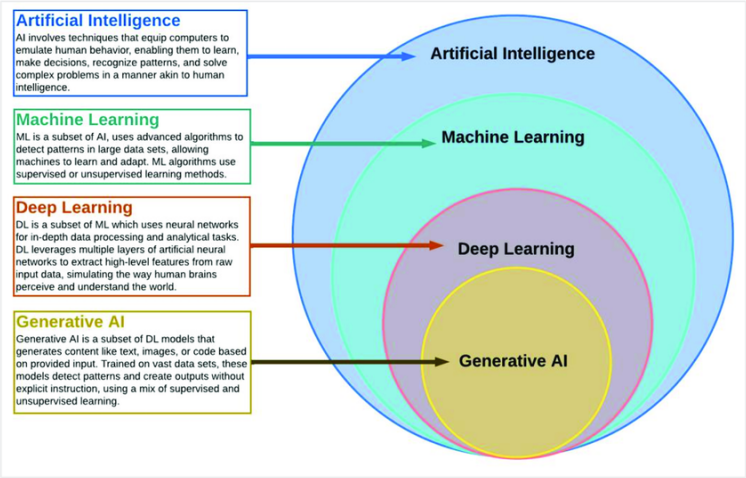
What are Artificial Intelligence, Machine Learning, Deep Learning and Generative AI?

To start off, most people often get confused over these three terms. Artificial intelligence refers to techniques, methodologies, and algorithms that includes those of Machine Learning, Deep Learning, and generative AI. In a general overview, AI equip computers to simulate human behaviour, enabling them to learn, makde decisions, recognize patterns, and solve complex problems in a manner like human intillegence. Therefore, it's objective is to create a intelligent agents, which get the percpetion of the real world through the using of sensors, learn using some of the advanced ML tecniques, make decisions and finally implement through acutators.



Hierrachical Relationship

Machine Learning: It is a subset of the AI which is the science of programming a machine to make it learn to perform a task from the data, rather than through programming.

Deep Learning: It is again the subset of the AI, but also further subset of the Machine Learning field which is an ensemble of tecniques and alogorithm that exploit neural networks for in depth data processing and analytical tasks. And it involves multiple layers of artificial neural netowkrks to extract high-level of features from raw input data, simulating the way human brains, percieve and understand the world.

Generative AI: This is again the subset of deep learning models which is more advanced form of AI, that has the capacity to generate content like text, images, or code based on provided input.

Short and Suit example:

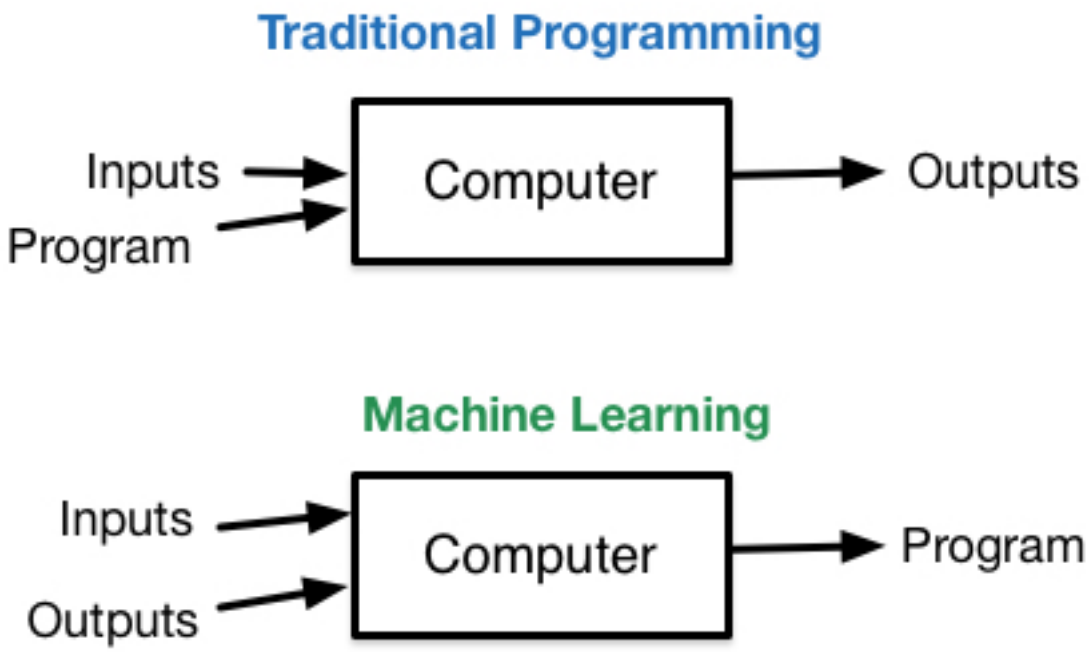
An Autonomous car:

Artificial in this system, collects data from real world using sensors(road, cars, road signs, speed, objects), possesses a set of rules of behaviour that has its intelligence embeded. Some of the intelligence are: If a car is about to collide with an object, brake preventively, with the rules: a set of actuators implementing relative decisions(brakes, steering, ABS).

In this AI system of the car has a sub module of Machine Learning that allows it to improve over time, as the car "sees" different roads and situtations and increase its performance compared to some metric(safety, reaction time to braking, consumption).

Addditionally, sub-modules can use Deep Learning techniques such as neural networkds, trained to recognize the route of the road, the shapers of cars, distinguish them from those of tress and pedestrians, and so on.

Traditional vs Modern Programming: Machine Learning



Traditionally, the classic approach to the problem consists in designing a process(algorithm) that is then realized in a programming language implmentation), thus solving the problem iin a detterministic fashion.

The approach of Machine Learning consists instead in seeing a lot of input examples with the output considered correct, and programming the machine to detetc the recuring patterns that occur in the data. So, what happens is, in this ML method, there involves corrected input and output together, and programmed the machine to find the recurring patterns that occur in a dataset/business model. Then pattern is used by machine as "knowledge", and according to that knowledge, machine tries to return the correct output provided new input(seen or unseen).

And here comes the important terms, **training**, which is the process of feeding with data and its result in a model: a set of parameters properly 'adjusted' so they could recongnize the patterns that interest us for the given problem. Once a model is obtained, it can be used to predict the correct output to inputs that it has never "seen".

Some of the great examples of using Machine Learning is applied in the real world:

1. Spam email filter.
2. Hand drawn figures or symbols, such as numbers, letters, or figures recognition
3. Recommeded system: A system of customization of content suggested based on what you've already seen such as Netflix recommends the next movie to watch, Facebook suggesting groups releated to our interest, Amazon shows prdoucts often purchased togther, youtube suggesting the related videos often watched.
4. Sentiment analsis: This is analysis of extracting important information from tweets or other data generated by humans about a particular event or character. For example, the post that I tweet in the twitter can be analysed whether the people like or hate the tweets(negative, positive, neutral)
5. Prediction of next words: A system of writing assistance that, as the text in composed, it foresees the next words and suggests them. Such as automatic completion of smartphone or the facebook search bar. This has already been implemented in copilot and notebook python.
6. A computer vision system that recognize the model and brand of a car by seeing it with a sensor.

Below are not a Machine learning examples:

1. Search engineer: this system in not a machine learning application as it does not improve with experience, and has not got "intelligent", instead have to program explicitly and is totally based on keywords.

2. A sensor programmed detecting car number plates. As it may seem like that it is releated to the concept of computer vision but there is not involvement of improving with experience, and its performance which are totally based on programming only at the design stage, where it is explicitly calibrated to detect a standard object(the license plate).

In summary, Machine learning are appropriate for:

1. Fluid environments, where the problem constantly changes and in an unprdictable way.
2. Complex problems where the traditional approach would be impracticable or would lead to "frankenstein" of code with high maintenance cost. The ML approach can significantly simplify the code and achieve better performance.
3. Get information about complex problems and discover patterns through large amounts of data.