# Artificial Intelligence – Deep Learning

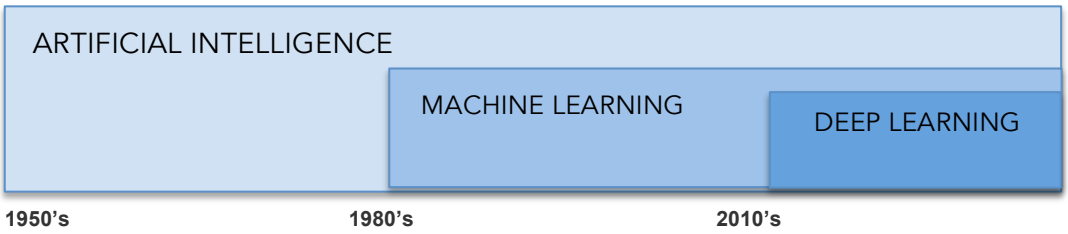
A Non-Technical Introduction

Alfred Pong

*November 2016*

Artificial Intelligence (AI), a branch of science that started in the 1950's, is an attempt to make computers to think, learn and react as well as or better than humans. In a way, AI is about understanding, and then mimicking how we think, learn and process information.

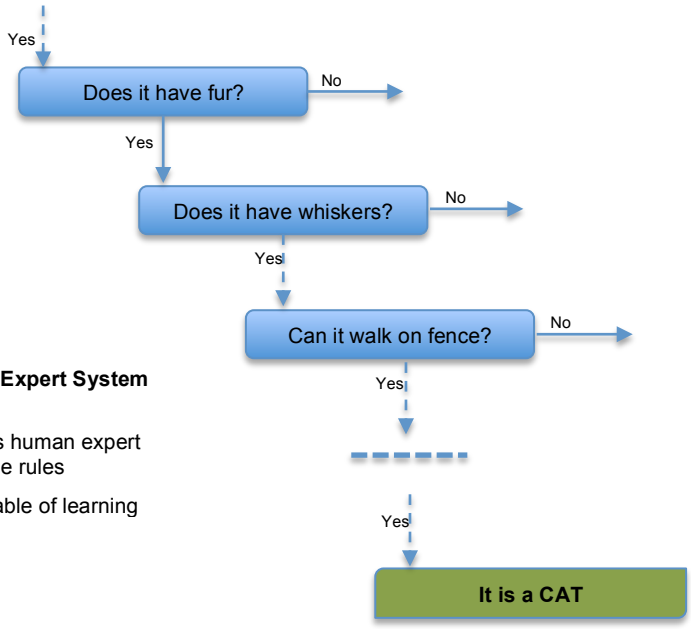
The science and applications of AI have evolved since the early years:




## Generation 1 (From 1950's): Rule Based Systems (No Learning)

In the early days, most applications of AI were rule-based computer programs (commonly known as Expert Systems) designed to solve problems that human brains performed easily. Such AI programs required experts to develop rules and combine with programs to solve problems. It required a programmer to write a program to capture the knowledge of a subject matter expert. The program then asked a series of questions to a user (usually not an expert in that subject) and then based on the answers/input provided, the computer would suggest a "solution" to the problem.

Let's say we want to develop a computer program to help Mary (who has never seen a cat) to determine if the animal in a photo she is holding in her hand is a CAT. And let's say Mary is sitting in front of a computer and can input a Yes or No answer to a series of questions asked by the computer. To do this, we can first capture the knowledge of a cat expert (by asking the expert to provide a set of characteristics of a cat). We then create a set of rules based on these characteristics and develop the computer program (simulating a decision-making flow process).




**Rule-Based Expert System**

- Requires human expert to provide rules
- Not capable of learning

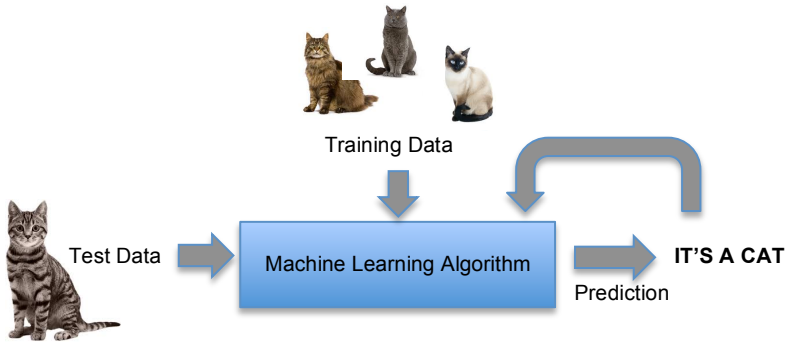
Based on the input from Mary, the computer can make a decision if the animal is indeed a Cat or not.

This rule-based approach requires the close involvement of domain experts to manually provide information to fine tune the programs to produce better solutions. They are therefore not very accurate and are limited by their inability to learn on their own.

