Intro. to Machine Learning / Deep Learning

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Course Overview

- This class is an introductory class to understand the concept of Machine Learning(ML) and Deep Learning(DL).
- Without heavy mathematics, the class conveys the foundation of ML techniques.
- After completion of this course, it gives a way to design your own ML model using pytorch.

day	lecture	assignment	solution
day 1	intro & gradient descent	TBD	TBD
day 2	regression	TBD	TBD
day 3	python programming	TBD	TBD
day 4	pytorch introduction	TBD	TBD
day 5	exercise & DL guidance	TBD	TBD

Figure 1: Course Schedule

- Hands-on assignments are strongly recommended. (though they will be handled in the next class)
- Any programming experience might be helpful, but not necessary.
- Any feedback on my English is welcome. The detailed format can be seen in github

What is Machine Learning?

A wikipedia says

Machine learning (ML) is a field of study in artificial intelligence concerned with the development and study of statistical algorithms that can **learn from data** and generalize to unseen data, and thus perform tasks **without explicit instructions**.

What is Machine Learning?

(unofficial) In shorts,

Machine learning (ML) is a technique that finds **function approximation** which represents the data well.

What is Deep Learning?

A wikipedia says,

Deep learning focuses on utilizing multilayered neural networks to perform tasks such as classification, regression, and representation learning.

What is Deep Learning?

Unofficially,

Deep Learning (DL) is a Machine Learning approach whose model is composed of **multi-layered neural network**.

What is ML/DL?

Everything might be confusing.
But, after finishing the course, You will grasp the philosophy and fundamentals of Machine Learning as well as Deep Learning framework.

- Machine learning (ML) is a technique that finds **function approximation** which represents the data well.
- Deep Learning (DL) is a Machine Learning approach whose model is composed of **multi-layered neural network**.

Category of Machine Learning

- **Unsupervised learning**: learn data without label.
- **Supervised learning**: learn data with label.
- **Reinforcement learning**: learn policy from environment.

