EXPLAINED
WHAT IS AI EXACTLY?

Accenture Applied Intelligence

So you've heard all about AI, and you know it's a big deal. But what is it exactly? Answering that question isn't as straightforward as it might seem. In fact, there's no single accepted definition of "artificial intelligence". And that's because AI as we know it isn't really a technology in its own right at all.

In reality, it's a collection of different technologies that can be brought together to enable machines to act with what appears to be human-like levels of intelligence.

Rather than add to the growing list of attemps to definitely describe AI, we prefer to think of the technology as a framework of capabilities. This is undoubtedly the best way to understand what AI is, and to get a sense of the technologies that underlie it. Our framework is centred around the **principal things that AI enables a machine to do**.

There are four:

SENSE. AI lets a machine perceive the world around it by acquiring and processing images, sounds, speech, text, and other data.

COMPREHEND. AI enables a machine to understand the information it collects by recognising patterns. Much as humans interpret information by understanding the patterns presented and their context, though it does not derive true “meaning”.

ACT. AI enables a machine to take actions in the physical or digital world based on that comprehension.

LEARN. AI enables a machine to continuously optimise its performance by learning from the success or failure of those actions.

WHAT'S IN A NAME?
COGNITIVE COMPUTING AND AI

Cognitive computing is a term widely used by AI practitioners. So what is it? And how is it different from AI? Unfortunately, just as AI has not widely accepted definition, cognitive computing can mean different things to different people. That said, "cognitive" in this sense can, for the most part, be treated as referring to an AI's perceptive capabilities – an AI's ability to sense and comprehend its environment.

The power of machine learning

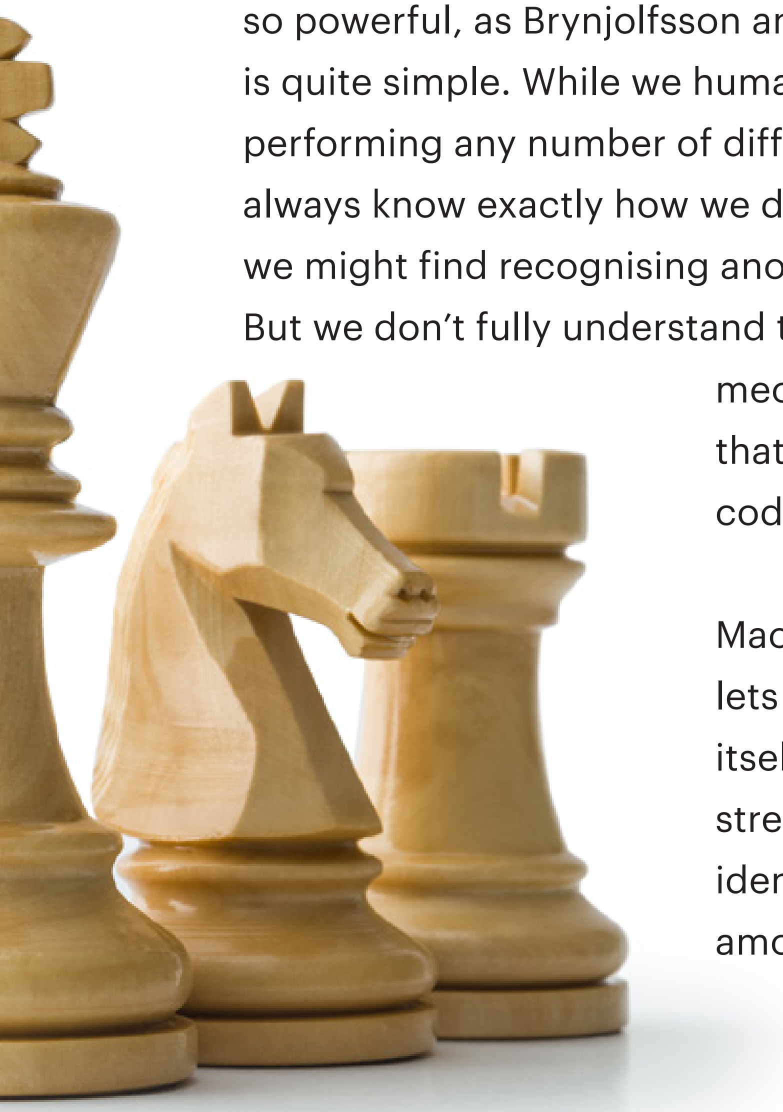
An AI's ability to learn is fundamental. Indeed, being able to decide which actions are required to complete a task by analysing data, rather than being explicitly coded to act in a pre-defined way, is arguably what makes a system "intelligent" and differentiates AI from other forms of automation.

