Session 49

Classification for Text Dataset

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What will We Learn Today?

1. Text Classification
2. Sentiment analysis
3. Classification using Machine Learning models

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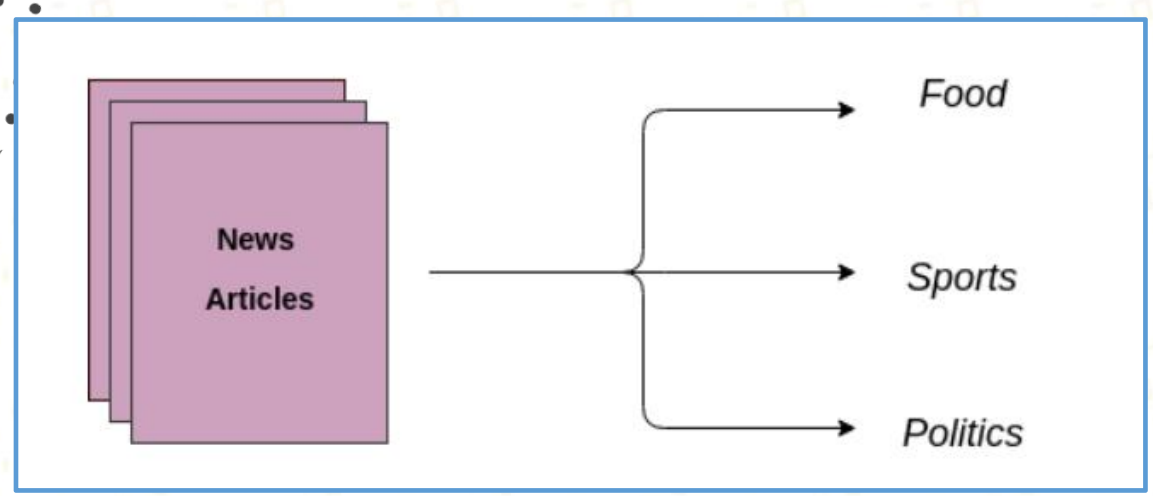
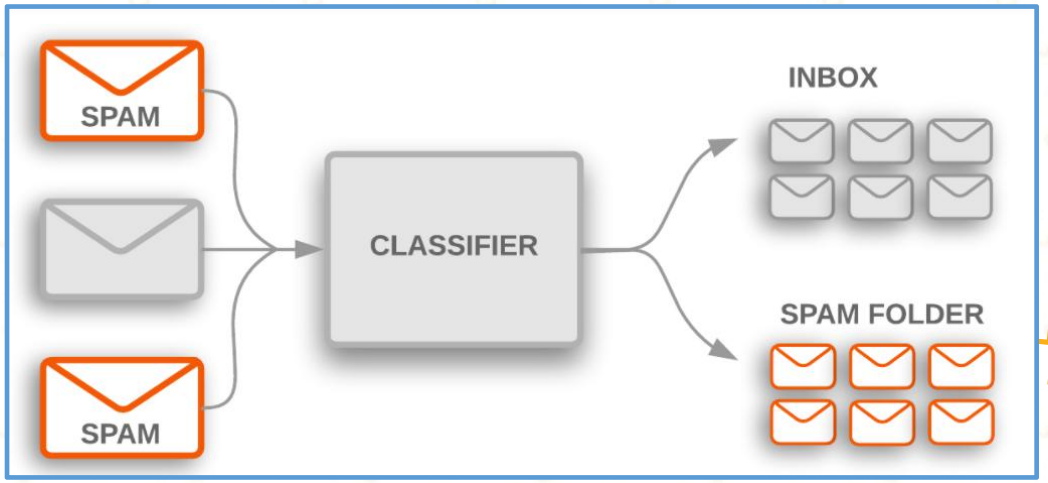
Text Classification

