1. RPA Foundations

What the Technology Can Do

RPA (Robotic Process Automation) has become one of the hottest categories for venture capital investment. In November 2018, Automation Anywhere announced that the Softbank Vision Fund invested $300 million in the start-up.1 But it was not the only amount.

In April 2019, UiPath announced it raised $568 million for its Series B round, with tier-one investors like Coatue, Wellington, CapitalG, Accel, and Sequoia.

In only about two years, UiPath had seen an explosion in growth:

The valuation went from $110 million to $7 billion.

The annual recurring revenues surged from $8 million to $200 million.

The employee base jumped by 16X to 2,500.

There was also the launch of six new releases of the UiPath Enterprise RPA platform.

The CEO and cofounder of UiPath , Daniel Dines, said: "We are at the tipping point. Business leaders everywhere are augmenting their workforces with software robots, rapidly accelerating the digital transformation of their entire business and freeing employees to spend time on more impactful work. UiPath is leading this workforce revolution, driven by our core determination to democratize RPA and deliver on our vision of a robot helping every person. I am humbled by the amazing support our customers, partners and investors give us every day, inspiring us to work harder to evolve RPA as the platform that not only unlocks the true potential of AI, but also other emerging technologies. We are just getting started."

What Is RPA?

RPA can be a slippery term. The word "robotic" does not refer to a physical robot – instead, it is about a software-based robot (or bot) that can automate human actions in the workplace (generally for white collar applications in clerical and administrative functions).

A bot can be delivered via the cloud or through downloadable software. Even the word "process" is not particularly descriptive either. A better alternative would be "tasks," which are individual action items that are a part of a process.

OK, then what really is RPA? Well, in a nutshell, RPA involves bots that perform a set of specified actions or tasks, such as the following:

- The cut-and-paste of information from one app to another
- The opening of a web site and login
- The opening of an e-mail and attachments
- The read/write of a database
- The extraction of content from forms or documents
- The use of calculations and workflows
- Such things may sound kind of mundane, boring, and simplistic.

RPA is focused on those tasks that are really a waste of efforts for workers.

Various RPA software companies view the concept.

UiPath : "Robotic Process Automation is the technology that allows anyone today to configure computer software, or a 'robot' to emulate and integrate the actions of a human interacting within digital systems to execute a business

process. RPA robots utilize the user interface to capture data and manipulate applications just like humans do. They interpret, trigger responses and communicate with other systems in order to perform on a vast variety of repetitive tasks. Only substantially better: an RPA software robot never sleeps, makes zero mistakes and costs a lot less than an employee."

Automation Anywhere: "RPA is really as simple – and powerful – as it sounds. Robotic Process Automation enables you with tools to create your own software robots to automate any business process. Your 'bots' are configurable software set up to perform the tasks you assign and control."

PEGA: "Robotic process automation (RPA) can be a fast, low-risk starting point for automating processes that rely on outdated legacy systems. Bots can pull data from manual systems without APIs into digital processes, ensuring faster and more efficient outcomes."

Kryon Systems : "Robotic Process Automation enables enterprises to create true virtual workforces that drive business agility and efficiency. A virtual workforce, comprised of software robots that can execute business tasks on enterprise applications, becomes an integral part of an enterprise's greater workforce. It is managed just as any other team in the organization and can interact with people just as other employees would interact with one another. Virtual workers (robots) complete business processes, just as a person would, but in less time, with greater accuracy and at a fraction of the cost".

Difference with RPA vs. other forms of automation (like an Excel macro)

1. A macro is only for a particular application. But with RPA, the system can be used for just about anything, whether on a PC or even a mainframe.
2. RPA can record a person's actions to help create the automation. Some systems will even use sophisticated technologies like AI (Artificial Intelligence) to help with this.
3. RPA platform will become a valuable repository of knowledge about how work is done in an organization. This can provide insights on how to improve workflows and processes, which could drive even further efficiency.

Flavors of RPA

There are different types of RPA approaches. On a high level, you can divide the flavors into the following:

1. **Attended RPA** (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.

    A prime 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** : 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, 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** (referred to as cognitive RPA): This is the latest generation of RPA technology, which leverages AI to allow the system to learn over time (an example would be the interpretation of documents, such as invoices). Because of this, there may be even less human intervention since the RPA software will use its own insights and judgements to make decisions.

