Pattern Recognition
Homework 1 announcement

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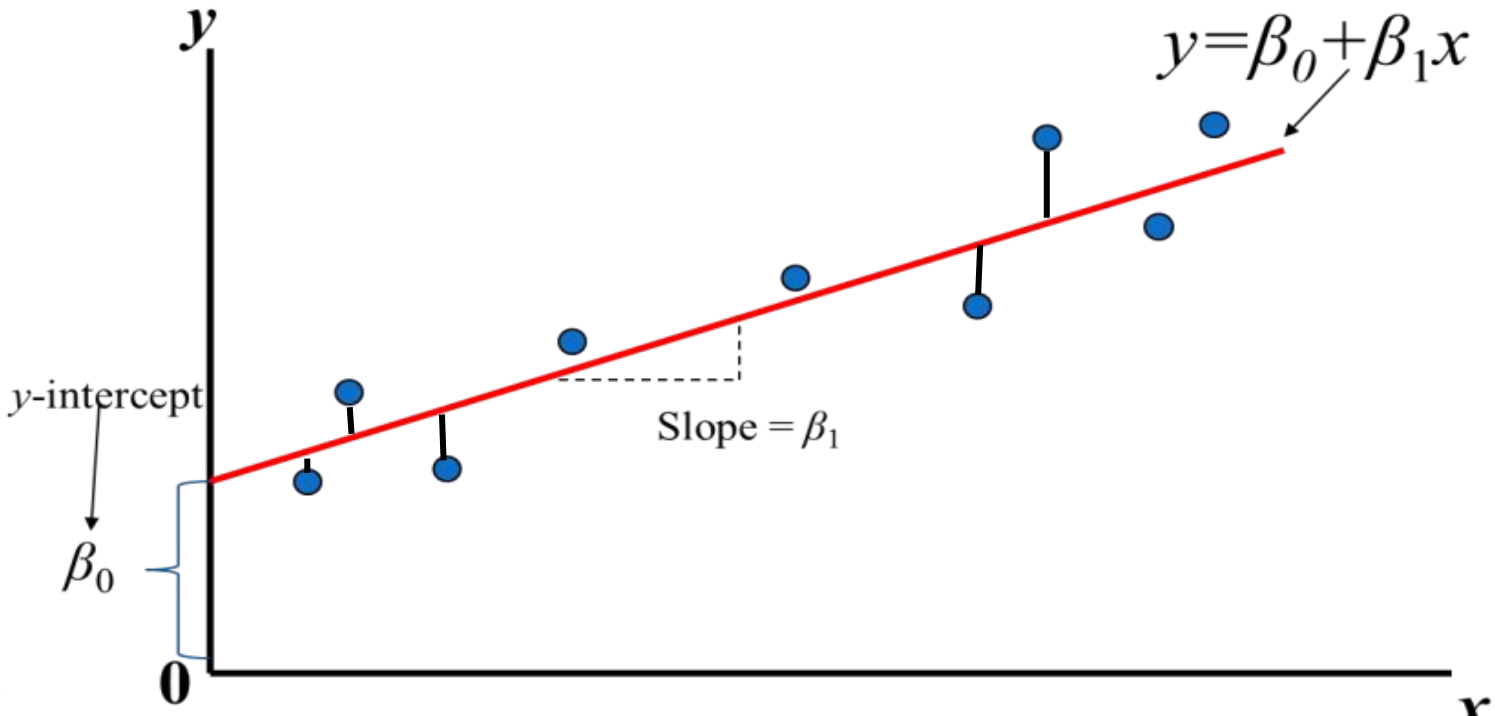
Homework 1

- **Deadline: March. 23, Wed at 23:59**
  1. Code assigment (60%): Implementing linear regression using only numpy
  2. Short answer questions (40%): Write your answer on **pdf**
- Submit the **code (.py/.ipynb)** and **answers (.pdf)** on E3
  - Include your answers of code/question in the pdf
  - HW1 questions
  - Sample Code

Naming rules: <STUDENT ID>_HW1

Linear Regression

- Find the value of β_0 and β_1



How to find β0 and β1?

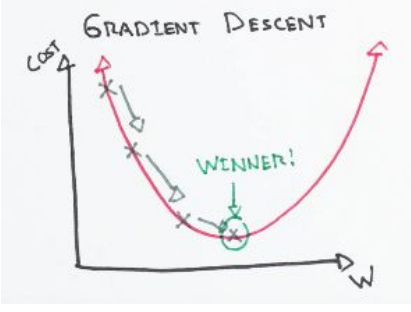
TRY and Error

β0 = -2, -1, 0, 1, 2,...
β1 = 1, 2, 3, 4, 5,...

Closed form solution

$$\hat{\beta} = (X^T.X)^{-1}X^T.Y$$

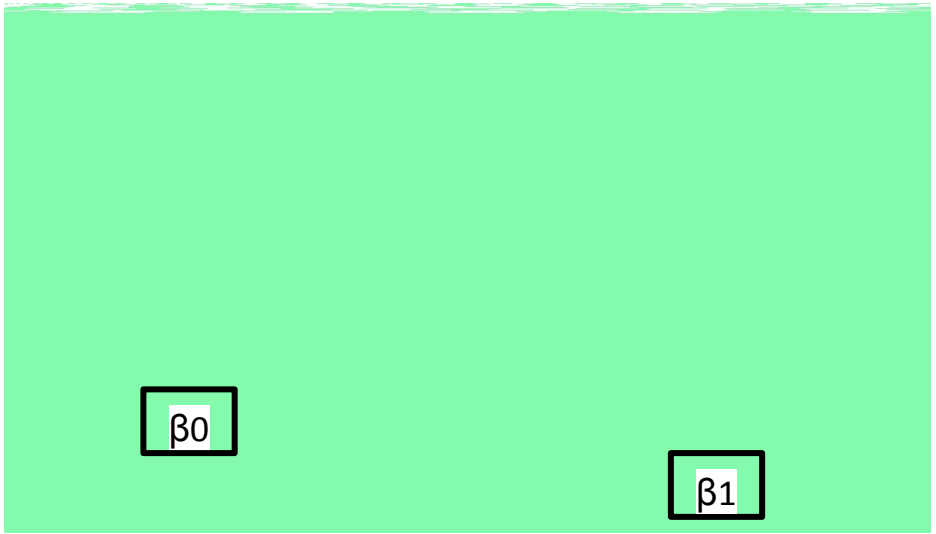
Gradient Descent



Gradient Descent

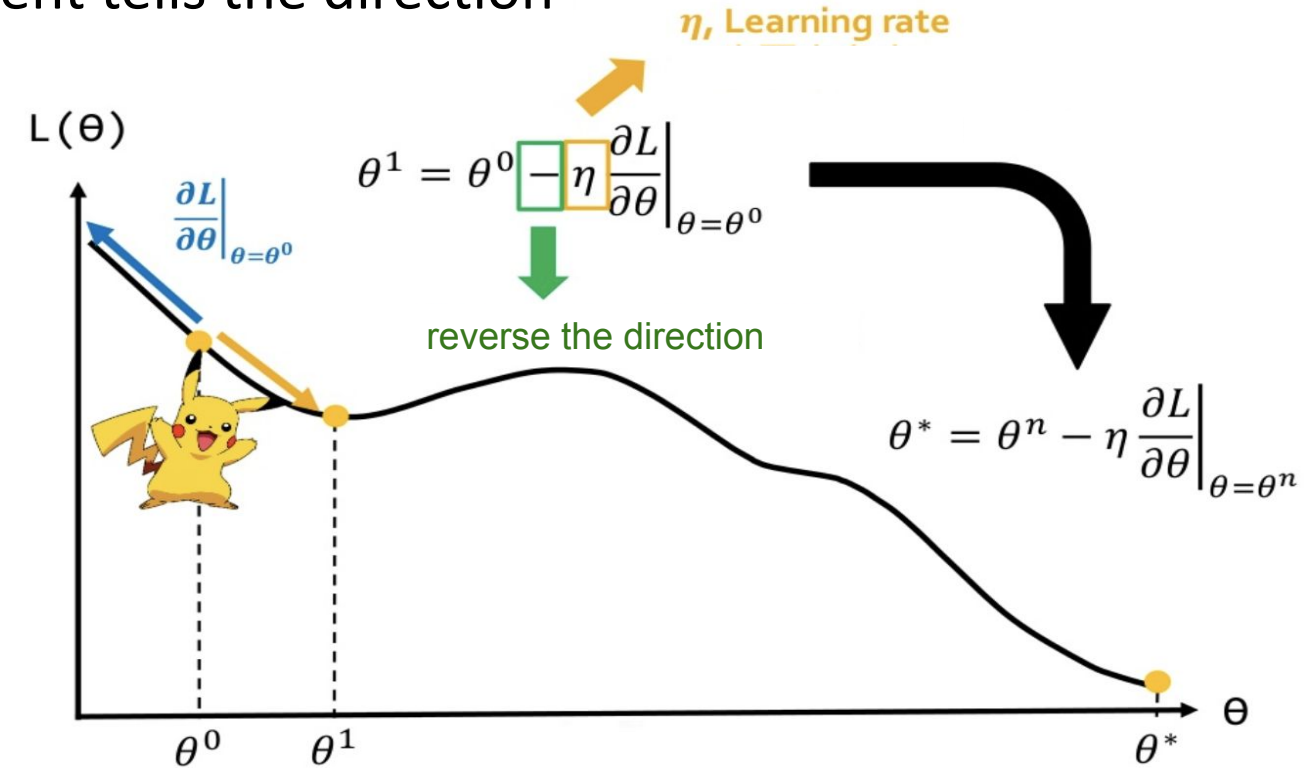
- x-axis and y-axis represent the value of weights
- z-axis represents the loss of the corresponding weights

- Targets: Find the weights that minimize the loss



Gradient Descent

- Gradient tells the direction



Gradient Descent pseudo code

Algorithm

1. Initialize weights randomly $\sim N(0, \sigma^2)$
2. Loop until convergence:
   i. Pick batch of B data points
   ii. Compute gradient. $\frac{\partial J(\Theta)}{\partial \Theta} = \frac{1}{B}\sum_{k=1}^{B} \frac{\partial J_k(\Theta)}{\partial \Theta}$
   iii. Update weights $\theta <- \theta - \eta \frac{\partial J(\Theta)}{\partial \Theta}$
3. Return weights

- Supplementary materials: Andrew NG: Gradient Descent

Code readability

- Write beautiful Python code with PEP8 guidelines for readability
- Base requirement: use whitespace correctly!

Python

```
# Recommended
def function(default_parameter=5):
    # ...


# Not recommended
def function(default_parameter = 5):
    # ...
```

Python

```
# Recommended
my_list = [1, 2, 3]

# Not recommended
my_list = [ 1, 2, 3, ]
```

Python

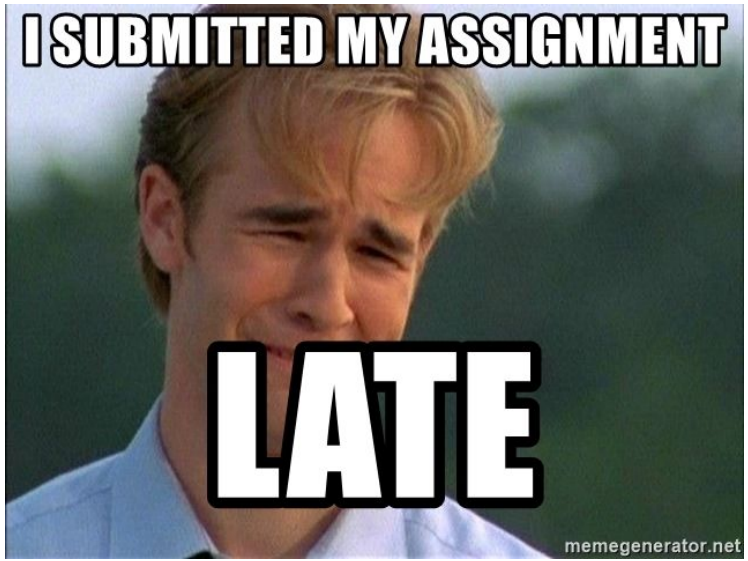
```
x = 5
y = 6

# Recommended
print(x, y)

# Not recommended
print(x , y)
```

Late policy

- We will deduct a late penalty of 20 points per additional late day
- For example, If you get 90 points of HW but delay for two days, your will get only 90- (20 x 2) = 50 points!



