques provided by UiPath Studio for debugging in order to check whether the workflow is running successfully or to find out errors in order to rectify them.
- At the top of the UiPath window, we can see various available methods of debugging inside the **EXECUTE** block, as shown in the following screenshot:

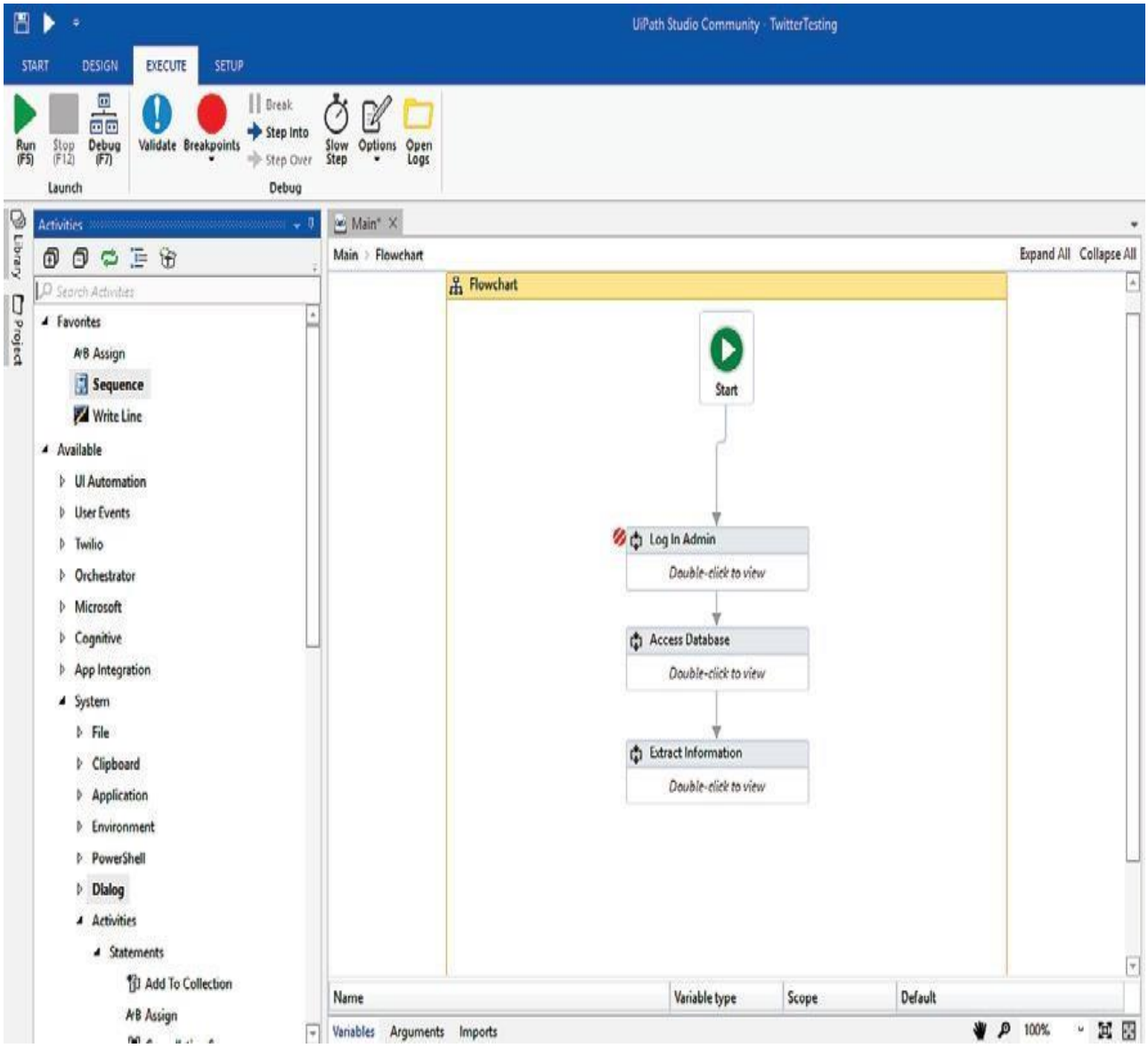


As shown in the preceding screenshot, there are various techniques for debugging. They are:

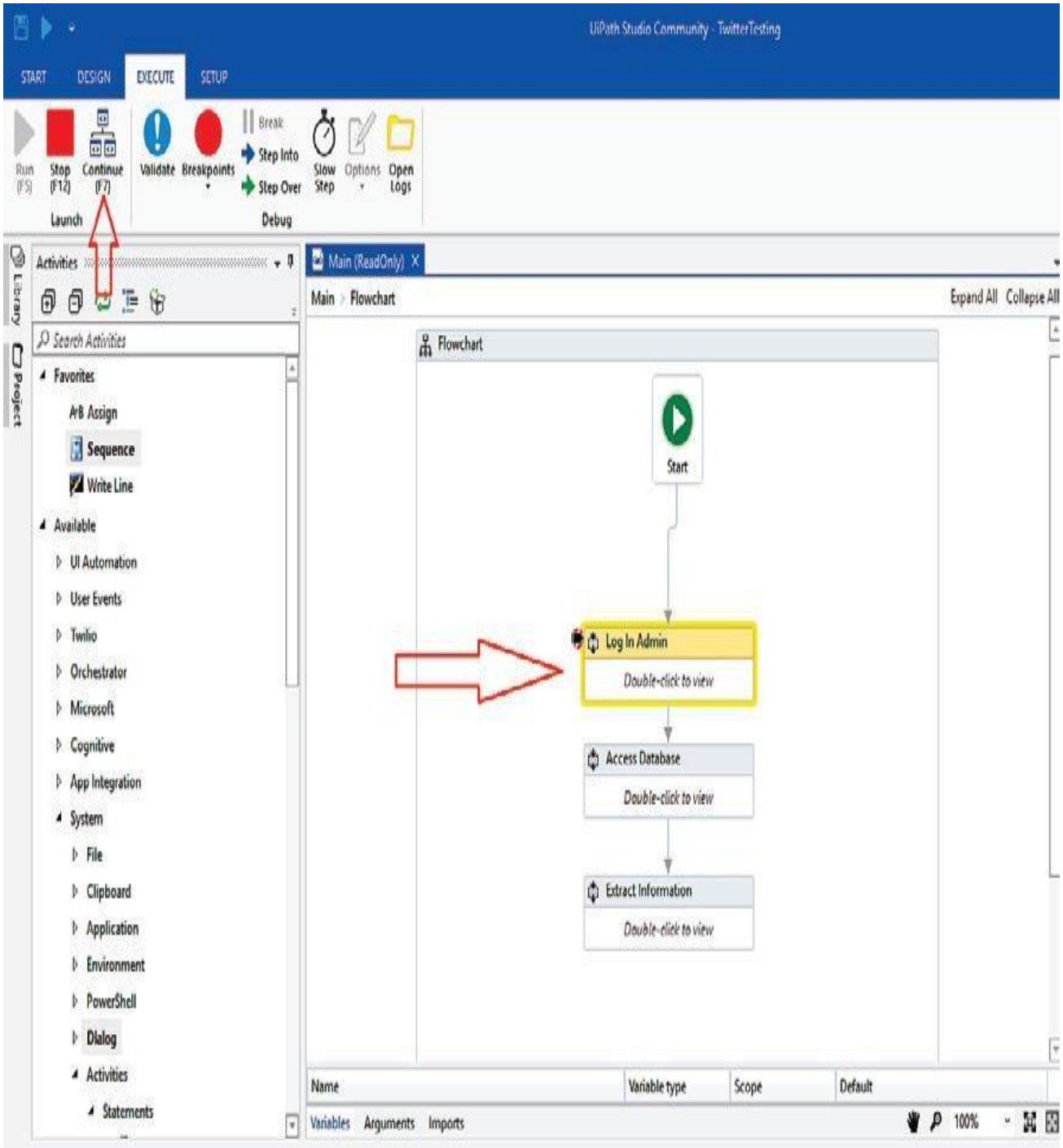
(i) Setting breakpoints
(ii) Slow step
(iii) Highlighting
(iv) Break

