# Sample Exam

1. Select the correct answer (1 point for each question)
   1. Which of the following running time is :

a). b).

c). d). Both b) and c)

e). Both a) and b)

* 1. Which of the following running time is :

a). b).

c). d). Both b) and c)

e). Both a) and b)

* 1. Consider the problem of sorting distinct positive integer numbers , what is the size of the input?

a). b).

c). d).

* 1. Consider the following algorithm for testing whether a given number is prime: for all , test whether is dividable by , which statement is true?

a). The algorithm runs in time, and is a polynomial time algorithm

b). The algorithm runs in time, and is a pseudo-polynomial time algorithm

c). The algorithm runs in time, and is a polynomial time algorithm

d). The algorithm runs in time, and is a pseudo-polynomial time algorithm

1.5 Which of the following statement is true:

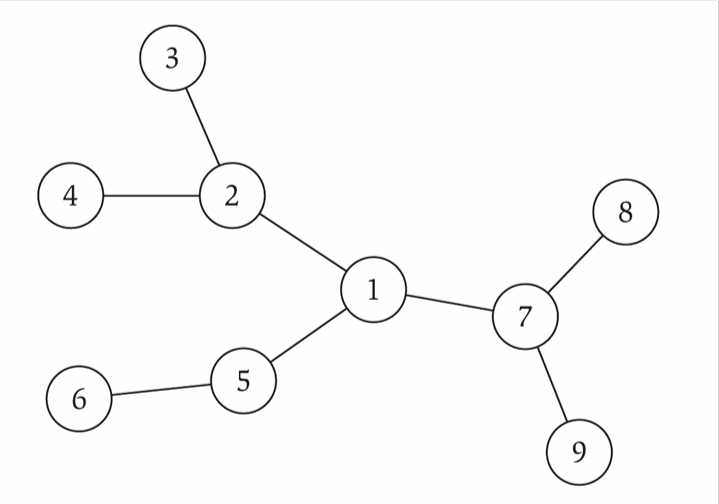
a). A stable matching always exists in a bipartite graph and the Gale-Shapley algorithm always finds one stable matching.

b). A stable matching does not necessarily exist in a bipartite graph, but if it exists, the Gale-Shapley algorithm always finds one stable matching.

c). A stable matching always exists in any graph. The Gale-Shapley algorithm always finds the stable matching.

d). A stable matching always exists in a bipartite graph. The Gale-Shapley algorithm does not necessarily find a stable matching.

1.6 Consider the following graph



Which statement is true:

a). This is a bipartite graph and also a tree

b). This is a bipartite graph but not a tree

c). This is a tree but not a bipartite graph

d). This is not a tree and not a bipartite graph

1.7 Which of the following statement is true:

a). A bipartite graph can have both odd cycle and even cycle

b). A bipartite graph can have an even cycle but cannot have an odd cycle

c). A bipartite graph can have an odd cycle but cannot have an even cycle

d). A bipartite graph cannot have odd cycle nor even cycle

1.8 Consider the following graph and the cut

A picture containing clock, sitting, table, computer

Description automatically generated

Which edge is in the cut set of :

a). is not a cut (not connected)

b).

c).

d).

1.9 Which of the following statement is true:

a). Any graph admits a spanning tree that consists all of its vertices

b). If a graph is connected, then it always admits a spanning tree that consists all of its vertices

c). If a graph has no cycle, then it always admits a spanning tree that consists all of its vertices

d). If a graph has more edges than vertices, then it always admits a spanning tree that consists all of its vertices

1.10 Which of the following statement is true:

a). There exists an algorithm for multiplying two integers that runs in time , which is linear time in input.

b). There exists an algorithm for multiplying two integers that runs in time , which is near linear time in input.

c). There exists an algorithm for multiplying two integers that runs in time , which is nearly linear time in input.

d). Using FFT (fast fourier transform), it is impossible to have an algorithm for multiplying two integers that runs in time , because FFT requires time.

1. (2 points) Is the following graph bipartite or not? State your reason.

A picture containing clock, object, watch, indoor

Description automatically generated

1. (2 points) Find out a stable matching for the bipartite graph with the following preference list:

A:

B:

C:

X:

Y:

Z:

1. (2 points) Maximum spanning tree: Given is an edge-weighted connected graph . The goal to find a spanning tree of the graph whose total edge weight is maximized. Give an algorithm for this problem.
2. (2 points) Consider a variant of knapsack problem where given is a set of items, with each item having a profit , a length and a weight . The goal is to find a subset of items such that their total length is at most , total weight is at most , and total profit is maximized. Design a dynamic programming algorithm for this problem that runs in time.