## Generation 2 (From 1980's): Machine Learning (Simple Learning)

In machine learning, we do not require human experts to provide rules. Instead, machine learning is the practice of using algorithms to analyze data, learn from it, and then make a determination or prediction about something. In the process of learning, the programs become more "clever" and therefore improve the accuracy on its prediction.

Let's say we want to write a program for the computer to predict accurately if a photo we feed the computer contains a cat. It would be very difficult to write such a program to solve a problem like "how to recognize a cat on a photo" because we do not know how our brain does it (though it comes so naturally to us). So instead of writing a computer program by hand, we collect lots of examples of cat photos to "feed" to a machine-learning algorithm. This algorithm then takes these examples (we call such examples "*Training Data*") and produces a program that can correctly recognize a cat on any given photo (we call this the "*Test Data*").




This method is quite accurate in predicting an outcome if we feed the algorithm well labeled data (such as clean images of different kinds of cats in the example above) and provide a test data that is also not too far off. However, if we try to ask the machine to recognize a much less obvious image like the one below, simple Machine Learning will not be very good in its prediction.

This is where Deep Learning comes in.

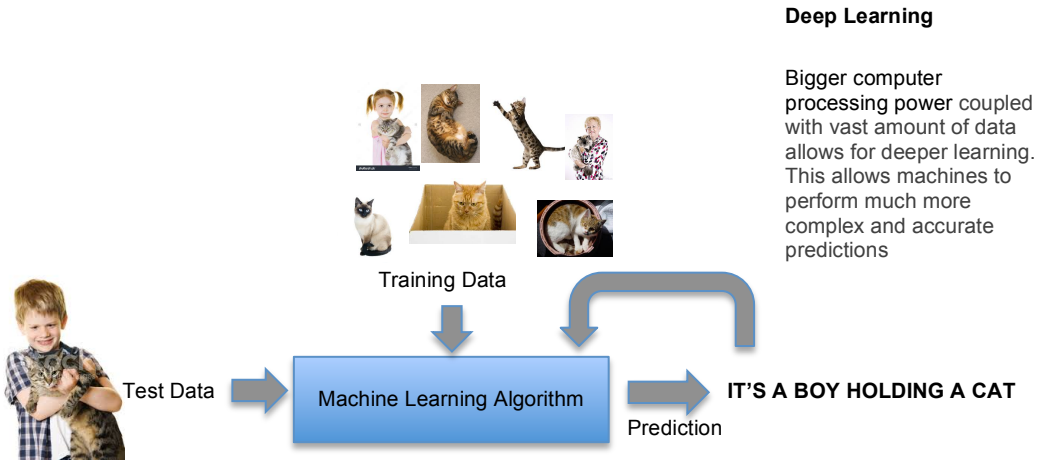
## Generation 3 (From 2010's): Deep Learning

Machine Learning has recently evolved into Deep Learning mainly due to these two factors:

1. Access to much faster and more powerful computers resulting in much bigger processing power
2. Availability of vast amounts of data resulting in much better training for the computer

Deep Learning allows machines to train itself much longer and therefore learn much "deeper" and ultimately producing much more accurate predictions.

In the Cat example, if we feed millions of different images of cats in different variety (curled up, standing, inside a box, with a human, etc.) and let a powerful computer process and learn from these images continuously, it can ultimately be able to recognize a much more complex image (such as a boy holding a cat).




## What Are the Commercial Possibilities of Deep Learning?

Deep Learning has enabled and improved many practical applications of Machine Learning and the overall field of AI – from voice and image recognition to much better personalization in eCommerce.

Current and future commercial applications of Deep Learning include:

- A Cyber security firm is using deep learning in order to recognize new threats that have never been detected before and thus keep organizations one step ahead of cyber criminals.
- An eCommerce company is using deep learning to categorize products in images posted by sellers.
- A U.S. insurance company, is looking into using deep learning to identify fraudulent claims
- Some medical institute in the US is exploring whether deep learning could help to more accurately predict a patient's outcome from images of his or her cancer.
- Driverless cars being developed by various companies.
- A software sales teams are using Deep Learning to recommend which prospects to contact next or what kinds of product offerings to recommend.
- A major consulting firm is using deep learning to help solar and wind companies better predict weather and improve alternative energy production.
- A startup company is using deep learning to bring precise medical diagnostics to the developing word where radiologists and other trained professionals might not be on hand to analyze test results

In the not too distant future, this could be a new shopping experience:

While surfing on the Internet, Miss Chen sees a pair of pretty shoes worn by her favorite movie star. She captures the image of the shoes, goes to her favorite shopping site and uploads the image to the search box. The search result immediately returns a list of shoes for sale on the site that look exactly or similar to the uploaded image. Miss Chen selects the one she likes and makes the purchase…

***Alfred Pong*** *is the Managing Director of the SES Group, an Asia focused executive search firm. He can be contacted at apong@sesasia.com*