(i) Setting breakpoints

→While debugging a workflow, we can set breakpoints in between if we want to run the program up to a specific location.
→This is useful when we have to stop before an activity ends completely. In such a case, we should use a breakpoint on the previous activity, as shown in the following screenshot:



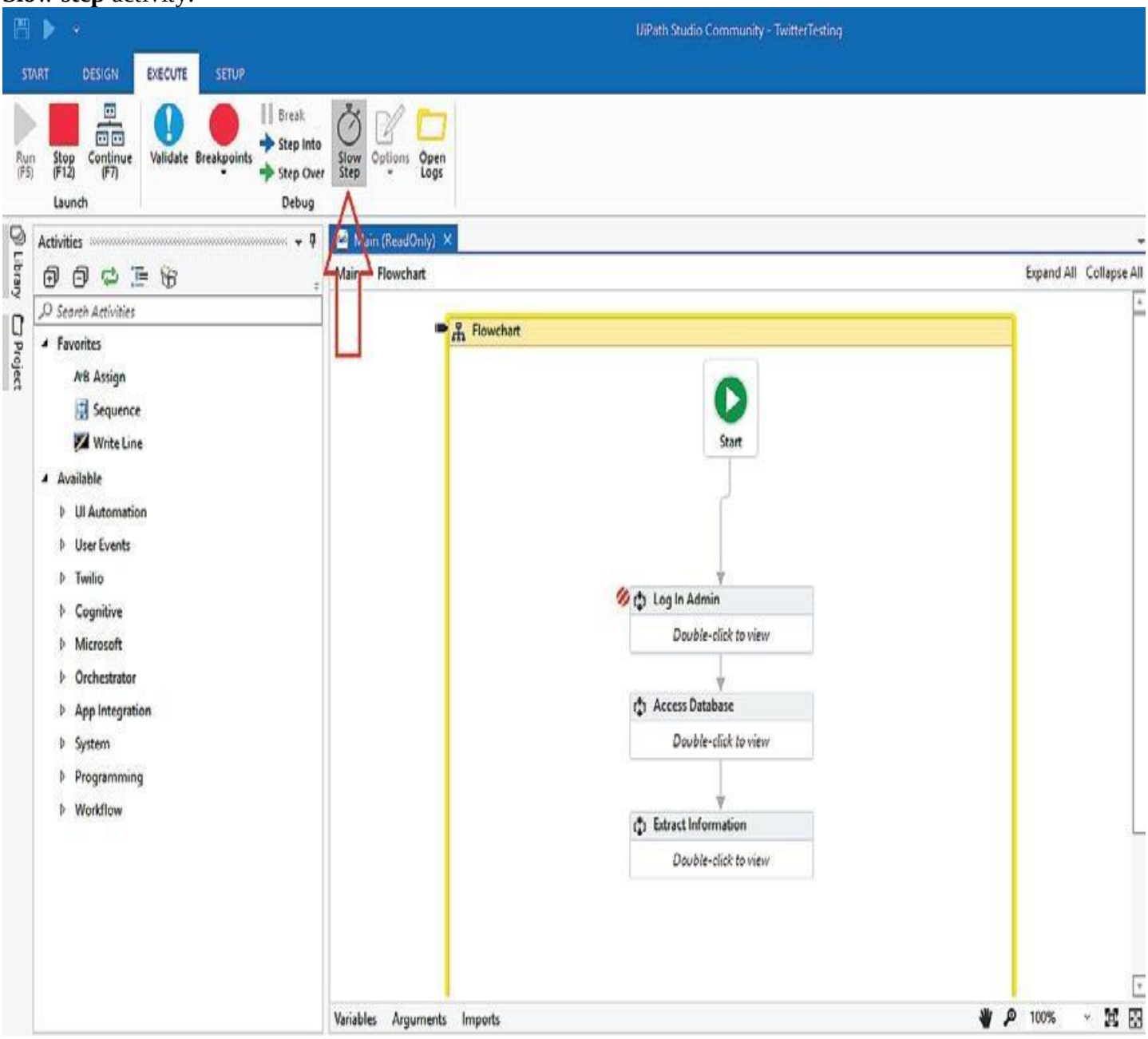
→The highlighted region indicates the breakpoint since the execution stops just after the breakpoint.
→ In order to continue any further, we have to click on the **Continue** button on the top corner indicated by the arrow:



When we click on **Step into**, the relevant part will start to execute; after we click on **Step over**, execution will jump to the next part, and so on.

(ii) Slow step

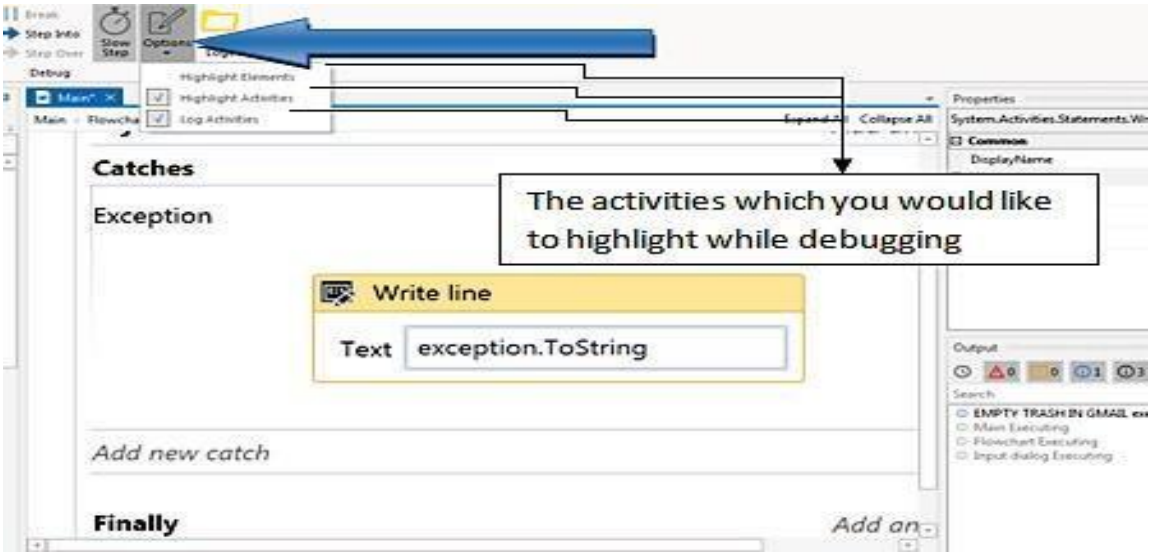
This is an activity in the **EXECUTE** block through which we can reduce the execution speed of a particular process or activity. This way, we can identify each and every process and keep an eye on where to find the error. In the Output panel, all activities or steps can be viewed. The following screenshot shows how to use the **Slow step** activity:



As indicated by the arrow in the preceding screenshot, when we click on **Slow step** the execution time for this particular step increases.

