

Question 1: Access Methods.....[430 points]

- (i) **[10 points] Access Methods:**
Define an access method. List two types of access methods.
- (ii) **[10 points] Access Methods:**
Distinguish the sequential scan method from the index scan method.
- (iii) **[10 points] Access Methods:**
Distinguish between base and derived data structures.
- (iv) **[10 points] Slotted Pages:**
Why does data grow from one side and slots from the other side in a slotted page?
- (v) **[10 points] Slotted Pages:**
Motivate the need for a slotted page design (as opposed to sequentially adding the tuples to the page).
- (vi) **[10 points] Slotted Pages:**
Motivate the need for keeping track of the first free slot.
- (vii) **[10 points] Slotted Pages:**
Does each slot store a tuple or a single field?
- (viii) **[30 points] Slotted Pages:**
What are the two components of a page identifier? What are the two components of a tuple identifier? What are the two components of a slot identifier?
- (ix) **[10 points] Slotted Pages:**
Distinguish between a regular slot and a slot pointing to another record.
- (x) **[10 points] Record Layout:**
What is time complexity for accessing an attribute with a naive layout (*i.e.*, serializing the attributes)?
- (xi) **[10 points] Record Layout:**
What is time complexity for accessing an attribute with a offset-based layout?
- (xii) **[10 points] Record Layout:**
List two reasons for reordering the attributes within the record layout.
- (xiii) **[10 points] NULL Values:**
Define a NULL value. Is NULL equal to NULL in SQL?
- (xiv) **[10 points] NULL Values:**
Distinguish between two-valued and three-valued logic.
- (xv) **[10 points] NULL Values:**
List two techniques for storing NULL values in a record.
- (xvi) **[10 points] Large Values:**
Distinguish between BLOB and CLOB.
- (xvii) **[10 points] Large Values:**
List two techniques for storing large records.

- (xviii) **[10 points] Large Values:**
Motivate the need for organizing a BLOB value as a B+tree.
- (xix) **[10 points] Large Values:**
Motivate the need for storing a BLOB value as an extent list.
- (xx) **[10 points] Large Values:**
Suggest a technique for quickly evaluate predicates on columns of BLOB type.
- (xxi) **[10 points] Free Space Inventory:**
What is the purpose of a free space bitmap? Is it maintained for a page or for a segment?
- (xxii) **[10 points] Free Space Inventory:**
Justify the need for approximating the available free space (instead of storing the actual value).
- (xxiii) **[30 points] Free Space Inventory:**
Explain the hybrid approach for encoding free space: (1) logarithmic scale for lower range, and (2) linear scale for upper range with an example.
- (xxiv) **[10 points] Free Space Inventory:**
Justify the need for caching the FSI state.
- (xxv) **[10 points] Space Allocation:**
Explain the purpose of specifying the min and max values in the space allocation function.
- (xxvi) **[10 points] Index Structures:**
Distinguish between point queries and range queries.
- (xxvii) **[10 points] Index Structures:**
Distinguish between index and table heap.
- (xxviii) **[10 points] Index Structures:**
What is the input and output for a index lookup?
- (xxix) **[10 points] Index Structures:**
What is the input and output for a table heap lookup?
- (xxx) **[10 points] B+Tree:**
Distinguish between a B+tree and a BTree.
- (xxxi) **[10 points] B+Tree:**
Distinguish between a B+tree and a Binary Search Tree.
- (xxxii) **[10 points] B+Tree:**
Justify the need for a higher fanout (*i.e.*, degree) in B+Tree.
- (xxxiii) **[10 points] B+Tree:**
Distinguish between an inner node and a leaf node.
- (xxxiv) **[10 points] B+Tree:**
How many keys and values are present in a full inner node of a B+tree with degree k ? What is the purpose of the keys? What is the purpose of the values?

- (xxxv) **[10 points] B+Tree:**
How many keys and values are present in a full leaf node of a B+tree with degree k ? What is the purpose of the keys? What is the purpose of the values?
- (xxxvi) **[10 points] Hash Table:**
Define a hash table.
- (xxxvii) **[10 points] Hash Table:**
Why is a hash table a good fit for in-memory but not for disk?
- (xxxviii) **[10 points] Hash Table vs B+Tree:**
Distinguish between a hash table and a B+tree.
- (xxxix) **[10 points] Hash Table:**
List two limitations of hash table.