RegdNo. 322201297

Assignment No. 2

Course Code: ECAP538 **Registration Number:** 322201297

Instructions:

a. Attempt all questions given below in your own handwriting. Assignment in typed format will not be considered for evaluation.

b. The student has to complete the assignment in the allocated pages only. Any other page in case utilized shall not be considered.

Q1. Illustrate lower bound theory and its different techniques. [10 Marks] [CO3, L4]

Lower bound theory in algorithm analysis is used to determine the minimum amount of resources (such as time or space) required to solve a particular problem. It helps in understanding the inherent complexity of a problem and sets a benchmark for the efficiency of algorithm.

Different techniques used in lower bound theory includes:

1. Decision tree technique: Decision tree are used to analyze the worst case scenario of an algorithm. By constructing a decision tree, we can determine the minimum number of comparisons or operations required to solve a problem.
2. Adversary Argument: This technique involves assuming an adversary that tries to make the algorithm perform the maximum number of operations. By analyzing the adversary's strategy, we can establish lower bounds on the algorithm's performance.
3. Reduction Technique: In reduction techniques, lower bounds are established by reducing a known problem to the problem at the hand. By showing that the current problem is a least as hard as the known problem, we can determine lower bounds.
4. Information Theory: Information theory concepts, such as entropy and information ~~concept~~ content, are used to analyze the lower bounds of algorithms. By quantifying the information content of inputs and outputs, lower bounds can be established.
5. Pigeonhole Principle: The pigeonhole principle is used to establish lower bounds by showing that there are more possible inputs than distinct outputs. This helps in determining the minimum complexity required to process all possible inputs.

By applying these technique, lower bound theory helps in understanding the limitations of algorithms and provides insights into the inherent complexity of computational problems.

Signature of the Student Tariq

Note:-

CO: is the Course Outcome as per your course syllabus.

L1-L6: Learning level objectives as per Revised Bloom Taxonomy (RBT).

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Q2. Discuss compression tree problems with example. [10 Marks] [CO2, L2]

Compression tree problems involve representing data in a compressed from using tree structures. One common example of compression tree problems is Huffman coding, which is a widely used algorithm for lossless data compression.

Huffman Coding Example

Consider the following set of characters and their frequencies:

Characters: A B C D E

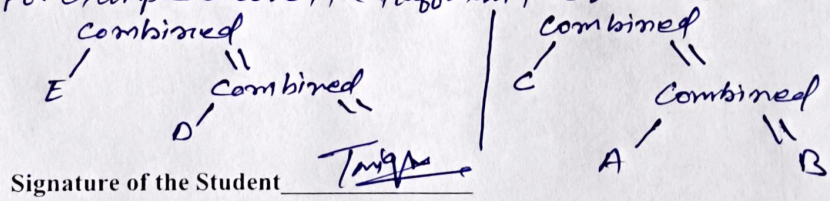
Frequency: 5 9 12 13 16

To compress this data using Huffman coding, we follow these steps:

1. Create a leaf node for each character with its frequency
2. Create a min-heap (priority queue) of all the nodes.
3. While there is more than one node in the heap:
   a. Remove the two nodes with the lowest frequency
   b. Create a new internal node with these two nodes as children. The frequency of the children.
   c. Add the new node back to the heap.
4. The root of the heap is the root of the Huffman tree.

By traversing the Huffman tree, we assign binary codes to each character based on their position in the tree. Characters closer to the root have shorter codes, while characters closer to the root have shorter codes, while characters farthest away have longer codes.

For example above, the Huffman tree would look like this:



Signature of the Student Tanya

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