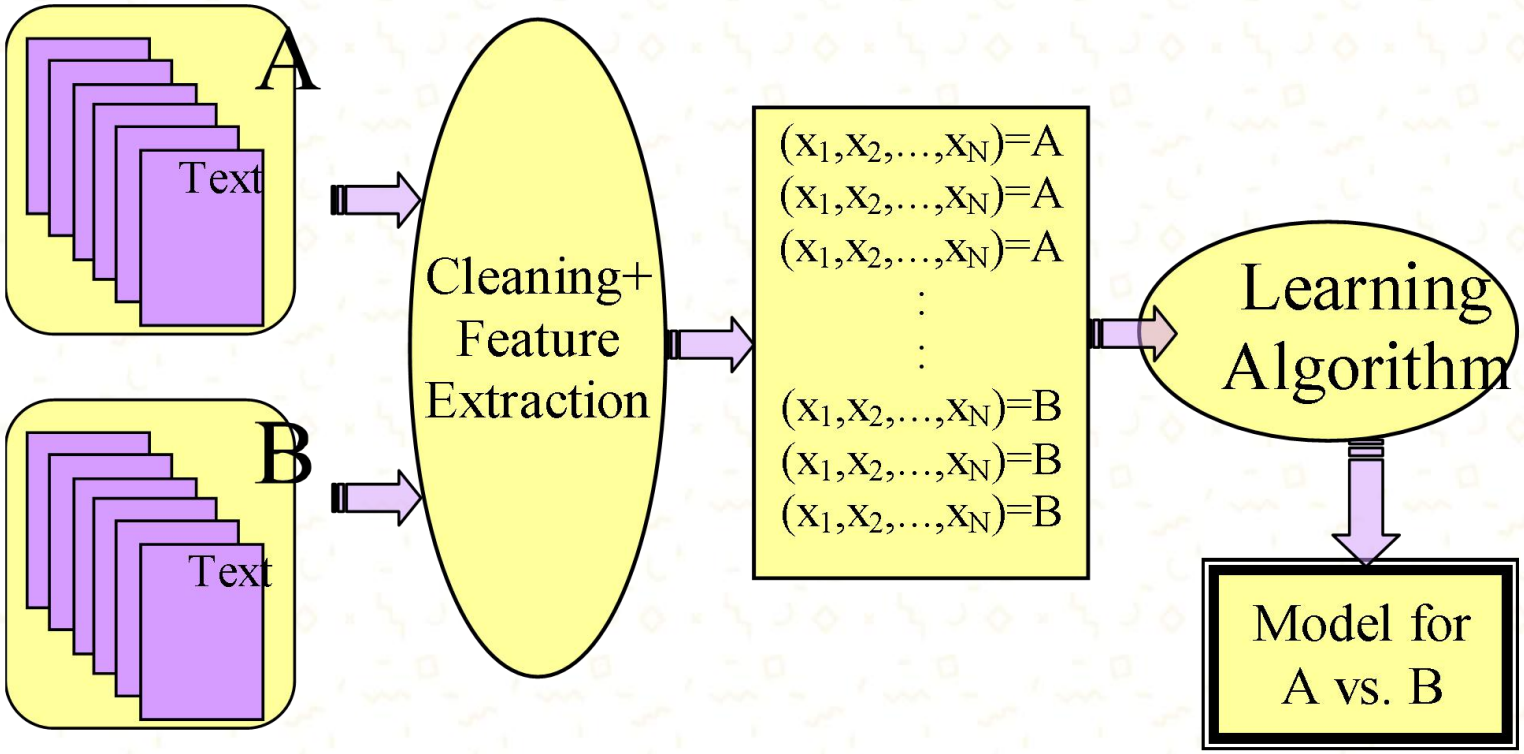
Text Classification

- *Text classification* juga dikenal sebagai *text tagging* atau *text categorization* adalah proses mengkategorikan teks ke dalam kelompok tertentu.
- *Text classification* adalah salah satu tugas dasar dalam *natural language processing (NLP)* dengan aplikasi yang luas contohnya *sentiment analysis, topic labeling, spam detection, dan intent detection*.



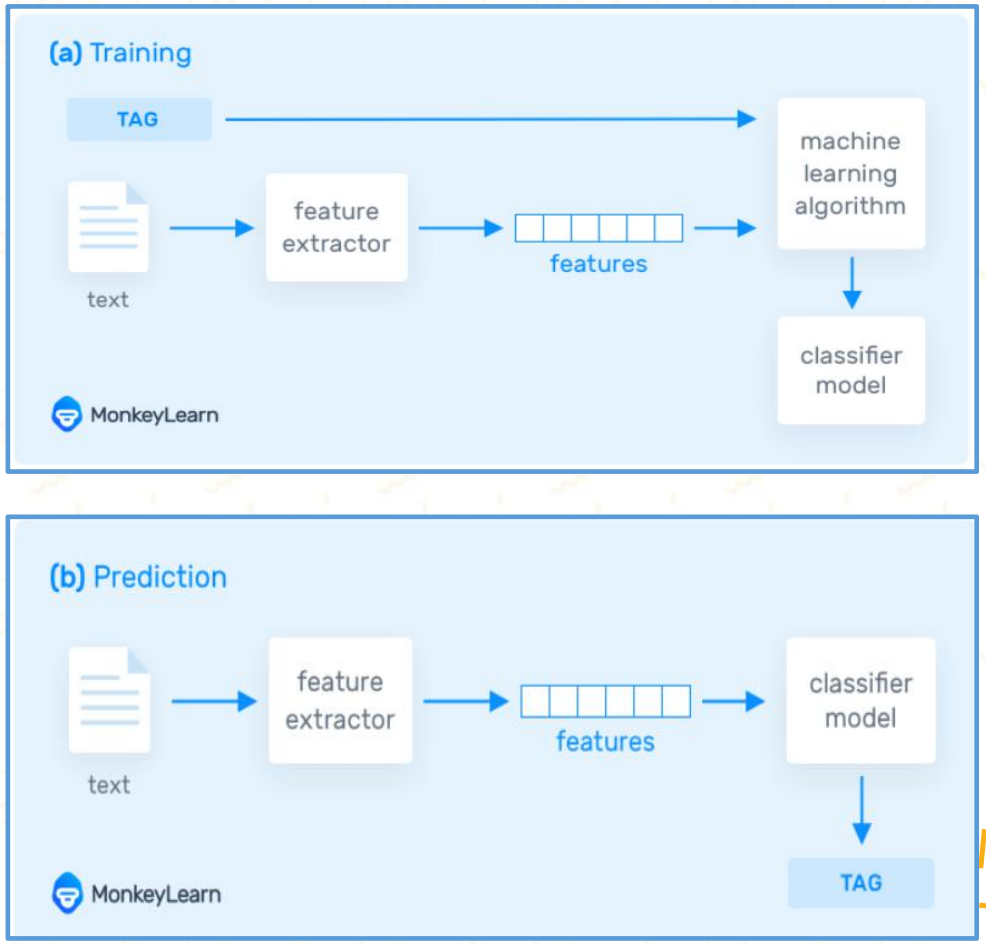


Text Classification



Text Classification

- Ada tiga pendekatan dalam *text classification*
- ***Rule-based System***
  - Teks dipisahkan ke dalam kelompok terorganisir menggunakan *handicraft linguistic rules.*
- ***Machine Learning-based System***
  - *ML-based classifier* membuat klasifikasi berdasarkan pengamatan sebelumnya dari kumpulan data
- ***Hybrid System***
  - Menggabungkan *machine learning classifier* dengan *rule-based system*, digunakan untuk meningkatkan performa.



Machine Learning-based System

https://monkeylearn.com/text-classification/

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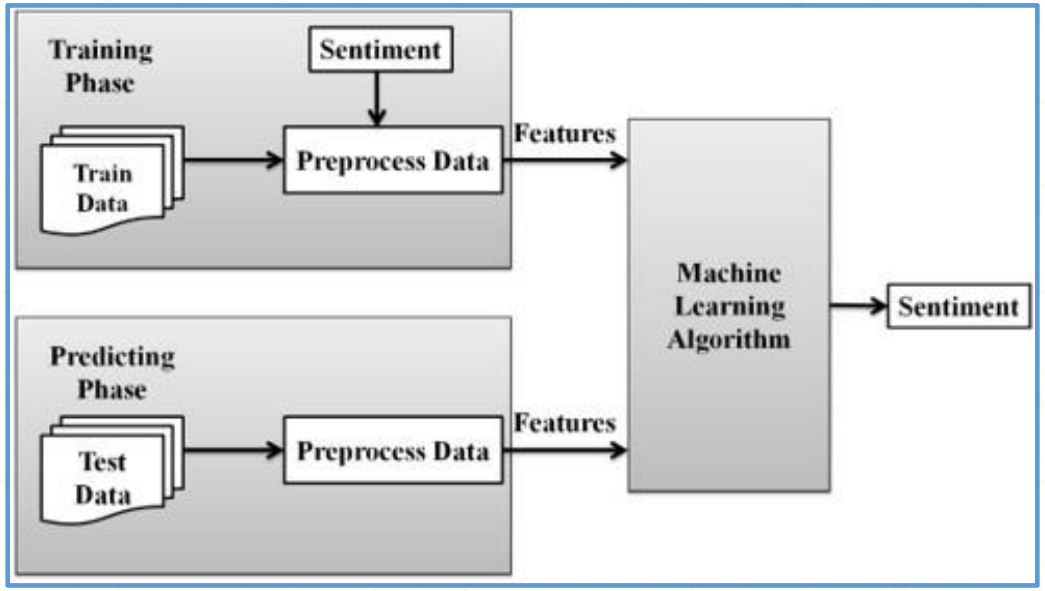
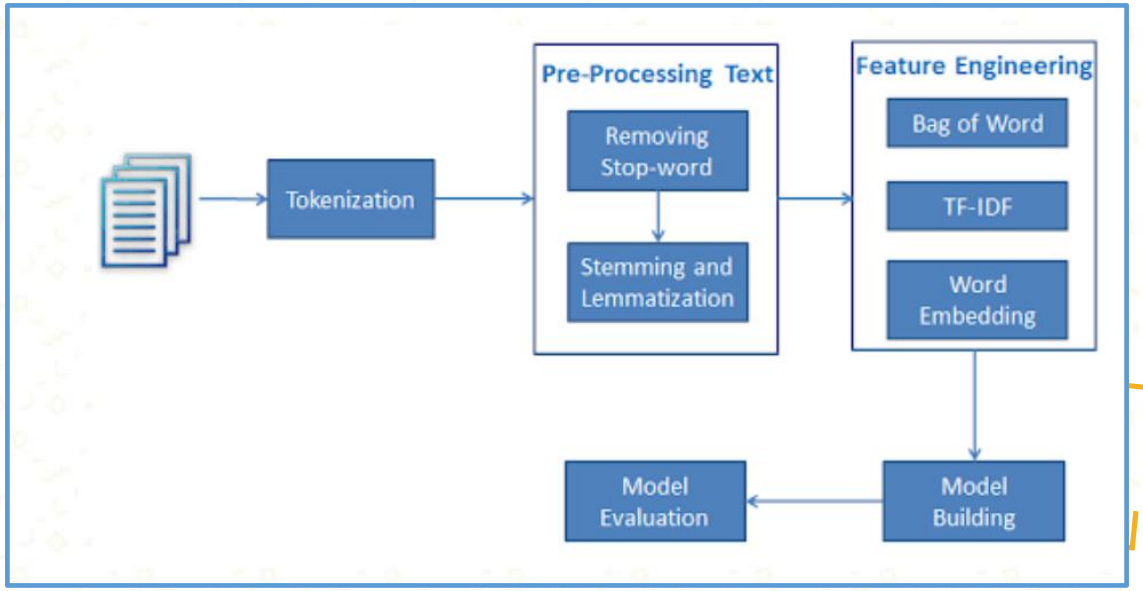
Sentiment analysis

Sentiment Analysis-Definition

- Salah satu contoh aplikasi dari *text classification* adalah *sentiment analysis.*
- Adalah metode yang secara otomatis memahami persepsi pelanggan terhadap suatu produk atau layanan berdasarkan komentar mereka.





Pre-processing the Text

1. Tokenization
2. Removing stop words
3. Stemming or Lemmatization

sudah dijelaskan di pertemuan sebelumnya

1

Text
"The cat sat on the mat."
↓
Tokens
"the", "cat", "sat", "on", "the", "mat", "."

2

Stop Words

These words include:

- a
- I
- the
- in
- of
- for
- at
- to
- on
- with
- from

3

Stemming vs Lemmatization

Feature extraction

1. Bag of Words
2. TF-IDF (Term frequency–inverse document frequency)
3. Word Embedding

sudah dijelaskan di pertemuan sebelumnya

```
doc1 = "saya belajar pemrograman dan belajar melukis"
doc2 = "saya membantu adik saya belajar menulis"
doc3 = "ibu belajar menjahit"
```

1

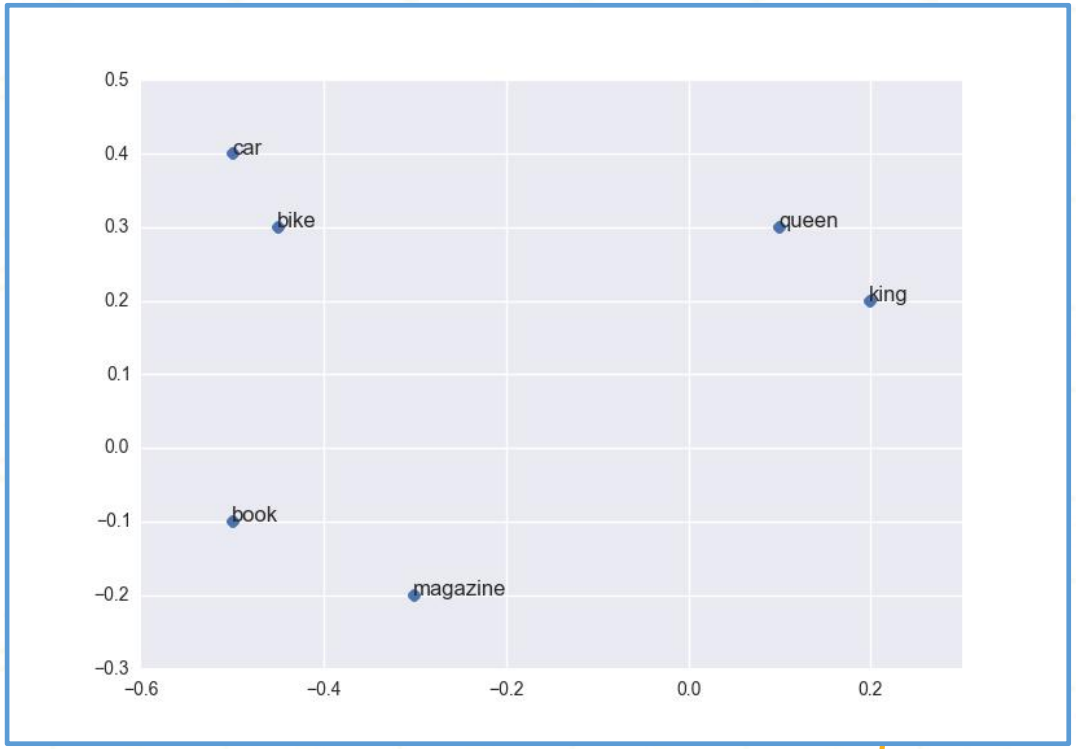
adik	belajar	dan	ibu	melukis	membantu	menjahit	menulis	pemrograman	saya
0	2	1	0	1	0	0	0	1	1
1	1	0	0	0	1	0	1	0	2
0	1	0	1	0	0	1	0	0	0

