PROGRAM STUDI
TEKNIK INFORMATIKA – S1
FAKULTAS ILMU KOMPUTER
UNIVERSITAS DIAN NUSWANTORO

MATA KULIAH
DATA MINING

Technology vector created by sentavio - www.freepik.com

DATA MINING
"Hierachical Clustering"

TIM PENGAMPU DOSEN DATA MINING

2021

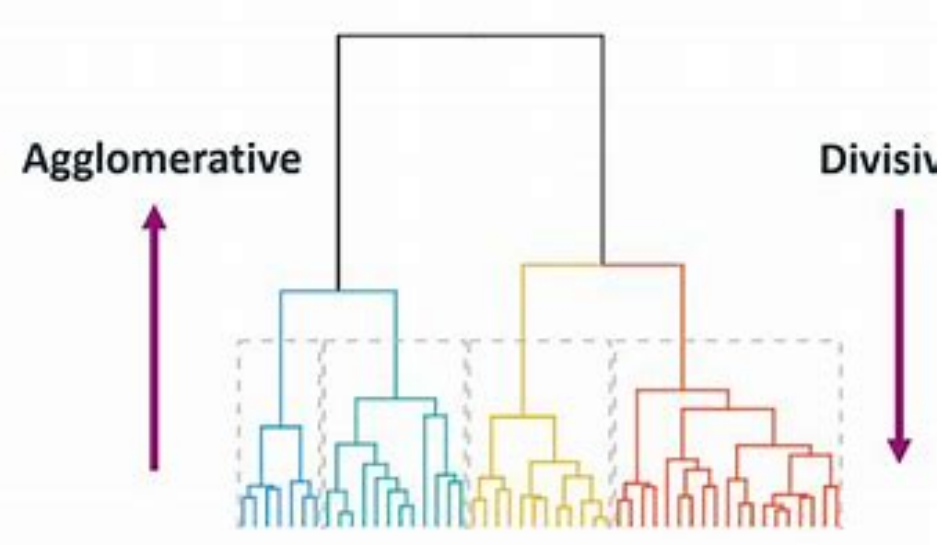
MATERI PERKULIAHAN

Materi Pra UTS	
#1	Pengantar Data Mining
#2	Data utk Data Mining (Jenis2 Data, Pengukuran Data, Nilai dan Atribut)
#3	Preprosesing Data (Data Cleaning, Missing Value, Transformasi Data, koding python)
#4	Metode Learning (Disiplin Data Mining, Supervised & Unsupervised, Klasifikasi,Prediksi, Estimasi, Klastering,dan Asosiasi)
#5	Klasifikasi dengan Naive Bayes + Python
#6	Klasifikasi dengan KNN + Python
#7	Klasifikasi Decision Tree + Python
Evaluasi Tengah Semester (UTS)	

Materi Pasca UTS	
#8	ANN & Deep Learning + Python
#9	Klastering (Teknik Klaster, Metode Partisi, Metode Hirarkis)
#10	Metode Partisi (K-Means Klastering + Python)
#11	Metode Hirarkis (HAC + Python)
#12	Regresi (Sederhana dan Multivariate) + Python
#13	Asosiasi + Apriori / FP-Growth + Python
#14	Validasi dan Pengujian Model
Evaluasi Akhir Semester (UAS)	

Hierarchical Clustering

- Pendekatan klastering berbasis hirarki
- Terbagi kedalam dua kelompok:
  - Agglomerative Clustering (bottom up)
  - Divisive Clustering (top down)

