

## Q1 Academic Honesty

0 Points

It is a violation of the Academic Integrity Code to look at any reference material other than your textbook and lecture notes, or to give inappropriate help to someone or to receive unauthorized aid by someone in person or electronically via messaging apps such as WhatsApp. Academic Integrity is expected of all students of Hacettepe University at all times, whether in the presence or absence of members of the faculty. Do NOT sign nor take this exam if you do not agree with the honor code.

Understanding this, I declare I shall not give, use or receive unauthorized aid in this examination.

Signature (Specify your name and surname as your signature)

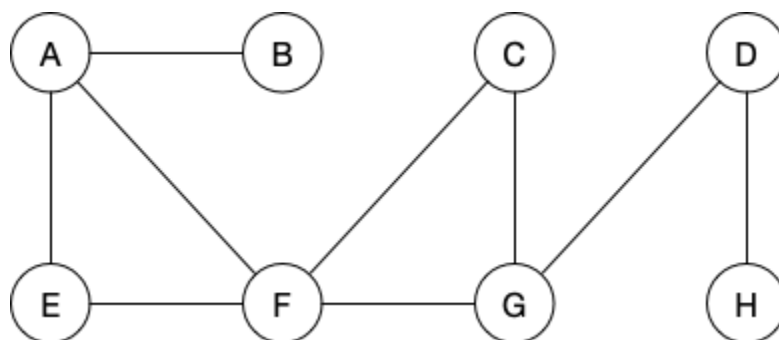
Mehmet Taha USTA MTUSTA

*While answering the following questions, please consider the implementations that we discussed in our lectures unless stated otherwise.*

## Q2 Depth First Search

16 Points

Consider the undirected graph given below.



Suppose the adjacency-lists representation of this graph is as follows:

```

A:  F B E
B:  A
C:  G F
D:  H G
E:  F A
F:  G E C A
G:  F C D
H:  D

```

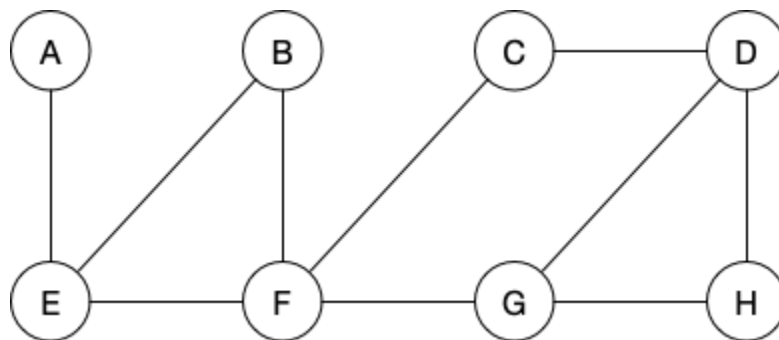
Run depth-first search from vertex A. Give the sequence in which the search discovers (marks) the vertices. **Your answer should be a sequence of uppercase letters separated by whitespace, e.g. A B C ....**

A E F C G D H B

### Q3 Breadth First Search

16 Points

Consider the undirected graph given below.



Suppose the adjacency-lists representation of this graph is as follows:

```

A:  E
B:  E F
C:  F D
D:  H C G
E:  A F B
F:  G C E B
G:  F H D
H:  D G

```

Run breadth-first search from vertex A. Give the sequence in which the vertices are dequeued from the FIFO queue. **Your answer**

should be a sequence of uppercase letters separated by whitespace, e.g. A B C ....

A E B F C G D H

## Q4 Graph Representation

16 Points

A directed graph  $G(V, E)$  can be represented with edge list, adjacency matrix and adjacency list representations. Given that  $E \gg V$ , select the best representation for finding the indegree of a given vertex  $v$  and write down its asymptotic complexity in  $O$  notation.

### Q4.1

8 Points

Which representation is best for finding the indegree.

- ☐ Edge List
- ☐ Adjacency matrix
- ☒ Adjacency list

### Q4.2

8 Points

What is the complexity

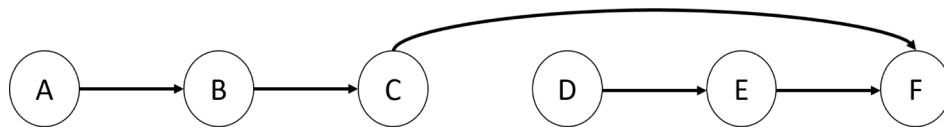
Complexity

$O(V)$

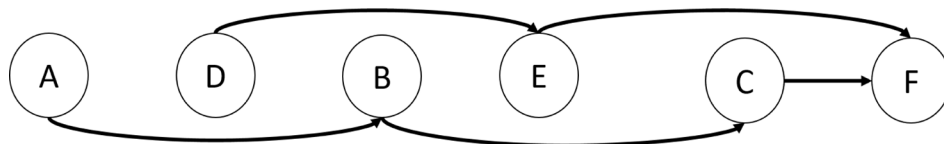
## Q5 Topological Sort

16 Points

Topological sort algorithm produces an ordering depending on the order which DFS algorithm processes the vertices. For example one order which topological sort produces is shown below.



This is produced only when a DFS visit for D is executed first, then DFS for A is executed by the topological sort, for example if the vertices are processed in the order DABCEF. For this same graph is it possible to have the following topological sort? If yes, please write down the order of DFS visits producing this output.



DEFCBA

## Q6 DFS&BFS Storage

12 Points

Both DFS and BFS require  $\Omega(V)$  storage for their operation. (That is, for working storage, above and beyond the storage needed to represent the input.)

- ☒ True
- ☐ False, both require  $\Omega(1)$
- ☐ False, DFS requires  $\Omega(V)$  but BFS requires  $\Omega(1)$
- ☐ False, both require  $\Omega(E)$

## Q7 Bipartite graph

12 Points

What is the time complexity to check if an undirected graph  $G$  with  $V$  vertices and  $E$  edges is bipartite or not if  $G$  is stored in an adjacency matrix?

- ☐  $O(E)$
- ☐  $O(E + V)$
- ☒  $O(V^2)$
- ☐  $O(E \log E)$

## Q8 Eulerian path

12 Points

An **Eulerian path** is a path that uses every edge of a graph exactly once. Number of vertices with odd degrees in a graph having a Eulerian path is

- ☐ 0
- ☐ 2
- ☒ either 0 or 2
- ☐ greater than 2

## Quiz 2 - Graphs

● GRADED

### STUDENT

Mehmet Taha Usta

### TOTAL POINTS

**56 / 100 pts**

### QUESTION 1

Academic Honesty

0 / 0 pts

### QUESTION 2

Depth First Search

**8 / 16 pts**

### QUESTION 3

## Breadth First Search

4 / 16 pts

## QUESTION 4

## Graph Representation

8 / 16 pts

4.1 (no title)

0 / 8 pts

4.2 (no title)

8 / 8 pts

## QUESTION 5

## Topological Sort

0 / 16 pts

## QUESTION 6

## DFS&amp;BFS Storage

12 / 12 pts

## QUESTION 7

## Bipartite graph

12 / 12 pts

## QUESTION 8

## Eulerian path

12 / 12 pts