Pembelajaran Mesin

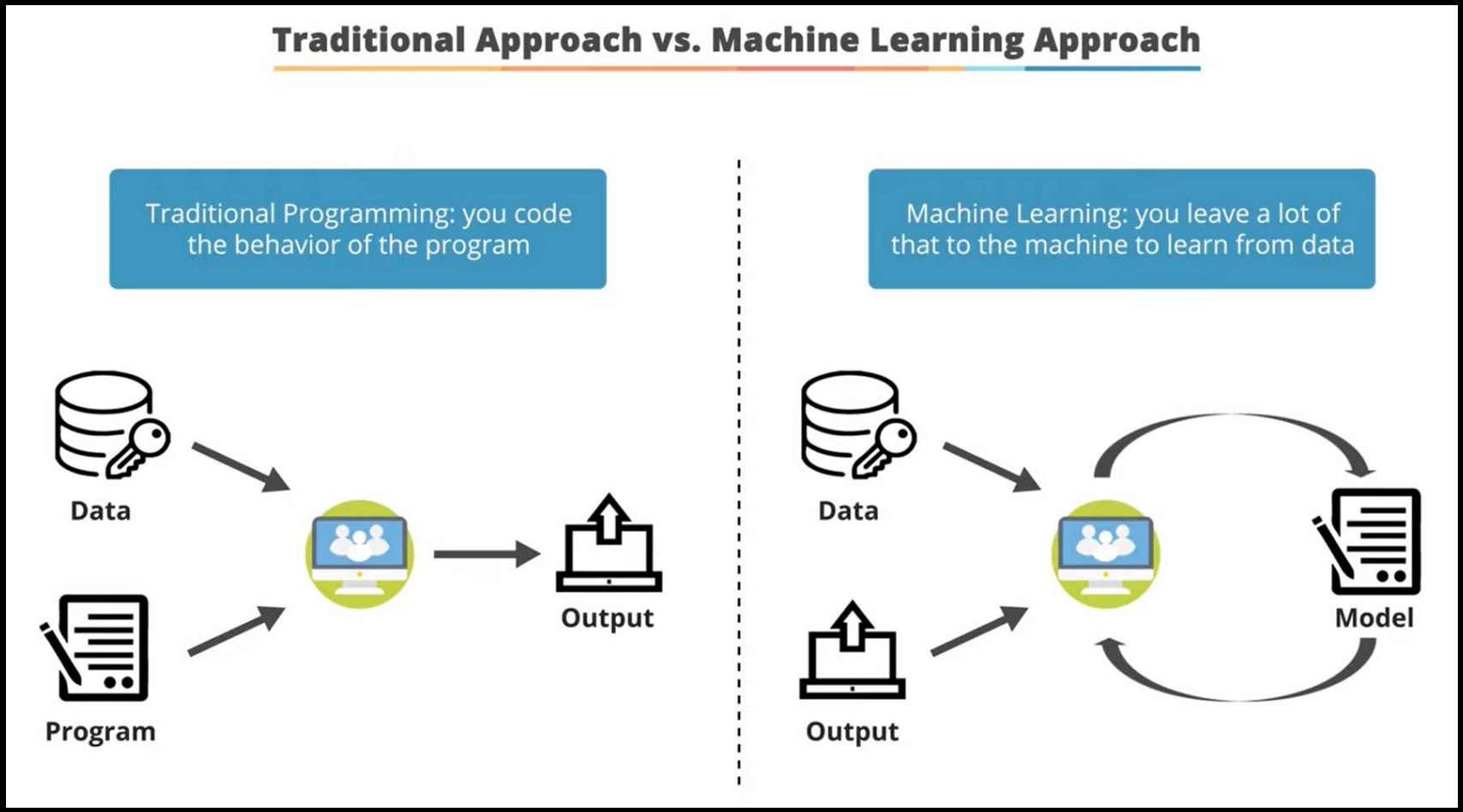
Machine Learning (ML)

Artificial Intelligence?