And when the best AI systems are set the task of learning for themselves, the results can be extraordinary. AlphaGo, the AI developed by Google DeepMind, became the first computer program to defeat a professional human player at the highly-complex board game Go.[1] AlphaGo was taught the rules of play, and then shown thousands of different human vs. human games so that it could discern the winning strategies by itself. The result: victory over the legendary world Go champion, Lee Sedol.

But even that wasn't the end of DeepMind's Go success. The company subsequently developed a second, even more powerful, version of AlphaGo - AlphaGo Zero[2], which taught itself winning strategies **simply by playing games against itself** – with no need to observe human players at all. Moreover, the latest iteration of the AI, AlphaZero, has gone even further. AlphaZero proved it could learn chess

by playing games against itself, surpassing human levels of skill in just four hours. The really interesting part of this feat was that AlphaZero wasn't specifically designed to play chess at all. Indeed, Jonathan Schaeffer[3], professor of computer science at the University of Alberta, and an expert in chess systems, believes this may be the very reason it has been able to develop unconventional strategies for winning. In this way, AlphaZero represents an important step away from narrow AI towards general AI.

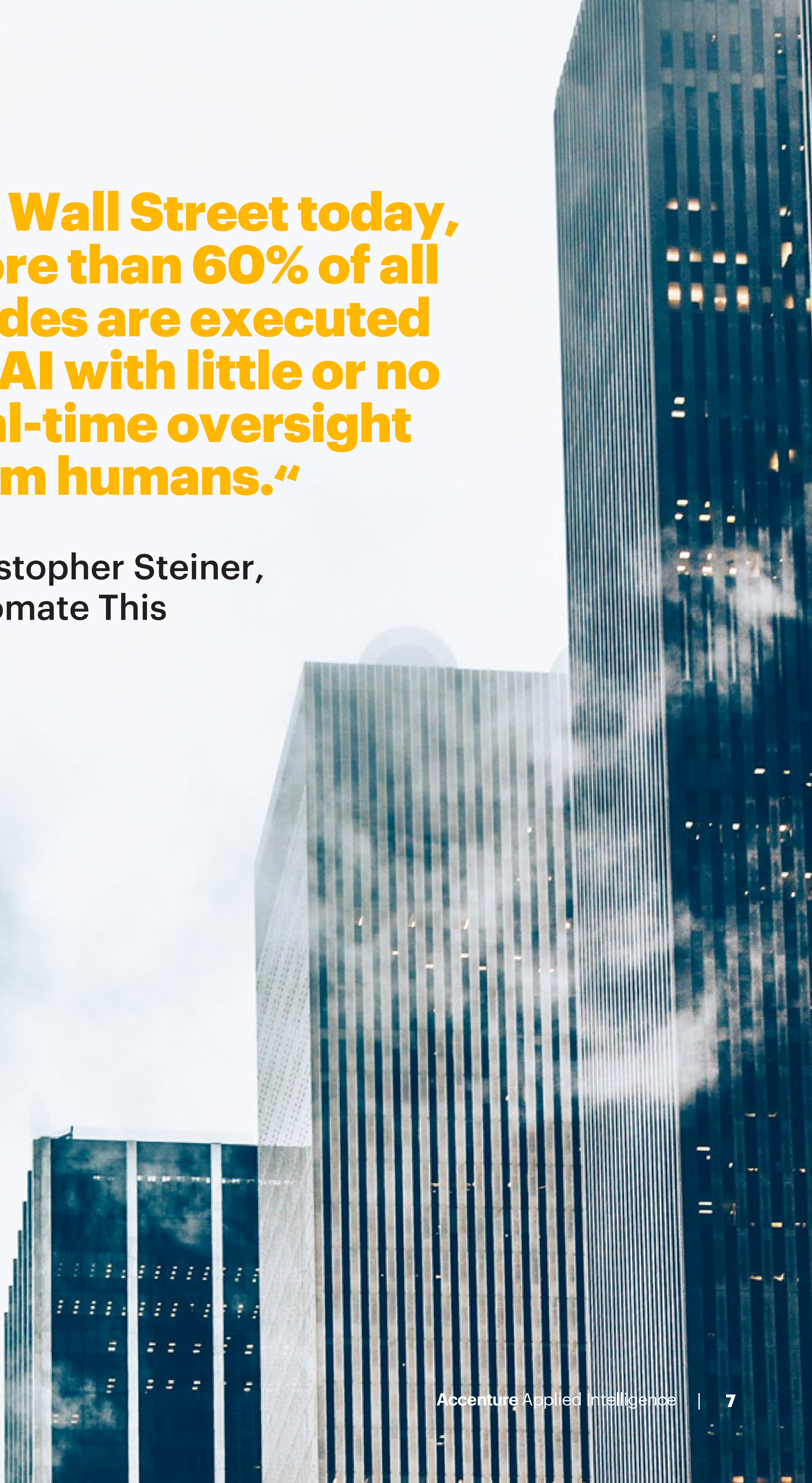
This is what we call **machine learning**. And the reason it's so powerful, as Brynjolfsson and McAfee have observed[4], is quite simple. While we humans are fantastically skilled at performing any number of different activities, we don't always know exactly how we do what we do. So, for example, we might find recognising another person's face very easy. But we don't fully understand the precise physiological mechanisms that let it happen. And that makes it very difficult to directly code the capability into a machine.



