National University

of Computer & Emerging Sciences Peshawar Campus

Student Name: _____ Section: _____ Roll No: _____

Program: CS 18 (Section A & B)
Semester: Spring – 2020
Time Allowed: **3** hours
Course: **Design & Analysis of Algorithm (CS 301)**

Examination: **ONLINE** Final Exam
Total Marks: **80**
Date: **22nd June, 2020**
Instructor: Mr. Fazl-e-Basit

NOTE:

1. **Solution of students should not match. Otherwise ZERO credit may be assigned to all matched solutions in each Question. So to earn more, do not share your solution.**
2. **Total time for paper solving is 2 Hours & 20 Minutes. Rest of 40 minutes are for (i) Any mishap (ii) Reviewing (iii) Scanning & Uploading on SLATE.**
3. **Timely Submission will have solid 10 marks, 30 minutes late 6/10, 45 minutes late 3/10 and after that NO ACEEPTANCE. So be careful about timely submission.**
4. **Scan solution in Sun light so that your scan is clear. You may lose marks with unclear scan.**
5. **Scan solution in the same order of questions given in Question paper and make single pdf file.**

[45 Minutes]

Q. 1) Generate the **Huffman Code Tree** of your name found in the following attached table. I have modified some names to make the length of each name almost equal. Answer the following questions: **[20]**

1. Provide Frequency table of each letter present in your name.
2. Show step by step Huffman Code Tree of your name and generate the final **tree** AND your **codes**.
3. Technically how does receiver know what the codes are?
4. Which algorithmic strategy is used in your solution? Justify your choice.
5. Which type of tree will represent the: **(i)** Most-Optimal **(ii)** Sub-Optimal & **(iii)** Least-Optimal **Huffman Codes.** Give reasoning for each case.

[Time breakdown for above parts: 4 + 15 + 8 + 8 + 10 = 45 Minutes]

1	15P-6006	AHSAN FAZEEL SYED
2	15P-6017	MAHAM ZAKRIYYAA
3	15P-6171	ABDUL MOUEED HAFEZ
4	16P-6002	MUHAMAD UZAIR KHAN
5	16P-6006	AWAIS AHMED QARNI
6	16P-6013	SULEMAN KHAN JAN
7	16P-6022	SAJID ANWAR KHAN
8	16P-6051	RAJ BAKHTAWAR SYED
9	16P-6054	AHMED TARIQ JANJUA
10	16P-6062	MANZUR AHMAD MITHA
11	16P-6080	HAMID MEHMOOD JAN
12	16P-6140	UMM E HAANI ALAM
13	17P-6001	DANISH SHAFIQ SYED
14	17P-6014	SYED MUSTAFA SHAH
15	17P-6020	FAIZAN AHMAD KHAN
16	17P-6023	SYED JAWAD HASSAN
17	17P-6026	FAHAD JALAL KHAN
18	17P-6032	ALI HASSAN RIAZ

34	17P-6102	SYED BASHARAT HUSSAIN
35	17P-6104	FAHAD SALEEM KHAN
36	17P-6119	AMMAD AMIR JAN
37	17P-6124	ASJID AHMED SYED
38	17P-6130	ARSLAN FALAK SHER
39	17P-6132	SHAHAB ASLAM KHAN
40	17P-6144	HAFEEZ ULLAH JUNAID
41	17P-6150	AAMIR AHMAD KHAN
42	17P-6151	HUZAIFA HAMID KHAN
43	17P-6152	ROHAN ZAHID FAROOQUI
44	17P-6159	MOMINA IFFAT IFTIKHAR
45	17P-6162	HAMMAD HASSAN JAN
46	17P-6353	FARYAL ISHFAQ SYED
47	18P-0010	MUBARIZ AHMED KHAN
48	18P-0011	SYEDA SANA HAIDER
49	18P-0013	ABDULLAH JAN KHAN
50	18P-0016	AMMAR ABID KHAN
51	18P-0023	HAMBAL ABID JAN

19	17P-6035	TASHFEEN LATIF JAN
20	17P-6038	KOSAR AHMAD SYED
21	17P-6047	SHERAZ HUSSAIN KHAN
22	17P-6052	ZUNERA SYED BUKHARI
23	17P-6055	UZAIR FAHEEM KHAN
24	17P-6057	NADIA ABBAS RIAZ
25	17P-6061	HAIDER TAMSIL JAN
26	17P-6067	HASSAN SHABBIR CHEEMA
27	17P-6072	AYESHA SYED AZIZ
28	17P-6082	MUHAMMAD UMER KHAN
29	17P-6084	KHADIJA HAYAT SYED
30	17P-6089	ARSLAN AHMAD KHAN
31	17P-6093	QASIM AHMAD KHAN
32	17P-6094	SYEDA RIDA FATIMA
33	17P-6101	SHOUZAB KHAN JAN