"The science and engineering of making intelligent machines, especially intelligent computer programs". (John McCarthy)

ARTIFICIAL INTELLIGENCE

AI in a nutshell



GENERAL FLOW

Traditional Approach

8 → f(x) = 2x → 16

data

x	y
1	2
2	4
3	6
4	8
5	10
6	12
7	14

y = 2x

Mudah melihat fungsinya (rule)!

Coba Tebak Fungsi/Rule-nya…!

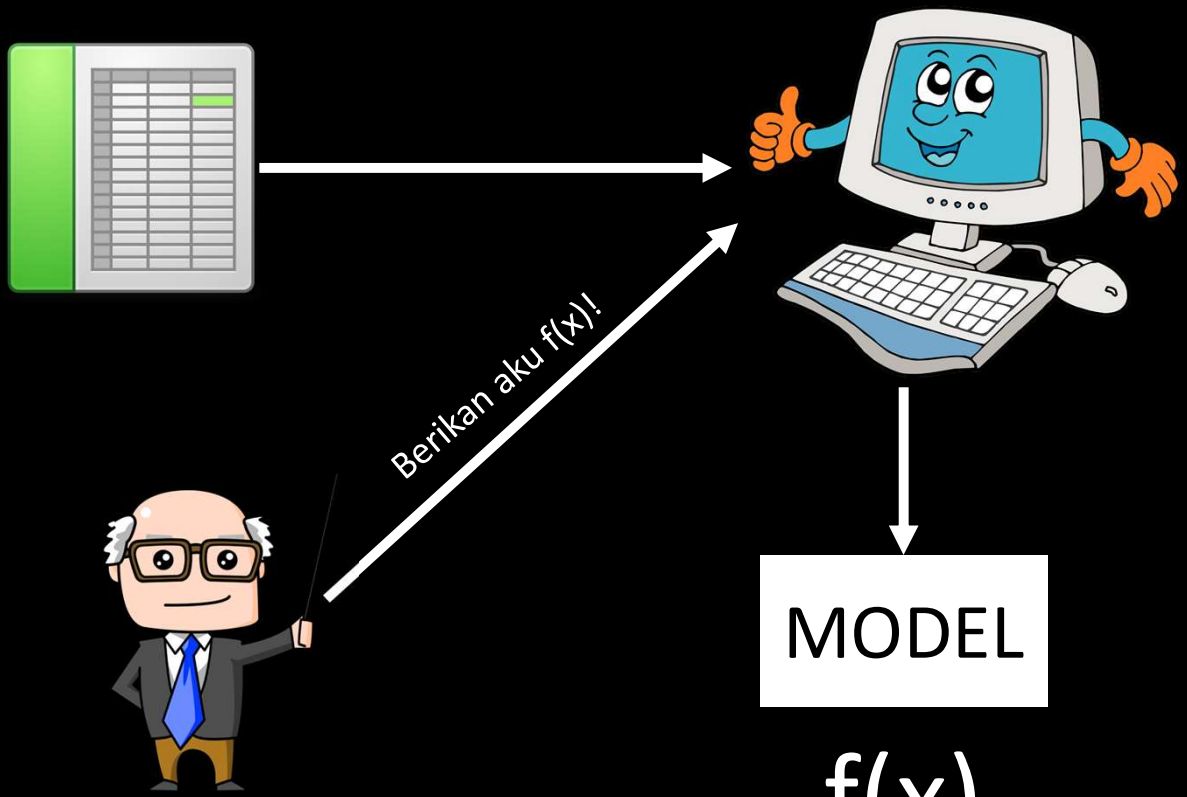
x	y
1	1
2	4
3	9
