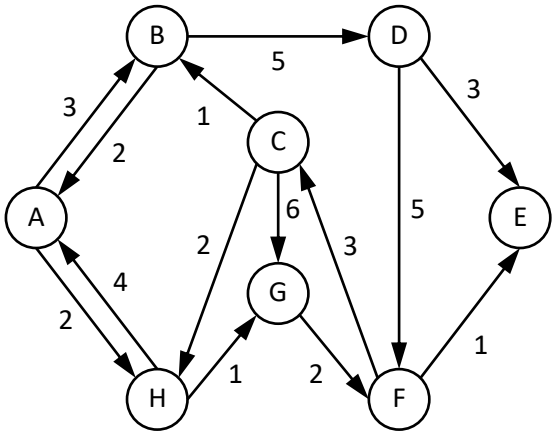
Degree in Software Engineering – Data Structures

Seminars 2 and 3: Graphs Academic year 2019/20

Exercise 1 (2.5 pts): Let G(V, E, W) be the graph given by the following representation:



Apply Dijkstra's algorithm to calculate the minimum-cost path from node C to any other node in G. Initialize the cost vector, D, the path vector, P, and the set of visited nodes, S, used by the algorithm and show their contents in each iteration from initialization to end. After that, answer the following questions and justify your answers:

- Is there a path from C to D? If so, reconstruct the minimum-cost path and indicate its cost.
- Is there a path from C to E? If so, reconstruct the minimum-cost path and indicate its cost.
- Would it be possible to know if there is a path between nodes A and E?

Exercise 2 (1.5 pts): Given the following vectors obtained after executing Dijkstra's algorithm on a graph from node C:

Vector D

A	B	C	D	E	F
∞	1		7	5	3

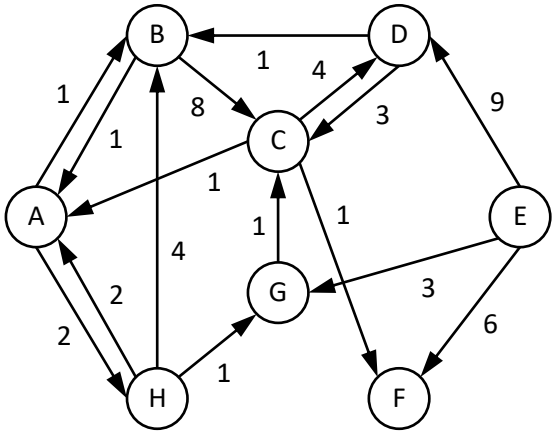
Vector P

A	B	C	D	E	F
–	C		E	F	B

Indicate whether there is a path between the following nodes and why. If so, reconstruct the minimum-cost paths using the previous vectors and indicate their costs. Show the process followed in each step of the reconstruction.

- From C to B.
- From C to A.
- From C to D.

Exercise 3 (2.5 pts): Let G(V, E, W) be the graph given by the following representation:



Apply the Floyd-Warshall algorithm to calculate the minimum-cost paths between every pair of nodes in G. Define the cost matrix, A, and the path matrix, P, used by the algorithm and show their contents after the execution of the algorithm. After that, answer the following questions and justify your answers:

- Is there a path from H to A? If so, reconstruct the minimum-cost path and indicate its cost.
- Is there a path from A to E? If so, reconstruct the minimum-cost path and indicate its cost.
- Is there a path from B to F? If so, reconstruct the minimum-cost path and indicate its cost.

Exercise 4 (1.5 pts): Given the following matrices obtained after executing the Floyd-Warshall algorithm on a graph:

Matrix A

	A	B	C	D	E	F
A	0	3	5	9	7	5
B	∞	0	2	6	4	2
C	∞	1	0	7	5	3
D	∞	∞	∞	0	∞	∞
E	∞	∞	∞	2	0	∞
F	∞	6	5	4	2	0

Matrix P

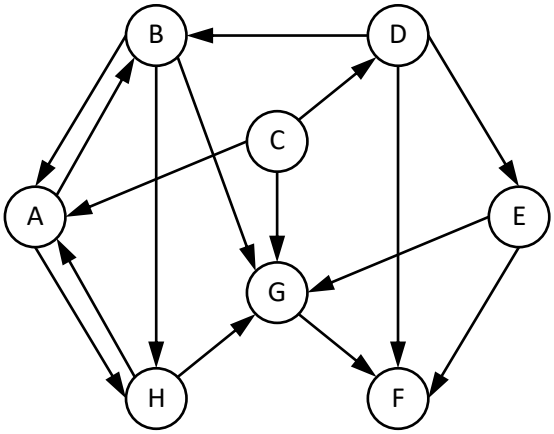
	A	B	C	D	E	F
A	–	–	B	F	F	B
B	–	–	–	F	F	–
C	–	–	–	F	F	B
D	–	–	–	–	–	–
E	–	–	–	–	–	–
F	–	C	–	E	–	–

Indicate whether there is a path between the following nodes and why. If so, reconstruct the minimum-cost paths using the previous matrices and indicate their costs. Show the process followed in each step of the recursive algorithm (you may use the tree representation learnt in class).

- From A to D.
- From E to F.
- From F to C.

Is there any drain node or source node in the graph? If so, indicate which are these nodes.

Exercise 5 (2 pts): Let G(V, E) be the graph given by the following representation:



Perform a depth-first search from the following departure nodes, showing the order in which the nodes would be visited step by step. If several neighbor nodes can be considered as candidates from a given node, the priority in which they should be visited is given by the alphabetical order. In each case, indicate whether all nodes of the graph are accessible from the departure node or not.

- From A.
- From C.
- From D.
- From G.