संगणक विज्ञान एवं अभियांत्रि की विभाग

Computer Science & Engineering Department

National Institute of Technology Sikkim, Ravangla, South Sikkim-737139

(AN INSTITUTE OF NATIONAL IMPORTANCE, GOVT. OF INDIA)

Second Online Examination (Type I)

Marks: 10 **Time: 45 minutes**

Advance Algorithm (CS15102) for B.Tech (5th Semester), CSE

Instructions:

- **Online Google form:** You have to write the answer in the online **google form**. Each online submitted answer is limited to maximum 20 words only. **Submit the google form by 11:45AM.**
- **Submission of justification/rough works:**
  - Take A4/blank paper and write your Name, Roll No., Subject Name with Subject Code and Date at the top of the first paper.
  - You have to write justification behind your answer or a rough work for each answer. **The submitted answer in the google form without justification will not be considered.**
  - Sign at the end of each page.
  - Submit the **scan/photocopy** of the justification/rough works through **google class**.
  - **Submit the rough works by 12:00Noon.**

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Answer all the questions:

1. Assume a *dynamic table* where size of the table is dynamically changed as per requirement.
   - TABLE-INSERT inserts into the table an item that occupies a single slot, that is, a space for one item. *Expansion required for full table*.
   - TABLE-DELETE removes an item from the table, thereby freeing a slot. *Contraction required for sufficiently empty table*.

   To analyze the amortized cost of the i^{th} TABLE-INSERT and TABLE-DELETE operation, let
   - num_i denote the number of items stored in the table after the i^{th} operation.
   - $size_i$ denote the total size of the table after the i^{th} operation, and
   - Φ_i denote the potential after the i^{th} operation.
   - $\alpha(T)$ be the load factor of the table T.

   The potential function for such operation is designed as follow.

   $$\text{Potential function } \Phi(T) = \begin{cases} num[T] - \frac{size[T]}{2}, & \text{If } \alpha(T) \geq \frac{1}{2} \\ \frac{size[T]}{2} - num[T], & \text{If } \alpha(T) < \frac{1}{2} \end{cases}$$

   What is the amortized cost of i^{th} TABLE-INSERT operation when $\alpha_{i-1} < ½$ and $\alpha_i \geq ½$?

2. Consider the $Q1$. If $\alpha_{i-1} \geq ½$, the amortized cost of the TABLE-INSERT operation is at most ____.

3. Consider the $Q1$. Assume, $\alpha_{i-1} < ½$ and the i^{th} TABLE-DELETE operation does trigger a contraction. What is the amortized cost of such i^{th} operation?

4. Use Masters theorem: $T(n) = 6T(n/3) + n^2 \log n$

5. An algorithm has time complexity $T(n) = 2n^3 + 33n^2 + 64$. Asymptotically analyze it based on Theta (Θ).

6. An algorithm has time complexity $T(n) = 2n^2 + 25n + 5n\log n$. Asymptotically analyze it based on Big-omega (Ω).

7. Consider the following recursive function.

```
fun (n)
{
    If (n ≤ 0) then
        Print "NIT"
    Else
    {
        x = fun(n-1) + fun(n-1)
        Print "Sikkim"
    }
}
```

   What is the time complexity of fun(n)?

8. The problem of determining whether any element from a given list greater than k (for a given k) exists or not is in NP (Write *True* or *False*).

9. 3SAT is NP-Complete problem. If 3SAT is polynomial time reducible to the problem B then B is NP-Complete (Write *True* or *False*).

10. Let $T(n)$ be a polynomial and $O(T(n))$ be the time complexity of non-deterministic Turing machine for the given input of length n. What is the time complexity of the equivalent deterministic Turing machine for the same input?

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