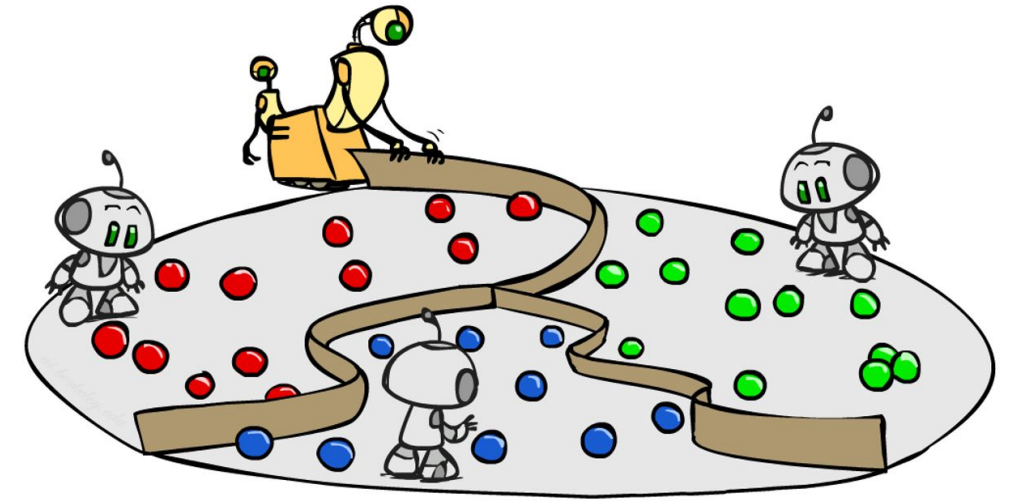
CS-ELEC2C: Machine Learning

Overview of Machine Learning



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The **‘tasks’** to be performed could involve **thinking**, or **acting**, or **some combination of these.**

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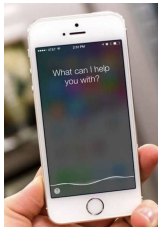

Speech Recognition
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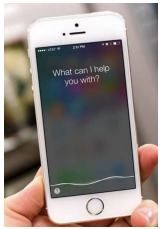

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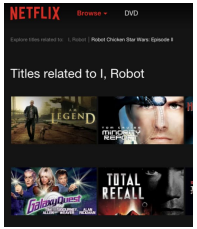

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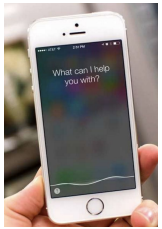

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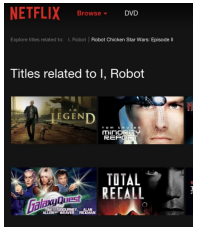

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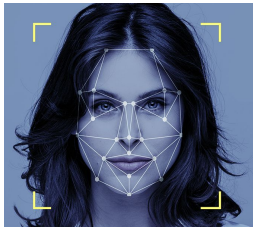

Facial Recognition
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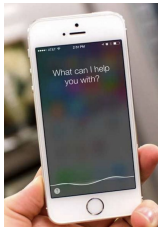

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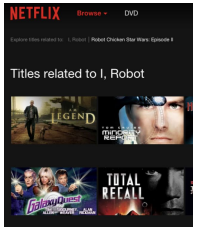

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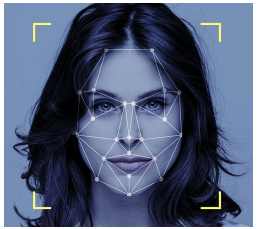

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(Are you this person?)

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(How should it move?)

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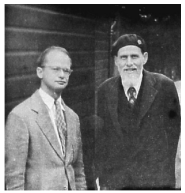

The Inception of Artificial Intelligence (1943 - 1956)

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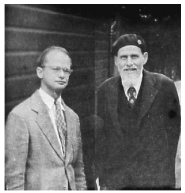

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Early enthusiasm, great expectations (1952-1969)

The intellectual establishment of the 1950s, by and large, preferred to believe that “a machine can never do X”. **AI researchers naturally responded by demonstrating** one X after another. They **focused in particular on tasks considered indicative of intelligence in humans**, including games, puzzles, mathematics, and IQ tests. John McCarthy referred to this period as the “Look, Ma, no hands!” era.

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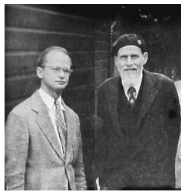

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A Dose of Reality (1966-1973)

From the beginning, **AI researchers were not shy about making predictions of their coming successes**. In almost all cases, however, these early systems failed on more difficult problems. They failed because, **first was that many early AI systems were based primarily on “informed introspection”.** The second reason for failure was a **lack of appreciation of the intractability of many of the problems** that AI was attempting to solve.

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Expert Systems (1969-1986)

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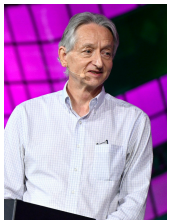

In the mid-1980s at least four different groups **reinvented the back-propagation learning algorithm** first developed in the early 1960s. The algorithm was applied to many learning problems in computer science and psychology. In addition, brittleness of expert systems led to a new, **more scientific approach incorporating probability** rather than Boolean logic, machine learning rather than hand-coding, and experimental results rather than philosophical claims.