4	16
5	25
6	36
7	49

y =

x	y
1	3
2	7
3	13
4	21
5	31
6	43
7	57

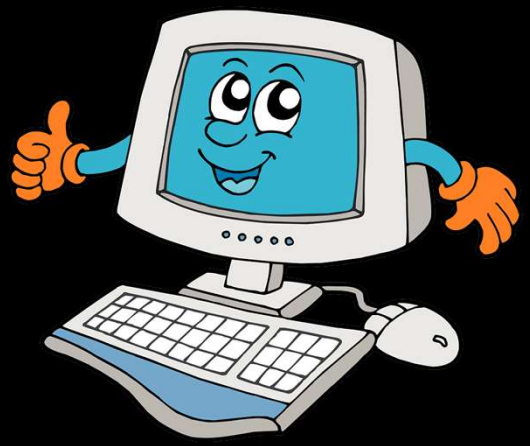
y =

Machine Learning Approach

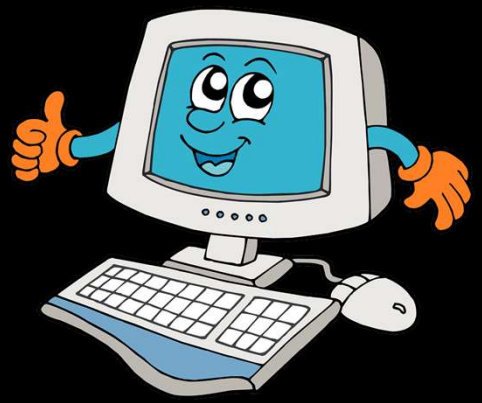


GOAL?

Aku sudah terlatih dan pintar!



Jadi, apa yang bisa kubantu?



Ya, aku bisa memprediksi “sesuatu”

Dari data di masa depan yang belum pernah kulihat

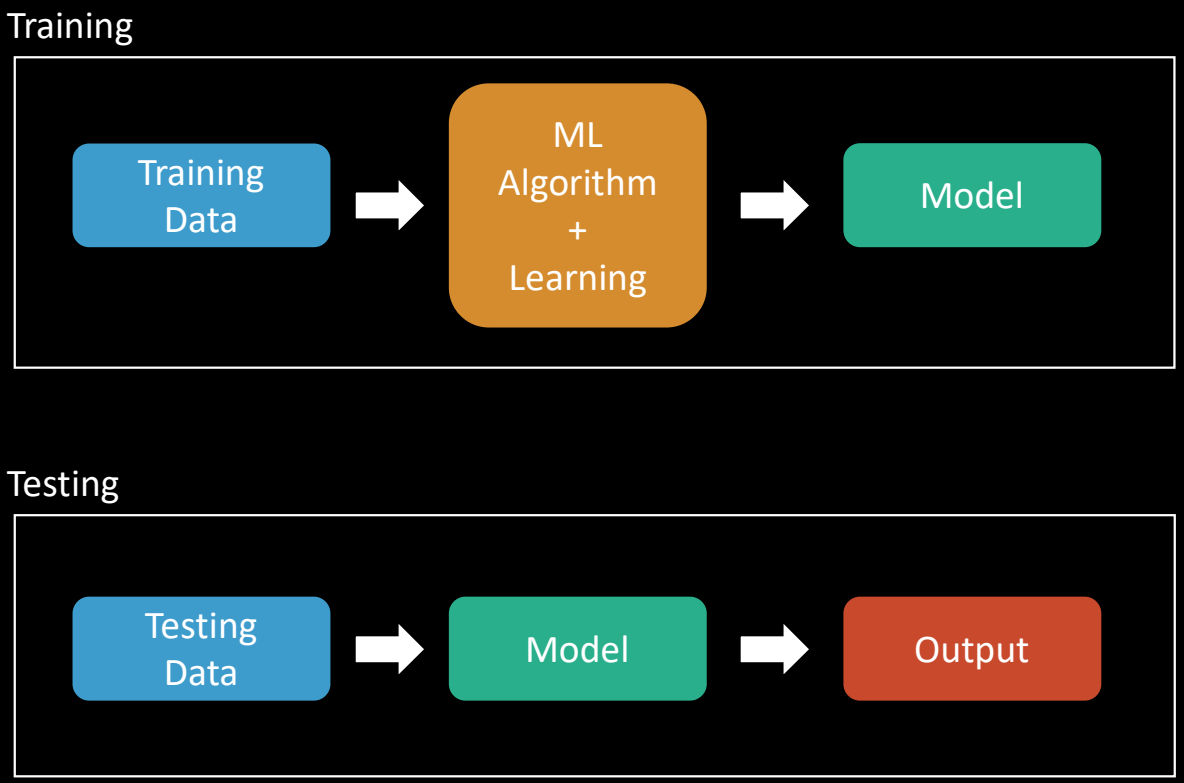
Perlu diingat!