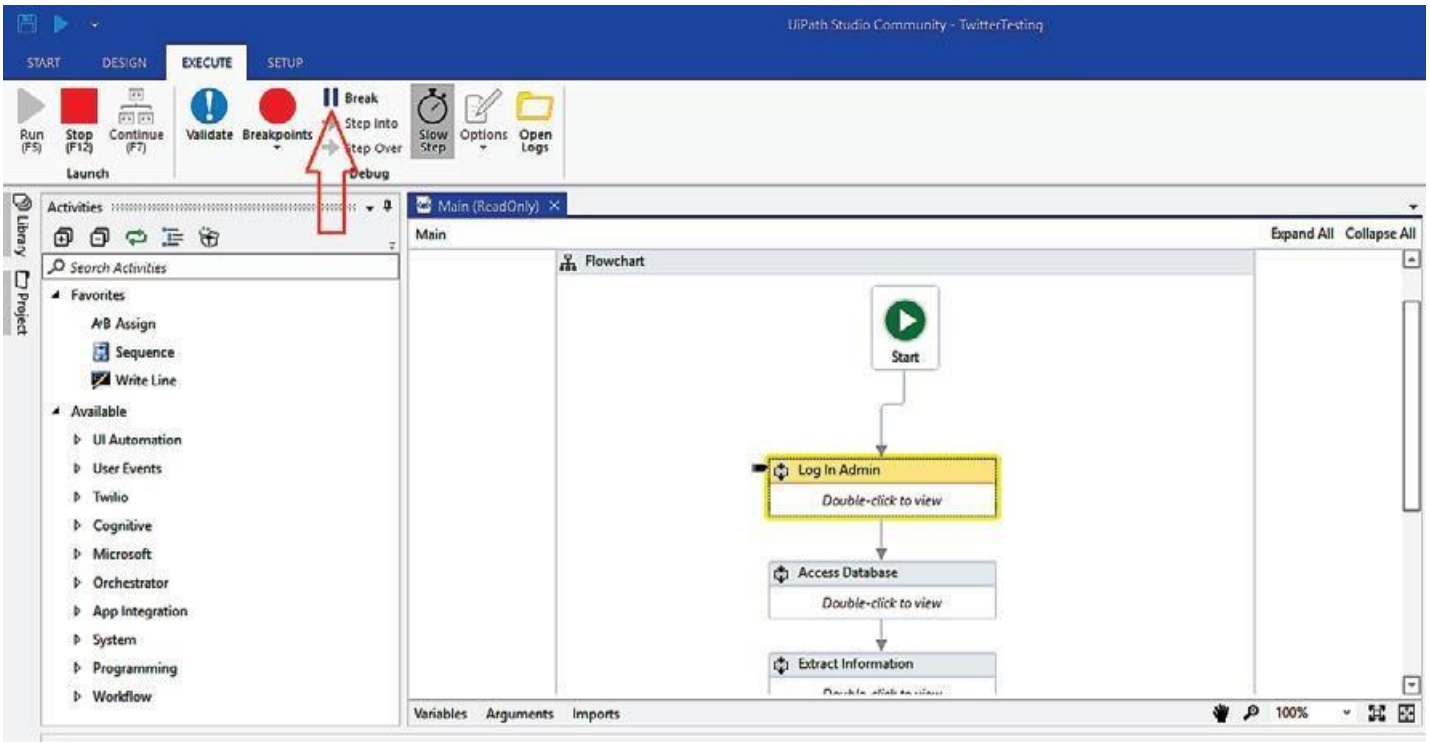
(iii) Highlighting

Highlighting is used to highlight the steps we have taken during automation and to identify each and every step in the workflow. It is very useful while debugging and its panel can be found in the **Options** menu of the **Execute** section in the Ribbon:

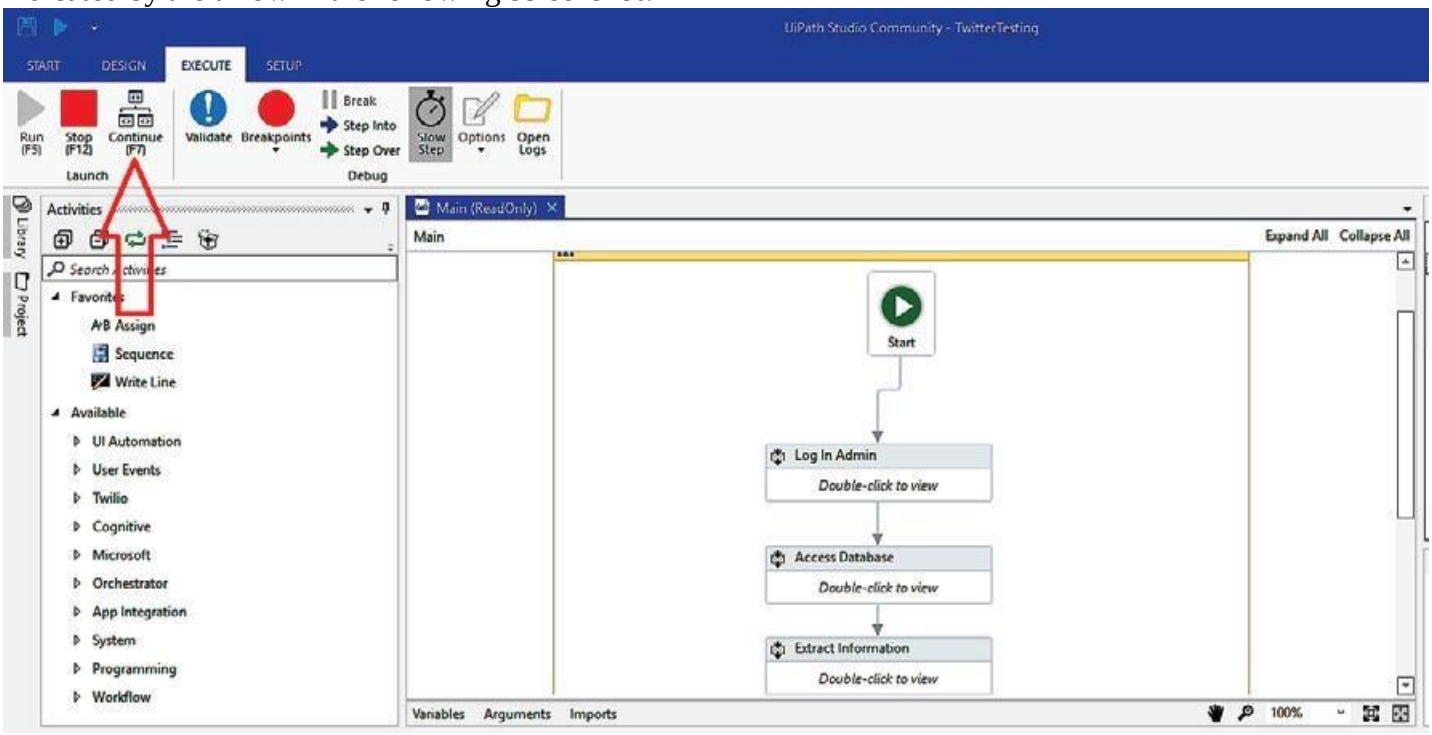


(iv) Break

The Break activity is used to break a process at a certain point. Suppose we have a sequence performing seven activities together and we want to break the execution at a certain activity. For this, we can use the **Break** activity, as shown in the following screenshot:



While debugging, an option for **Break** is available (indicated by the arrow in the preceding screenshot). We can break at any point we want to. If we want to continue any further, we just have to click on **Continue**, as indicated by the arrow in the following screenshot:



Or we can stop the execution at that point by clicking on the **Stop** option.