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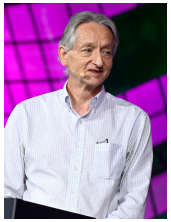

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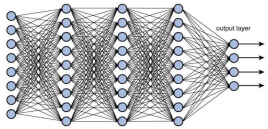
Big Data and Deep Learning (2001–, 2011–)



Remarkable advances in computing power and the creation of the World Wide Web have facilitated the creation of very large data sets—a phenomenon sometimes known as **big data**. This has led to the **development of learning algorithms specially designed to take advantage of very large data sets.** The term **deep learning refers to machine learning using multiple layers of simple, adjustable computing elements.** Experiments were carried out with such networks as far back as the 1970s, and in the form of **convolutional neural networks**

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In **many cases it is very difficult to specify those rules**, e.g., given a picture determine whether there is a cat in the image

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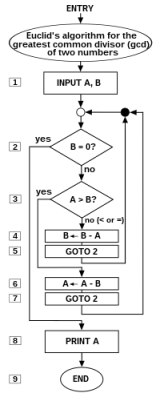
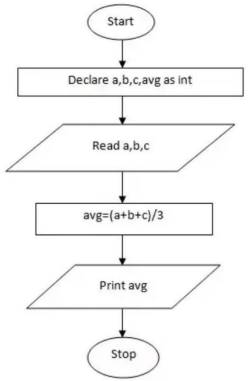
It's different from the usual Computer Science algorithms because want to **implement unknown function**, only have **access to sample input-output pairs** (training examples)





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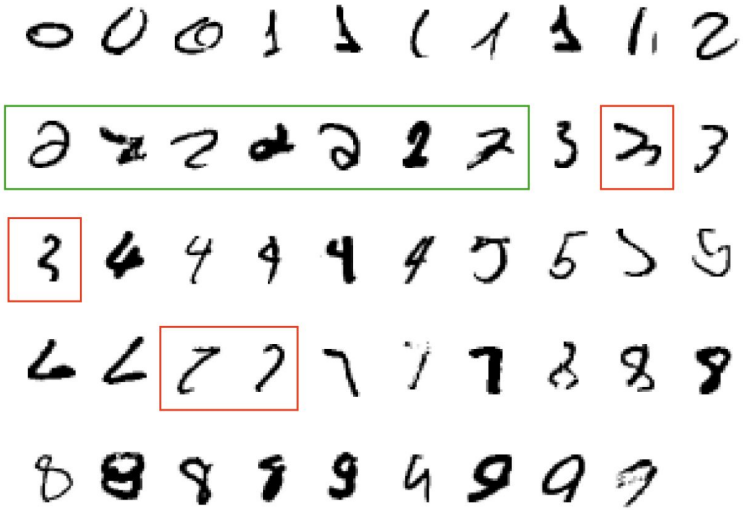

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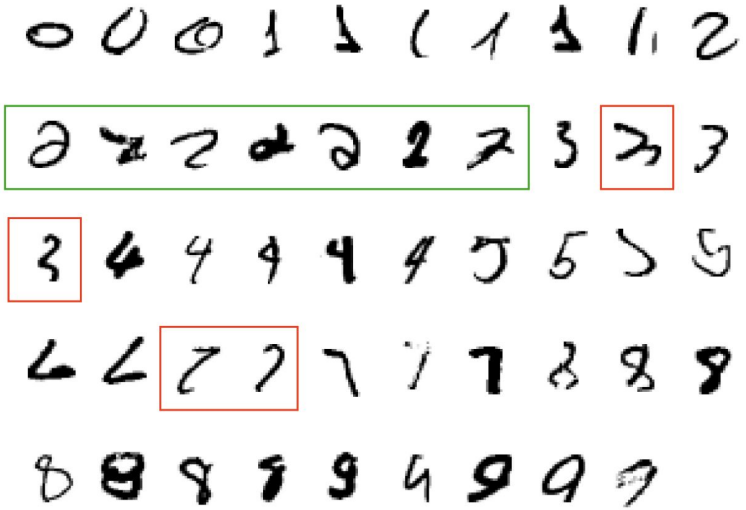

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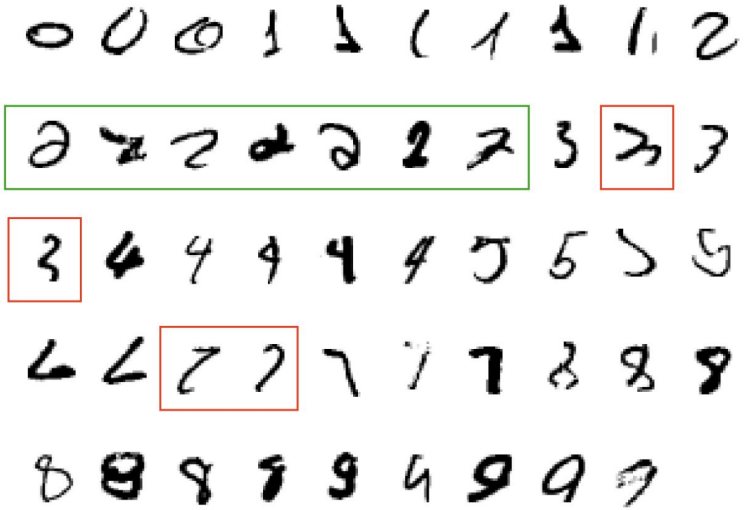