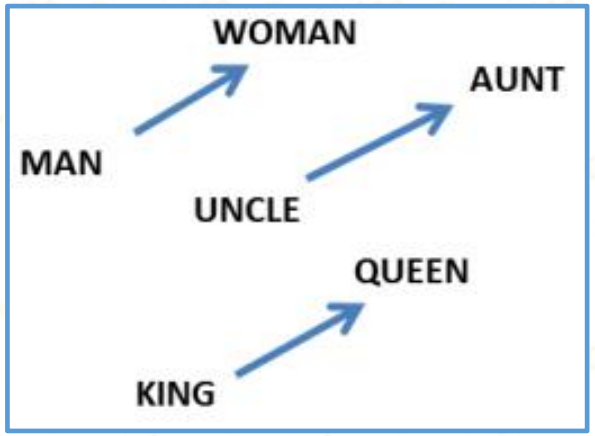
2

adik	belajar	dan	ibu	melukis	membantu	menjahit	menulis	pemrograman	saya
0	2	2.0986123	0	2.0986	0	0	0	2.09861229	1.405465
2.098612	1	0	0	0	2.09861229	0	2.0986123	0	2.81093
0	1	0	2.0986	0	0	2.09861229	0	0	0

Word Embedding

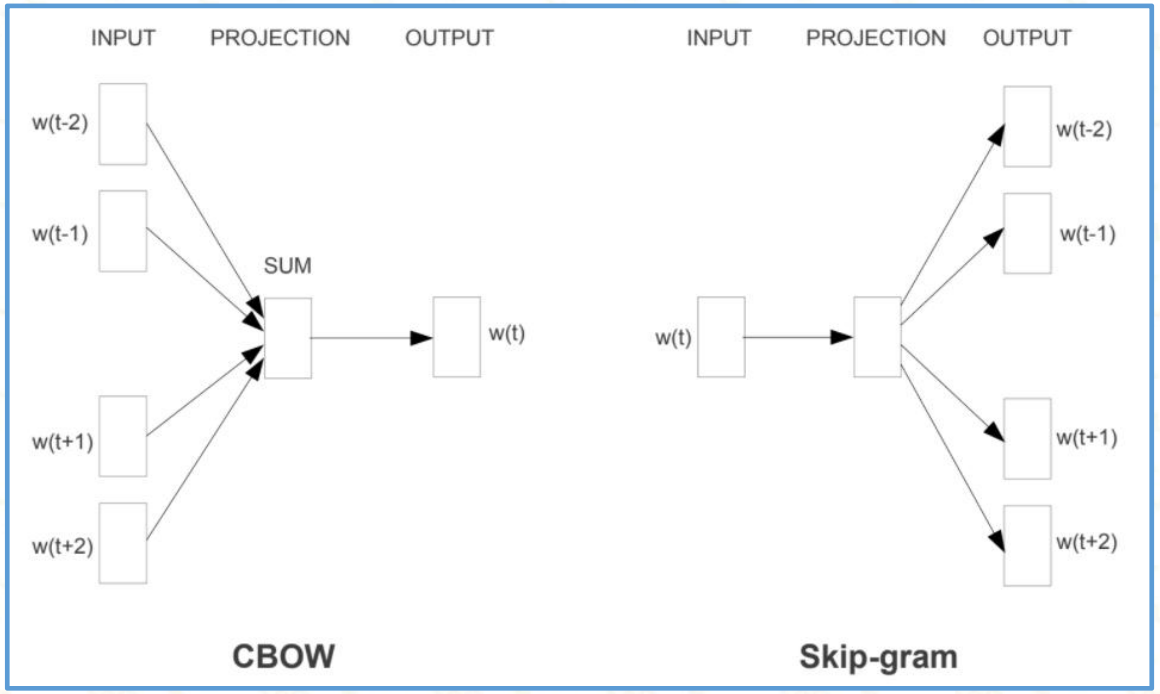
- *Word embedding*
  - Mampu menangkap konteks kata dalam dokumen, kesamaan semantik, hubungan dengan kata lain, dll.
  - Dengan *word embedding*, kata-kata yang memiliki properti tertentu, misalnya berada pada konteks yang sama, atau memiliki *semantic meaning* yang sama berada tidak jauh satu sama lain pada *space* tersebut.





Word2Vec

- Menggunakan model *ANN* untuk mempelajari asosiasi kata dari kumpulan teks yang besar.
- *Word2Vec* terdiri dua teknik yaitu *Continous Bag of Words (CBOW)* dan *Skip Gram Model.*
- The *CBOW* model memprediksi kata saat ini berdasarkan konteksnya.
- *Skip-gram model* belajar dengan memprediksi kata-kata di sekitarnya dengan diberikan kata saat ini.