5.5 Collecting crash dumps

- Collecting crash dumps basically refers to collecting information when your UiPath Studio crashes.
- We can enable and disable crash dumps.
- These dumps provide us with information regarding the UiPath crash.

Memory dumps are of two types**full dumps** and **minidumps**.
→ Full dumps provide us with complete information about the encountered crash
→ minidumps provide us with just the main information regarding the crash.
→When a crash is encountered, we first have to identify the process which has crashed.

Note:
Usually, a dialog will appear on the screen indicating the nature of the crash and the application involved.
A UiPath process could crash, such as Uistudio.exe, Uiexplorer.exe, or Uilauncher.exe, or the target application you want to automate may crash.

Enabling crash dumps

The following are the steps to enable crash dumps:

1. To enable crash dumps, we first have to download the `EnableFullDump.erg` file for full dumps from `https://cdn2.hubspot.net/hubfs/416323/QuickAnswers/EnableFullDump.reg?t=1513326308120` or the `EnableMiniDump.erg` file from `https://cdn2.hubspot.net/hubfs/416323/QuickAnswers/EnableMinDump.reg?t=1513326308120`
2. Double-click the file and click Yes. Administrator rights are needed to access the registry settings
3. The dumps folder is `%TEMP%` whose complete path is like `C:\\users 2;username\AppData\Local\TEMP`
4. When the application crashes, you will find the `.dmp` file in the `TEMP` folder. For example, if UiExplorer crashes then a file such as `UiExplorer.exe.7429.dmp` will be found in the `TEMP` folder

Disabling crash dumps

To disable crash dumps, perform the following steps:

1. Download the `DisableDump.reg` file from `https://cdn2.hubspot.net/hubfs/416323/QuickAnswers/DisableDump.reg?t=1513326308120`.
2. Double-click the file and click Yes to disable crash dumps, Administration rights are needed for this action.

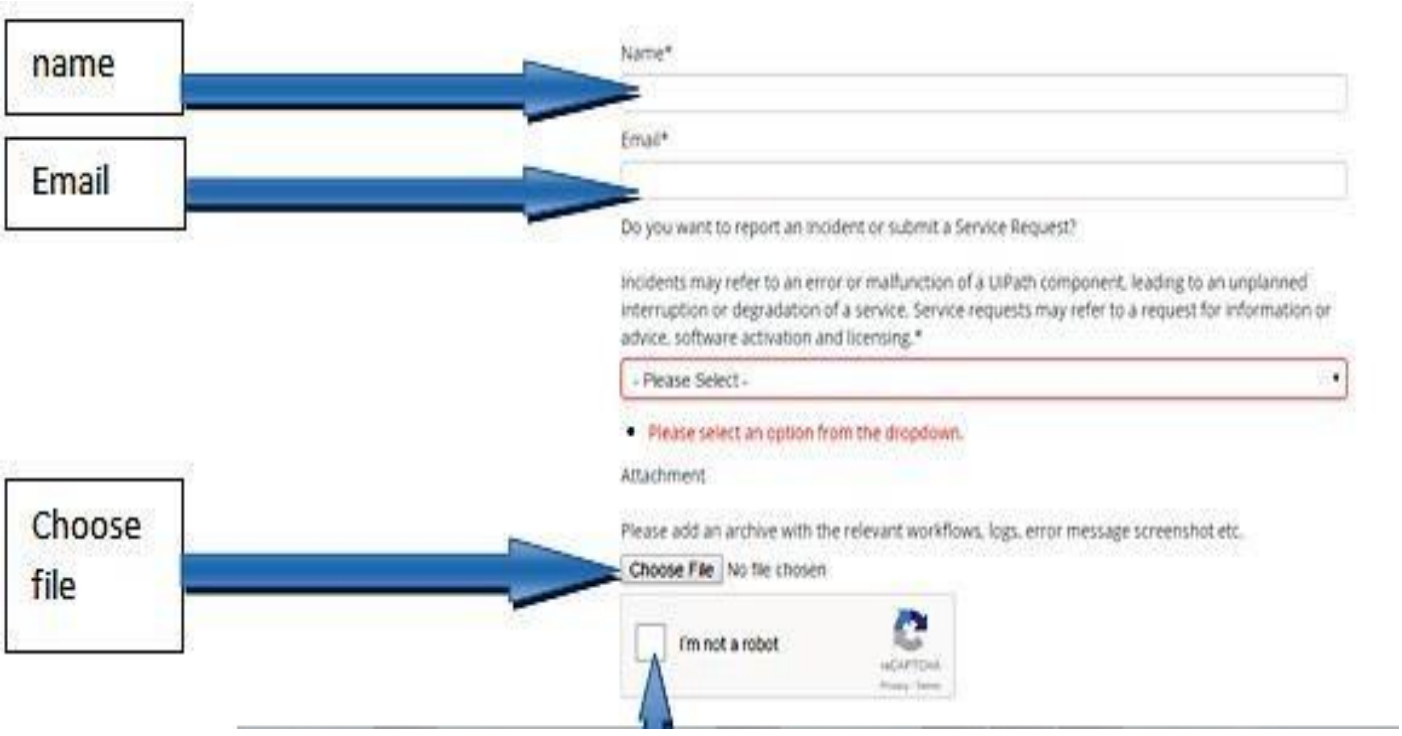
5.6 Error reporting

A user may encounter an error in UiPath and want to report it. As mentioned before, there are two types of customer for UiPath:
(i)Enterprise Edition customers
(ii)Community Edition customers

Enterprise Edition customers

If you are an Enterprise customer, then you can report the error to the UiPath community in a very simple way:

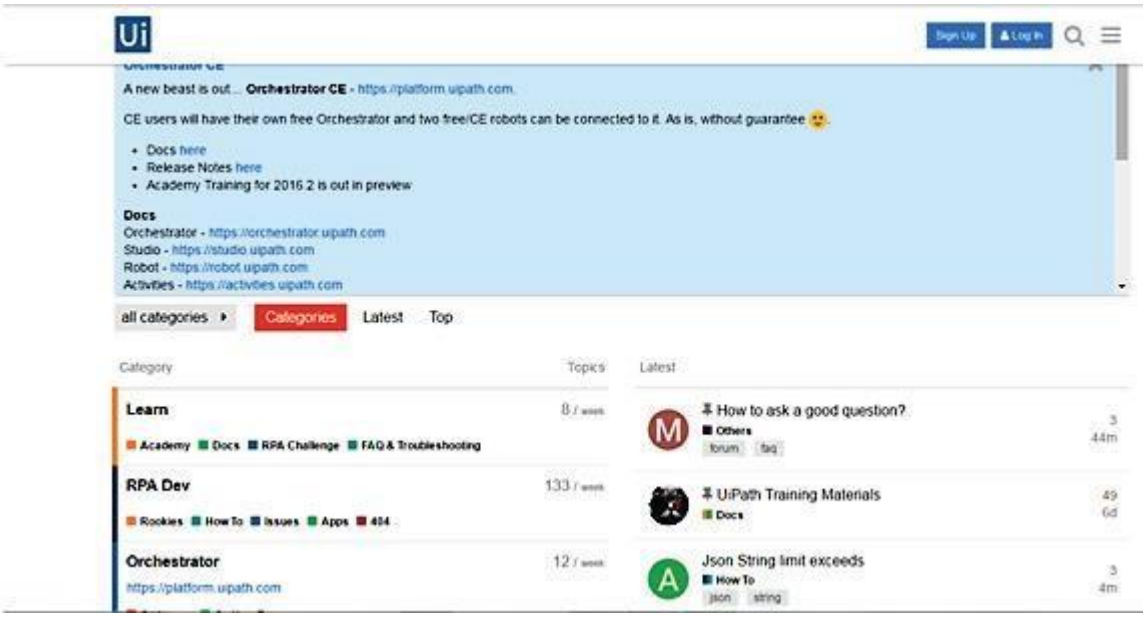
1. Just go to this link: `https://www.UiPath.com/contact-technical-and-activations`.
2. You will be re-directed to a page where you have to fill out a simple form containing some basic details and then upload the file in which the error is encountered, as shown in the following screenshot.
3. After uploading, just click on the **Submit** button. UiPath will respond to you with the proper solution:



Community Edition users

Since the Community Edition is free, UiPath does not provide support to Community Edition users. However, all solutions to errors encountered can be found by going to the UiPath forum. All types of errors and their solutions are properly discussed in the forum. You can also go to the resources page and find the solution to your problem.

For this, visit https://forum.Uipath.com/:



5.7 Future of RPA

A Look at the Next Few Years

Back in 1965, when computers were still in the formative stages of development, Gordon Moore came up with "Moore's Law" that postulated that the number of transistors on a chip would double about every two years. While it was somewhat off – the timing is usually about 18 months or so – it was still revolutionary.

Moore's Law showed the incredible transformative power of computers. Of course, Moore would go on to start one of the world's most iconic companies, Intel.

But there was something else about his law – that is, it is one of the few things in the technology world that has been highly predictable. The pace of change and innovation can be mind-boggling.

Keep in mind that many of the top tech founders and visionaries have been wide off the mark on their predictions. For example, when Apple launched the iPhone in 2007, Microsoft CEO Steve Ballmer had this to say: "There's no chance that the iPhone is going to get any significant market share."

Or how about the time when Digital Equipment Corp. president Ken Olsen said in 1977:
"There is no reason anyone would want a computer in their home." So yes, making predictions about the future is a hazardous activity! But then again, it is important to try. There needs to be ongoing debate to help fuel innovation. In this chapter, we'll take out the crystal ball and make some predictions about RPA.

Consolidation and IPOs

With over 70 RPA vendors on the market – and with perhaps more that will be formed because of the interest of venture capitalists – there will likely be increased consolidation.

It will be difficult for many of these players to stand out and get the attention of potential customers. As seen with operators like UiPath, Automation Anywhere, and Blue Prism, there has already been a pickup in acquisitions. Yet this is likely to accelerate. It certainly helps that the large companies have substantial amounts of cash on their balance sheets.

The acquisitions will be essentially to help expand the RPA technology stack, to move into new industries, and pick up customers. "RPA vendors need to diversify beyond their own niche technologies and core products to grow their position in the industry," said Dr. Gero Decker, who is the CEO of Signavio. "Specifically, vendors will need to better examine the use cases and capabilities that automation can do, therefore expanding the reach and capabilities behind their automation. They also need to make it easier to implement automation, and automate capabilities beyond older, redundant tasks."

There will also likely be some IPOs. Currently, the only pure-play public company is Blue Prism. But in the next few years, we will likely see Automation Anywhere and UiPath pull off IPOs. This will not just be about raising capital, either. After all, there has been little trouble with this. But being public provides other benefits, including the following:

1.Prestige: Not many companies have what it takes to be public. Often, there must be high levels of revenues, a diverse customer base, an extensive product line, and a path to profitability. Being public also raises a company's visibility with the media and analysts.
2.Liquidity: Employees may have taken lower salaries in exchange for equity in a company. Because of this, they eventually want to see a return on this – which is much easier when a company is publicly traded.
3.Transparency: With many RPA companies private, it is difficult to gauge the industry. What really are the revenues? Is there customer concentration? Any issues with the core infrastructure? For the most part, a public company is legally required to provide full disclosure of material information. This not only makes it easier to evaluate a company's prospects but builds confidence with larger customers.

Microsoft

Historically, Microsoft has been a follower when it comes to new technologies. This was the case, for example, with the GUI-based operating system as well as the Internet browser. It also took several interactions to get these products to a place that was competitive. But when it did, the results were incredible, as seen with Windows 3.0. Then again, Microsoft has enormous advantages: seemingly unlimited capital, a trusted global brand, a strong ecosystem of partners, and a massive customer base.
So what about RPA? Yes, it's now becoming a priority.

At the Ignite conference in November 2019, Microsoft announced its official foray into the market.
The company leveraged its Power Platform – which allows for BI, low code, and workflow management – to create Power Automate. It also uses Selenium, which is an open source application that allows for the recording and automating of web applications.It comes with more than 275 prebuilt connectors to apps and services. There are also AI capabilities and of course native integrations with Office 365, Dynamics 365, and Azure. While there is some coding needed, it is still high level and there is a drag-and-drop system to create the workflows. Interestingly enough, when it comes to creating alerts and triggers, you can seamlessly use Microsoft Teams.

Power Automate is definitely a solid offering. However, it still lacks enterprise-grade features, such as identity management. But such things will likely be added in the next couple years.

If anything, Power Automate will allow Microsoft to learn and iterate on RPA systems. And given the company's deep reservoir of talent and financial resources, it seems like a good bet that the progress will be rapid .

Attended Automation

RPA technology has been mostly about unattended automation. And this should not be surprising. This type of automation is easier to handle. Hey, there is no involvement with people! But attended automation has much potential for making a huge difference. An employee, for example, can leverage the intelligence of a bot while using his or her own skills to solve problems. Attended automation should lead to much synergy – the best of humans and machines.

The good news is that the technology is starting to get better, especially with improved integration and AI. "We'll see more businesses pivot their attention toward attended automation," said Francis Carden, who is the VP of digital automation and robotics at PEGA. "They will start to recognize how combining bots and humans together can produce optimal outcomes in a faster and more agile way. They will realize that in many use cases, such as in call centers and large front and back offices, attended RPA can be rapidly deployed to many more users for the most common tasks and delivers a much faster and
more valuable route to ROI."