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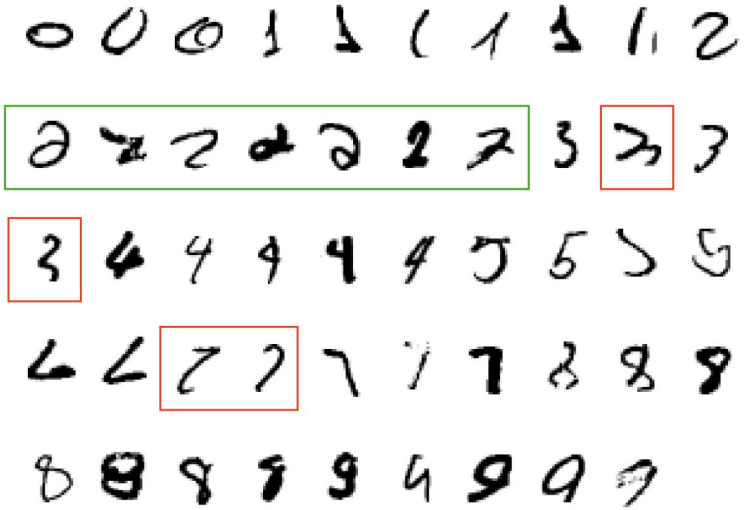

The program produced by the learning algorithm **may look very different from a typical hand-written program**. If we do it right, the program works for new cases as well as the ones we trained it on.

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Reinforcement: Learn actions causing occasional rewards and punishments. **Learning by experimentation**

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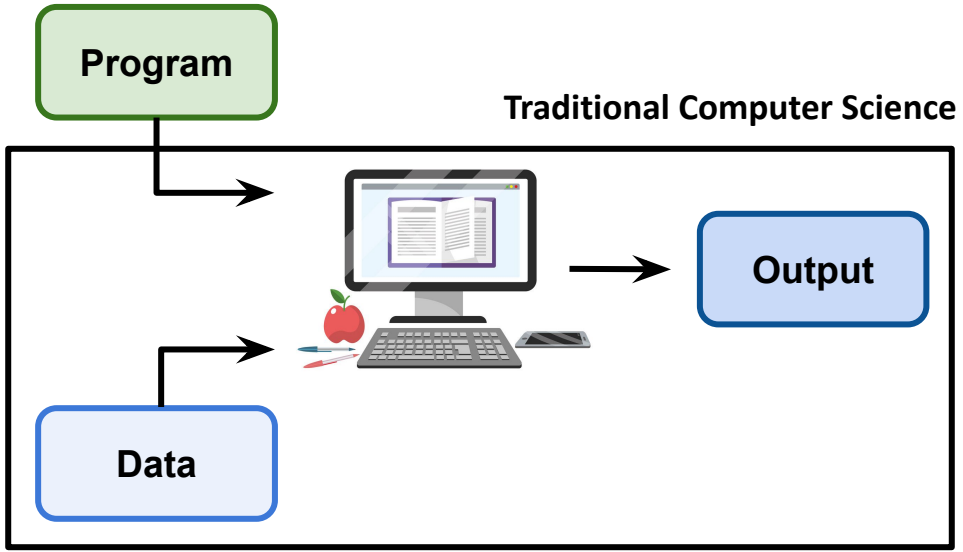

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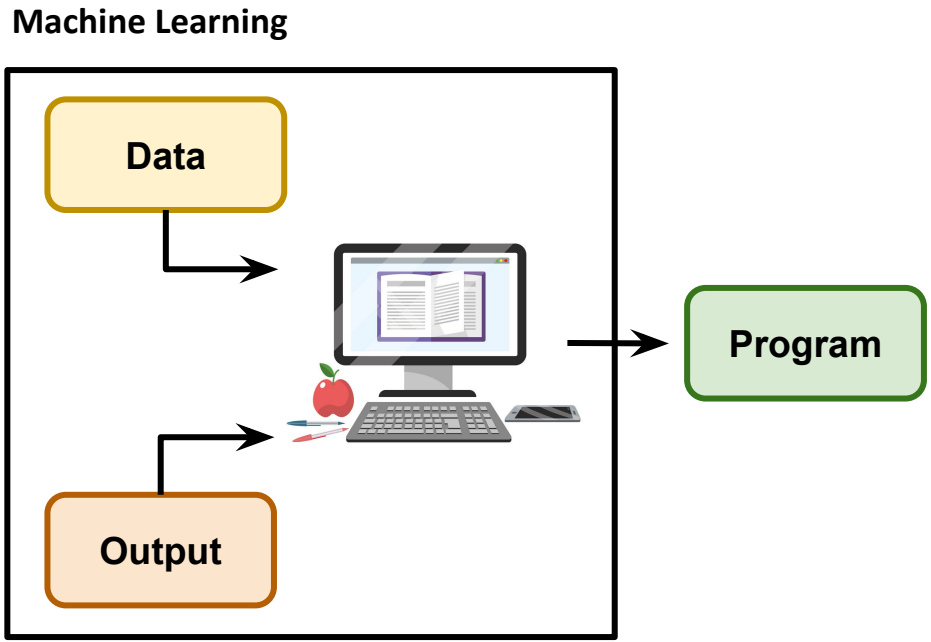