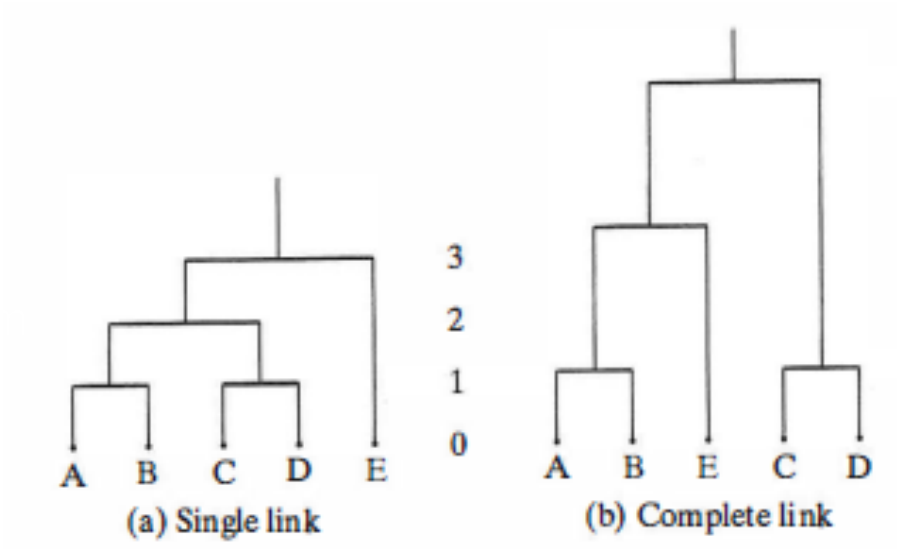


Agglomerative Clustering

- Menggunakan distance matrix
- Menghasilkan Dendrogram

Distance Matrix

Item	A	B	C	D	E
A	0	1	2	2	3
B	1	0	2	4	3
C	2	2	0	1	5
D	2	4	1	0	3
E	3	3	5	3	0



$d_{AB\to C} = \min(d_{AC}, d_{BC})$

$d_{AB\to C} = \max(d_{AC}, d_{BC})$

$d_{AB\to C} = \text{avg}(d_{AC}, d_{BC})$

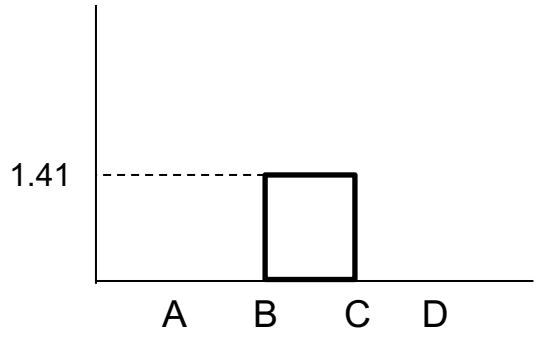
Contoh

Dalam contoh ini sudah terbentuk distance matrix, kemudian kita bisa menggunakan beberapa linkage untuk membentuk dendrogram dan melakukan clustering.

	A	B	C	D
A	0			
B	2.24	0		
C	2.24	1.41	0	
D	1.73	2	2	0

Single Linkage

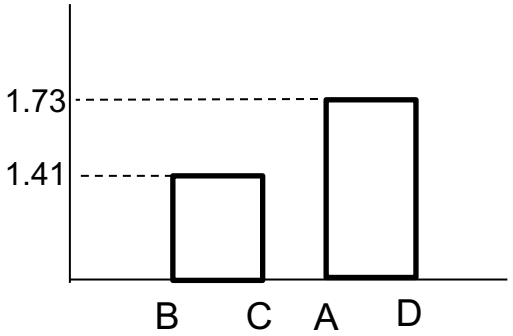
	A	B	C	D
A	0			
B	2.24	0		
C	2.24	1.41	0	
D	1.73	2	2	0



	A	BC	D
A	0		
BC	2.24	0	
D	1.73	2	0

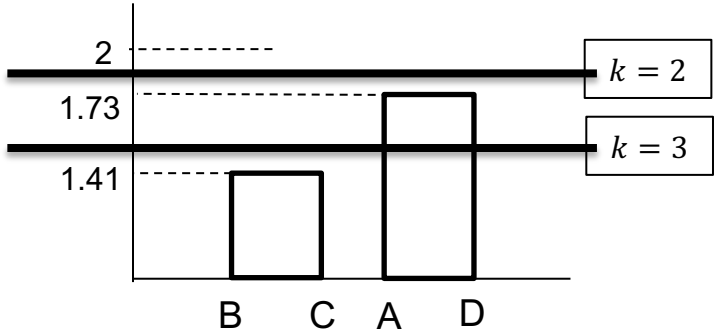
$d_{A\to BC} = \min(d_{AB}, d_{AC}) = \min(2.24,2.24) = 2.24$

$d_{D\to BC} = \min(d_{DB}, d_{DC}) = \min(2,2) = 2$



	AD	BC
AD	0	
BC	2	0

$d_{BC\to AD}$
$= \min(d_{BCA}, d_{BCD})$
$= \min(2.24,2) = 2$



$k = 2$ -> {AD} {BC}

$k = 3$ -> {A} {D} {BC}

Davies Bouldin Index

$$DBI = \frac{1}{N}\sum_{i=1}^{N} R_i$$

$$R_i = \max_{i \neq j} R_{i,j}$$

$$R_{i,j} = \frac{SSW_i + SSW_j}{SSB_{i,j}}$$

$$SSW_i = \left(\frac{1}{T_i} \sum_{j=1}^{T_i} |x_j - A_i|^p \right)^{1/p}$$

$$SSB_{i,j} = \left(\sum_{k=1}^{n} |A_{i,k} - A_{j,k}|^p \right)^{1/p}$$

$p=1$ for Manhattan Distance, $p=2$ for Euclidean Distance

n = the vector length of centroid

N = number of the cluster

T_i = size of cluster i

A_i= centroid of the cluster i

x = data points

SSW_i = Sum of Square Within-Cluster i

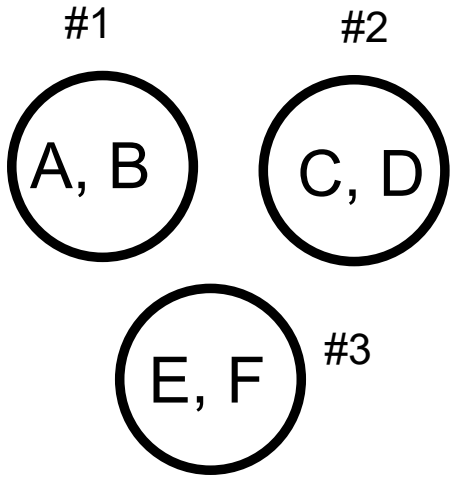
$SSB_{i,j}$ =Sum of Square Between-Cluster i and j