History of RPA

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.

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. Because of this, an employee may have to use multiple applications in their daily activities that could involve wasteful tasks like moving data from one to the other.

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.

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:

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.

"The evolution of the RPA market is like any major technology trend," said Mihir Shukla, who is the CEO and cofounder of Automation Anywhere.

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 2019.9

Here are some other metrics to note:

> - By 2020, RPA along with AI will reduce the business shared-service centers by 65% (Gartner). There will also be adoption by 40% of large enterprises, compared to 10% in 2019.
> - Based on current projections, there will likely be saturation in the RPA market by 2023 (Deloitte).
> - The financial impact from RPA could hit $6.7 trillion by 2025 (McKinsey & Company).
> - In terms of the global market share for RPA software, North America represents 51% and Western Europe is at 23%. But Asia is starting to get traction, especially Japan.
> - By 2023, the forecast is that there will be $12 billion in spending on RPA services (Forrester).

The Benefits of RPA

When it comes to RPA, the most talked about benefit is the **ROI.**

Here's another perspective from consulting firm, A.T. Kearney: "On average, a software robot costs one-third as much as an offshore employee and one-fifth as much as onshore staff. Barclays Bank attributes savings worth the equivalent of roughly 120 full-time employees and an annual reduction in bad debt provisions of $250 million.

Telefónica O2, which uses more than 160 robots to automate 15 core processes and nearly 500,000 transactions per month, says that its return on investment in robotic process automation has exceeded 650 percent."

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: RPA generally does not involve an onerous implementation and integration. RPA is easy for a person to use since there is no requirement for understanding complex coding. As a result, there is not as much reliance on the IT department for support, which is certainly a win–win, or a need for heavy training.

Compliance: You can easily configure a bot to make sure the actions are compliant with regulatory requirements

Another compliance benefit is that there will be **less intervention with the data from people**, which lessens the possibility of fraud. What's more, RPA provides a strong audit trail to allow for better tracking and monitoring.

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.

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.

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.

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 is common to retain third-party consultants to help with the implementation process.

Technical Debt: This describes software that is not a comprehensive solution that ultimately requires ongoing reworking, updates, and changes. And yes, 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 : This is when RPA is pervasive across the whole organization. While this can result in major benefits, there are also potential land mines. 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. Actually as RPA gets more pervasive in manufacturing, there may even be risks of property damage and bodily harm.

Expectations: With the hype at feverish levels for RPA (it's a top headline grabber for many business and technology publications), this could easily lead to disappointment. 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.24

Preparation: You need to do a deep dive in how your current tasks work. If not, you may be automating bad approaches! In the next chapter, we'll take a look at the best practices for avoiding this problem.

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 like Citrix. Yet this can make an RPA system fail. How? The reason is that it cannot capture the text on the screen. However, some of the latest RPA offerings, such as from UiPath, are solving the problem.

RPA Compared to BPO, BPM, and BPA

In the discussion about RPA, you may hear terms like business process management (BPM), business process outsourcing (BPO), and business process automation (BPA). They can get kind of confusing but they have key distinctions.

Here's a look:

BPM: With the intense competition from Japan during the 1970s and 1980s, US companies were desperately seeking new and innovative approaches to improve their efficiency and competitiveness. Part of this meant adopting different management approaches, such as Six Sigma (this includes a combination of project management and statistical techniques), lean production (which is based on the manufacturing principles of Toyota), and total quality management or TQM (a blend of Six Sigma and lean production).

All of this would converge into a major wave called BPM.

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.

Here's how a blog from UiPath describes things: "Consider this analogy to self-driving cars: a BPM approach would require us to rip up all paved roads and install infrastructure for the new cars to move about on their own, while an RPA approach seeks to operate a pre-existing car just as a human would. Google has come at the problem from an RPA angle, because replacing all roads (especially in the U.S.) is just unfathomable.

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).

One of the big attractions of BPO is the benefit of lower wage rates in other countries. The employee bases will also often be educated and multilingual.

But there are certainly other major advantages. For example, a company does not have to waste its attention on noncore functions. In fact, by outsourcing various areas of a company, there is the benefit of having a specialist provide the service, which should mean getting better results.

Generally speaking, a BPO will have three types of strategies:

1. Offshore: This is where the employees are in another country, usually far away.
2. 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.
3. 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.

> ➢ **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.

Now as for RPA, what is the connection then with BPO? RPA is automating BPO-type activities. Based on studies from firms like Everest Group, KPMG, and Deloitte, the cost advantages of RPA over outsourcing can be as much as 70%.27 This may mean there will be less outsourcing in the coming years. Yet BPO companies have been adapting to this.

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.

RPA is really about automating a part of the process, whereas BPA will take on all the steps.

Consumer Willingness for Automation

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 the years 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."

The Workforce of the Future

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. Yet this may not be enough to make up for the shortfall. The Forrester study, for example, forecasts that there will be replacement of 16% of US jobs and the creation of 9% of new ones.

Or look at the research from McKinsey & Company. Its analysis shows that technologies like RPA could automate a whopping 45% of the activities of a company's workforce.

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.

2. RPA Skills

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.

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.

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. All in all, it means that the IT department may be spending valuable time on noncore activities. 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.

Because of all this, companies have been looking at another approach – that is, cloud computing.

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. According to a report from Gartner, the market for public cloud services is forecasted to jump from $214.3 billion in 2019 to $331.2 in 2022.

Here's what Gartner's vice president of research had to say: "Cloud services are definitely shaking up the industry. At Gartner, we know of no vendor or service provider today whose business model offerings and revenue growth are not influenced by the increasing adoption of cloud-first strategies in organizations. What we see now is only the beginning, though. Through 2022, Gartner projects the market size and growth of the cloud services industry at nearly three time the growth of overall IT services."

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.

With AWS, other mega tech firms were caught off guard and scrambled to develop their own cloud platforms. The two most common ones include Microsoft's Azure and Google Cloud. In fact, many companies often use two or more of these in order to provide for redundancy (this is known as a multi-cloud strategy).

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. He accomplished this in 1990. Although, it would not be until the mid-1990s, with the launch of the Netscape browser, that the Internet revolution was ignited.

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 Yes, this means that the text is bold.

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).

No doubt, 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.

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: a document scanner (which could even be something like your smartphone) and 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

Because of all this, OCR in the early years was far from accurate. But over time, with the advances in AI algorithms, fuzzy logic, and more powerful hardware, the technology has seen great strides in accuracy rates, which can be close to 100%.

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. 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.

Finally, even though RPA systems may have their own OCR, this may not necessarily be enough. Some industries and segments, such as healthcare, insurance, government and banking, still rely heavily on handwritten forms – all of which can be time-consuming and costly.

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).

The dominant form is the relational database – developed in 1970 by IBM researcher E. F. Codd – that uses structured data. 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. Then came a smattering of start-ups to seize the opportunity. But by the late 1980s, Oracle and SAP dominated the market for the enterprise (Microsoft would essentially be the standard for the mid-market).

While relational databases proved to be quite effective, there were still some nagging issues. Perhaps the biggest was data sprawl. This describes when there is a growing number of tables that get proliferated across the organization. This often makes it extremely difficult to centralize the data, which can make it challenging to get a holistic view.

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.

Given all this, there emerged various alternatives to relational databases. For example, there was the data warehouse that started as an open source project in the late 1990s from Doug Cutting. The technology would undergo various iterations, resulting in the development of Hadoop. Initially, Yahoo! used this to handle the Big Data demands from its massive digital platforms. Then other major companies, like Facebook and Twitter, adopted Hadoop. The key was that a data warehouse could make it possible to get a 360 degree view of data.

Companies like Google, Amazon.com, and Microsoft have been investing heavily in data warehouse systems. New approaches that have gone against the model for relational databases. MySQL (which is now owned by Oracle) and PostgreSQL.

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.

Another major secular trend is the transition of databases to the cloud.

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. Yet there are some things to keep in mind:

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).

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.

What is AI? : It's software that ingests large amounts of data that is processed with sophisticated algorithms that help answer questions, detect patterns, or learn. AI is actually made up of a variety of subcategories (Figure 2-1).

