

ALGORITHMS, DATA AND SECURITY A.Y. 2025/26
Final on May 11th, 2026

Surname _____ Name _____

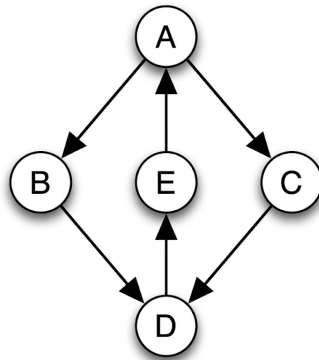
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Question 1 (points 7)

- Explain how the K-means clustering algorithm works, also specifying the distance metrics it uses.
- Explain how the optimal number of clusters K can be determined in the K-means algorithm.
- Explain why and how a clustering algorithm can be integrated into the context of a recommender system.

Question 2 (points 9)

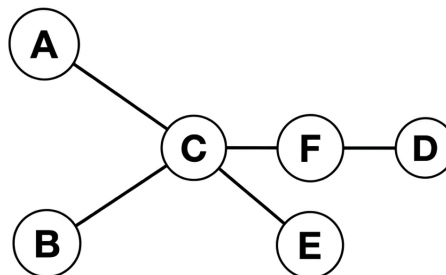
- Describe how the PageRank algorithm works and explain when the algorithm terminates.
- Apply the *basic* PageRank update rule for 3 iterations to the network shown below, starting with an initial PageRank value of 0.2 for all nodes.



- Considering the above network structure, which node(s) do you expect to achieve the highest PageRank score after many iterations of the algorithm, and why?
- Why do we improve the *basic* PageRank update rule, and how it is improved?
- Discuss the importance of the PageRank algorithm, explaining its applications in network analysis.

Question 3 (points 8)

- Define the diameter of a graph (or network).
- Describe the goal of the centrality measures.
- Define betweenness centrality and explain how it differs from closeness centrality.
- Given the network below, find its diameter, the degree centrality of each node and, without computing it, identify the node with the highest betweenness, motivating your answer.



Question 4 (points 8)

- Explain what a denial-of-service attack is and how attackers can enhance its effectiveness.
- Explain what a phishing attack is, describing how it works and the main techniques used to prevent it.
- Explain how public key cryptography works and discuss its pros and cons in comparison to private key cryptography.
- Explain the steps involved in digital signature creation and verification, and how it uses public-key cryptography.

Additional question for non-attending students only (15 minutes extra)

Question 5

- Considering the Neo4j graph database and its query language Cypher, explain the goal and meaning of the following query. The graph data model is shown below:

```
MATCH (meg:Person {name: 'Meg Ryan'})-[:ACTED_IN]->(:Movie)<-[:ACTED_IN]-(coActor:Person) RETURN coActor.name
```

- How does this query demonstrate the power of graph databases in exploring relationships among entities?