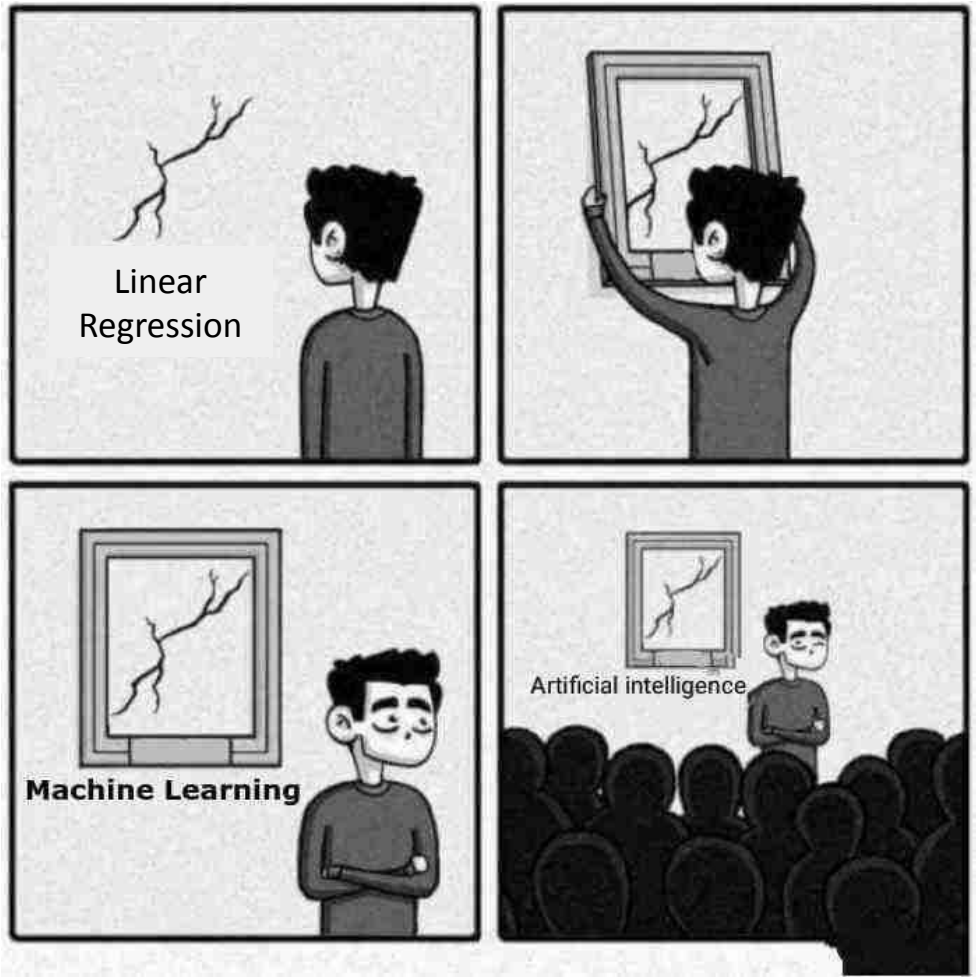
FAQ

- Why my loss is high and the training can not converge
  - Make sure you calculate the gradients correctly
  - Use smaller learning rate
- Can I use deep learning frameworks such as TensorFlow, Pytorch?
  - **No!** In HW1, you are request using only Numpy to implement linear regression and gradien descent. You can use matplotlib to plot the results.
- **DO NOT** copy homework from others! Otherwise, both of you will get 0 points for the homework

Notice

- Submit your homework on E3-system !
- Check your email regularly, we will mail you if there are any updates or problems of the homework
- If you have any questions or comments for the homework, please mail me and cc Prof. Lin
  - Prof. Lin, lin@cs.nctu.edu.tw
  - TA Jimmy, d08922002@csie.ntu.edu.tw
  - TA 晨軒, derekt.cs06@nctu.edu.tw
  - TA 政儒, ace52751208@gmail.com

Have fun!


Linear
Regression
Machine Learning
Artificial intelligence