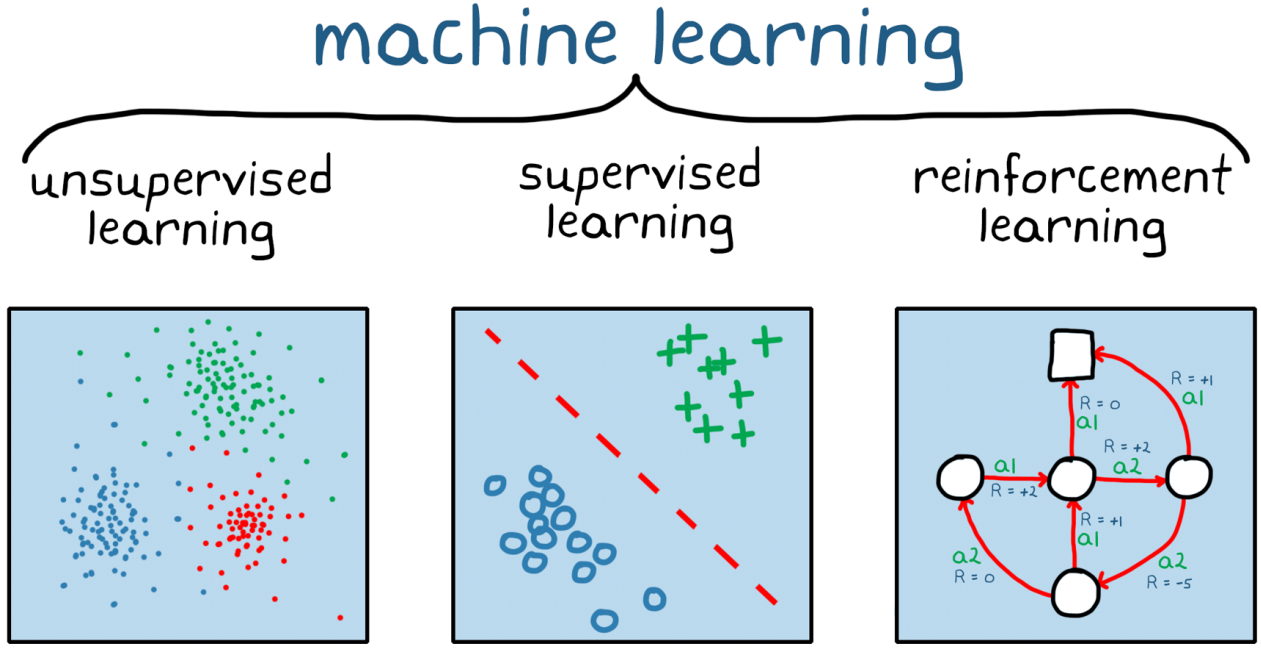

Figure 2: Machine Learning Concept

Category of Machine Learning

- **Unsupervised learning**: Clustering
- **Supervised learning**: Image classification, Text recognition, etc...
- **Reinforcement learning**: Robotics

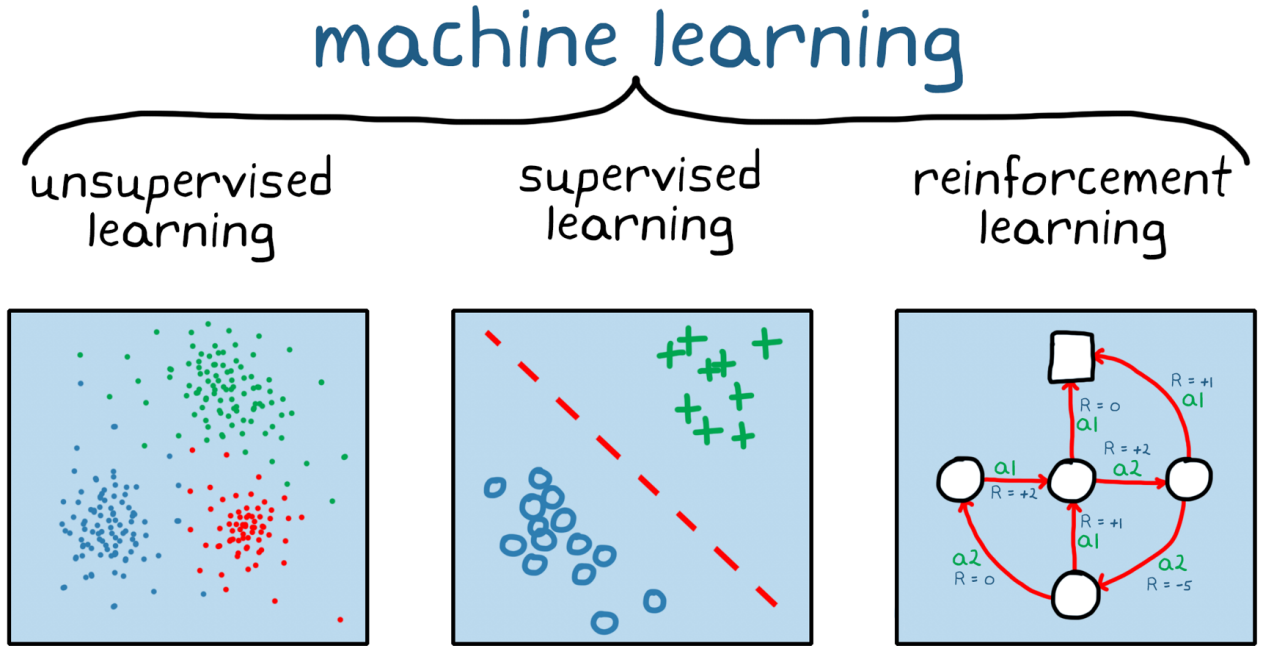

Figure 3: Machine Learning Concept

- An injection into the circular flow of income is money into the economy. Injections come in the form of exports, investment and government spending.
- A withdrawal into the circular flow of income is money going out of the economy. This is often in the form of imports, taxation and saving money.
- These injections and withdrawals mean that money can be put into the circular flow of income, however it can also escape the flow (or leak).
- If injections $=$ withdrawals, the economy is in equilibrium.
- Net injections result in a growth of the economy, whereas net withdrawals result in a contraction of the economy.

