

Math 101-002
Exam 3, April 17

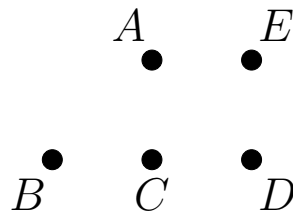
Name	CSU ID #
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Be sure to read each question fully and carefully. Multiple choice answer bubbles must be fully filled in. There is space to the right of each multiple choice question to show work, if your work is correct you can get points even with an incorrect multiple choice answer.

1. For questions 1a through 1g consider the following information about a weighted graph G with vertices A through E :

Edge	AB	AC	AD	AE	BC	CD	DE
Weight	1	7	10	5	3	4	2

- (a) Based on the information presented in the tableau, fill in the edges of the graph G with their corresponding weights: (4 points)



- (b) What is the degree of separation between the vertices B and D ? (2 points)

- ☐ 1
☐ 2
☐ 3
☐ 4

- (c) What is the degree of separation between the vertices B and E ? (2 points)

- ☐ 1
☐ 2
☐ 3
☐ 4

- (d) The diameter of the graph G is: (2 points)

$\text{diam}(G) = \underline{\hspace{1cm}}$.

(e) The redundancy of the graph G is: (2 points)

$$\text{red}(G) = \underline{\hspace{1cm}}.$$

(f) Between the following, mark the option which is not a spanning tree of G : (2 points)

☐ AB, BC, CD, AE

☐ AB, AD, AE, DE

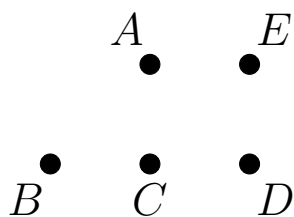
☐ AC, AD, BC, DE

☐ AD, AE, BC, CD

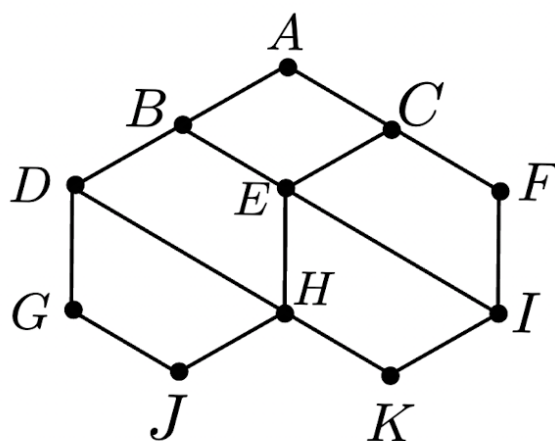
(g) Write down the weight of the minimal spanning tree produced by Kruskal's algorithm: (2 points)

$$\text{weight}(MST) = \underline{\hspace{1cm}}.$$

Help yourself by drawing the tree in question in what follows:



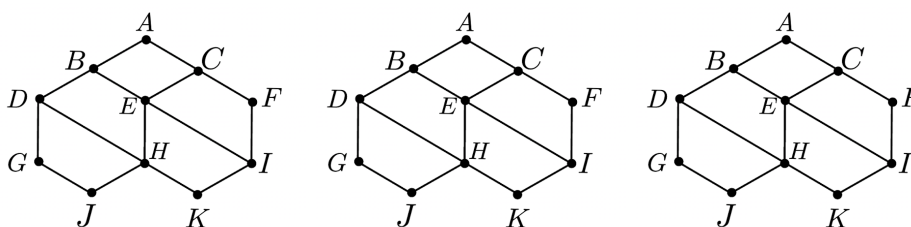
2. For questions 2a through 2d consider the following graph:



- (a) Between the following options, which is a spanning tree that makes D and K have degree of separation 4? (2 points)

- ☐ $AB, AC, BD, BE, CF, DG, FI, GJ, HK, IK$
☐ $AC, BD, BE, CE, CF, DG, EI, GJ, HJ, IK$
☐ $AC, BE, CF, DH, EI, FI, GJ, HJ, HK, IK$
☐ $AB, CE, CF, DG, EH, FI, GJ, HJ, HK, IK$

Help yourself with three other copies of the graph:



- (b) Write down the degree of separation of the vertices F and G : (2 points)

$$d(F, G) = \underline{\hspace{2cm}}$$

- (c) Write down the redundancy of the graph G : (2 points)

$$\text{red}(G) = \underline{\hspace{2cm}}$$

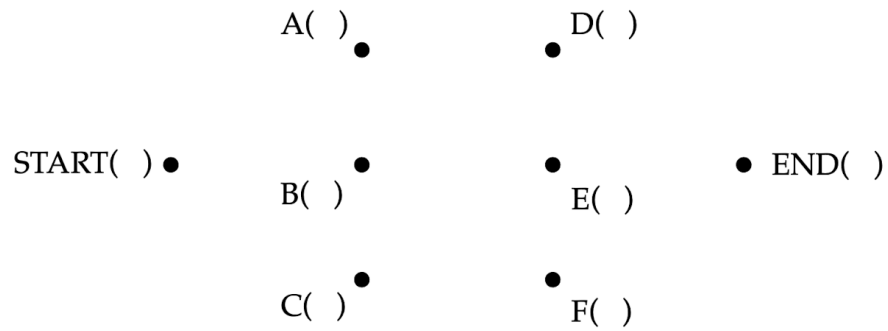
- (d) Between the following pairs of vertices, only pair has a different degree of separation. Find it: (2 points)

