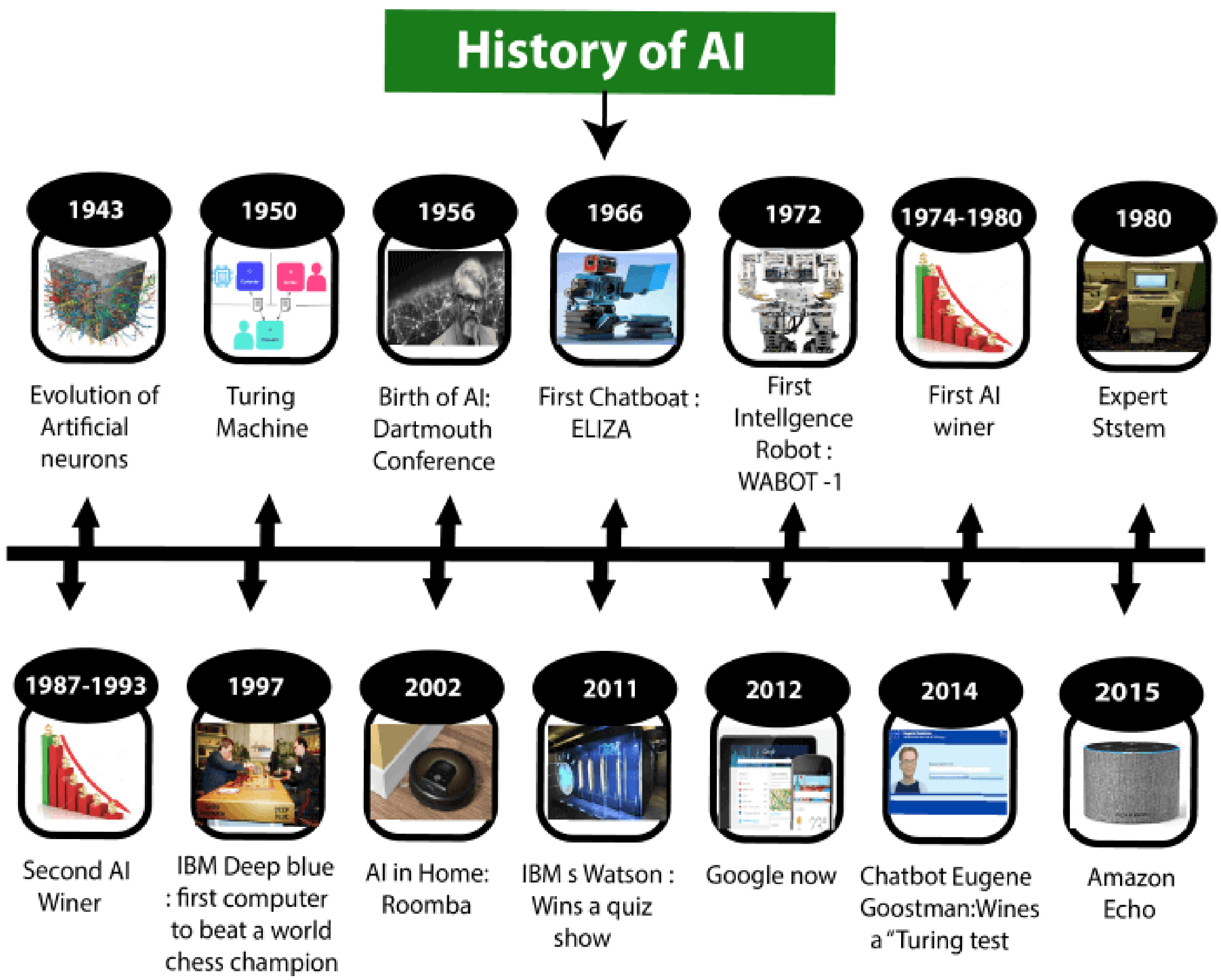
Unit 1 An overview to AI

The evolution of AI to the present

Artificial Intelligence is not a new word and not a new technology for researchers. This technology is much older than you would imagine. Even there are the myths of Mechanical men in Ancient Greek and Egyptian Myths. Following are some milestones in the history of AI which defines the journey from the AI generation to till date development.