52	18P-0030	MOMINA ATIF DAR
53	18P-0034	SYED ASAD ZAMAN
54	18P-0035	SYED MUHAMMAD ALI
55	18P-0039	SHAFEEQ AHMAD JAN
56	18P-0040	SYED AHMED ABBASI
57	18P-0042	TAIMOOR HAYAT KHAN
58	18P-0050	SYED ZEESHAN JAN
59	18P-0054	MUHAMMAD IFTIKHAR JAN
60	18P-0058	ALI MUZAHIR SIDDIQI
61	18P-0075	SYED SALMAN ARIF
62	18P-0109	USMAN SHABBIR KHAN
63	18P-0111	MUBASHER KHAN SHER
64	18P-0131	ASIM MAHMOOD KHAN
65	18P-0141	MUHAMMAD SHURAIH
66	18P-0148	SYED ALI HASHIM
67	16I-0016	IMRAN AKHTAR JAN

[20 Minutes]

Q. 2) We suppose that the partitioning algorithm in Quicksort always produces two sub-arrays, one with size **1** and other with size **n-2**. Write down the recurrence that represents this case and solve it using **iterative/substitution** method. Also draw a **recursion tree** for this case. Assume **n** is always even. **[10]**

[20 Minutes]

Q. 3) I want to make a change of Pakistani Currency I have. Problem can be defined as how can a given amount of money be made with the ***least number*** of coins/change of available single Coins or Notes i.e. finding the number of ways of making ***least number*** of changes for a particular amount of rupees, n, using a given set **'C'** of Coins/Notes. For example in Pakistani coin/rupee system: C = {1, 2, 5, 10, 20, 50, 100, 500, 1000, 5000} and **'n'** can be any number whose change is required.

- An Example: n = 4, C = {1, 2, 3}, Possible Solutions are: {1, 1, 1, 1}, {1, 1, 2}, {2, 2}, {1, 3}

Propose a solution for this problem using any popular algorithmic strategies such as **Divide & Conquer**, **Dynamic Programming,** or **Greedy Algorithm** etc. Also provide the **Complexity Analysis** of your proposed solution. **[10]**

[15 Minutes]

Q.4) First determine the worst-case running time of algorithm/function **F()** as a θ function of n. Next determine the total running time of algorithm/function **G()** as a θ function of n. Justify each answer. **[8]**

```
F(n)
    if (n mod 2 == 1) return n;
    else return F(n/2);
```

```
G(n)
    for k ← 1 to n do
        print F(k);
```

[14 Minutes]

Q.5) Give Worst & Best case analysis of following program segment in Asymptotic Notation. **[8]**

```
a = 0;
for (i=1; i < n; i++)
        for (j=1; j < i * i; j++)
                for (k=1; k < j; k++)
                    {  cin>>a;
                       if ( a % 2 == 0)
                           break;
                    }
```

[6 Minutes]

Q.6) How we can handle NP-Complete problems as they are hard to solve? **[5]**

[20 Minutes]

Q.7) Mention the following statements are True or False. Give **brief explanation** of your choice. **[9]**

(i)) If a vertex $v \in V$ of a given connected graph G=(V, E) is visited during level 'P' of a breadth-first search from source vertex $s \in V$, then every path from s to v has length at most 'P'.

(ii) If a graph G=(V, E) is represented as an adjacency matrix, Depth-first search will take $\Theta(V^2)$ time.

(iii) It takes O(V) time to compute the in-degree of every vertex if a given directed graph G=(V, E) is represented in adjacency-list representation.

(iv) In a dynamic programming algorithm, we can compute all values of sub problems in a bottom-up fashion, asymptotically faster than using recursion and memoization.

(v) Best case input for Quicksort algorithm occurs when array is sorted.

(vi) Graph traversal using BFS can be done in linear time.

(vii) All Connected graphs which are undirected having **n** vertices has exactly **n-1** edges.

(viii) If there are 'n' numbers $a_1, \ldots, a_n$, the median of the smallest ten numbers and the largest ten numbers among them can be computed in $O(n)$ time.

(ix) If there are 'n' numbers $a_1, \ldots, a_n$, where for every $1 \le i \le n$, $a_i \in \{-5, 9, 100\}$; their sorted order can be output in $O(n)$ time.

Q.8) Timely submission of above Question Paper on SLATE **[10]**

Best of Luck!