Barry Cooper, who is the enterprise group president at NICE, agrees with this thesis. "We're starting to see a shift as enterprises are beginning to understand and embrace the benefits of automation and view it as a way to improve the overall workload and performance of their employees," he said. "This is especially true when providing employees with their own personal robotic assistant. Attended bots are programmed to provide employees with the guidance and assistance they require, in real time directly from their desktops, and automate anything which is repetitive and doesn't require their special
skills. Enterprises are realizing that attended automation will have a positive impact on their employee's adoption of automation and ultimately on the service they provide to their customers."

To get a sense of this, consider Automation Anywhere, which has acquired Klevops, a start-up based in Paris. According to the deal's press release: "Automation Anywhere fast forwards the RPA category to Attended Automation 2.0, where managers can easily orchestrate workstreams across a team of employees and bots, driving a higher level of employee productivity and improved customer experience.

This enables customers to automate more processes than ever before, with the same level of central governance, security and analytic capability for which Automation Anywhere has always been known.This approach is likely to see much traction in industries that rely heavily on contact centers, such as banks and telecom companies.

The RPA Career

→Even though the emergence of the Internet has resulted in the reduction of certain jobs, there have been new professions created like digital marketing.
→Something similar is happening with RPA. "Hiring for RPA skills will explode across all industries and job functions," said Prince Kohli, who is the CTO of Automation Anywhere. "With more than 5,000 RPA jobs in the U.S., there is already incredibly high demand for RPA specialists. Starting salaries will
skyrocket."

→This will not just be for developers, business analysts, and managers. There will also be growth for those who have experience in verticals, such as IT, BPO, HR, education, and insurance.
→But for those companies that implement RPA, there will be a need on how to transition existing workers. This is certainly an opportunity – but will not be easy. Companies must rethink the traditional approaches to talent management.
→ According to research from Leslie Willcocks, Mary Lacity, and John Hindle, change management is the most seriously under-recognized and underfunded component of successful RPA implementations.4
"We will see more companies embracing training opportunities to upskill their employees for RPA jobs, opening the doors for new career opportunities and growth," said Barry Cooper, who is the enterprise group president at NICE.
→To do this, companies must go beyond just offering training courses. There will need to be a focus on areas like providing interesting opportunities and incentives.

Scaling RPA

While the early stages of an RPA implementation are generally successful, it usually gets more difficult to scale the technology. What winds up happening is that there is a hodgepodge of bots throughout an organization, which often means not getting the maximum results.

"As more and more organizations adopt RPA, we have yet to see an enterprise-wide adoption of more than 50–100 bots," said Harel Tayeb, who is the CEO of Kryon Systems.

To help improve things, RPA vendors are retooling their systems to help achieve scale, such as by adding AI and process mining. "With the benefits of RPA, corporations are looking for scalability and are struggling in two areas related directly to processes – inability to identify candidates for automation after tackling the 'low hanging fruit' and dealing with bad processes," said Ray LeBlanc, who is the product strategy manager at Verint.

"Process mining is the logical solution; however, the solutions are expensive, still take considerable time, and don't truly align with RPA. We are starting to see solutions that are targeted to a smaller sample size, that is, number of users, but also are focused on actual workflow on the desktop, that are focused on discovering processes that are suitable to benefit from RPA."6

There will also be a move toward using Business Process Management solutions.
"RPA began as a stand-alone technology but the future of RPA is clearly integration into larger end-to-end process automation platforms and programs," said Michael Beckely, who is the CTO of Appian. "When unified with human workflow, BPM, API integrations, Artificial Intelligence/Machine Learning services, and RPA can be efficiently orchestrated with humans and other systems to maximum benefit.

The so-called 'problems' with RPA really become features when viewed within the greater context of an overall Automation project."7 He notes that the financial services industry – which was an early adopter of RPA – is already shifting toward a holistic approach.

"Whereas RPA was sometimes started as a way to bypass overburdened IT departments, as RPA projects scale, IT is increasingly taking charge," said Beckely. His company has built a system, called the Robotic Workforce Manager, that uses low code to enable the scaling of RPA projects to hundreds and even thousands of bots. For example, Union Bank – one of the largest banks in the Philippines – has used this, along with UiPath, for the unification of its automation initiatives.

The company was able to deploy over 400 automated applications in under three months and accelerated processing times by 300%. "Through this process of digital transformation, UBP achieved 97% digitization," said Beckely. "Business executives require real-time visibility into robotic workforce operations so they can analyze bot value by process and department and achieve greater business impact through end-to-end automation.

RPA business users need better ways to automate human-in-the-loop activities and self-service controls to start and schedule robotic processes on-demand. With end-to-end process visibility across people and robots, users can confidently tackle much greater workloads than ever before."

Vertical-Specific Companies

In general, most of the RPA vendors have solutions that span multiple industries. Yet the companies still usually have specialties. Actually, as RPA starts to mature, there will likely be more vertical-based players.

Customers will want a more specialized approach, as there will usually be unique use cases.
Just look at Olive, which is targeting the healthcare industry.

The founder and CEO – Sean Lane – actually has an interesting background. He started his career as an intelligence officer in the Air Force working at the National Security Agency. There he had valuable experience dealing with enormous engineering challenges. He even completed five tours of duty in Afghanistan and Iraq.
But when he returned home, he saw another devastation: the impact of the opioid addiction crisis. To do something about this, he looked at how he could leverage his experience with finding insights from data.

When he started learning about the healthcare system, he realized the enterprise systems were highly proprietary and would not talk to each other. The technologies were also unintuitive and often required hiring consultants and outsourcing firms to add new capabilities. This made it particularly difficult to do cutting-edge initiatives like AI. Because of this, he saw there was an opportunity to bring automation to the industry.

"My focus was on building an AI-powered digital workforce," said Lane. "Instead of building new software to replace disparate systems, we would create the first health care specific digital employee to automate robotic, error-prone workflows, emulating the manual tasks employees had once done – only faster and more accurately. With Olive, I've set out to carve a trillion dollars out of the cost of healthcare while improving the human experience."

The name Olive is the "digital person" that provides the automation. She is quick and does her work in a confidential manner, helping with tasks like collections, coding, and credentials. There is also a deep understanding of the complex language of healthcare as well as the EHRs, patient accounting systems, and third-party clearinghouses.

"If something breaks?" said Lane, "Olive proactively fixes it. If a payer portal changes? Olive will adapt her workflow.
And if Olive gleans a cost-saving insight from the large amounts of data she's processing? She'll surface it and e-mail her manager about it. This allin- one approach makes it so automations work for our customers. They don't work for their automations.

What's most exciting is that every Olive is able to learn collectively, like a network, so that hospitals never have to solve the same problem twice. I ultimately see Olive's digital workforce as a way to build global awareness – a true internet of healthcare."

The healthcare industry is certainly a prime target for RPA. Note that an estimated $1 trillion in spending in the United States goes to administration. And unfortunately, an employee will engage in mundane tasks like filing folders or moving data across a myriad of systems and interfaces. In light of this, is it any wonder that burnout and boredom are the leading causes of turnover and that attrition in the healthcare industry is so high?
"Imagine what we could accomplish if we eliminated even 1% of the burden of time and cost," said Lane. "The research that could be funded, the treatments that could be developed, the cures that could be found."

Hype Factor

Back in 1995, Gartner analyst Jackie Fenn developed the "Hype Cycle," which caught a lot of attention. The irony is that her framework was, well, hyped quite a bit! Her premise: Major technologies undergo fairly predictable cycles.