CBOW model

https://machinelearningmastery.com/what-are-word-embeddings/

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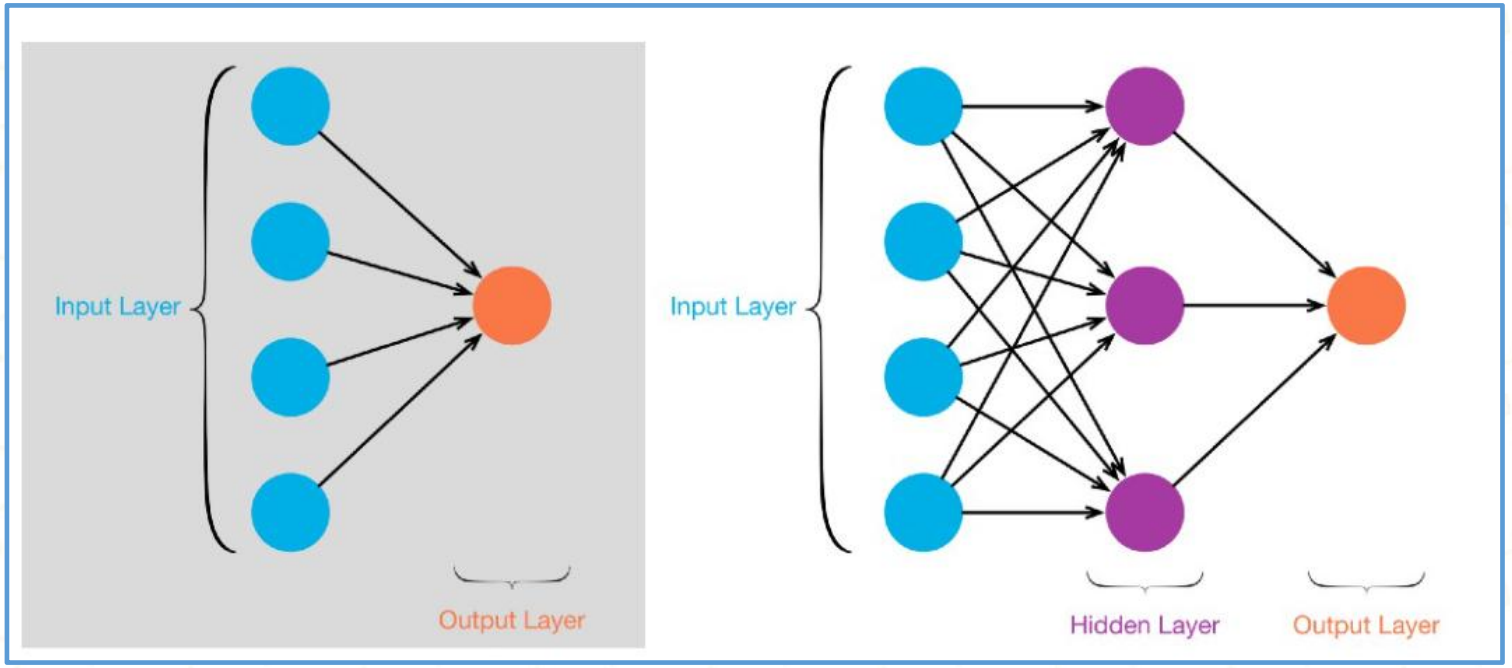
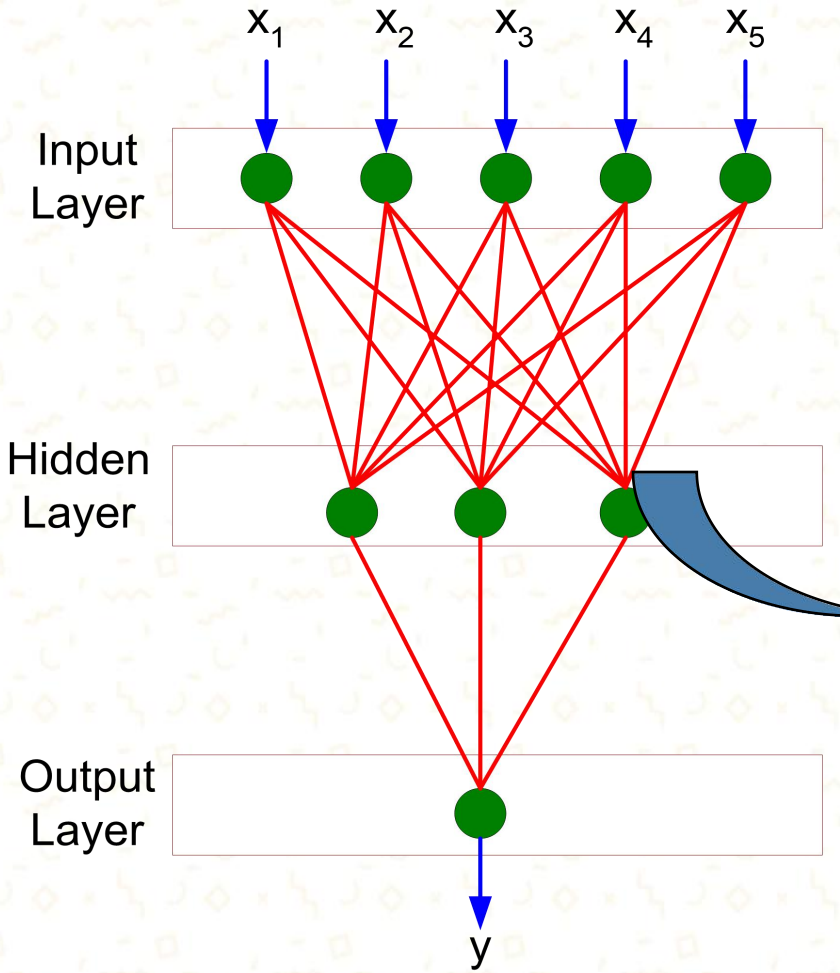
Classification using Machine Learning models