Prediksiku hanya estimasi, bisa saja salah ☺

Machine Learning Definition

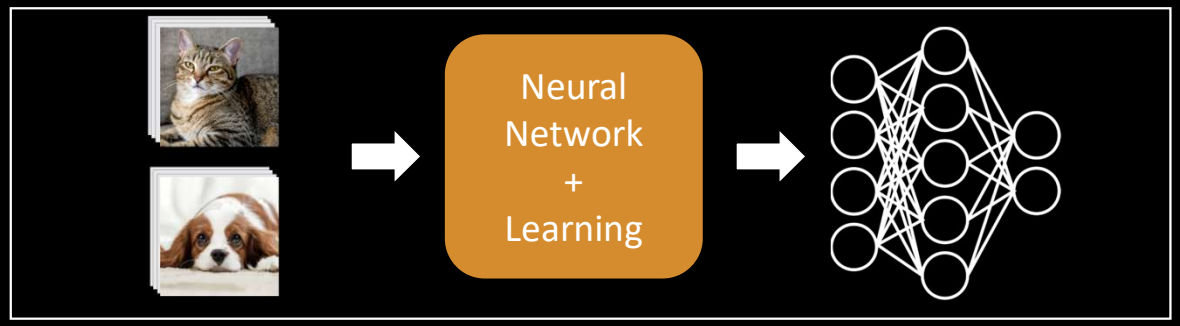
“Machine learning is a branch of artificial intelligence that enables computers to learn from data and improve their performance over time without being explicitly programmed.“ (Arthur Samuel)

Workflow

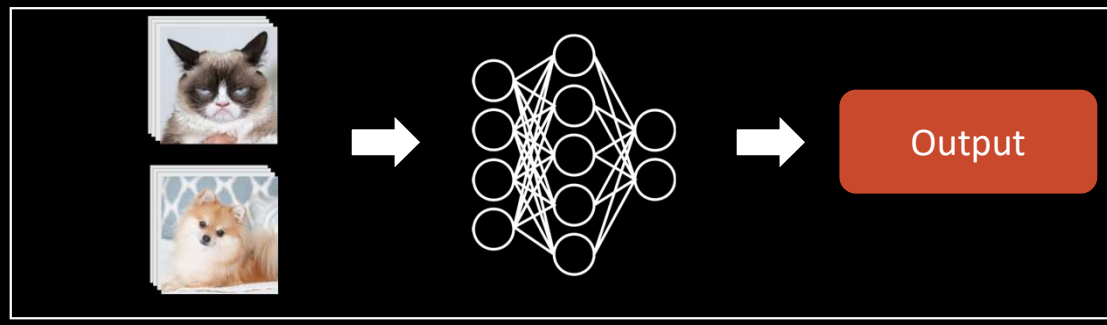

Training
Training Data
ML Algorithm + Learning
Model
Testing
Testing Data
Model
Output

Workflow (cont'd)

