

ALGORITHMS, DATA AND SECURITY A.Y. 2024/25
Final on May 6th, 2025

Surname _____ Name _____

ID number _____

Question 1 (points 8)

- Describe the goal and the steps of the user-based collaborative filtering algorithm.
- Given the ratings shown in the following table, predict Mary's rating for Avatar by applying the user-based collaborative filtering algorithm.

	La La Land	Frankestein Junior	Avatar	Spider-Man	Joker
Tom	3	4	4	5	
Mary	5	5	?	3	4
John	2		5	5	3
Lucy		4	2	4	5

The similarity values are provided in the following table (the order of users in the table's rows and columns is: Tom, Mary, John, Lucy):

1.00000000	-0.8528029	0.8164966	0.08111071
-0.85280287	1.0000000	-0.6237783	-0.12105003
0.81649658	-0.6237783	1.0000000	-0.49669963
0.08111071	-0.1210500	-0.4966996	1.00000000

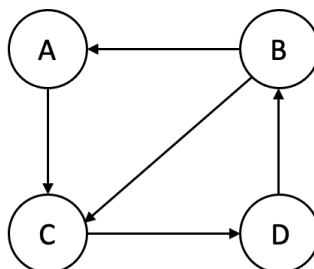
- Which are the main ideas of the matrix factorization algorithm?

Question 2 (points 7)

- Explain the K-means clustering algorithm.
- Discuss the pros and cons of the K-means clustering algorithm, especially in comparison to the hierarchical clustering algorithm.
- What is the goal of the elbow method, and how do we use this method?

Question 3 (points 8)

- Describe how the PageRank algorithm works, explain its *basic* update rule, and explain when the algorithm terminates.
- Apply the *basic* PageRank update rule for 2 iterations to the network shown below, starting with an initial PageRank of 0.25 for all nodes. Which node(s) do you expect to achieve the highest PageRank score after many iterations of the algorithm, and why?



- c) Describe the goal of the centrality measures, explain a centrality measure of your choice different from PageRank and discuss how these two centrality measures differ.

Question 4 (points 9)

- a) Describe the man-in-the-middle attack.
- b) Explain how public key cryptography works and discuss its pros and cons in comparison to private key cryptography.
- c) Explain how digital signature works.
- d) What is federated learning and how does it work?