Maturation of Artificial Intelligence (1943-1952)

- **Year 1943:** The first work which is now recognized as AI was done by Warren McCulloch and Walter pits in 1943. They proposed a model of **artificial neurons**.
- **Year 1949:** Donald Hebb demonstrated an updating rule for modifying the connection strength between neurons. His rule is now called **Hebbian learning**.
- **Year 1950:** The Alan Turing who was an English mathematician and pioneered Machine learning in 1950. Alan Turing publishes **"Computing Machinery and Intelligence"** in which he proposed a test. The test can check the machine's ability to exhibit intelligent behavior equivalent to human intelligence, called a **Turing test**.

The birth of Artificial Intelligence (1952-1956)

- **Year 1955:** An Allen Newell and Herbert A. Simon created the "first artificial intelligence program"Which was named as **"Logic Theorist"**. This program had proved 38 of 52 Mathematics theorems, and find new and more elegant proofs for some theorems.
- **Year 1956:** The word "Artificial Intelligence" first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. For the first time, AI coined as an academic field.

At that time high-level computer languages such as FORTRAN, LISP, or COBOL were invented. And the enthusiasm for AI was very high at that time.

The golden years-Early enthusiasm (1956-1974)

- **Year 1966:** The researchers emphasized developing algorithms which can solve mathematical problems. Joseph Weizenbaum created the first chatbot in 1966, which was named as ELIZA.
- **Year 1972:** The first intelligent humanoid robot was built in Japan which was named as WABOT-1.

The first AI winter (1974-1980)

- The duration between years 1974 to 1980 was the first AI winter duration. AI winter refers to the time period where computer scientist dealt with a severe shortage of funding from government for AI researches.
- During AI winters, an interest of publicity on artificial intelligence was decreased.

A boom of AI (1980-1987)

- **Year 1980:** After AI winter duration, AI came back with "Expert System". Expert systems were programmed that emulate the decision-making ability of a human expert.
- In the Year 1980, the first national conference of the American Association of Artificial Intelligence **was held at Stanford University**.

The second AI winter (1987-1993)

- The duration between the years 1987 to 1993 was the second AI Winter duration.
- Again, Investors and government stopped in funding for AI research as due to high cost but not efficient result. The expert system such as XCON was very cost effective.

The emergence of intelligent agents (1993-2011)

- **Year 1997:** In the year 1997, IBM Deep Blue beats world chess champion, Gary Kasparov, and became the first computer to beat a world chess champion.
- **Year 2002:** for the first time, AI entered the home in the form of Roomba, a vacuum cleaner.
- **Year 2006:** AI came in the Business world till the year 2006. Companies like Facebook, Twitter, and Netflix also started using AI.

Deep learning, big data and artificial general intelligence (2011-present)

- **Year 2011:** In the year 2011, IBM's Watson won jeopardy, a quiz show, where it had to solve the complex questions as well as riddles. Watson had proved that it could understand natural language and can solve tricky questions quickly.
- **Year 2012:** Google has launched an Android app feature "Google now", which was able to provide information to the user as a prediction.
- **Year 2014:** In the year 2014, Chatbot "Eugene Goostman" won a competition in the infamous "Turing test."
- **Year 2018:** The "Project Debater" from IBM debated on complex topics with two master debaters and also performed extremely well.
- Google has demonstrated an AI program "Duplex" which was a virtual assistant and which had taken hairdresser appointment on call, and lady on other side didn't notice that she was talking with the machine.

Various Approaches to Artificial Intelligence

Cybernetics and brain simulation

In the 1940s and 1950s, a number of researchers explored the connection between neurology, information theory, and cybernetics. Some of them built machines that used electronic networks to exhibit rudimentary intelligence, such as W. Grey Walter's turtles and the Johns Hopkins Beast. Many of these researchers gathered for meetings of the Teleological Society at Princeton University and the Ratio Club in England. By 1960, this approach was largely abandoned. First problem was that building hardware that simulates neurological processes requires a too many components, and it would he physically hard to connect such large number of neurons as human has. Nowadays some scientist are getting also back to this approach.

Symbolic

When access to digital computers became possible in the middle 1950s, AI research began to explore the possibility that human intelligence could be reduced to symbol manipulation. The research was centered in three institutions: Carnegie Mellon University, Stanford and MIT, and each one developed its own style of research. John Haugeland named these approaches to AI "good old-fashioned AI" or "GOFAI". During the 1960s, symbolic approaches had achieved great success at simulating high-level thinking in small demonstration programs. Approaches based on cybernetics or neural networks were abandoned or pushed into the background. Researchers in the 1960s and the 1970s were convinced that symbolic approaches would eventually succeed in creating a machine with artificial general intelligence and considered this the goal of their field.

Sub-symbolic

By the 1980s progress in symbolic AI seemed to stall and many believed that symbolic systems would never be able to imitate all the processes of human cognition, especially perception, robotics, learning and pattern recognition. A number of researchers began to look into "sub-symbolic" approaches to specific AI problems.

Researchers from the related field of robotics, such as Rodney Brooks, rejected symbolic AI and focused on the basic engineering problems that would allow robots to move and survive. Their work revived the non-symbolic viewpoint of the early cybernetics researchers of the 1950s and reintroduced the use of control theory in AI.

Interest in neural networks and “connectionism” was revived by David Rumelhart and others in the middle 1980s. These and other sub-symbolic approaches, such as fuzzy systems and evolutionary computation, are now studied collectively by the emerging discipline of computational intelligence.

Statistical approach to artificial intelligence

In the 1990s, AI researchers developed sophisticated mathematical tools to solve specific subproblems. These tools are truly scientific, in the sense that their results are both measurable and verifiable, and they have been responsible for many of AI’s recent successes. The shared mathematical language has also permitted a high level of collaboration with more established fields (like mathematics, economics or operations research). Stuart Russell and Peter Norvig describe this movement as nothing less than a “revolution” and “the victory of the neats.” Critics argue that these techniques are too focused on particular problems and have failed to address the long-term goal of general intelligence.

What should all engineers know about AI?

Engineers can profit from the revolution in AI research that is changing the ground rules of the profession. AI expert and consultant William Taylor provides a practical explanation of the parts of AI research that are ready for use by anyone with an engineering degree and that can help engineers do their jobs better.Taylor tours the field of artificial intelligence in a highly readable and engaging manner, outlining in detail how engineers can work with AI. In separate chapters he discusses the three basic programming styles - function-based programming, object-oriented programming, and rulebased programming - as well as the use of Lisp and Prolog. He concludes by offering several suggestions for getting started in the field. As Taylor defines it, AI is a programming style that has much in common with engineering practice: programs operate on data according to rules in order to accomplish goals. While the term "artificial intelligence" is generally defined as meaning the design of computers to think the way people do, Taylor points out that for engineering purposes it is more accurately defined as a few software ideas that work well enough to be used. And as AI technology matures, computers will be able to provide actual design help. They will, in effect, serve as design apprentices, offering suggestions and handling actual parts of the design.

AI Engineering Concepts

- **AI depends on the human element** AI augments, but does not replace, human knowledge and expertise. This basic understanding affects engineers of AI systems in two dimensions: human-machine teaming and the probabilistic nature of AI "answers." Engineers developing AI systems must account for human-machine teaming--the interactions between the system and the people who build and use it. Often, the success of those interactions comes down to trust and transparency: How should AI systems be deployed in environments where people have become accustomed to ignoring automation? How can you address ethics--accounting for algorithms not having a sense of morality? Further, AI will produce probabilistic answers: How does AI present results to a human as based on a probability distribution, not as a discrete answer? How does the human know when a prediction is bad?
- **AI depends on labeled and unlabeled data as well as the systems that store and access it** -the availability of data and the speed at which today's computers can process it are reasons why AI is exploding today. AI systems are really good at classifying, categorizing, and partitioning massive amounts of data to make the most relevant pieces available for humans to analyze and make decisions. Engineers must consider the data itself--provenance, security, quality, and aligning test and training data--and the hardware and software systems that support that data. Large amounts of data require a computing environment that has the capacity to handle it. Managing data requires designing storage solutions around physical data constraints and types of queries desired.

- **One AI, many algorithms** When we talk about AI, ML, and deep learning, we are referring to many different algorithms, many different approaches, not all of which are neural-network based. AI is not a new field, and many of the algorithms in use today were generated in the 1950s, 1960s, or 1970s. For example, the A* shortest path algorithm was conceived in the 1950s, and improved on in the 1960s.

- **The insight is the benefit of AI** Engineers face the reality that it is impossible to test a system in every situation it will ever encounter. An AI system adds capability for the engineering because it can find an answer to never-seen-before situations that is insightful and has a very good probability of being correct. However, it is not necessarily correct, but probabilistic. Thus, gaining increased confidence in AI is hard for engineers who need to focus on creating and validating a system.

- **An AI system depends on the system under which it runs** When building a system that does not incorporate AI, you can build it in isolation, test it in isolation, and then deploy it and be certain it is going to behave just as it did in the lab. An AI system depends on the conditions under which the AI runs and what the AI system is sensing, and this context adds another level of complexity.

Emerging AI Technologies

The four AI technologies are:

- **AI-enhanced Analytics Solutions:** Forrester defines this category as one that helps orchestrate the customer journey and experience. These systems can understand the customer, learn preferences, predict next best action/solution, and surface insights. We believe this is a top priority area for the contact center as AI-enhanced analytics solutions can deliver new and stronger business benefit. Fraud detection is just one example.

- **Deep Learning (DL):** DL is a type of machine learning algorithm that is a game changer in its ability to generate better predictions/insights, scale up with large data sets, and reduce the effort to build the model. In the contact center, DL is used in conversational systems (speech rec, NLG, NLU, etc), Speech Analytics, and other areas. Contact Solutions and Verint use DL in their products today and believe this will be one of the primary drivers of future innovation.

- **Natural Language Generation (NLG):** NLG is a part of the tech stack in conversational systems. NLG uses advanced AI algorithms to generate speech from text. NLG is used to generate speech in Alexa, in Virtual Assistants and in a Natural Language IVR. We use NLG as part of our SmartCare conversational platform that powers IVR and Chatbot channels.

- **Speech Analytics:** Speech analytics uses AI technology to recognize speech, convert speech into text, and perform analytics on the text data set. This technology is used today in many contact centers to improve customer interactions, CX and agent performance.

AI and ethical concerns

- **Unemployment. What happens after the end of jobs?**

  The hierarchy of labour is concerned primarily with automation. As we've invented ways to automate jobs, we could create room for people to assume more complex roles, moving from the physical work that dominated the pre-industrial globe to the cognitive labour that characterizes strategic and administrative work in our globalized society.

  Look at trucking: it currently employs millions of individuals in the India alone. What will happen to them if the self-driving trucks promised by Tesla's Elon Musk become widely available in the next decade? But on the other hand, if we consider the lower risk of accidents, self-driving trucks seem like an ethical choice. The same scenario could happen to office workers, as well as to the majority workforce in developed countries.

  If we succeed with the transition, one day we might look back and think that it was barbaric that human beings were required to sell the majority of their waking time just to be able to live.

- **Inequality. How do we distribute the wealth created by machines?**

  Our economic system is based on compensation for contribution to the economy, often assessed using an hourly wage. The majority of companies are still dependent on hourly work when it comes to products and services. But by using artificial intelligence, a company can drastically cut down on relying on the human workforce, and this means that revenues will go to fewer people. Consequently, individuals who have ownership in AI-driven companies will make all the money.

  We are already seeing a widening wealth gap, where start-up founders take home a large portion of the economic surplus they create. In 2014, roughly the same revenues were generated by the three biggest companies in Detroit and the three biggest companies in Silicon Valley ... only in Silicon Valley there were 10 times fewer employees.

  If we're truly imagining a post-work society, how do we structure a fair post-labour economy?

- **Humanity. How do machines affect our behaviour and interaction?**

  Artificially intelligent bots are becoming better and better at modelling human conversation and relationships. In 2015, a bot named Eugene Goostman won the Turing Challenge for the first time. In this challenge, human raters used text input to chat with an unknown entity, then guessed whether they had been chatting with a human or a machine. Eugene Goostman fooled more than half of the human raters into thinking they had been talking to a human being.

  This milestone is only the start of an age where we will frequently interact with machines as if they are humans; whether in customer service or sales. While humans are limited in the attention and kindness that they can expend on another person, artificial bots can channel virtually unlimited resources into building relationships.

- **Artificial stupidity. How can we guard against mistakes?**

  Intelligence comes from learning, whether you're human or machine. Systems usually have a training phase in which they "learn" to detect the right patterns and act according to their input. Once a system is fully trained, it can then go into test phase, where it is hit with more examples and we see how it performs.

  Obviously, the training phase cannot cover all possible examples that a system may deal with in the real world. These systems can be fooled in ways that humans wouldn't be. For example, random dot patterns can lead a machine to "see" things that aren't there. If we rely on AI to bring us into a new world of labour, security and efficiency, we need to ensure that the machine performs as planned, and that people can't overpower it to use it for their own ends.

- **Racist robots. How do we eliminate AI bias?**

  Though artificial intelligence is capable of a speed and capacity of processing that's far beyond that of humans, it cannot always be trusted to be fair and neutral. Google and its parent company Alphabet are one of the leaders when it comes to artificial intelligence, as seen in Google's Photos service, where AI is used to identify people, objects and scenes. But it can go wrong, such as when a camera missed the mark on racial sensitivity, or when a software used to predict future criminals showed bias against black people.

We shouldn't forget that AI systems are created by humans, who can be biased and judgmental. Once again, if used right, or if used by those who strive for social progress, artificial intelligence can become a catalyst for positive change.

- **Security. How do we keep AI safe from adversaries?**

  The more powerful a technology becomes, the more can it be used for nefarious reasons as well as good. This applies not only to robots produced to replace human soldiers, or autonomous weapons, but to AI systems that can cause damage if used maliciously. Because these fights won't be fought on the battleground only, cybersecurity will become even more important. After all, we're dealing with a system that is faster and more capable than us by orders of magnitude.

- **Evil genies. How do we protect against unintended consequences?**

  It's not just adversaries we have to worry about. What if artificial intelligence itself turned against us? This doesn't mean by turning "evil" in the way a human might, or the way AI disasters are depicted in Hollywood movies. Rather, we can imagine an advanced AI system as a "genie in a bottle" that can fulfill wishes, but with terrible unforeseen consequences.

  In the case of a machine, there is unlikely to be malice at play, only a lack of understanding of the full context in which the wish was made. Imagine an AI system that is asked to eradicate cancer in the world. After a lot of computing, it spits out a formula that does, in fact, bring about the end of cancer – by killing everyone on the planet. The computer would have achieved its goal of "no more cancer" very efficiently, but not in the way humans intended it.

- **Singularity. How do we stay in control of a complex intelligent system?**

  The reason humans are on top of the food chain is not down to sharp teeth or strong muscles. Human dominance is almost entirely due to our ingenuity and intelligence. We can get the better of bigger, faster, stronger animals because we can create and use tools to control them: both physical tools such as cages and weapons, and cognitive tools like training and conditioning.

This poses a serious question about artificial intelligence: will it, one day, have the same advantage over us? We can't rely on just "pulling the plug" either, because a sufficiently advanced machine may anticipate this move and defend itself. This is what some call the “singularity”: the point in time when human beings are no longer the most intelligent beings on earth.

- **Robot rights. How do we define the humane treatment of AI?**

  While neuroscientists are still working on unlocking the secrets of conscious experience, we understand more about the basic mechanisms of reward and aversion. We share these mechanisms with even simple animals. In a way, we are building similar mechanisms of reward and aversion in systems of artificial intelligence. For example, reinforcement learning is similar to training a dog: improved performance is reinforced with a virtual reward.

  Right now, these systems are fairly superficial, but they are becoming more complex and life-like. Could we consider a system to be suffering when its reward functions give it negative input? What's more, so-called genetic algorithms work by creating many instances of a system at once, of which only the most successful "survive" and combine to form the next generation of instances. This happens over many generations and is a way of improving a system. The unsuccessful instances are deleted. At what point might we consider genetic algorithms a form of mass murder?

  Once we consider machines as entities that can perceive, feel and act, it's not a huge leap to ponder their legal status. Should they be treated like animals of comparable intelligence? Will we consider the suffering of "feeling" machines?

  Some ethical questions are about mitigating suffering, some about risking negative outcomes. While we consider these risks, we should also keep in mind that, on the whole, this technological progress means better lives for everyone. Artificial intelligence has vast potential, and its responsible implementation is up to us.