In this course, we focus on **Supervised Learning**.

Most of applications fall in Supervised learning (thus much promising).

Interim Summary

What we learned so far...

- Academic and unofficial definition of ML / DL
- The three items in Machine Learning technique
- And we only focus on Supervised Learning among them.

Gradient Descent Overview

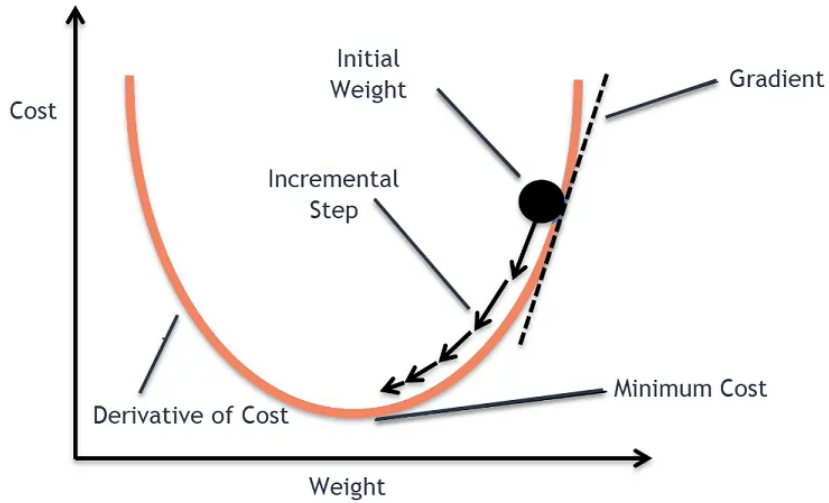

Figure 4: Gradient Descent is a way how Machine Learning framework learn. It is a core for Machine Learning

Gradient Descent Concept

Derivates always points to the local (perhaps global) minimum point. why?
Because, gradient $\frac{dy}{dx}$ at minimum point is 0.

The idea of gradient descent, in order to find minimum point, is an iterative process until the gradient becomes zero.

Gradient Descent Tutorial

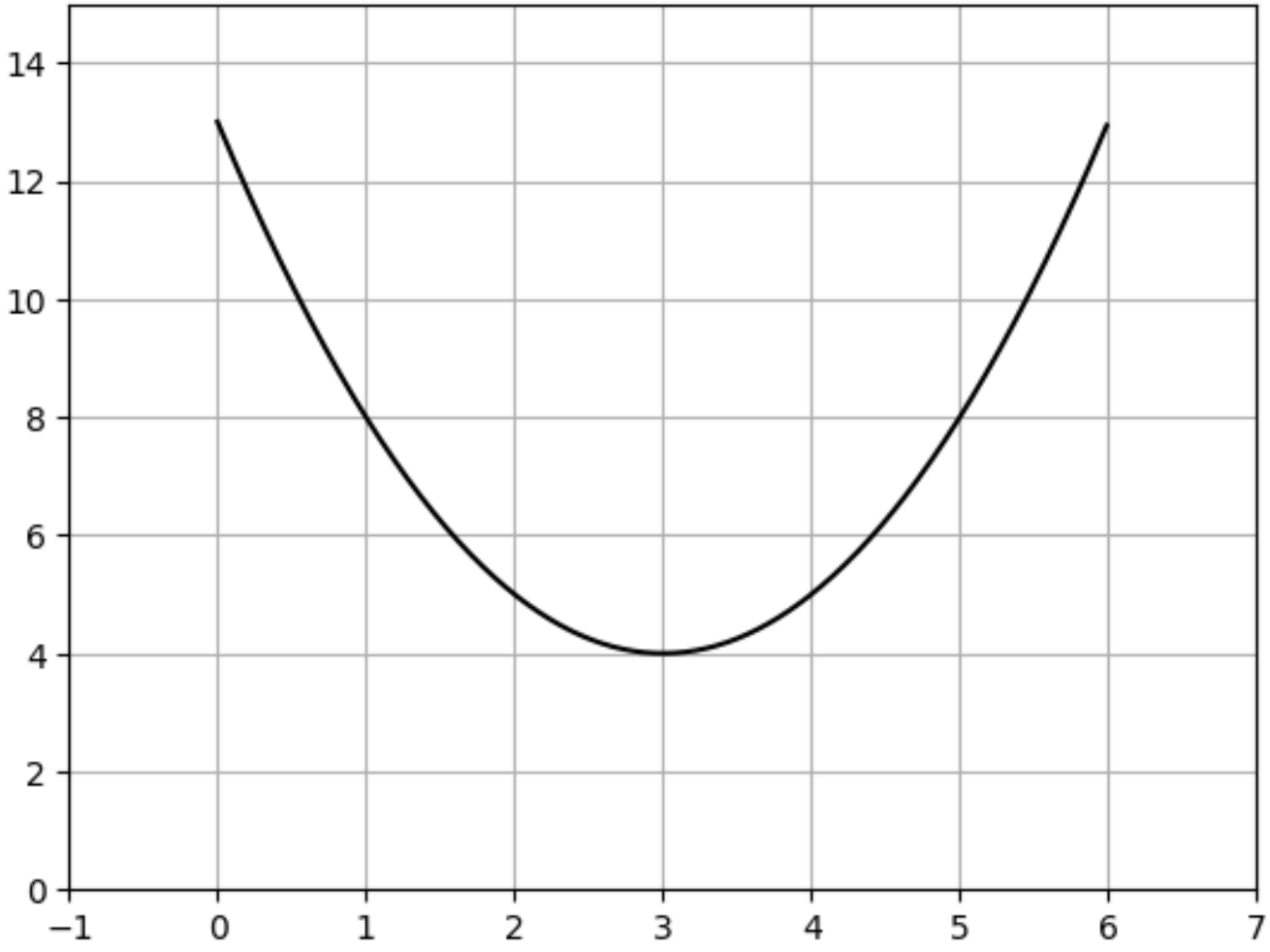

Figure 5: Function of $y = (x - 3)^2 + 4$

Comparison to Analytic Solution

How to get the minimum point(and its corresponding value)?

$$y = f(x) = (x-3)^2 + 4$$
$$\frac{dy}{dx} = 2(x-3) = 0$$

$$x^* = 3$$
$$y^* = f(x^*) = 4$$

Gradient Descent Tutorial

Do it !

Gradient Descent Tutorial

Algorithm 1: Gradient Descent Algorithm

$x \leftarrow x_0$;

for $i \leftarrow 1$ **to** N_{iter} **do**

  $y \leftarrow f(x)$;

  $x \leftarrow x - \alpha \frac{df(x)}{dx}$;

return x;

Gradient Descent Tutorial

Starts from $x_0 = 5$.
Learning rate is 0.1

Iteration	x	dy/dx	y
Iter 1	5.000	4.0	8
Iter 2	4.6	3.2	6.56
Iter 3	4.28	2.56	5.64
Iter 4	4.023	2.04	5.04
Iter 5	3.819	1.64	4.67
...	...	...	...
Iter 99	3.000	1e-9	4.0

Table 1: Gradient Descent tutorial

Today's summary

- Machine learning is based on gradient descent
- Gradient Descent is an iterative process which requires derivatives of function
- (Somehow intuitive...) Selection of learning rate α affects to convergence. (assignments)