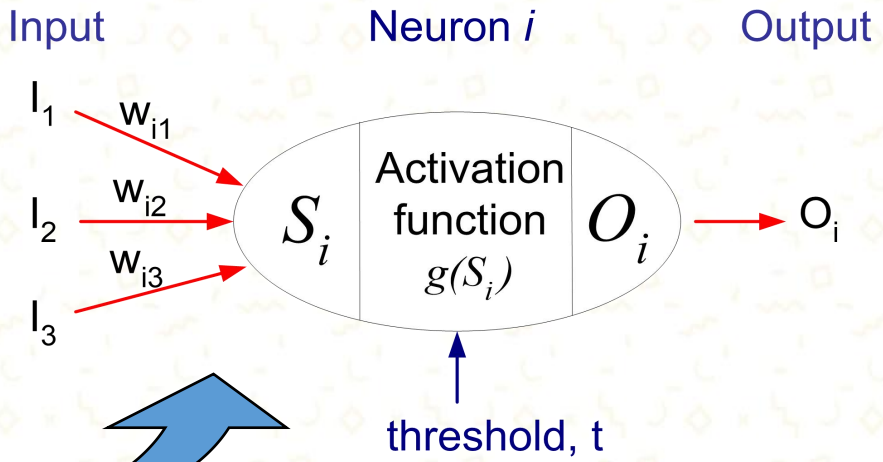
Multilayer perceptron (MLP)

- Type dari Artificial Neural Network Model yang terdiri dari tiga jenis layer — input layer, hidden layer, output layer.
- Kecuali node input, setiap node adalah neuron yang menggunakan fungsi aktivasi nonlinier.
- MLP menggunakan backpropagation untuk training-nya.



