CSE 312 2. Midterm

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I. QUESTION (20 POINTS)

Give a big-Oh characterization, in terms of N, of the running time of the following functions. Show your work.

a.)
```
int magic1(int N){
    int i, sayi = 1;
    while (N > 1){
        sayi++;
        N = N / 2;
    }
    return sayi;
}
```
b.)
```
int magic2(int N){
    if (N == 1)
        return 1;
    else
        return 1 + magic2(N / 2);
}
```

II. QUESTION (15 POINTS)

Let say we have N numbers. Our aim is to get the following objectives as fast as we can. What is the order of time complexities from the smallest to the largest?

a) Find a specific one given that the array is sorted.
b) Sort the numbers.
c) Find the k'th largest number given the array is not sorted.

III. QUESTION (18 POINTS)

A word can be changed to another word by a 1-character substitution. Assume that a dictionary of 5-letter words exists. Give an algorithm to determine if a word A can be transformed to a word B by a series of 1-character substitutions, and if so, outputs the corresponding sequence of words. Note that all intermediate words must be in the dictionary. As an example, bleed converts to blood by the sequence bleed, blend, blond, blood.

IV. QUESTION (18 POINTS)

The objective of the Kevin Bacon game is to link a movie actor to Kevin Bacon via a shared movie roles. The minimum number of links is an actor's Bacon number. For instance, Tom Hanks has a Bacon number of 1; he was in Apollo 13 with Kevin Bacon. Sally Fields has a Bacon number of 2, because she was in Forrest Gump with Tom Hanks, who was in Apollo 13 with Kevin Bacon. Assume that you have a comprehensive list of actors, with roles in films, give an algorithm to find an actor's Bacon number.

V. QUESTION (14 POINTS)

A rook stands on the upper left square of a chess board. Two players make turns moving the rook either horizontally to the right or vertically downward. The player who can place the rook on the lower right square of the chessboard wins. Who will win? Describe the winning strategy.

VI. QUESTION (15 POINTS)
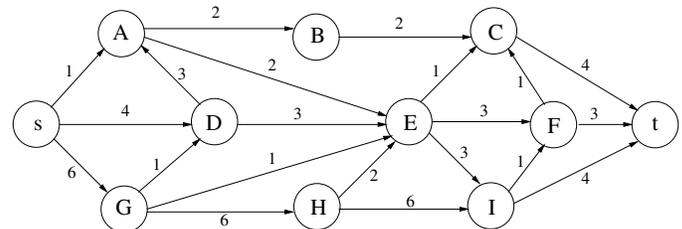
Find the minimum spanning tree of the graph. You can use either Prim or Kruskal's algorithm.