

Tuesday 08/01/2019

Final Exam

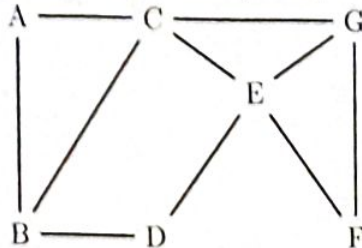
Duration: 90 minutes

Name:

Solutions

Student No:

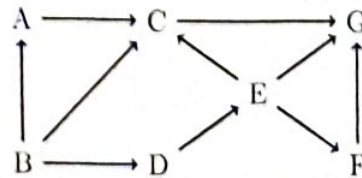
P1 [16 (1*16) points] Graph Definitions - Undirected Graph



Tick ALL appropriate definitions for each sequence:

Sequence	Walk	Path	Circuit	Cycle
A-C-E-F-G-E-C-B	✓			
A-C-E-F-G-E-D-B-A	✓		✓	
B-C-G-F-E-D-B	✓		✓	✓
A-C-G-E-D	✓	✓		

P2 [24 (2*8+8*1) points] Graph Basics - Directed Graph



Write the in-degrees of the vertices:

A: 1 B: 0 C: 3 D: 1

Write the out-degrees of the vertices:

E: 3 F: 1 G: 0

Is there a cycle in this graph?

Yes: No

Give a topological order for the graph:

B, D, E, A, C, F, G

Other possible solutions are also accepted. All arrows must go to right.

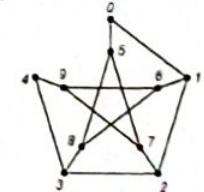
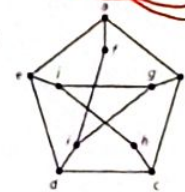
P3 [20 (10*2) points] Graph Isomorphism

a) Are the graphs on the right isomorphic? If yes give an isomorphism, if not explain why.

a	b	c	d	e	f	g	h	i	j
5	7	9	6	8	0	2	4	1	3

or 9 7 5 8 6 4 2 0 3 1

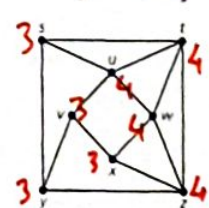
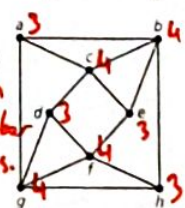
Yes



b) Are the graphs on the right isomorphic? If yes give an isomorphism, if not explain why.

a	b	c	d	e	f	g	h

No. Because the 1st graph does not have 3-degree neighbor vertices while the 2nd one has.



P4 [20 (4*1+1*16) points] Minimum Spanning Trees In the map below, find a minimal spanning tree by using Prim's Algorithm starting from Antalya and write the cities in the order you add them to the MST.



1	Antalya	9	Uşak
2	Burdur	10	Afyon
3	Isparta	11	Konya
4	Denizli	12	Karaman
5	Muğla	13	Mersin
6	Aydın	14	Nigde
7	Manisa	15	Nevşehir
8	Izmir	16	Akşehir

Also possible:

7 Izmir
8 Manisa
9 Uşak
10 Afyon

7 Uşak	7 Uşak
8 Izmir	8 Manisa
9 Manisa	9 Izmir
10 Afyon	10 Afyon

P2 Extra



A and C can be anywhere as long as A → C, B → A, E → C, C → G points towards right.

P5 [20 (10*2) points] Graph Programming Suppose that you already have a graph class and a method that returns the shortest path between two given vertices. (Assume all edges have weight 1.) Your task is to add two new methods to this class, `getEccentricity()` and `getDiameter()`. Fill these methods below. Recall that eccentricity of a vertex is the distance to the farthest vertex and diameter is the longest distance in a graph.

```
public class Graph {
    ArrayList<Vertex> vertices;
    public Graph() { /*Already written*/ }
    ...
    public int shortestPath(Vertex v, Vertex w) { /*Already written*/ }
    public int getEccentricity(Vertex v) { //Fill this method
        int max = 0;
        for (int i = 0; i < vertices.size(); i++) {
            int temp = shortestPath(v, vertices.get(i));
            if (temp > max)
                max = temp;
        }
        return max;
    }
    public int getDiameter() { //Fill this method
        int max = 0;
        for (int i = 0; i < vertices.size(); i++) {
            int temp = getEccentricity(vertices.get(i));
            if (temp > max)
                max = temp;
        }
        return max;
    }
}
```

PBonus [10 points] Graph Programming Suppose you also have a method that returns the neighbor vertices of a vertex. Also suppose that vertices have a boolean field visited which is false by default. Write a method that starts from a vertex and visits all unvisited vertices exactly once. (just change visited field of each vertex to true.)

```
public ArrayList<Vertex> getNeighbors(Vertex v) { /*Already written*/ }
public void visitAll(Vertex v) { //Fill this method
    if (v.visited == false) {
        v.visited = true;
        for (int i = 0; i < getNeighbors(v).size(); i++) {
            visitAll(getNeighbors(v).get(i));
        }
    }
}
```