General Structure of MLP



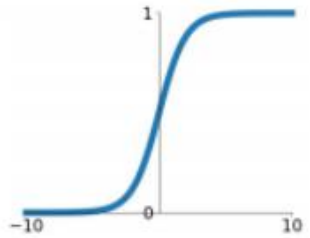


Training ANN means learning the weights of the neurons

Activation function

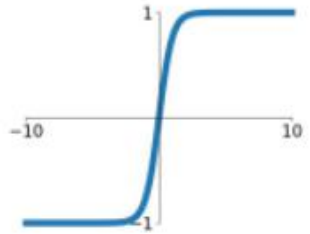
Sigmoid

$$\sigma(x) = \frac{1}{1+e^{-x}}$$



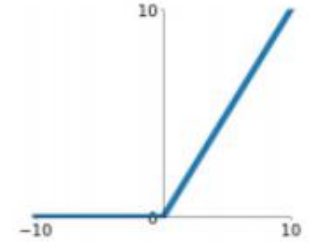
tanh

$$\tanh(x)$$

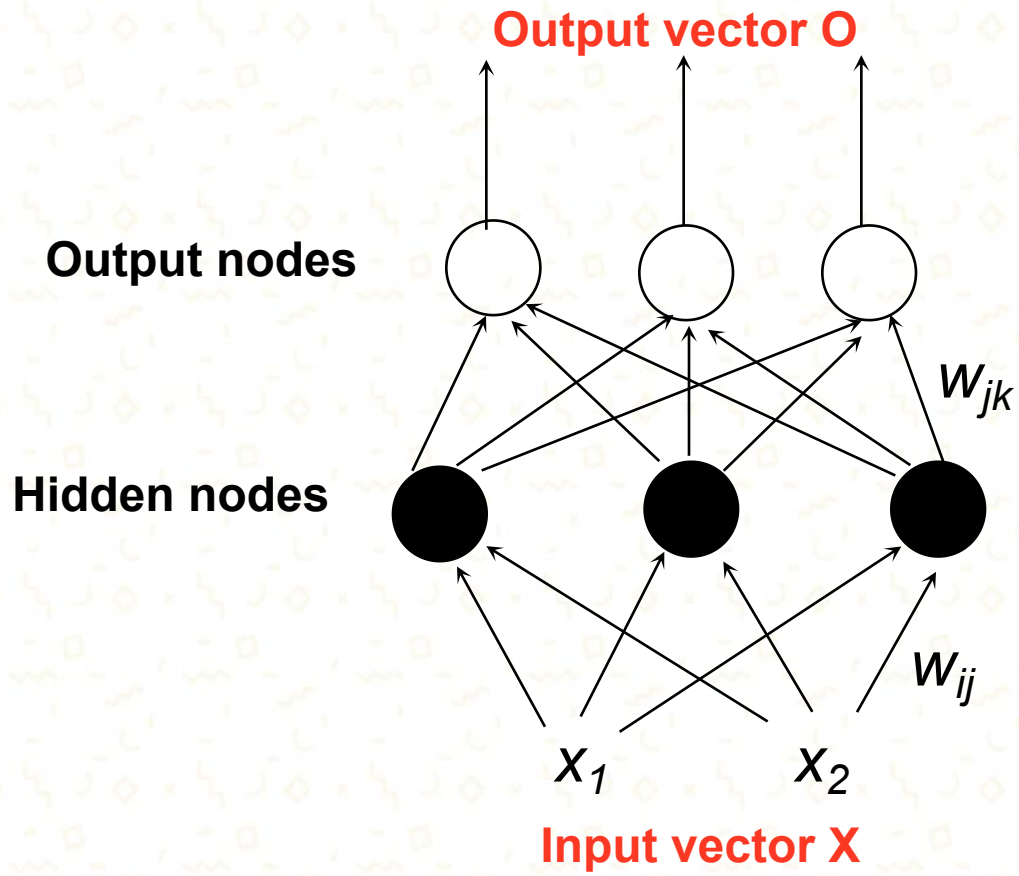


ReLU

$$\max(0, x)$$



Multilayer perceptron

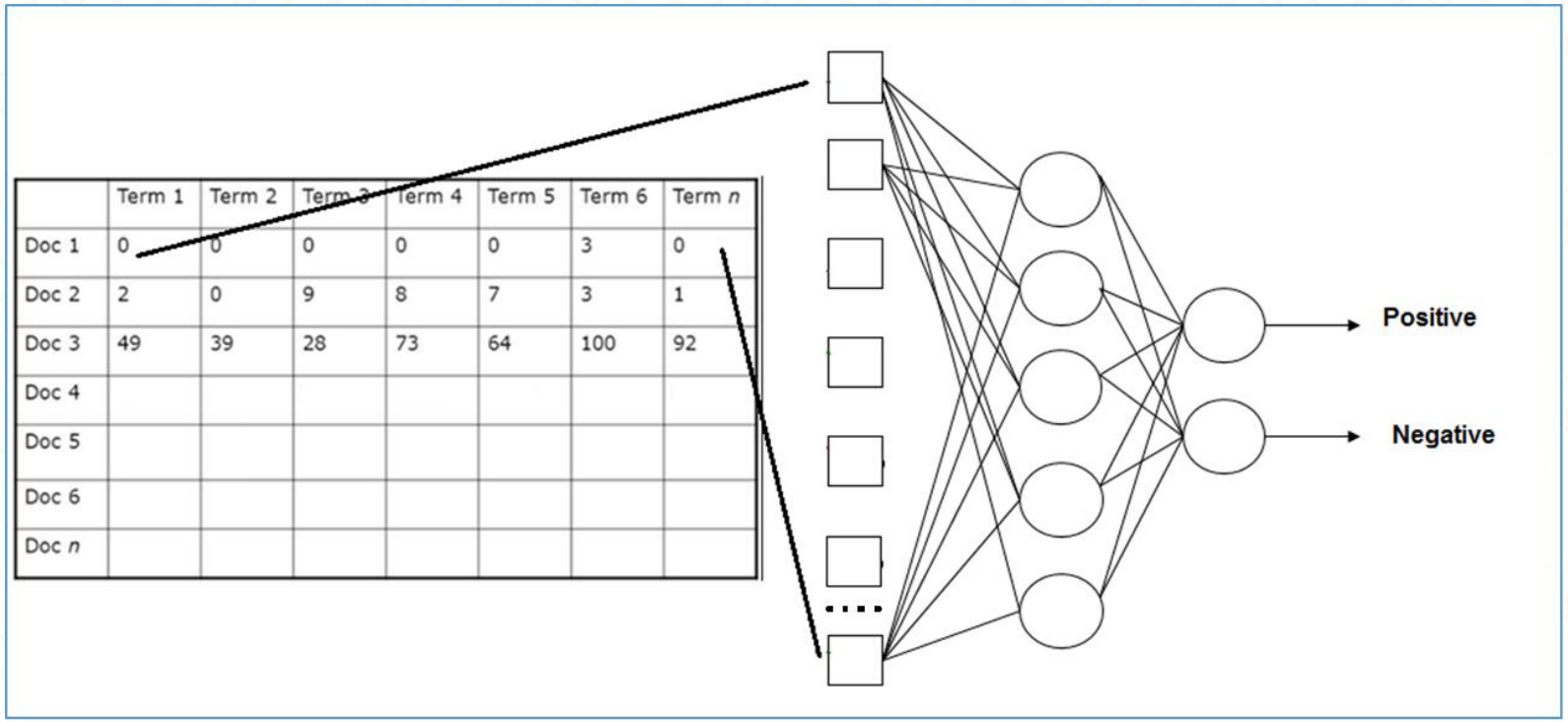


$$O_k = \frac{1}{1+e^{-\sum h_j w_{jk} + \theta_k}}$$

$$h_j = \frac{1}{1+e^{-\sum x_i w_{ij} + \theta_j}}$$

Sentiment analysis using MLP

- Use X_train as features for MLP

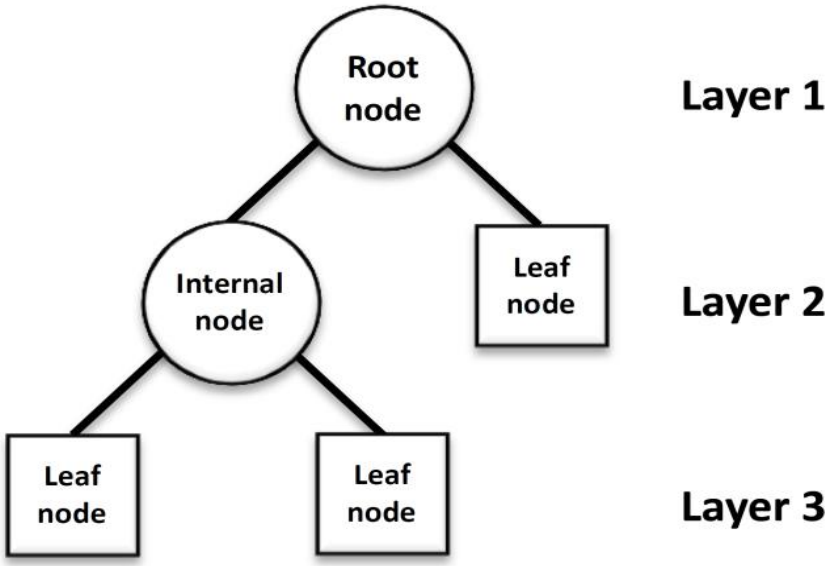


Discussion on NN

- Keuntungan
  - **Robust** -berfungsi baik ketika training set mengandung error
  - Output bisa discrete, real-valued, atau vector
- Kekurangan
  - Waktu yang lama saat training
  - Sulit untuk dipahami

Decision Tree Induction

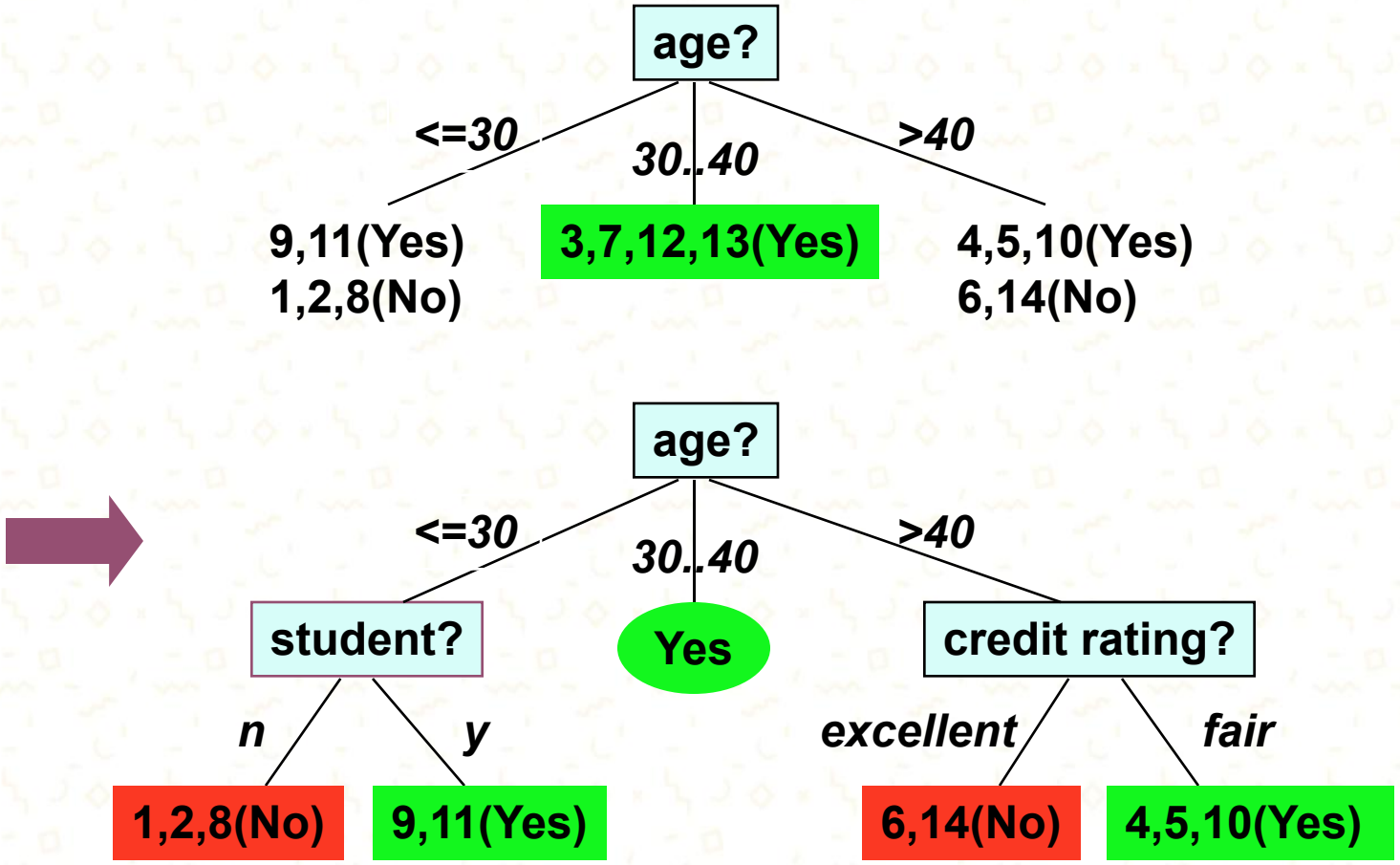
- Basic algorithm
  1. At start, all the training examples are at the root
  2. Test **attributes are selected** on the basis of a heuristic or statistical measure (e.g., information gain)
  3. **Examples are partitioned** recursively based on selected attributes



Training Dataset

No.	age	income	student	credit_rating	buys_computer
1	<=30	high	no	fair	no
2	<=30	high	no	excellent	no
3	31…40	high	no	fair	yes
4	>40	medium	no	fair	yes
5	>40	low	yes	fair	yes
6	>40	low	yes	excellent	no
7	31…40	low	yes	excellent	yes
8	<=30	medium	no	fair	no
9	<=30	low	yes	fair	yes
10	>40	medium	yes	fair	yes
11	<=30	medium	yes	excellent	yes
12	31…40	medium	no	excellent	yes
13	31…40	high	yes	fair	yes
14	>40	medium	no	excellent	no

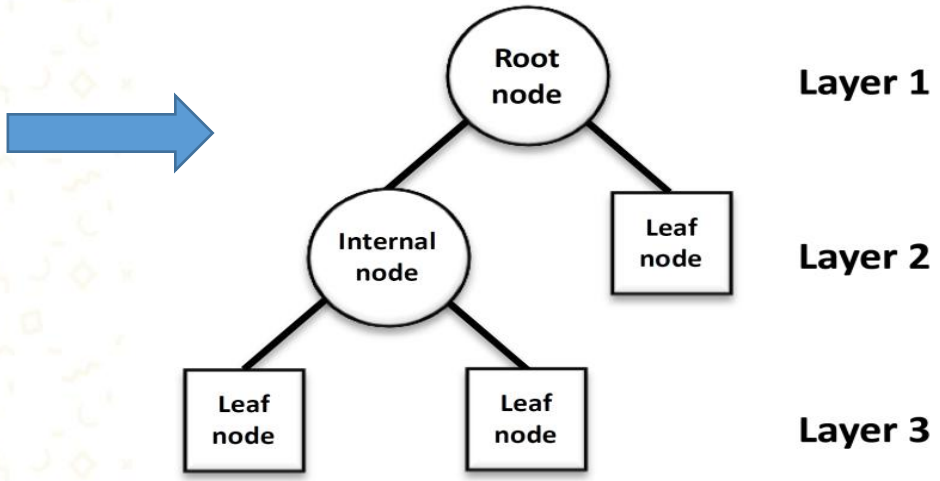
Algorithm for DT Induction - Example



Sentiment analysis using DT

- Use X_train as features for DT

	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6	Term *n*	class
Doc 1	0	0	0	0	0	3	0	
Doc 2	2	0	9	8	7	3	1	
Doc 3	49	39	28	73	64	100	92	
Doc 4								
Doc 5								
Doc 6								
Doc *n*								



Discussion on DT

- Kelebihan
  - Dapat diubah menjadi aturan klasifikasi yang dapat dipahami
  - Relatif cepat
- Kekurangan
  - Sensitive (not robust) terhadap noises
  - Continuous-valued attributes - partisi secara dinamis nilai atribut kontinu ke dalam set interval diskrit

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Let’s practice

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Thank YOU