CSL303: Quiz 2

07 November 2025

1. **(Storage Structures)** Consider a relation 'Employees(ID, Name, Department, Salary)' with 1 million records. Each record is 100 bytes long, and the disk block size is 4096 bytes. The file is currently organized as a Heap File. A frequent query is: `SELECT Name, Salary FROM Employees WHERE Salary > 80000;` The 'Salary' attribute has a uniform distribution between 30,000 and 150,000.

   Calculate the approximate number of block accesses required to execute this query with the current Heap File organization.

2. **(Buffer Management)** A database system has a buffer pool with 4 frames. A sequence of page requests is made as follows: `A, B, C, D, A, E, B, F, C, G, D, A`

   Initially, the buffer pool is empty. Trace the state of the buffer pool frame-by-frame for the entire sequence using the **Least Recently Used (LRU)** replacement policy. For each request, show which page is in which frame and indicate whether the request resulted in a page hit or a page fault.

3. **(B+ Tree Mechanics)** Consider a B+ Tree with an order of $n = 4$ (meaning a node can have at most 4 children and at most 3 keys). Starting with an empty tree, perform the following operations in sequence:

   (a) Insert the values: 10, 20, 5, 15, 25, 30, 7

   (b) From the resulting tree, delete the value 15.

   (c) From the resulting tree, delete the value 20.

   Draw the final structure of the B+ Tree after all operations are complete. Show the tree's state after each major step (i.e., after the initial insertions, after the first deletion, and the final tree).