Training



Testing



Jenis-jenis learning

Supervised Learning

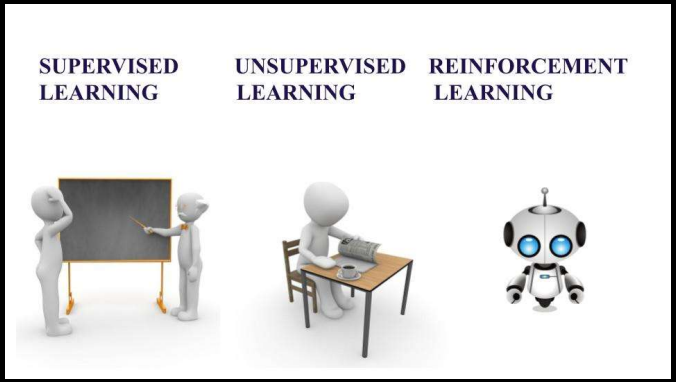
Model dilatih dengan data yang diberi label sesuai keluaran yang sebenarnya.

Unsupervised Learning

Model dilatih dengan data yang tidak terlabel. Model diharapkan mencari pola tersembunyi.

Reinforcement Learning

Model dilatih pada lingkungan tertentu dengan trial and error. Biasanya dengan proses reward and punishment.



Intuition Behind Learning

Parameters

Internal variables or settings of a model that determine its behavior and ability to make predictions. Parameters are learned or adjusted during the training phase of the model.

Loss function

Also known as cost function or objective function, is a mathematical function that measures the difference between the predicted output of a machine learning model and the actual output.

Optimization

Process of finding the best set of parameters or weights for a model that minimizes a given loss function.

Training data: $\{(x_i, y_i)\}_{i=1}^{n}$

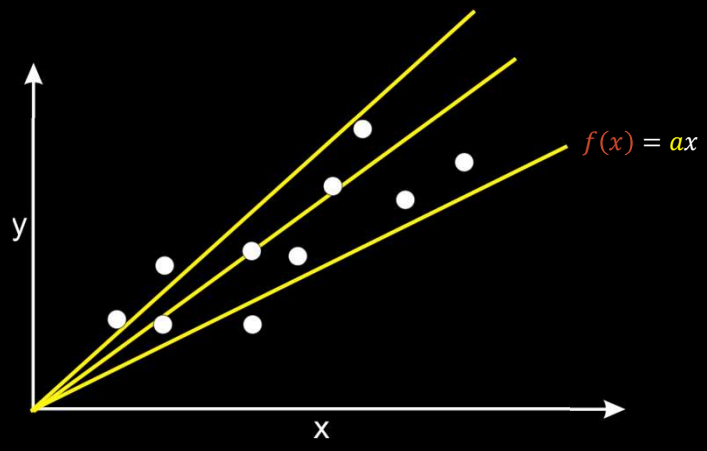
$$f(x) = ax + b$$

Temukan a dan b terbaik, sehingga $f(x_i) \approx y_i$

Let's play..

Training data: $\{(x_i, y_i)\}_{i=1}^{n}$

$f(x) = ax + b$ Temukan a terbaik, sehingga $f(x_i) \approx y_i$

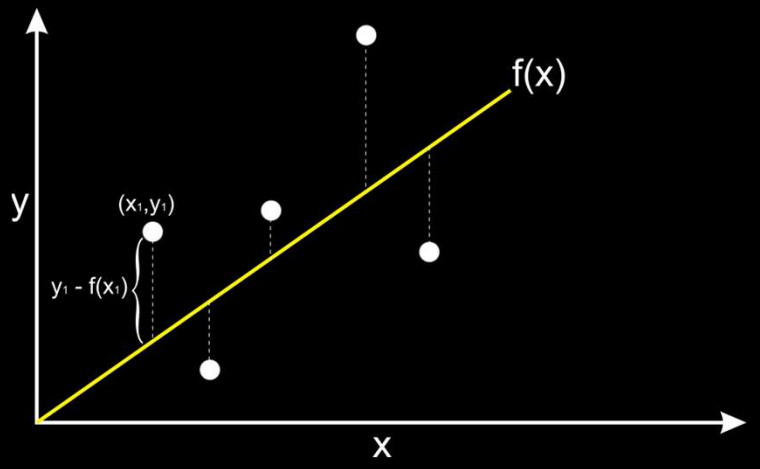


1. Pilih sebuah Loss Function:

$$L(a) = \frac{1}{n} \sum_i (y_i - f(x_i))^2$$

$MSE\ (Mean\ Squared\ Error)$

$$L(a) = \frac{1}{n} \sum_i (y_i - ax_i)^2$$



Let's play.. (cont'd)