Davies Bouldin Index

Raw data

Data	x	y
A	1	2
B	3	1
C	5	2
D	4	5
E	7	8
F	7	10

Clustering



DBI ?

$$DBI = \frac{1}{N}\sum_{i=1}^{N} R_i$$

$$R_i = \max_{i \neq j} R_{i,j}$$

$$R_{i,j} = \frac{SSW_i + SSW_j}{SSB_{i,j}}$$

$$SSW_i = \left(\frac{1}{T_i}\sum_{j=1}^{T_i} |x_j - A_i|^p\right)^{1/p}$$

$$SSB_{i,j} = \left(\sum_{k=1}^{n} |A_{i,k} - A_{j,k}|^p\right)^{1/p}$$

Hierarchical Clustering di Python

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
from sklearn import datasets
iris = datasets.load_iris()
```

```
df=pd.DataFrame(iris['data'])
print(df.head())
```

```
     0    1    2    3
0  5.1  3.5  1.4  0.2
1  4.9  3.0  1.4  0.2
2  4.7  3.2  1.3  0.2
3  4.6  3.1  1.5  0.2
4  5.0  3.6  1.4  0.2
```

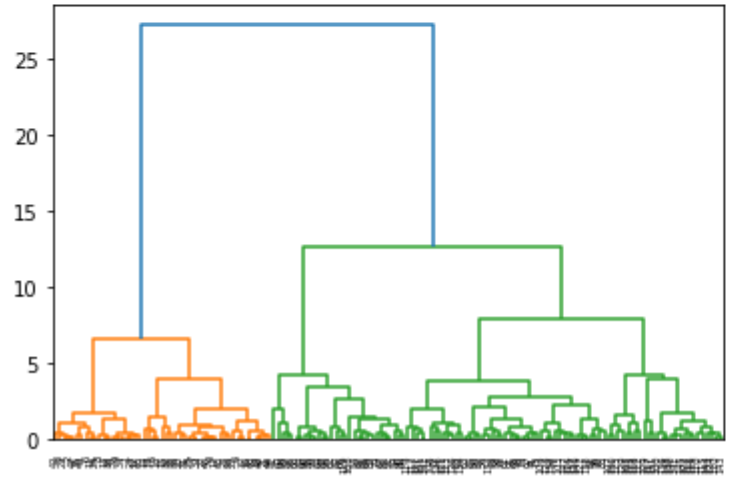
Penggunaan data iris yang terdiri dari 4 atribut: sepal length, sepal width, petal length, dan petal width.

	A	B	C	D	E
1	Sepal Length	Sepal Width	Petal Length	Petal Width	Class
2	5.1	3.5	1.4	0.2	Iris-setosa
3	4.9	3	1.4	0.2	Iris-setosa
4	4.7	3.2	1.3	0.2	Iris-setosa
5	4.6	3.1	1.5	0.2	Iris-setosa
6	5	3.6	1.4	0.2	Iris-setosa

```
# Import the whiten function
from scipy.cluster.vq import whiten
scaled_data = whiten(df.to_numpy())
```

```
# Import the fcluster and linkage functions
from scipy.cluster.hierarchy import fcluster, linkage
# Use the linkage() function
distance_matrix = linkage(scaled_data, method = 'ward', metric = 'euclidean')
```

```
# Import the dendrogram function
from scipy.cluster.hierarchy import dendrogram
# Create a dendrogram
dn = dendrogram(distance_matrix)
# Display the dendogram
plt.show()
```



Latihan Soal (Kuis)

Lakukan pengelompokan menjadi 3 cluster pada distance matrix dibawah ini.

	A	B	C	D	E
A	0				
B	2.5	0			
C	10.44	12.5	0		
D	4.12	6.4	6.48	0	
E	11.75	13.93	1.41	7.35	0

Referensi

1. Kusrini, Taufiq Emha, Algoritma Data Mining, *Penerbit Andi*, 2009.
2. Ian H. Witten, Frank Eibe, Mark A. Hall, Data mining: Practical Machine Learning Tools and Techniques 4th Edition, *Elsevier*, 2017.
3. Budi Santosa, Ardian Umam, Data Mining dan Big Data Analytics, Penebar Media Pustaka, 2018.
4. Yaya Heryadi, Teguh Wahyono, Machine Learning: Konsep dan Implementasi, Penerbit Gava Media, 2020.
5. Sumber gambar: www.freepik.com.

THANKS

ANY QUESTIONS?