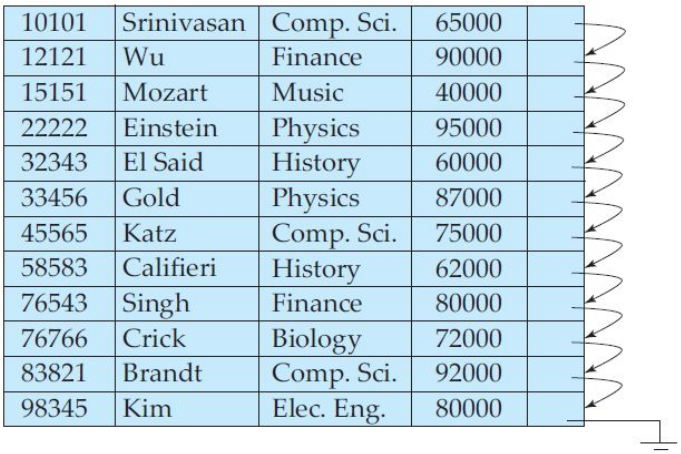
Quiz-2, CSE-202, Fundamentals of Database Systems

Name:_____
Roll Number:_____
Maximum Marks: 20 Time: 1 hour

Question-1: Consider a data file Instructor shown below with attributes Instructor ID, Instructor Name, Department, Salary.

10101	Srinivasan	Comp. Sci.	65000	
12121	Wu	Finance	90000	
15151	Mozart	Music	40000	
22222	Einstein	Physics	95000	
32343	El Said	History	60000	
33456	Gold	Physics	87000	
45565	Katz	Comp. Sci.	75000	
58583	Califieri	History	62000	
76543	Singh	Finance	80000	
76766	Crick	Biology	72000	
83821	Brandt	Comp. Sci.	92000	
98345	Kim	Elec. Eng.	80000	



(a) Construct a bitmap index on the attribute salary, dividing salary values into 4 ranges: below 50000, 50000 to below 60000, 60000 to below 70000, and 70000 and above. [**2.5 marks**] [Binary]

(b) Consider a query that requests all instructors in the Finance department with salary of 80000 or more. Outline the steps in answering the query, and show the final and intermediate bitmaps constructed to answer the query. [**2.5 marks**] [Binary]

Answer (a).
Bitmap for salary with S1, S2, S3 and S4 for the 4 ranges.

S1	0	0	1	0	0	0	0	0	0	0	0	0
S2	0	0	0	0	0	0	0	0	0	0	0	0
S3	1	0	0	0	1	0	0	1	0	0	0	0
S4	0	1	0	1	0	1	1	0	1	1	1	1

(**b**) Bitmap for the department name attribute.

CS	1	0	0	0	0	0	1	0	0	0	1	0
Fin	0	1	0	0	0	0	0	0	1	0	0	0
Mus	0	0	1	0	0	0	0	0	0	0	0	0
Phy	0	0	0	1	0	1	0	0	0	0	0	0
His	0	0	0	0	1	0	0	1	0	0	0	0
Bio	0	0	0	0	0	0	0	0	0	1	0	0
EE	0	0	0	0	0	0	0	0	0	0	0	1

In order to answer the query, take intersection of S4 and Finance bitmap rows.

Int	0	1	0	0	0	0	0	0	1	0	0	0

Scan the above bitmap. Wu and Singh are the instructors in the Finance department with Salary of 80000 or more.

Question-2: [**5 marks**] Consider two data files having records of following types:

File Emp: (eid: integer, ename: varchar, sal: integer, age: integer, did: integer)

File Dept: (did:integer, budget: integer, floor: integer, mgr_eid: integer)

Salaries range from Rs. 10,000 to Rs. 1,00,000, age varies from 20 to 80, each department has about five employees on average, there are 10 floors, and budgets vary from Rs. 10,000 to Rs. 10,00,000. You can assume uniform distribution of values.

For each of the following queries, which of the listed index choices would you choose to speed up the query? Explain briefly.

1. Query: Print ename, age, and sal for all employees.
   (a) Clustered hash index on <ename, age, sal> fields of Emp.
   (b) Unclustered hash index on <ename, age, sal> fields of Emp.
   (c) Clustered B+ tree index on <ename, age, sal> fields of Emp.
   (d) Unclustered hash index on <eid, did> fields of Emp.
   (e) No index. [1 mark for the correct option and 1.5 marks for explanation]