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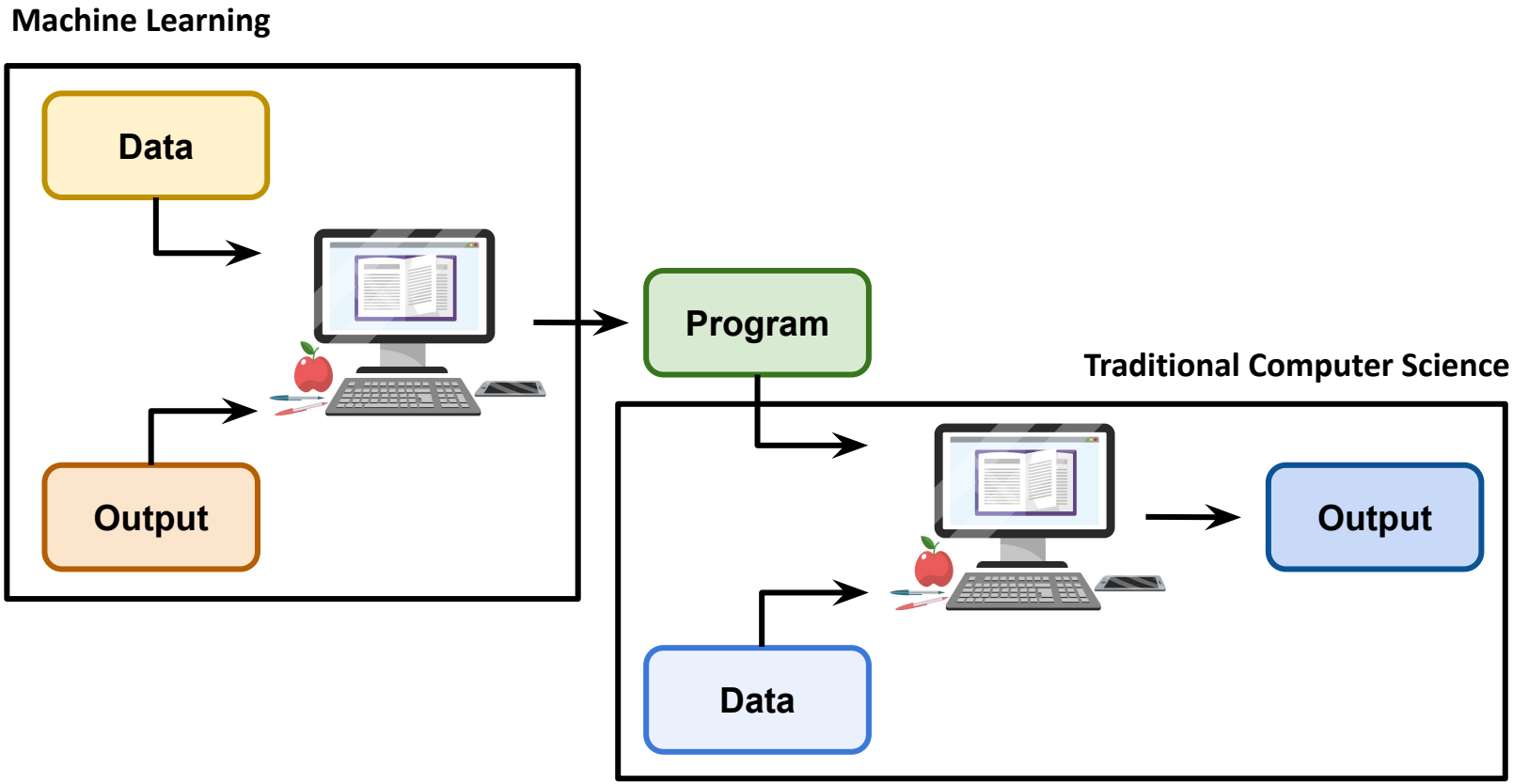

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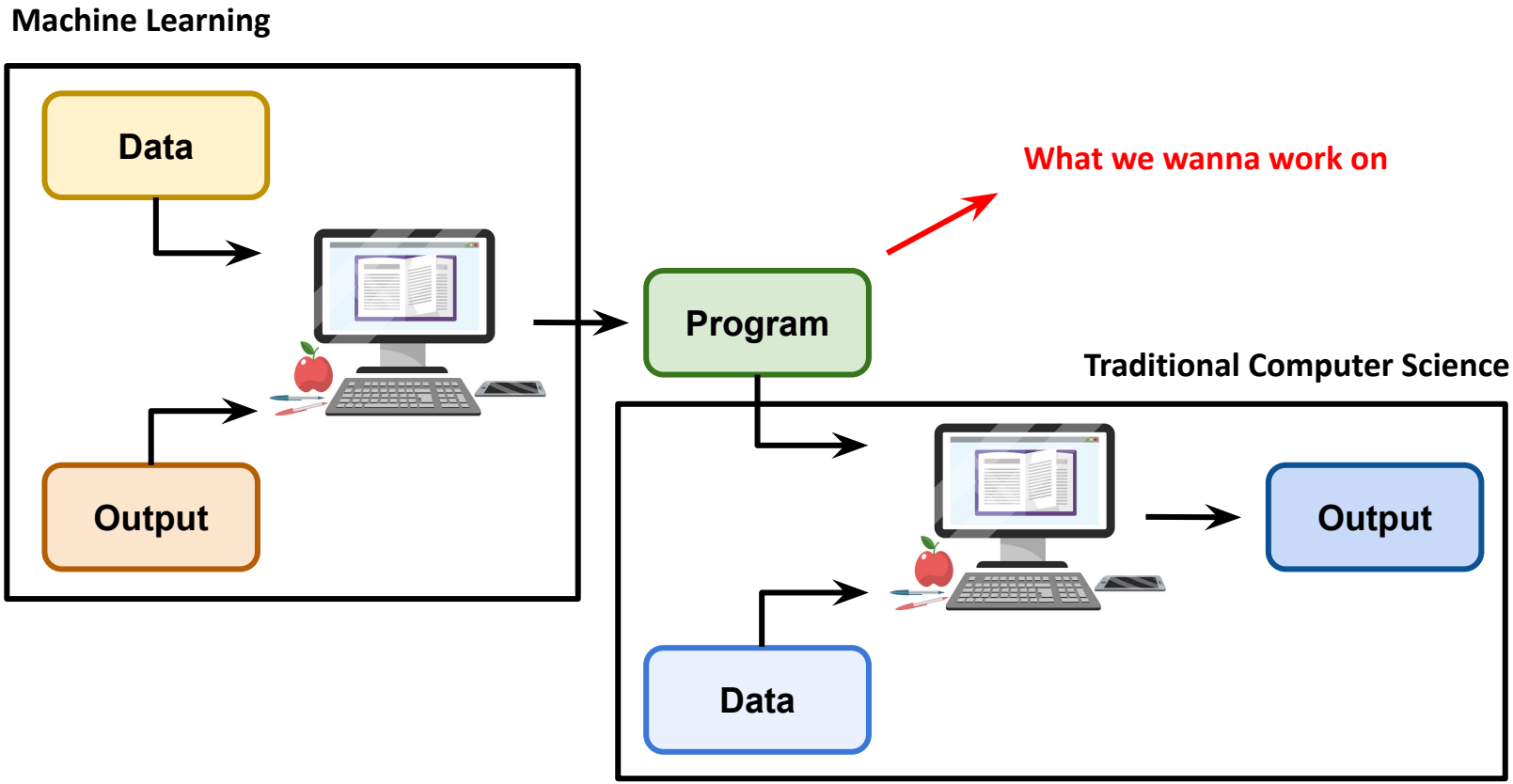

