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## Tugas 11 – Graph Analytics with GraphX

### Persiapan Praktikum

- Install Graphframes

```
js11.ipynb
[1]: pip install graphframes

Collecting graphframes
  Downloading graphframes-0.6-py2.py3-none-any.whl.metadata (934 bytes)
Requirement already satisfied: numpy in /opt/conda/lib/python3.11/site-packages (from graphframes) (1.24.4)
Collecting nose (from graphframes)
  Downloading nose-1.3.7-py3-none-any.whl.metadata (1.7 kB)
  Downloading graphframes-0.6-py2.py3-none-any.whl (18 kB)
  Downloading nose-1.3.7-py3-none-any.whl (154 kB)
-----
154.7/154.7 kB 1.4 MB/s eta 0:00:00
Installing collected packages: nose, graphframes
Successfully installed graphframes-0.6 nose-1.3.7
Note: you may need to restart the kernel to use updated packages.
```

### Langkah Praktikum

1. Import PySpark dan GraphFrames dan Inisialisasi SparkSession

```
js11.ipynb
[4]: from pyspark.sql import SparkSession
from pyspark.sql.functions import *
from pyspark.sql.types import *
from graphframes import GraphFrame # Library tambahan untuk graph processing di PySpark

# Inisialisasi Spark Session
spark = SparkSession.builder \
    .appName("FamilyRelationshipAnalysis") \
    .master("spark://spark-master:7077") \
    .config("spark.jars.packages", "graphframes:graphframes:0.8.2-spark3.2-s_2.12") \
    .getOrCreate()
```

## 2. Membuat Vertices dan Edges

```
js11.ipynb
[5]: # Data anggota keluarga (vertices)
vertices_data = [
    ("1", "Jack", 45, "father"),
    ("2", "Emily", 15, "daughter"),
    ("3", "Jessica", 40, "mother"),
    ("4", "Mike", 17, "son"),
    ("5", "Sarah", 70, "grandmother")
]

vertices = spark.createDataFrame(vertices_data, ["id", "name", "age", "role"])

# Data hubungan keluarga (edges)
edges_data = [
    ("1", "2", "father_of"),
    ("1", "3", "husband_of"),
    ("3", "2", "mother_of"),
    ("3", "4", "mother_of"),
    ("1", "4", "father_of"),
    ("5", "3", "mother_of")
]

edges = spark.createDataFrame(edges_data, ["src", "dst", "relationship"])
```

## 3. Membuat Graph dan Menampilkan Jumlah Vertices dan Edges

```
js11.ipynb
[7]: # Membuat graph dari vertices dan edges
family_graph = GraphFrame(vertices, edges)

# Menampilkan informasi dasar graph
print(f"Jumlah anggota keluarga: {family_graph.vertices.count()}")
print(f"Jumlah hubungan keluarga: {family_graph.edges.count()}")

Jumlah anggota keluarga: 5
Jumlah hubungan keluarga: 6
```

## 4. Menampilkan Semua Hubungan Keluarga dan Menampilkan Hubungan Spesifik dari *father\_of*

```
js11.ipynb
[8]: # Menampilkan semua hubungan keluarga
family_graph.edges.show()

# Menampilkan hubungan spesifik
family_graph.edges.filter("relationship = 'father_of'").show()

+---+---+-----+
|src|dst|relationship|
+---+---+-----+
| 1| 2| father_of|
| 1| 3| husband_of|
| 3| 2| mother_of|
| 3| 4| mother_of|
| 1| 4| father_of|
| 5| 3| mother_of|
+---+---+-----+

+---+---+-----+
|src|dst|relationship|
+---+---+-----+
| 1| 2| father_of|
| 1| 4| father_of|
+---+---+-----+
```

## 5. Mencari Relasi Anak dari Jack

```
js11.ipynb
[10]: # Mencari semua anak dari Jack
jack_children = family_graph.find("(a)-[e]->(b)") \
    .filter("a.name = 'Jack' AND e.relationship LIKE '%of'" \
    .select("b.name", "e.relationship")

jack_children.show()

+-----+
| name|relationship|
+-----+
| Mike| father_of|
| Emily| father_of|
| Jessica| husband_of|
+-----+
```

## 6. Menghitung In-Degree dan Out-Degree

```
js11.ipynb
[11]: # Menghitung jumlah hubungan masuk dan keluar
in_degree = family_graph.inDegrees
out_degree = family_graph.outDegrees
total_degree = in_degree.join(out_degree, "id", "outer") \
    .fillna(0) \
    .withColumn("total_degree", col("inDegree") + col("outDegree"))

# Menampilkan hasil
total_degree.join(vertices, "id").select("name", "inDegree", "outDegree", "total_degree").show()

+-----+
| name|inDegree|outDegree|total_degree|
+-----+
| Jessica| 2| 2| 4|
| Sarah| 0| 1| 1|
| Mike| 2| 0| 2|
| Jack| 0| 3| 3|
| Emily| 2| 0| 2|
+-----+
```

## 7. Visualisasi Draf Keluarga Menggunakan Networkx dan Matplotlib

```
js11.ipynb
[12]: # Mengumpulkan data untuk visualisasi
vertices_pd = family_graph.vertices.toPandas()
edges_pd = family_graph.edges.toPandas()

# Visualisasi menggunakan networkx dan matplotlib
import networkx as nx
import matplotlib.pyplot as plt

G = nx.DiGraph()

# Menambahkan nodes
for _, row in vertices_pd.iterrows():
    G.add_node(row['id'], name=row['name'], role=row['role'])

# Menambahkan edges
for _, row in edges_pd.iterrows():
    G.add_edge(row['src'], row['dst'], relationship=row['relationship'])

# Menggambar graph
plt.figure(figsize=(10, 8))
pos = nx.spring_layout(G)
nx.draw(G, pos, with_labels=True, labels=nx.get_node_attributes(G, 'name'))
edge_labels = nx.get_edge_attributes(G, 'relationship')
nx.draw_networkx_edge_labels(G, pos, edge_labels=edge_labels)
plt.title("Family Relationship Graph")
plt.show()
```

Hasil Visualisasi:

