Boğaziçi University, Dept. of Computer Engineering

CMPE 250, DATA STRUCTURES AND ALGORITHMS

Spring 2013, Midterm 2

Name: _____

Student ID: _____

Signature: _____

- Please print your name and student ID number and write your signature to indicate that you accept the University honour code.
- During this examination, you may not use any notes or books.
- Read each question carefully and **WRITE CLEARLY**. Unreadable answers will not get any credit.
- For each question you do not know the answer and leave blank, you can get %10 of the points, if you write only "I don't know the answer but I promise to think about this question and learn its solution".
- There are **5** questions. Point values are given in parentheses.
- You have **90 minutes** to do all the problems.

Q	1	2	3	4	5	Total
Score						
Max	20	20	20	20	20	100

1. Suppose you have algorithms with the five running times listed below. (Assume these are the exact running times.) How much slower do each of these algorithms get when you (i) double the input size, or (ii) increase the input size by one?

   - n^2
   - n^3
   - $100n^2$
   - $n \log n$
   - 2^n

(20 points)

2. Suppose we are given a graph with the following adjacency list representation of form

```
Source : Target1 Target2 .. TargetN

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

(a) Is this graph an undirected graph? Why, or why not?

(b) Show the sequence of nodes visited by a depth first search traversal starting from node A

```
A ____ ____ ____ ____ ____ ____ ____
```

(c) Show the sequence of nodes visited by a breadth first search traversal starting from node A

```
A ____ ____ ____ ____ ____ ____ ____
```

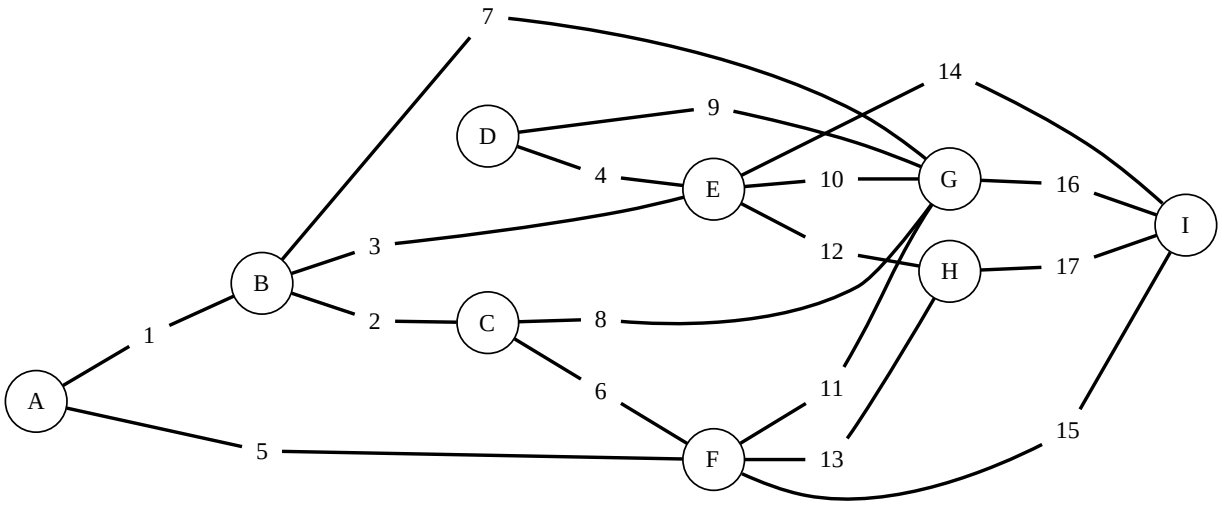
(d) Find the shortest path tree starting from node A (assuming each edge having weight 1) as an array of uplinks

Node	A	B	C	D	E	F	G	H
Distance	0	1						
Uplink	-1	A						

(20 points)

3. An undirected bipartite graph G is a graph such that the vertex set can be partitioned into two subsets such that no edge of G has both its vertices in the same subset. Give a linear algorithm to determine whether a given graph G is bipartite. *(20 points)*

4. Minimum spanning tree. For parts (a), and (b) consider the following weighted graph where each edge has a label equal to its weight.



(a) Complete the sequence of **edges** in the MST in the order that Kruskal's algorithm includes them.

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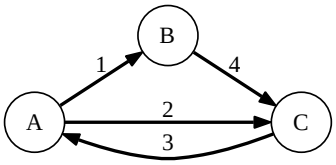
(b) Mark the edges of the minimum spanning tree and find the total weight.

(20 points)

5. Suppose for a given directed graph G. Describe an algorithm to find **a** directed cycle in G. Your algorithm should also print the nodes on the cycle. For example, for the graph below, your algorithm should alarm that there is a directed cycle and print out `A-B-C-A` **or** `A-C-A`



(20 points)