In fact, the Hype Cycle has five of them, which include the following:

The Technology Trigger: There emerges a transformative technology that quickly gets the attention of the media, entrepreneurs, and VCs. There are some prototypes for proof of concepts. But the commercial viability of the technology has yet to be established.
Peak of Inflated Expectations: At this stage, the technology has shown to be effective and this gins up lots of excitement. This can happen rapidly, especially with the power of social media and the availability of huge amounts of cash to fund new technologies. As should be no surprise, the hype gets to giddy levels. You will hear things like "game changer," "inflection point," and so on.
Trough of Disillusionment: There begin to be signs that the enthusiasm is evaporating. Some of the companies in the space are failing or not meeting expectations. Stock prices are getting hit. Customers are realizing that the new technology is not generating the promised ROI.
Slope of Enlightenment: Despite the issues and problems, the technology nonetheless gets more refined. The result is that the impact gets stronger. But the media no longer shows much interest and is focused on other red-hot categories.
Plateau of Productivity: Here the technology becomes mainstream and there are standards of its use. It is really just a natural part of the business world. This framework is far from perfect.

Consider that Gartner has had some flubs with its own predictions, such as with BPM and cloud computing. But the 5-step cycle is still useful. It's a way to allow for a longer-term perspective and to avoid being too early when it comes to adopting technologies.

According to Gartner: "If there are too many unanswered questions around the commercial viability of an emerging technology, it may be better to wait until others have been able to deliver tangible value."

Then where is RPA on the Gartner Hype Cycle? This is definitely tough to answer! One of the things to note is that RPA has been around for two decades and it was not until six or seven years ago that it really started to accelerate. But in my opinion, I think the industry is definitely beyond stage two and may actually be entering the early phases of stage three. The media attention is intense.

The funding has been plentiful. But at the same time, there are some signs of disillusionment. As noted in this chapter, there are challenges with scaling RPA as well as combining technologies like AI.

And some of the large players are experiencing growing pains. For example, in late October, Forbes published an interesting article that showed that UiPath laid off around 300 to 400 employees or 11% of the workforce. This is not to imply that UiPath is in big trouble. Far from it. The company remains in a strong position – in terms of its product line, customer base, and financials. But Wall Street is putting much more emphasis on a path to profitability. The implosion of WeWork – which lost billions of dollars in market value and almost went bust – was a wake-up call to many in the tech world.

This will mean that the strategies will likely be moderating in the coming years. As UiPath CEO Daniel Dines noted in the Forbes article, there will be a need to "balance growth ith efficiency."

Software-as-a-Service (SaaS) and Open Source

RPA software is still mostly on-premise. But there will probably be a transition toward a SaaS model. Part of this will be about having a cloud-native platform, which will make it easier for upgrades and data access (this will be critical for AI applications).

"When the software robot becomes a commodity, we will start to see the next wave of adoption in RPA," said Antti Karjalainen, who is the founder and CEO of Robocorp. "SMBs (small and medium size businesses) will want to have access to business process automation but they will not always have the required sophistication to adopt the technology. This gives an opening to a new type of service provider, **a robotics-as-a-service** (RaaS) operator, that can help SMEs by automating their business routines and maintaining the software robots for them. These RaaS operators can either focus on certain verticals, like car dealers or real estate agents, or they can work as general automation providers in their local area."

But also expect a change in the business model. As RPA scales, the costs can get prohibitive because of the per-bot fees. So customers will be looking for alternatives, say, a subscription approach. Companies like SAP, Intellibot, and Nintex have been offering lower-priced strategies as a way to get traction in the crowded RPA market, for example. Companies may also look to the open source approach as a way to deal with this as well. But of course, there are other benefits, such as a strong ecosystem of developers who keep innovating the platform. Granted, the landscape for open source software is fragmented. The projects tend to be small in terms of adoption – and the technology is not extensive. But this is expected to change. As seen with other industries, open source has become ubiquitous.

According to Karjalainen : "The traditional RPA infrastructure hasn't incentivized participation from the developer community to build RPA tools because of the high cost of entry for businesses has essentially limited market-share and profitability. However, as RPA becomes more open-source driven and the user-base grows, developer interest will increase and we'll begin seeing a subset of RPA-exclusive developers that will drive innovative creation of tools. We will identify the 'RPA developer' as a new developer category."

If anything, open source is likely to be critical for the RPA category. "Open source is a central pillar of modern cloud stacks, and if RPA is to have a role in hybrid cloud infrastructure, it must be open source as well," said Phil Simpson, who is the product marketing manager for process automation at Red Hat. "A number of open source RPA projects are available today, but few at this point can compare to proprietary products in the market currently, particularly around providing enterprise-grade support.

With that said, the industry is moving toward a more open and flexible model, and I anticipate we'll soon see parity between the two models, giving customers the ultimate in flexibility and choice."

Chatbots

Sometimes there is confusion between chatbots and RPA. While both involve the use of software bots, there are clear differences. A chatbot is a system that uses NLP (natural language processing) to communicate with people. In the consumer world, this would be Siri or Cortana. But of course, many companies are using chatbots for handling customer service.

The market for this technology is growing quickly. According to research from Reports and Data, the spending on chatbots is forecasted to go from $1.17 billion in 2018 to $10.8 billion by 2026, which represents a compound annual growth rate of 30.9%.Some of the biggest drivers include the pervasive use of social media and smartphones. Chatbots are expected to have a notable impact on the bottom line too. A research study from Juniper Research points out that the cost savings will hit $7.3 billion by 2023, up from only $209 million in 2019.

Then what does RPA have to do with chatbots? There are several use cases. First of all, a chatbot can be used internally as an assistant to help employees with gaining access to information or getting insights. But RPA can also help automate processes that deal with customer interactions.

Look at Aflac. The company, which has been around for more than 55 years, is a top provider of financial protection for health matters. There are over 50 million customers.

No doubt, Aflac has had to find ways to help automate processes. "We have been working with RPA for quite some time," said Keith Farley, who is the VP of US innovation at Aflac. "We have worked with screen scraping and other techniques – even before it was called RPA."

But it was in 2017 that the company implemented two systems from RPA vendors, which involved the help of a consultant. The first bot was for handling wellness claims, which was a quick success. Aflac has since gone on to create 28 more bots. Actually, one of the workers whose processes were partially automated became a manager of the RPA system. "We have reached a point of maturity," said Farley. "We are now looking at the next stage for automation."

A big part of the strategy is the use of chatbots. At first, Aflac leveraged the Facebook Messenger bot service. It was built to address common questions and would route to call center people when the chatbot did not have an answer. But in the end, it failed and Aflac took it down. But the company did not give up. "We embraced the failure and talked about new approaches," said Farley.

One of the problems was that Facebook Messenger could not identify the user, which made it impossible to provide personalized answers. Next, the database of Q&A information was subpar.
"We thought the solution was to bring people back into the loop," said Farley. "We started using a chatbot system where our employees would answer the questions. By doing this, we were able to create the right kind of data." This proved to be spot-on. The new chatbot system had a login to identify the users and a much richer database, with the number of question types going from 500 to over 20,000. The result has been a higher level of satisfaction from customers and reduced call center volume during peak times.