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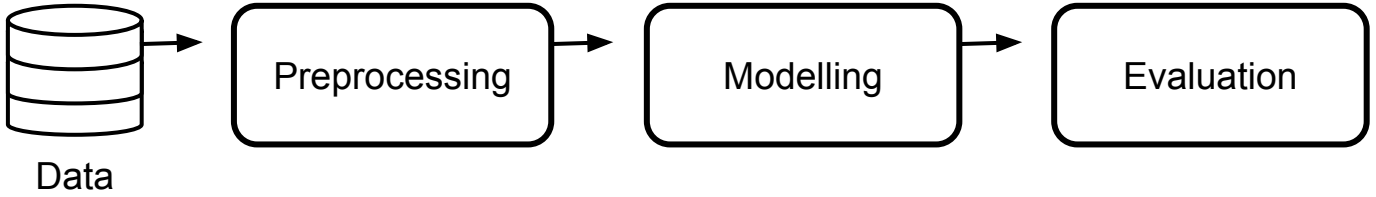

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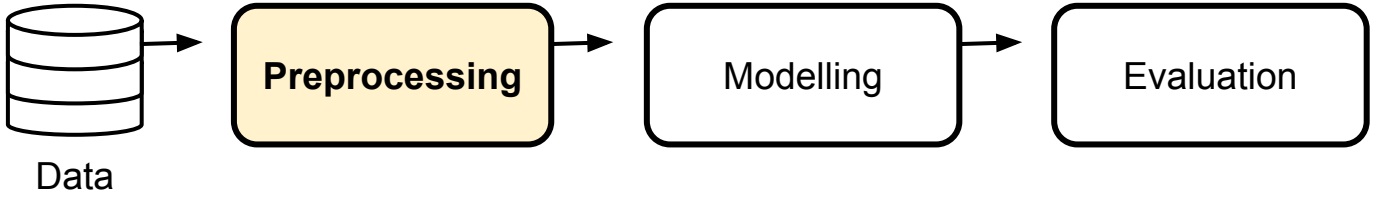

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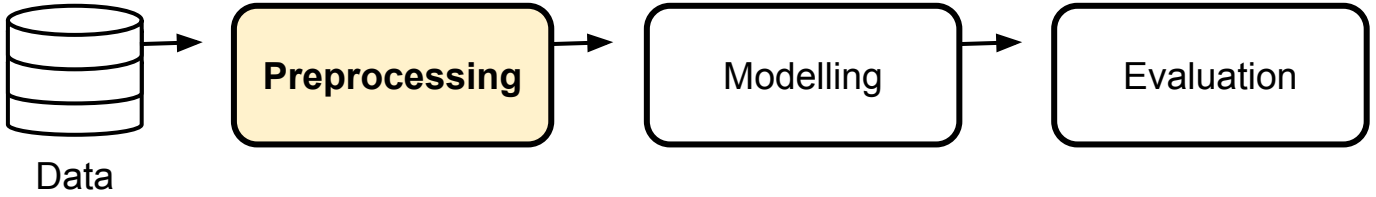

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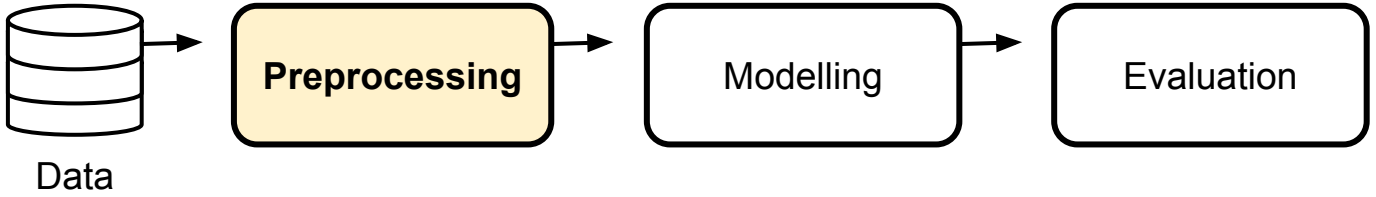