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 : While the roots of this go back to the 1960s, the technology was mostly an academic pursuit. It wasn't until about a decade ago that 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).
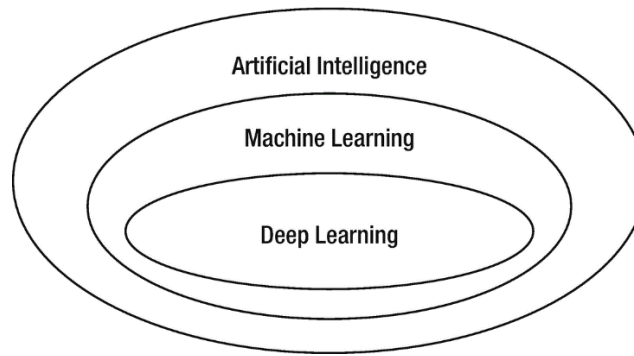
Figure 2-1:This is a high-level look at the key components of the AI world

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." A real-world example of this is Amazon.com, which built a recruiting system for hiring programmers. In other words, AI turned out to be the wrong approach.

➢ **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 about finding correlations in data not causation – and this is a major limiting factor.

➢ **Common Sense:** 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.

➢ **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:** So far, deep learning has been mostly useful with constrained environments, such as with board games. There is a defined set of dimensions, objects, and rules – the kinds of things that computers work well with. 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 trillions of synapses. And it only needs 50 watts a day to run! Modern computers can come nowhere matching this power. So if AI is to truly achieve real intelligence, there will need to be some dramatic breakthroughs.

There are two main types of data:

➢ **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, e-mails, and audio files).

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. But AI would be able to learn from the invoices and come up with its own rules and tasks.

Furthermore, there are other potential benefits of the technology: judgement, the use of reasoning, and the detection of highly complex patterns.

Cognitive Automation

Consider cognitive automation to be an application of AI, actually. First of all, it is mostly focused on automation of the workplace or processes in business. Next, cognitive 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 analyzing 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

Software development can be quite complex. Besides the technical aspects, there is a need to manage a team whose members may be located in different countries. In the meantime, technologies continue to evolve. What's often even harder is maintaining a software system as there is usually a need to add capabilities and upgrade the underlying technologies.

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. Therefore it's important to look at software management approaches.

One is called Agile, which was created back in the 1990s. 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. "Over the past few years, my volume of e-mail has declined substantially," said Tim Tully, who is the chief technology officer at Splunk. "The main reason is that I mostly use Slack with my developer teams."

Here are some other code development approaches:

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 about following 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.

Note: Grand View Research predicts that the global market for DevOps will reach $12.85 billion by 2025. This would represent an 18.60% compound annual growth rate.13

Flowcharts

An essential part of RPA is understanding workflows and systems, the use of flowcharts is common. 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.

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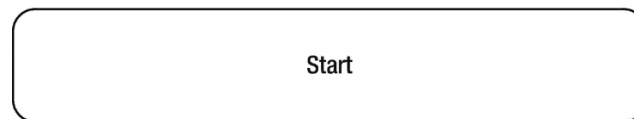
Start

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:
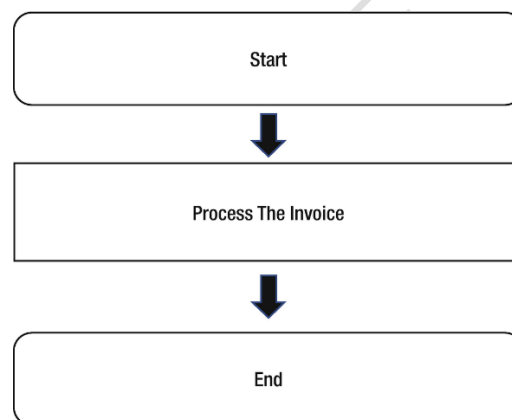
Start

Process The Invoice

End

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:
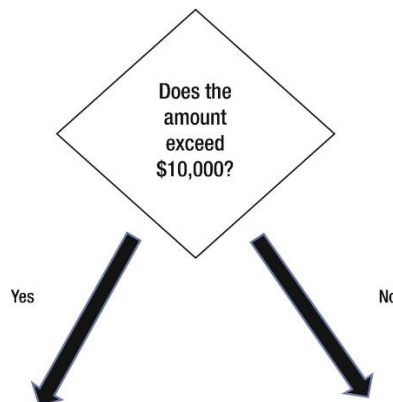
Does the amount exceed $10,000?

Yes   No

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