Machine learning, on the other hand, lets a machine learn to do it all by itself. Indeed, one of the core strengths of machine learning is identifying patterns in very large amounts of data.

"On Wall Street today, more than 60% of all trades are executed by AI with little or no real-time oversight from humans."

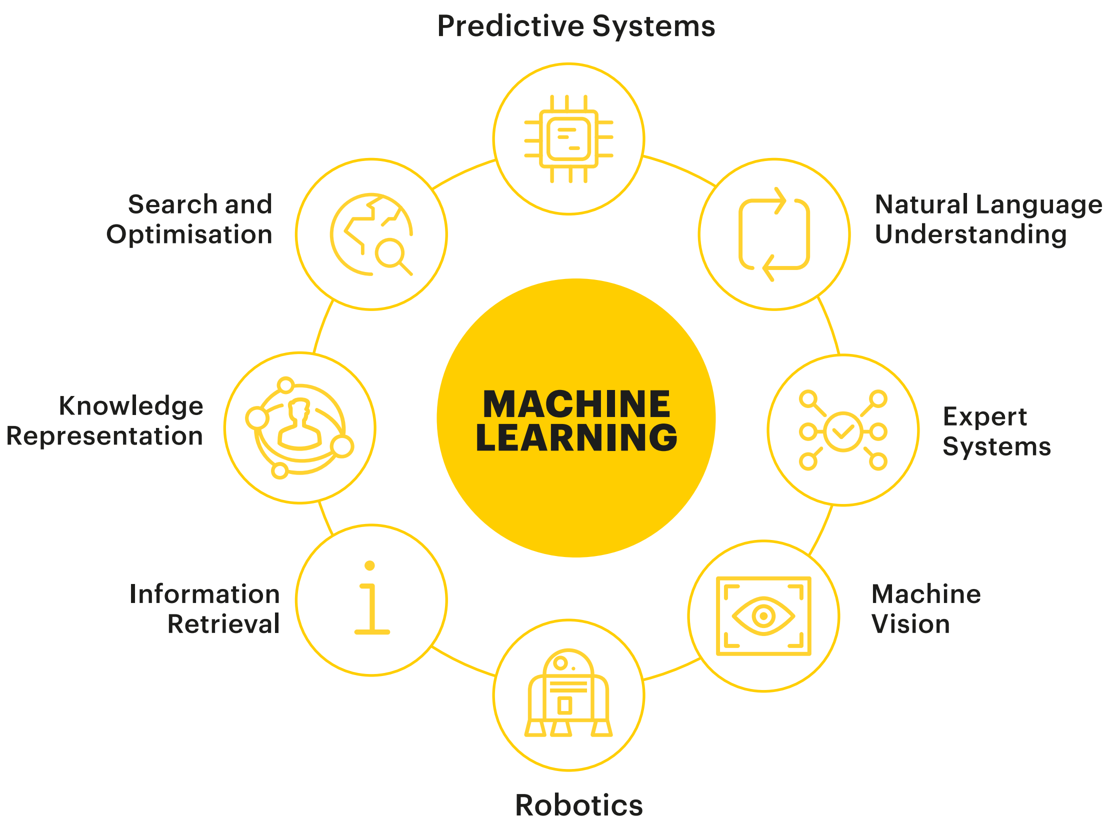
Christopher Steiner,
Automate This



A constellation of technologies

Machine learning lies at the core of AI systems. Its capability to learn from raw data powers the visible manifestations of AI that are becoming ever more prevalent today. So, whether it's predictive systems that can forecast what's likely to happen, natural language processing that can comprehend speech and text in close to real time, machine vision that can understand visual inputs with extraordinary accuracy, or optimising search and information retrieval, it's all based on machine learning.

Figure 1 - Machine learning capabilities



One critical advantage machine learning has over other techniques is its tolerance of "dirty" data. That is, data containing duplicate records, badly parsed fields, or incomplete, incorrect, or outdated information. These issues are a significant problem for businesses: most executives will recognise all too well that dealing with dirty data can be the bane of their professional lives.

Machine learning's flexibility – it's ability to learn and improve over time – means dirty data can be processed with far greater accuracy. It also means that the technology scales very well, something that becomes ever more important in our current age exploding data volumes.

More than 85% of customer interactions will be managed without a human by 2020.[5]

Gartner

The different ways a machine can learn

One of the real strengths of machine learning is that there are different types of learning algorithms which can be used, including supervised, unsupervised, and reinforcement.

SUPERVISED LEARNING. This kind of algorithm takes a labelled data set (data that has been organised and described), deduces the salient features that characterise each label, and learns to recognise those features in new data. So, for example, you might show the algorithm a large number of labelled images of cats, and it would then learn how to recognise a cat and spot one in any number of other, completely different pictures.