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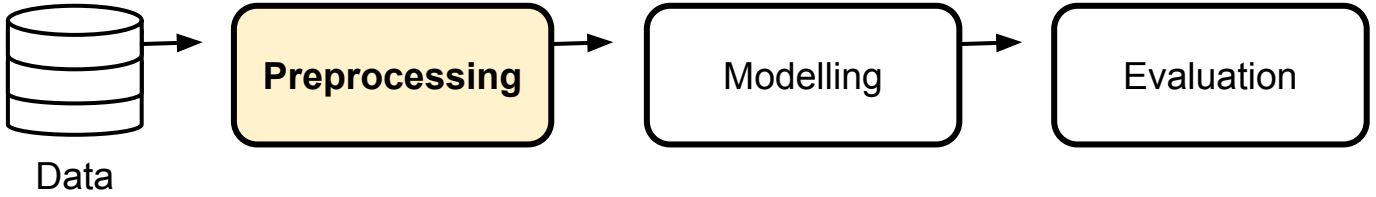

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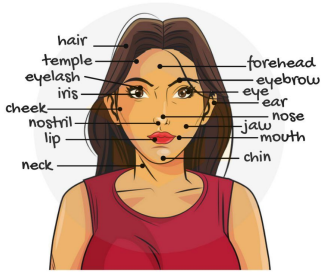

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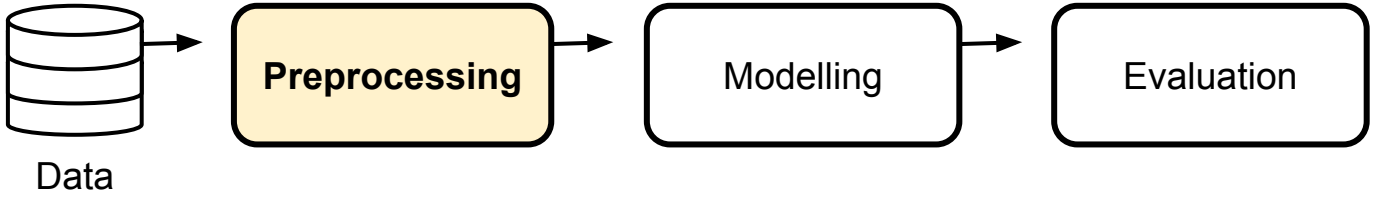

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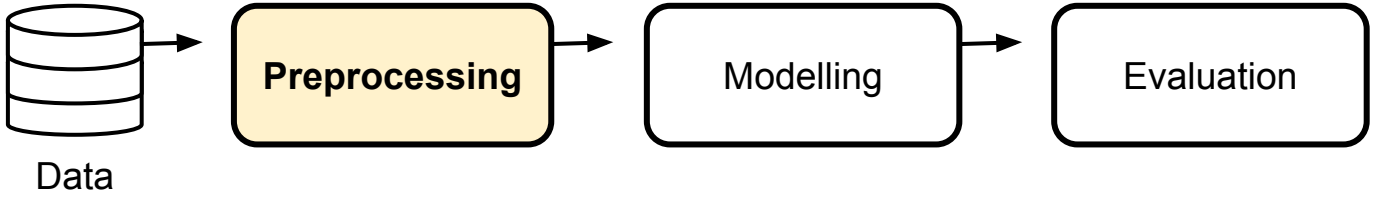

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Data Cleaning: The process of fixing or removing incorrect, corrupted, incorrectly formatted, duplicate, or incomplete data within a dataset.

Scaling and Normalization: Method used to transform the range of features of data. Since, the range of values of data may vary widely, it becomes a necessary step in data preprocessing while using machine learning algorithms.

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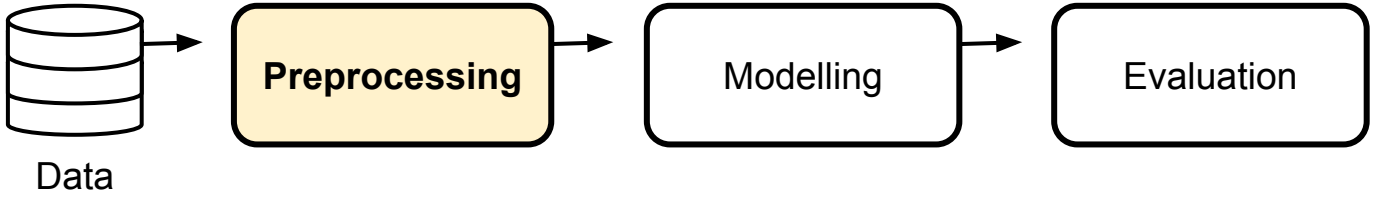

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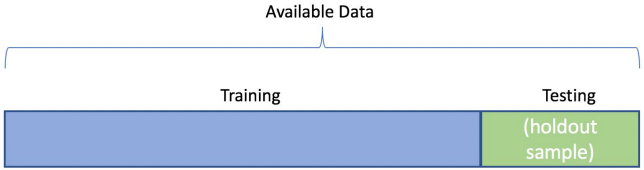

Splitting the Data: Train test split is a model validation procedure that allows you to simulate how a model would perform on new/unseen data.