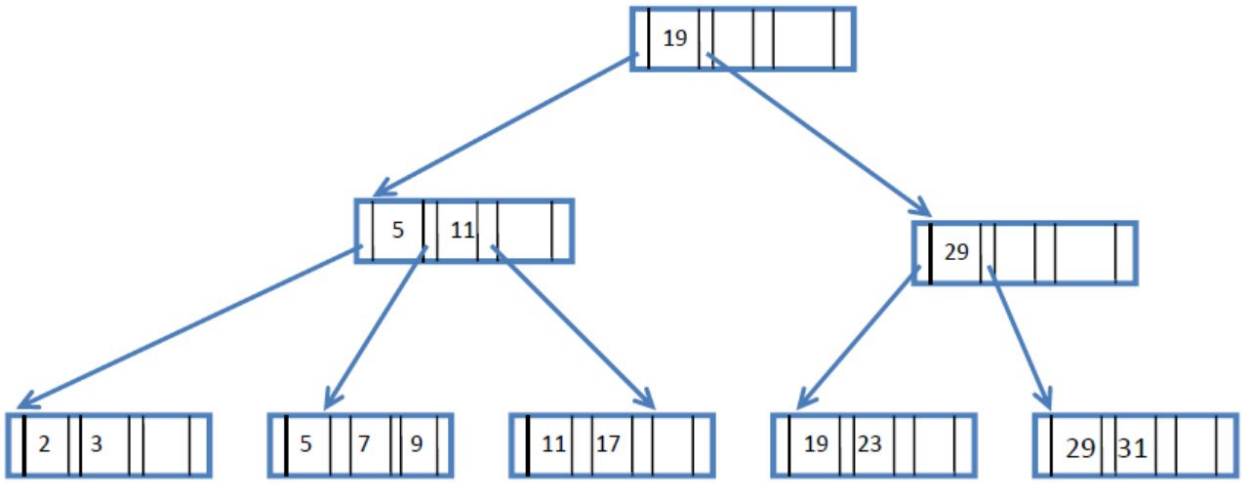
Answer. No index is the answer as we have to print ename, age, and sal for all employees. It can be done by a single linear scan over all employee records.

2. Query: Find the dids of departments that are on the 10th floor and have a budget of less than Rs. 15,000.

(a) Clustered hash index on the floor field of Dept.
(b) Unclustered hash index on the floor field of Dept.
(c) Clustered B+ tree index on <floor, budget> fields of Dept.
(d) Clustered B+ tree index on the budget field of Dept.
(e) No index. [1 mark for the correct option and 1.5 marks for explanation]

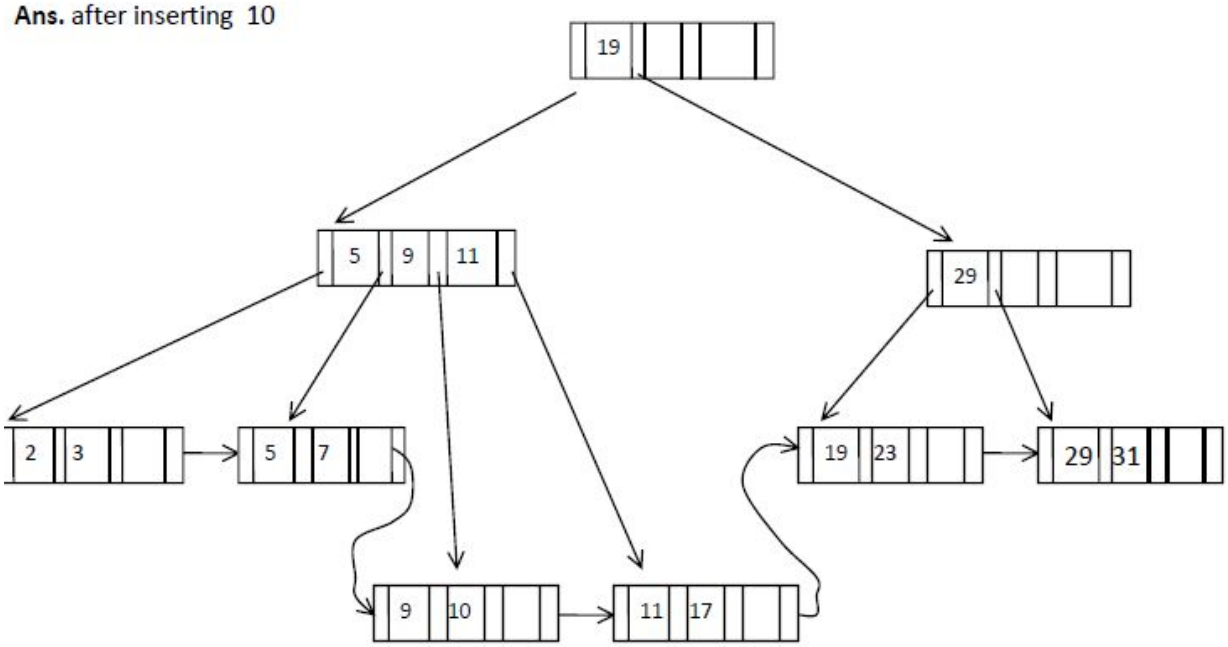
Answer. Clustered B+ tree index on <floor, budget>. First records with floor=10 can be retrieved and then results can be read in order of budget.