UNSUPERVISED LEARNING. This kind of algorithm requires no predefined labels in the data it uses. It takes an unlabelled data set, finds similarities and anomalies between different entries within that data set, and categorises them into its own groupings. So, you might show the algorithm a large number of unlabelled images containing, say, cats and dogs, and it would sort images with similar characteristics into different groups without knowing that one contained "cats" and the other "dogs".

REINFORCEMENT LEARNING. This kind of algorithm works by trial and error, using a feedback loop of "rewards" and "punishments". So, when the algorithm is fed a data set, it treats the environment like a game, and is told whether it has won or lost each time it performs an action. This way, it builds up a picture of the "moves" that result in success, and those that don't. DeepMind's AlphaGo and AlphaZero are good examples of the power of reinforcement learning.

Figure 2 - Puppy or bagel?

PUPPY OR BAGEL?

How hard is it to tell an animal from an item of food? Sometimes, much more difficult than you might think. One of the big trends storming the internet is all about the odd similarities between certain pets and snacks. Take the puppies and bagels in the image opposite, for instance. At first glance, it can be surprisingly challenging for a human to tell which is which. Not so for an AI. Pass the images through an image recognition API and you'll find the AI can distinguish the food from the pets with impressive accuracy.[6]

The artificial brain

So, how does machine learning actually work? Sitting behind many of the extraordinary advances in recent years lies a very advanced and elegant form of computing system – one inspired by the functioning of the animal brain itself. These systems are called **neural networks**, and they underpin much of today's cutting-edge work in AI.

A neural network comprises an interconnected set of "nodes" which mimic the network of neurons in a biological brain. Each node receives an input, changes its internal state, and produces an output accordingly. That output then forms the input for other nodes, and so on. This complex arrangement enables a very powerful form of computing called deep learning.

Deep learning uses multiple layers of filters to learn about the significant features of data in a data set. It's used for examples, in both image and speech recognition. Using a neural network, the output of each filter provides the input for the next, where each filter operates at a different level of abstraction.

