College of Engineering, Pune
END SEMESTER EXAM Nov 2013
Final B. Tech
EE 413- Computer Algorithms

Day & Date- Max. Marks- **60**

Timing - Duration – **3 hours**

Instructions:
1. Assume Data wherever necessary.
2. **All Questions are Compulsory**.
3. Figures and examples with proper explanation fetch full marks.

Q. 1 *Solve any Two (2)*

(a) Solve the following for the given Algorithms (below): **10**

(i) Introduce statements to increment ***count*** at all appropriate points in Algorithm given below.

(ii) Simplify the resulting algorithm by eliminating statements. The simplified algorithm should compute the same value for ***count*** as computed by the algorithm of Part (i)

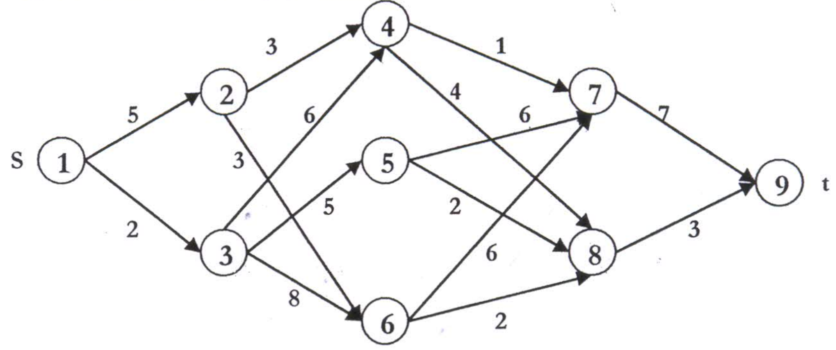
(iii) What is the exact value of ***count*** when the algorithm terminates? You may assume that the initial value of ***count*** is 0.

(iv) Obtain the step count for following Algorithm using the frequency method. Clearly show the **step count table**.

```
Algorithm Transpose(a, n)
{
    for i := 1 to n - 1 do
        for j := i + 1 to n do
        {
            t := a[i, j];
            a[i, j] := a[j, i];
            a[j, i] := t;
        }
}
```

```
Algorithm Mult(a, b, c, n)
{
    for i := 1 to n do
    {
        for j := 1 to n do
        {
            c[i, j] := 0;
            for k := 1 to n do
                c[i, j] := c[i, j] + a[i, k] * b[k, j];
        }
    }
}
```

(b) Find a minimum-cost path from s to t in the multistage graph of Figure shown below. Do this first using forward approach and then using the backward approach. 10



(c) Solve the recurrence relation 10

$$T(n) = \begin{cases} T(1) & n = 1 \\ a\,T\left(\frac{n}{b}\right) + f(n) & n > 1 \end{cases}$$

for the following choices of a, b and f(n) (c being constant).

i. a = 1, b =2, and $f(n)$ = cn.

ii. a = 5, b = 4, and $f(n)$ = cn^2

iii. a = 28, b = 3, and $f(n)$ = cn^3

(d) *(i)* Explain Tree Traversal Techniques, and write Algorithms for these techniques. 06

(ii) Explain Graph Coloring Problem. How an optimum solution can be generated using Backtracking Method? 04

Q. 2 *Solve any Four (4)*

(a) Find an optimal solution to the knapsack instance $n = 9, m = 20, (p_1, p_2, \dots, p_9) = (4, 6, 16, 5, 10, 12, 2, 7, 8)$, and $(w_1, w_2, \dots, w_9) = (12, 16, 9, 10, 4, 6, 2, 15, 3)$. 04

(b) What is the solution generated by Job Scheduling (JS) Algorithm when $n = 7, (p_1, p_2, \dots, p_7) = (3, 5, 20, 18, 1, 6, 30)$ and $(d_1, d_2, \dots, d_7) = (1, 3, 4, 3, 2, 1, 2)$? 04

(c) A sorting method is said to be stable if at the end of the method, identical elements occur in the same order as in the original unsorted set. Is merge a stable sorting method? Explain. 04

(*d*) Explain All-Pairs Shortest Paths problem. Solve it using Dynamic Programming Technique. **04**

(*e*) Show how ***QuickSort*** sorts the following sequence of keys: 1, 1, 1, 1, 1, 1, 1 and 5, 5, 8, 3, 4, 3, 2. **04**

Q. 3 *Solve any Three (3)*

(*a*) You are given a set of $\boldsymbol{n}$ jobs. Associated with each job $\boldsymbol{i}$ is a processing time $\boldsymbol{t_i}$, and a deadline $\boldsymbol{d_i}$, by which it must be completed. A feasible schedule is a permutation of the jobs such that if the jobs are processed in that order, then each job finishes by its deadline. Define a greedy schedule to be one in which the jobs are processed in non-decreasing order of deadlines. Show that if there exists a feasible schedule, then all greedy schedules are feasible. **08**

(*b*) Explain Tree Traversal Techniques, and write Algorithms for these techniques. **08**

(*c*) Explain the Algorithm for Finding the Maximum and Minimum using Divide and Conquer techniques. Show Time and Space complexity. **08**

(*d*) If k is a nonnegative constant, then prove that the recurrence **08**

$$T(n) = \begin{cases} k & n = 1 \\ 3T(n/2) + kn & n > 1 \end{cases}$$

has the following solution (for $\boldsymbol{n}$ a power of 2):

$$T(n) = 3kn^{\log_2 3} - 2kn$$