1. Pilih sebuah Loss Function:

$MSE\ (Mean\ Squared\ Error)$

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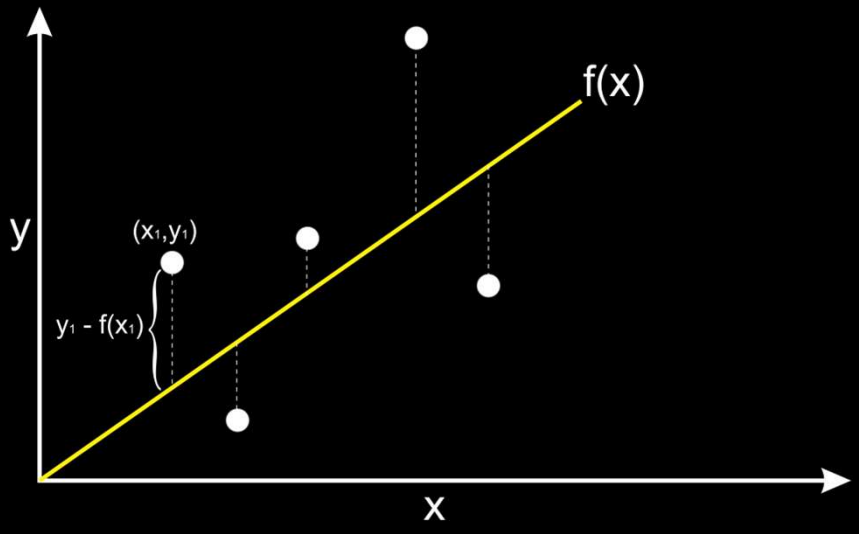
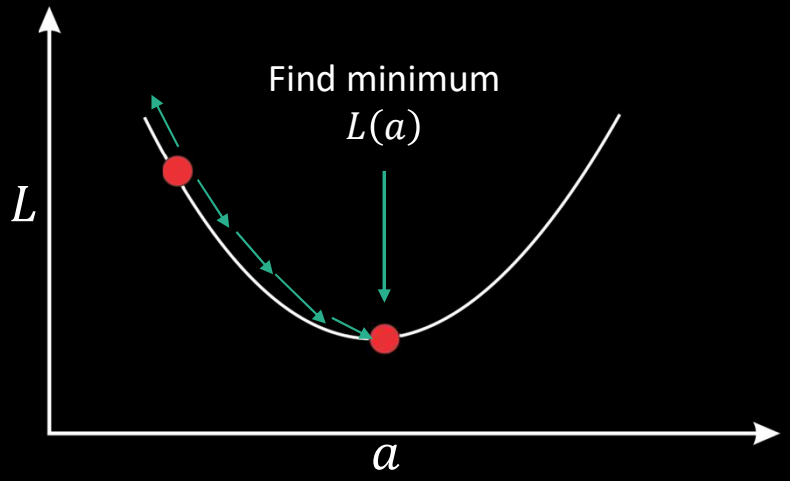
$$f(x) = ax$$