In this way, deep learning systems can handle much larger data sets than alternative approaches.

Facial recognition

Deep learning neural networks use layers of increasingly complex rules to categorise complicated shapes such as faces.[7]

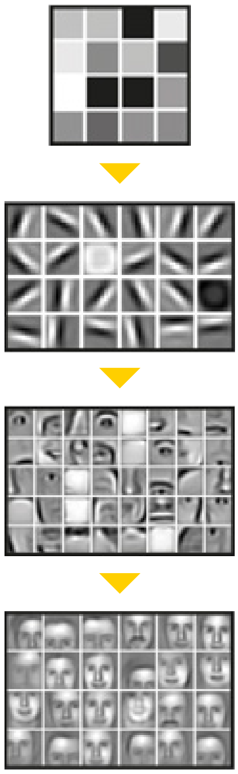
Figure 3 - How a neural network recognises objects

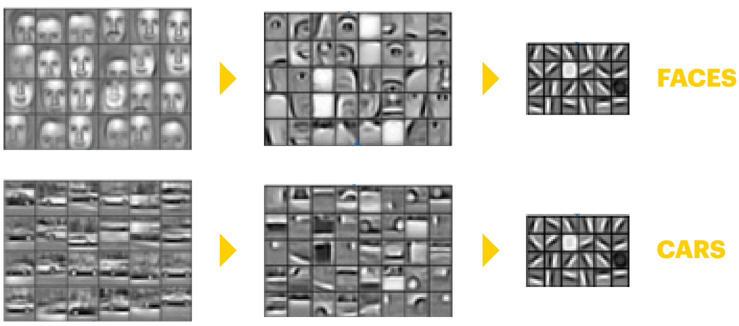
LAYER 1
The computer identifies pixels of light and dark.

LAYER 2
The computer learns to identify edges and simple shapes.

LAYER 3
The computer learns to identify more complex shapes and objects.

LAYER 4
The computer learns which shapes and objects can be used to define a human face.





WHAT KIND OF INTELLIGENCE ARE WE TALKING ABOUT?

When data scientists and others talk about AI, they often use two categorisations to clarify their meaning. These are **narrow AI vs. general AI and weak AI vs. strong AI.**

WEAK AI

This describes "simulated" thinking. That is, a system which appears to behave intelligently, but doesn't have any kind of consciousness about what it's going. For example, a chatbot might appear to hold a natural conversation, but it has no sense of who it is or why it's talking to you.

NARROW AI

This describes an AI that is limited to a single task or a set number of tasks. For example, the capabilities of IBM's Deep Blue, the chess-playing computer that beat world champion Gary Kasparov in 1997, were limited to playing chess. It wouldn't have been able to win a game of tic-tac-toe – or even know how to play.

STRONG AI

This describes "actual" thinking. That is, behaving intelligently, thinking as a human does, with a conscious, subjective mind. For example, when two humans converse, they most likely know exactly who they are, what they're doing, and why.

GENERAL AI

This describes an AI which can be used to complete a wide range of tasks in a wide range of environments. As such, it's much closer to human intelligence. Google DeepMind used reinforcement learning to develop an AI that learned to play a whole range of different games requiring different skills. The AI achieved human-like levels of performance at 29 classic Atari video games using only the on-screen pixels as its data input.[8]

SUPERINTELLIGENCE

The term "superintelligence" is often used to refer to general and strong AI at the point at which it surpasses human intelligence, if it ever does.

“Instead of trying to produce a programme to simulate the adult mind, why not rather try to produce one which simulates the child’s? If this were then subjected to an appropriate course of education one would obtain the adult brain.“

