National Institute of Technology Tiruchirappalli
Department of Computer Science and Engineering
Design and Analysis of Algorithms (CSPC42)

Cycle Test 1, Date: March 09, 2023

Duration: 1 Hour | II-B.Tech CSE-A, V Semester | Max marks: 20

1. Write an algorithm using the Tournament method to find an array's second-largest element. Compute an exact number of comparisons. Write at least two other algorithms for the same problem and compare the number of comparisons of all the algorithms.
(4M (CO1))

2. Find the Time complexity
(4M (CO1))

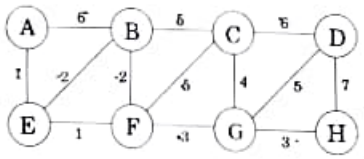
   1. $T(n) = 2T(n/2) + log\ n, \forall n \geq 1$ and $T(1) = 1$. (Use only substitution method)

   2. (a)
```
void fun(int n){
for (int i = n; i > 0; i /= 2)
      for (int j = 0; j < i; j++)
            printf(HI);}
```

   (b)
```
void fun(int n){
   for(int i=1;i<=n;i++)
      for(int j=1; j<=n; j+=i)
        printf(HI);}
```

3. Consider the weights and values of the four items listed below.
Items (1,2,3,4), weights (10,7,4,2), and Values (60,28,20,24). Note that there is only one unit of each item. The task is to pick a subset of these items such that their total weight is no more than 11 Kgs and their total value is maximized. Moreover, no item may be split. The total value of items picked by an optimal algorithm is denoted by V_{opt}. A greedy algorithm sorts the items by their value-to-weight ratios in descending order and packs them greedily, starting from the first item in the ordered list. The total value of items picked by the greedy algorithm is denoted by V_{greedy}. Then find the value of $V_{opt} - V_{greedy}$.
(4M (CO1, CO2))

4. Consider the following graph.
(4M (CO2))



   1. What is the cost of its minimum spanning tree?
   2. How many minimum spanning trees does it have?
   3. Write Prim's algorithm and analyze its time complexity.

5. Write Dijkstra's algorithm and its limitations. Analyze the time complexity of the algorithm.
Justify the statement: *"Dijkstra's algorithm is affected by negative edge weight cycles"*.
(4M (CO1, CO2))

Best Wishes