- ☐ A and H
☐ B and F
☐ I and G
☐ C and J

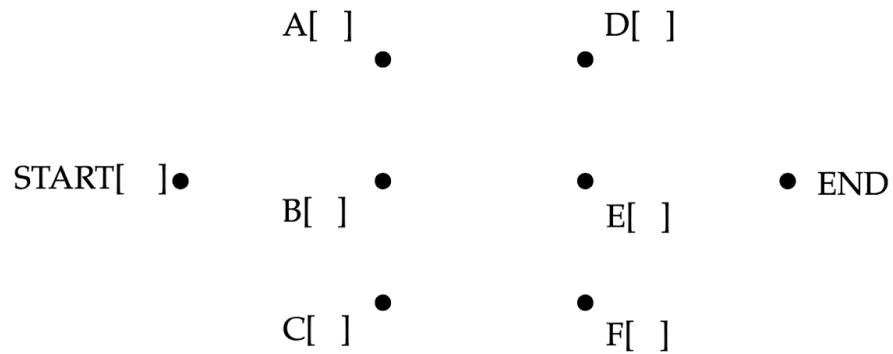
3. For questions 3a through 3e consider the following tableau with information on a project with six tasks A through E :

Task	Time	Precedent tasks
A	2	
B	4	
C	3	
D	4	A, B
E	2	A, C
F	1	B, C

- (a) Fill in the project digraph with the processing times and precedence relations: (4 points)



- (b) Apply the backflow algorithm to find the critical time of each task: (4 points)



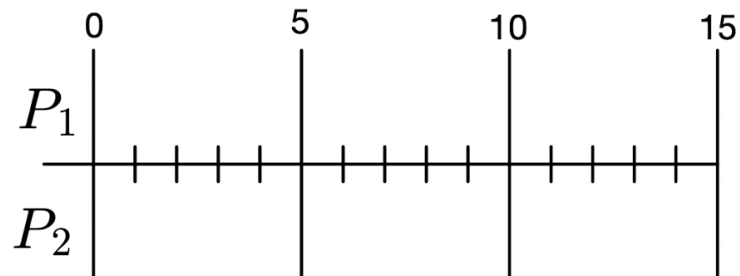
(c) What is the critical time for this project? (2 points)

Project Critical Time = ____.

(d) Write down a priority list of tasks based on the critical path algorithm: (2 points)

Project List = {____, ____, ____, ____, ____, ____}.

(e) Using the critical path algorithm create a schedule for two workers: (4 points)



4. Short answer:

- (a) Suppose a connected graph has 16 vertices and 64 edges. How many edges will any of its spanning trees have? (4 points)

- (b) We defined a *tree* as a connected graph with no cycles. Mention any of the three properties equivalent to being a tree. (4 points)

- (c) Consider your family tree as a graph where the relation is A is connected to B if A is B 's kid. Assume you have a nephew, what is the degree of separation between yourself and your nephew? (4 points)

5. In the following space draw the requested graphs:

- (a) A directed graph with a directed cycle. (4 points)

- (b) A directed graph without a directed cycle. (4 points)

6. (25 points) Realistically, when you're traveling in your local city, you're very likely to know your neighborhood and your route to your worksite. It is also likely that you know the places you frequent often such as the supermarket and houses of friends you visit often.

In this hypothetical scenario, you're driving to a concert this weekend and need to pick up several friends along the way. Some friends live close to you, while others are farther away in areas you're not familiar with. You also don't know the concert venue very well.

For this scenario, assume you have a physical map of the city and the addresses of your friends, but no access to GPS or navigation apps.

In the following space address the following prompts and discuss thoroughly and explain your reasonings:

- Do you think that this situation is better modeled through an Eulerian or Hamiltonian approach? Are you trying to make a walk or a circuit?
- Since some friends live nearby and others farther away, where you're not familiar, would that influence your choice of algorithm to pick up? Why?
- Could a mix of algorithms make for a better route?
- If you're running late or some friends aren't ready yet, how does that change your approach? Would it affect your choice of algorithm or the order in which you pick people up? Why or why not?

Sol:

- 8 pts clearly explains whether the situation is more Hamilton or Euler and adds evidence to support reasonings.
- 6 pts discusses how friends locations affects choice of approach
- 6 pts thoroughly considers whether a hybrid strategy would be beneficial.
- 5 pts similarly discusses how a time constraint could affect the choice.