Alan Turing, 1950

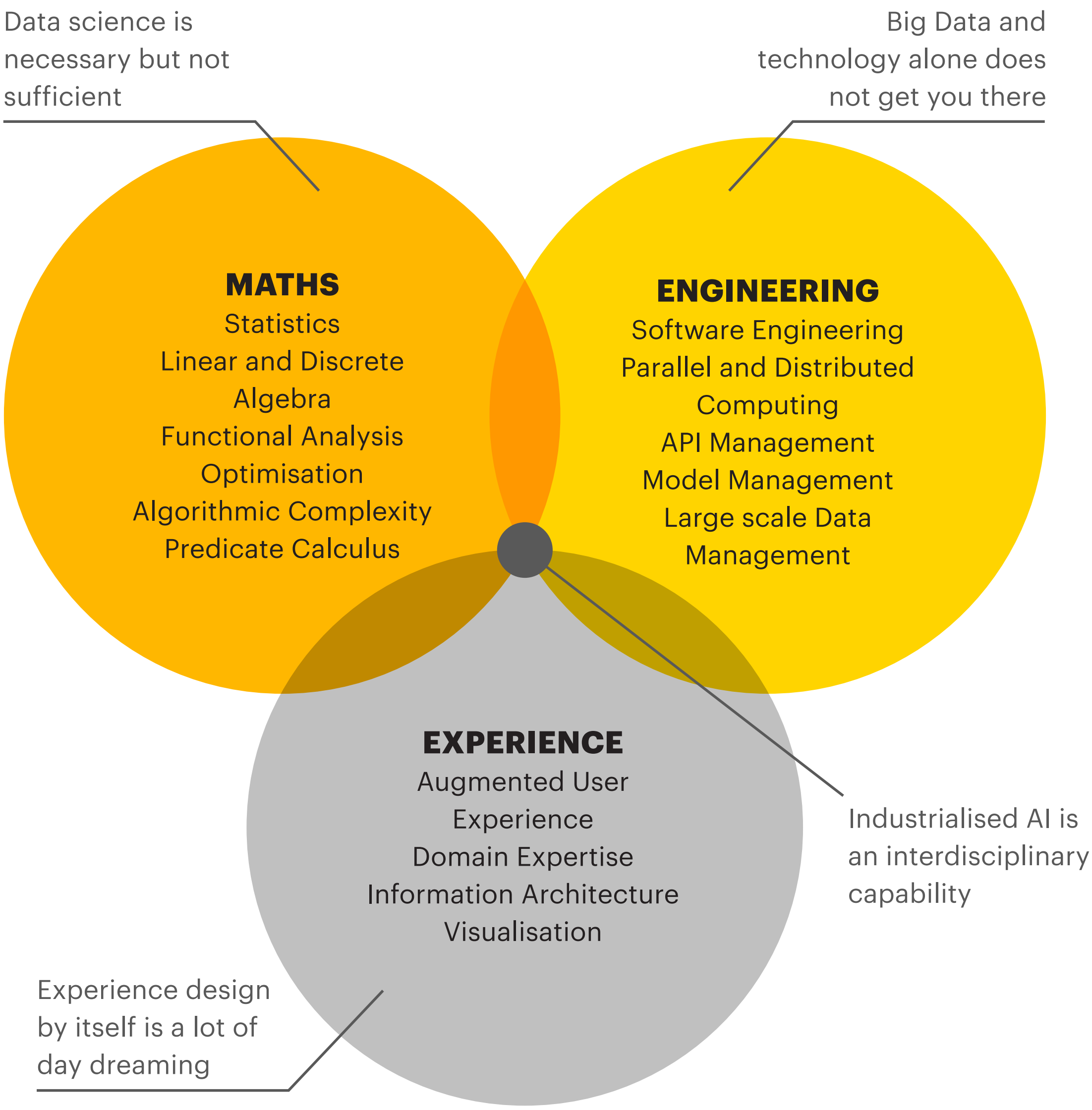
Time to train

The “learning” part of a machine learning process is, perhaps unsurprisingly, critical to the whole concept. Much as a human brain must learn throughout childhood to understand and process the information it receives, so must a machine learning algorithm or model be trained to comprehend its environment.

When companies get the training wrong, the results can be embarrassing – or worse. Microsoft’s now infamous chatbot Tay[9] was an experiment in machine learning through social media interactions. The AI was designed to learn to hold a natural-sounding conversation by speaking with other Twitter users. But she had to be quickly decommissioned when a collection of trolls and racially biased comments capitalised on her lack of filters and taught her a series of racial slurs and white-supremacist propaganda. Microsoft’s experience starkly highlights the need for strong governance and controls in deploying AI systems.