2. Tentukan tujuan (objective)

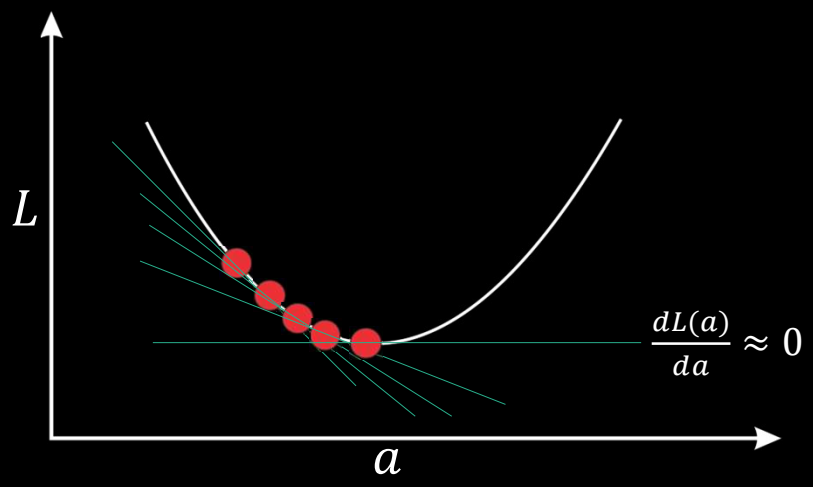
$$minimize\ L(a)$$



Let's play.. (cont'd)

2. Tentukan tujuan (objective)

$$minimize\ L(a)$$



3. Buat aturan untuk update nilai a

$$a_{baru} \leftarrow a_{lama} - \eta \frac{dL(a)}{da}$$

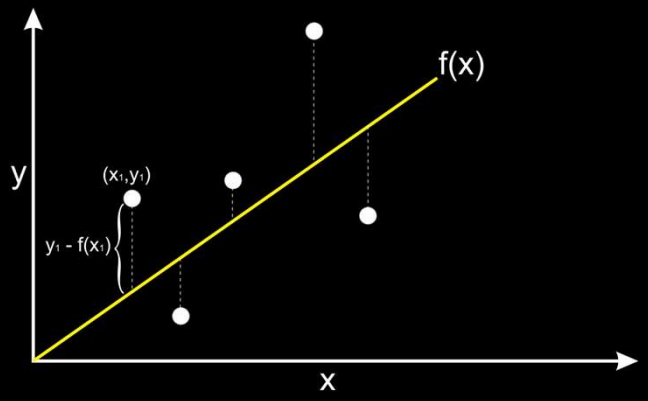
η = learning rate

3. Berhenti jika telah mencapai convergence

$$f(x) = a_{baru}x$$

We have a new model!!

Summary



We have dataset

$\{(x_i, y_i)\}_{i=1}^{n}$

We have a model

$f(x) = ax$

Calculate the loss

$$L(a) = \frac{1}{n}\sum_{i}(y_i - ax_i)^2$$

Update parameter(s)
(optimization/minimization)