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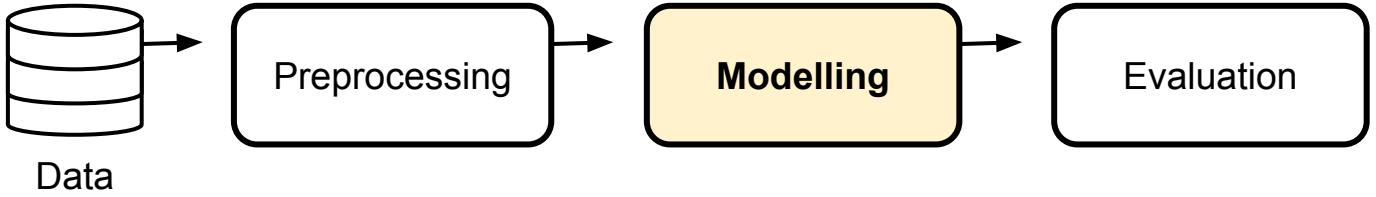

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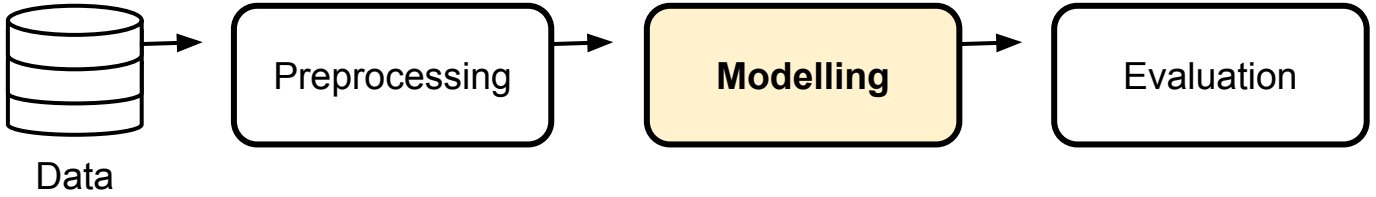

Modelling: Mathematically speaking, a model is **a description of a system using mathematical concepts** and languages. It is a mathematical representation of **objects and their relationships**

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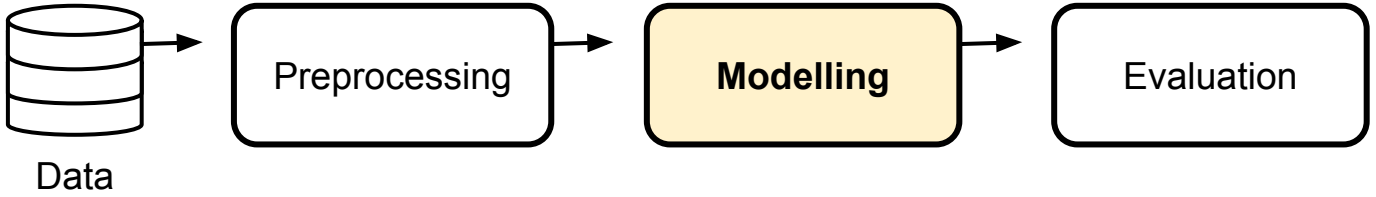

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$$Y = f(x)$$

Target Output **Function** **Inputs**

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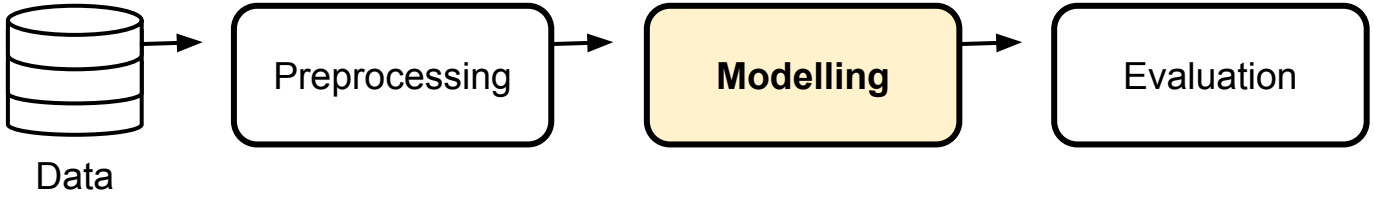

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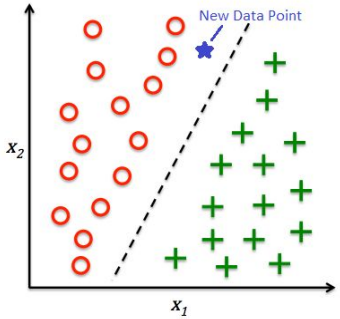

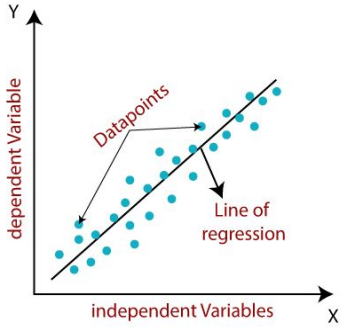

Do I have labels for my data?

What type of problem do I have?

What algorithm is suited for the problem?