Getting the training right takes more than just advanced maths. Industrialised machine learning is an interdisciplinary capability. It takes a blend of data science, engineering, and user experience design with **relevant domain knowledge**. None of these capabilities on their own will suffice.

Figure 4 - Industrialised AI as an interdisciplinary capability



Fitting analytics into the picture

So where does analytics fit into all this? Perhaps the question should be: how does AI fit into analytics? If we think of analytics as the field of analysing data to improve decision making, we can see how machine learning, along with other statistical analyses, plugs in to the process. After all, the goal of analytics is to derive insights from data – which is much the same as the goal of machine learning.

Analytics, and any machine learning algorithms that support it, can have different levels of sophistication depending on the degree of insight required. So, at the simpler end of the scale are so-called "descriptive analytics" which analyse historical data to understand what happened and why. Then come "predictive analytics" which use data to predict what will happen in the future. Finally, at the far end of the scale, come "prescriptive analytics" which not only forecast what will happen, but tell you what you need to do about it.

By 2020, insights-driven businesses will take $1.2 trillion per annum from their less-informed peers.[10]

Forrester

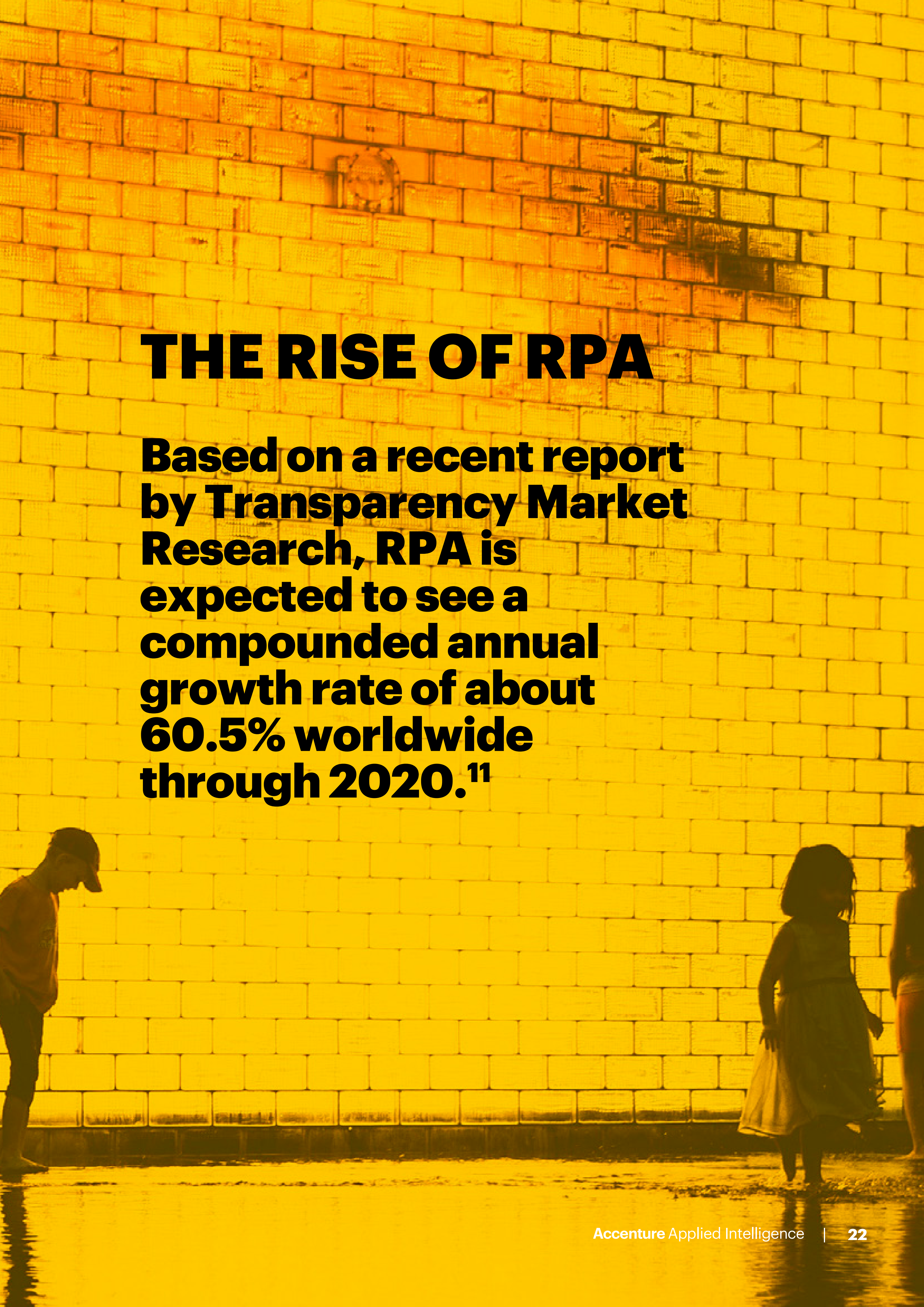
AI, robot

When it comes to thinking about AI, robots and robotics are often front of mind. In the public imagination, that can mean anything from Kubrick’s HAL, to Asimov’s mechanical men, to Honda’s Asimo.

In a business context, it can mean both the automation of manufacturing or service processes using mechanical robots – think car assembly lines – and, increasingly, the automation of administrative or service processes comprising both digital and manual inputs using Robotic Process Automation (RPA).

Strictly speaking, because RPA is designed for processes that never vary it doesn’t require any “intelligence” at all. So, for example, if a business process involves a person manually transferring data in a standard form from one system (for example a piece of paper) to another, the process can be easily automated through RPA with a form of keystroke emulation. Accenture applied RPA to a large manufacturing client’s invoice processing. **The result: a 70% elapsed time saving; a 30% productivity benefit; and 100% accuracy.**

That said, AI techniques are now being increasingly used in the emerging field of “cognitive RPA”. This enables a process with a degree of variation to be automated, and thus vastly increases the scope of RPA. That can include, for example, using machine learning to train a machine to recognise text in an image (known as optical character recognition).