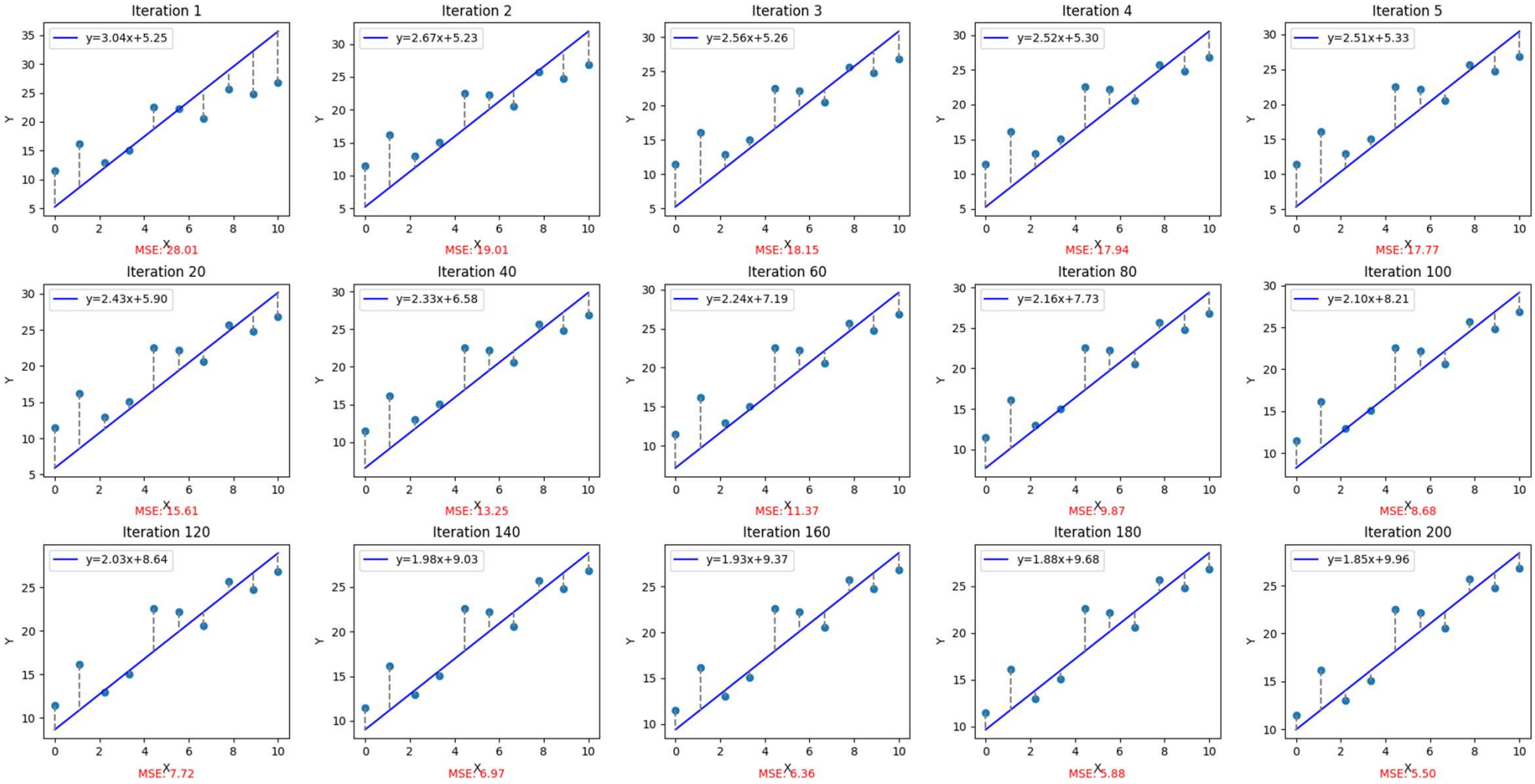
$$a_{baru} \leftarrow a_{lama} - \eta\frac{dL(a)}{da}$$

No

Stop(?)

Yes

$$f(x) = a_{baru}x$$


Iteration 1
y=3.04x+5.25
MSE: 28.01
Iteration 2
y=2.67x+5.23
MSE: 19.01
Iteration 3
y=2.56x+5.26
MSE: 18.15
Iteration 4
y=2.52x+5.30
MSE: 17.94
Iteration 5
y=2.51x+5.33
MSE: 17.77
Iteration 20
y=2.43x+5.90
MSE: 15.61
Iteration 40
y=2.33x+6.58
MSE: 13.25
Iteration 60
y=2.24x+7.19
MSE: 11.37
Iteration 80
y=2.16x+7.73
MSE: 9.87
Iteration 100
y=2.10x+8.21
MSE: 8.68
Iteration 120
y=2.03x+8.64
MSE: 7.72
Iteration 140
y=1.98x+9.03
MSE: 6.97
Iteration 160
y=1.93x+9.37
MSE: 6.36
Iteration 180
y=1.88x+9.68
MSE: 5.88
Iteration 200
y=1.85x+9.96
MSE: 5.50
X
Y

What we've learned..

- Definisi AI ML
- Intuisi learning dalam ML
- How to train ML (Parameters, Loss Function, Optimization)

Next lecture…

- Kapan kita menggunakan ML
- Membahas tugas-tugas dalam ML
- Membahas algoritma-algoritma dalam ML
- Cara menentukan metrik-metrik evaluasi performa ML

Question?

Thank You