"The second iteration was a big success," said Farley. "But we realized that the chatbot was not a replacement for employees. There are certain times when customers want to talk with a person. This is especially the case with our own business, where we deal with wrenching situations with illness and disease."

Artificial Intelligence

AI is likely to be the most important driver for RPA. Based on research from PwC, this technology is expected to add a whopping $15.7 trillion to global GDP by 2030, which is more than the combined output of China and India. According to the authors of the report:

"AI touches almost every aspect of our lives. And it's only just getting started." Despite this, AI is still limited and narrow. Consider your smartphone that has Alexa or Siri installed on it. While the technology is powerful, the core functionality is really about handling simple commands. It will not be until many years that we will be able to have a free-form conversation with an AI device.

In other words, when thinking about AI and RPA, look for clear-cut business use cases. Interestingly enough, according to a report from PwC, the focus should be on solving "boring" problems. The report highlights that executives are starting to realize this as they run into challenges with implementing projects. The PwC survey shows that – for 2020 – only 4% of companies plan to scale this technology across their organizations. Rather, the priority will be on functions like finance, HR, tax, and compliance. It may be as easy as something like intelligently extracting key information from a form. The survey also shows that 44% of executives see AI as a way to operate more efficiently and 42% believe it will lead to better productivity.

Even before thinking of putting together an AI project or buying a new software platform, it makes more sense to look at your existing systems. Keep in mind that they already likely have AI features built in! For example, companies like Oracle, Salesforce.com, and Microsoft have been investing heavily in revamping their software offerings. So the first step is to try out the new features. This should not only lead to improvements in automation but also provide some understanding of how to work with AI.

Many of the RPA vendors are also aggressively adding AI features (this is often referred to as intelligent automation or IA). But do not rush with these either. Take the time to operationalize the AI within your workflows. What is relevant for your company? What types of AI can be effectively managed?
Granted, it's a lot of work and there will be the need for extensive planning – but this will be well worth it.

"AI, especially machine learning, has a big role to play in making sense of all the data that will be generated," said Ryan Duguid, who is the chief of evangelism and advanced technology at Nintex. " When you start tracking every mouse click and keystroke, the volume of data is staggering."

Then what are some of the interesting use cases for AI and RPA? Well, there are plenty. Here are just a few, from Tom Wilde, who is the CEO at Indico: Corporate E-mail Inboxes: "Most companies have a central inbox that receives lots of emails from customers, contractors, suppliers and the like, often with attachments. You can use RPA to detect when a new e-mail arrives with an attachment, then automatically route the e-mail to an intelligent automation tool. Machine learning can then be used to extract the attachment and 'read' it, using OCR and NLP. It can also extract relevant unstructured content such as payment terms, invoice numbers, contractual language and so on. The tool can then normalize the data in an appropriate format and send it to a downstream platform, such as a CRM or ERP tool."

Contract Management : "Poor contract management can be costly. Businesses might not realize they are owed credits and they may overlook automatic renewal dates, or even fail to send invoices. The automation capabilities available in RPA platforms can address many of these issues, but may also be limited in their effectiveness due to the variability of language. For example, provisions and clauses across contracts may use different language but mean the same things. AI can help by understanding context through NLP, and normalizing this information so that the RPA system can automatically alert the right person to address potential issues."

Invoice Automation: "For invoice processing, RPA can automate data input, reconcile error correction and make binary decisions. But the real challenge is dealing with the many formats different vendors use for their invoices. Using NLP and other machine learning techniques, AI can understand and pull out necessary data from the invoices, normalize it to a structured format, then send it back to the RPA platform for automated data input, error handling, etc."

Financial Document Analysis: "Financial firms compile lots of data for monthly and quarterly reports. RPA assists by automating data collection from various structured sources. However, once you introduce unstructured PDF documents, RPA is generally ineffective. With the OCR and NLP capabilities of an AI solution, relevant information can be automatically pulled out and converted into a structured format so the RPA tool can deal with it."

Insurance Claims: "Insurance companies use RPA to automate some aspects of their claims process, such as inputting data from structured sources and ensuring all required fields are filled out. But insurance claims are full of unstructured data, such as photos showing auto damage, PDFs of drivers' licenses, or CT scans for a healthcare insurance claim.

AI solutions with machine learning can be used to extract relevant information from these sources, once again adding value to the RPA tool." With RPA and AI, you may not even have to write up reports anymore! This is possible with a technology called NLG, or natural-language generation.

"Integrating this extends the reach and impact of automation by instantly producing expertly written reports from structured data sets in the form of natural language narratives that are indistinguishable from those authored by business analysts or knowledge workers," said Sharon Daniels, who is the CEO of Arria.

Privacy and Ethics

Governments are getting more aggressive in dealing with regulating the use of data, especially as AI becomes a more powerful force. Europe has enacted the wide-ranging GDPR law and California has introduced the CCPA (California Consumer Privacy Act). These will likely be a framework for new laws in other countries and states.

As RPA gets more sophisticated and goes beyond rules-based approaches, companies will certainly need to be mindful of the new laws – but also be aware of the ethical minefields. A breach can definitely have a deleterious impact on a company, in terms of potential fines and reputational damage.

"The general scope of data privacy laws is to give consumers the right to know how and what type of personally identifiable information (PII) is collected, and the option to take legal action in the event that they should incur damages from bias or data security breaches," said Zachary Jarvinen, who is the Head of Technology Strategy, AI and Analytics at OpenText.

"Until now, most organizations have focused their efforts on structured information, but they must also be able to understand what PII is located in textual data documents. Archived data, in particular, is an especially pressing concern for most enterprises. AI-powered solutions will be instrumental in locating sensitive data and managing it through automated workflows.

Organizations will also need to establish internal data governance practices to determine who is accountable for data security and enterprise-wide policy, which may include creating teams that blend technical and regulatory expertise." There should also be steps taken to help deal with the inevitable bias in the data.

To this end, models need to make sure the datasets have been cleaned up and are diverse, in terms of backgrounds and characteristics. Next, companies will need to achieve explainability with the models. Black boxes will ultimately lead to distrust with the outcomes.

Note

Research from DataRobot shows that 59% of companies say they will invest in more sophisticated white box systems (to allow for more explainability), 54% said they will hire internal personnel to manage AI trust, and 48% will use third-party vendors for AI trust.

Finally, there may be more use of metadata. "This type of information lends itself well to data privacy, and with the correct machine learning and artificial intelligence modeling, can still provide critical information to the C-suite such as lead generation changes, third-party data access, potential breaches and more," said Steve Wood, who is the chief product officer at Boomi.

Conclusion

As AI accelerates, the results should be even better for RPA. We will also see more startups trailbalize new approaches. Just take a look Aisera, which has developed "Conversational RPA." This involves a human-like dialogue interface for business users, providing similar consumer-like application experiences like those of WhatsApp, Instagram, and Snapchat.

Conversational AI makes RPA more accessible and extends its reach to a wider audience, unlocking the power of RPA. In other words, the future certainly looks promising. According to Guy Kirkwood, the chief evangelist at UiPath: "RPA will be the repository for automation.

RPA is going to claim its place as a central platform for other enterprise automation tools. Basically, RPA will become the repository for automation in the same way that YouTube is a repository for video content. The centrality of RPA will run parallel with the development of automation code that is more useful and reusable, enabling it to spread even further than it previously has."