THE RISE OF RPA

Based on a recent report by Transparency Market Research, RPA is expected to see a compounded annual growth rate of about 60.5% worldwide through 2020.[11]

Indeed, we at Accenture often recommend RPA as an ideal starting point for a business that wants to begin an AI journey. That's because successfully using RPA means first acquiring a detailed understanding of the process to be automated. And that's also the first step in designing a broader and more sophisticated AI-powered automated solution. It's also essential in ensuring that existing, sometimes sub-optimal, processes are not simply emulated in digital form, but are re-engineered to exploit AI to the fullest extent possible.

An important point to note: RPA and cognitive RPA do more than simply cut costs. They also bring new levels of consistency and speed to a process, as well as offering 24/7 availability and the capacity to scale the process up and down in line with demand. And it should always be remembered that RPA replaces tasks, not people. Many organisations who use RPA redeploy their workforces to activities that add more value to the business – and are more interesting to boot!

We know this because we've done it ourselves. For all of the 17,000 jobs we've automated at Accenture, we've successfully redeployed our colleagues in other areas of our business. Indeed, a 2017 Gallup survey[12] the US suggested that only 13% of workers are worried about automation eliminating their jobs. Nevertheless, the impact of RPA and AI on the workforce is a sensitive issue which calls for careful management.

“RPA has changed the way we structure and allocate work, allowing us to focus on improvement initiatives... By automating routine tasks, we allow our skilled employees to focus on the more interesting and challenging parts of their jobs, which has the dual benefit of satisfied employees and improved customer experience. Accenture has been with us from the beginning, helping us in the exploratory phases of RPA right through to the implementation.“

Kristian Kjernsmo, Managing Director,
Circle K Business Centre at Circle K Europe

Recommended Reading

The Second Machine Age by Erik Brynjolfsson and Andrew McAfee
Machine, Platform, Crowd by Erik Brynjolfsson and Andrew McAfee
Life 3.0 by Max Tegmark
Human + Machine: Reimagining Work in the Age of AI by Paul Daugherty & James Wilson (forthcoming March 20th, 2018)
Homo Deus by Yuval Noah Harari
The Quest for Artificial Intelligence by Nils Nilsson
The Master Algorithm by Pedro Domingos
The Future of the Mind by Michio Kaku

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