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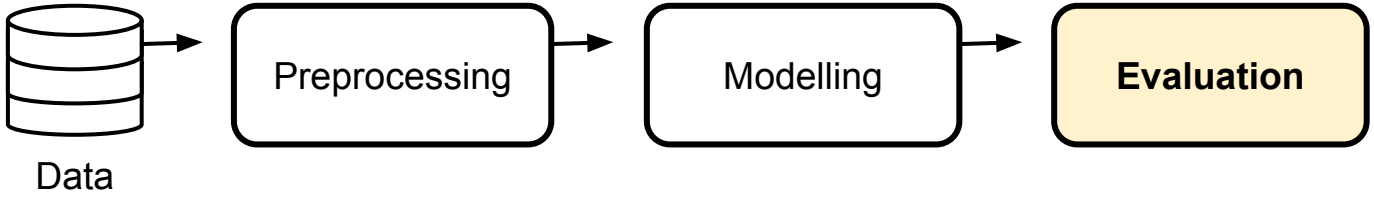

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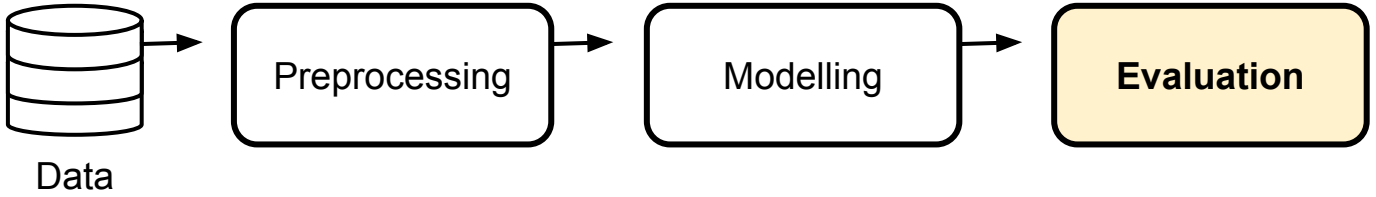

Evaluation: The process of using different evaluation metrics to **understand a machine learning model's performance**, as well as its **strengths and weaknesses**. Model evaluation is important to assess the efficacy of a model during initial research phases

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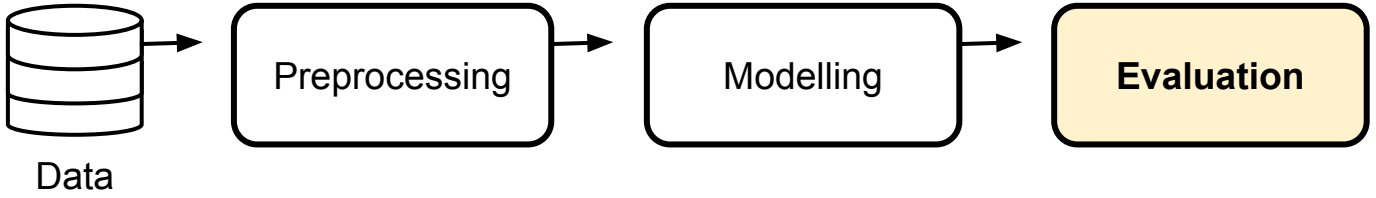

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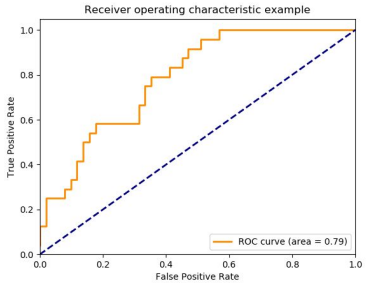
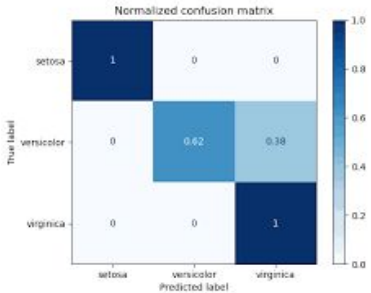




What metrics are relevant to the problem?

What strengths and weaknesses does the model have?

What are potential improvements to the model?

How are they all different?

What's the difference?

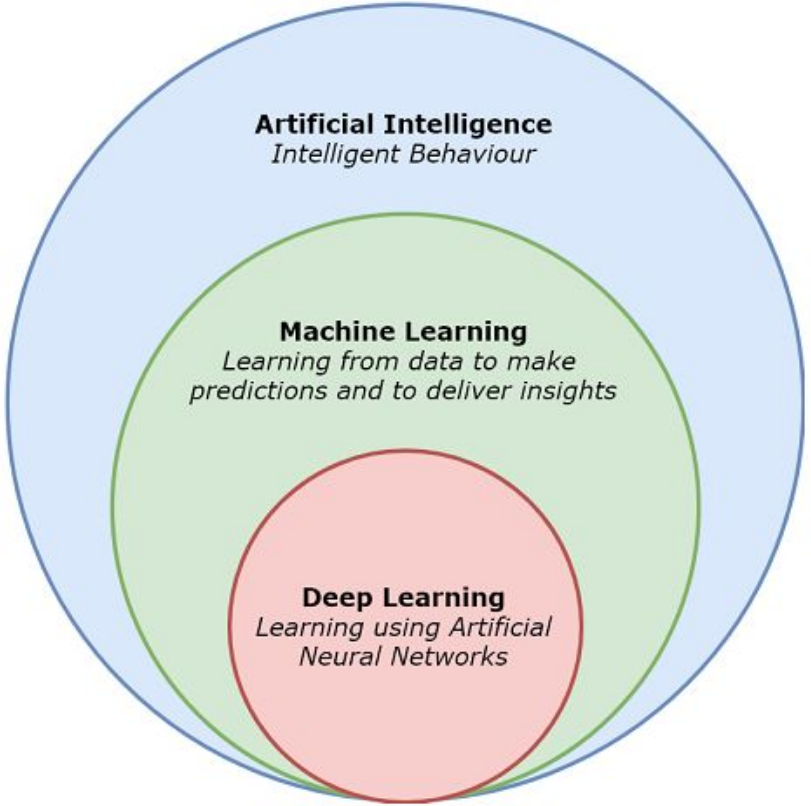
Artificial Intelligence

vs.

Machine Learning

vs.

Deep Learning



What can you say about AI now?