Question-3: [**6 marks**] Perform the following sequence of operations on the B+ tree: Insert 10, Insert 8, Delete 23. [2 marks + 2 marks + 2 marks].

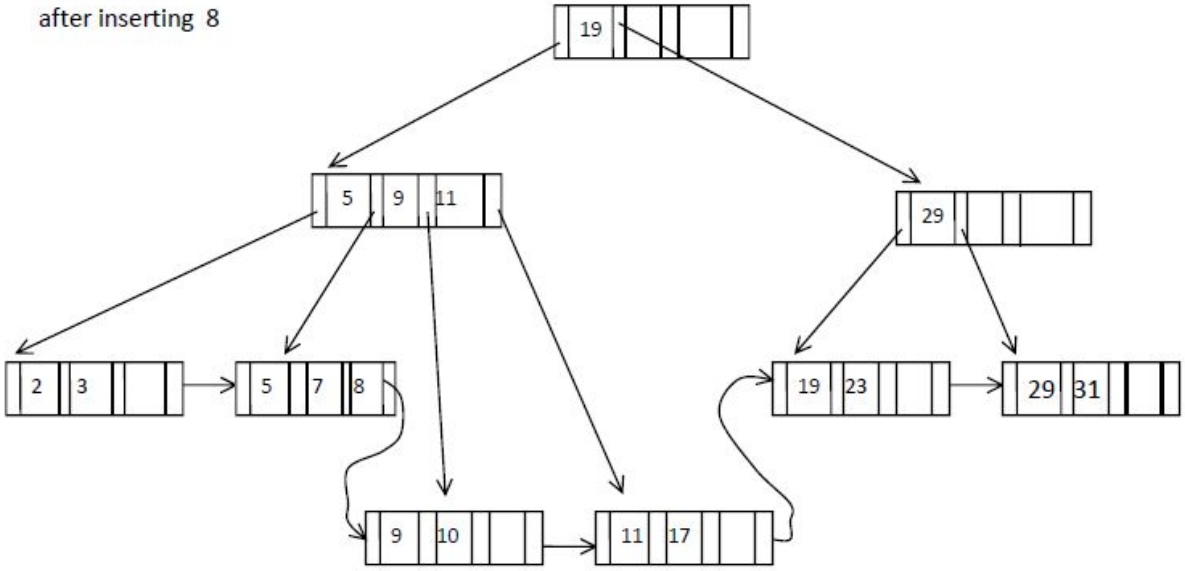


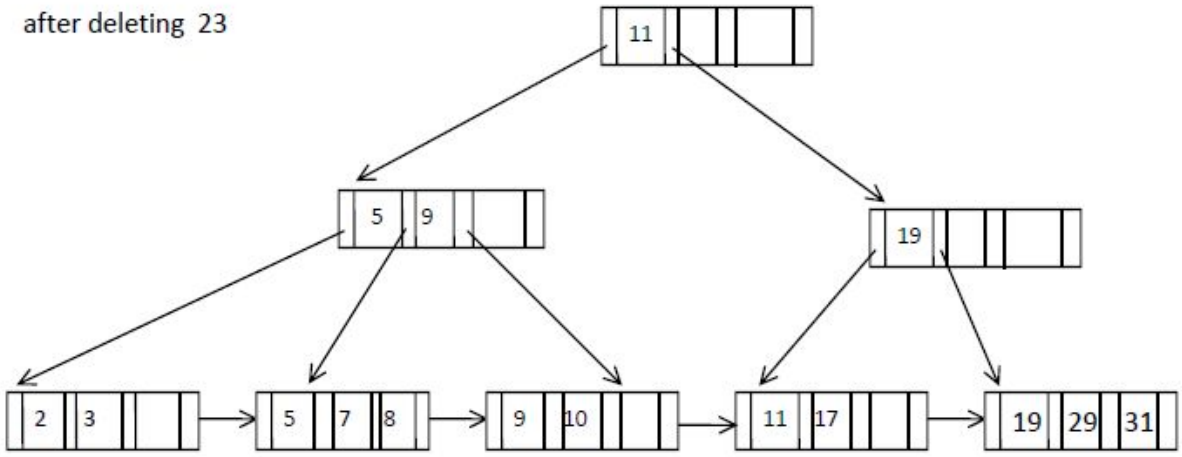
Answer.

Ans. after inserting 10



after inserting 8





Question-4: [**4 marks**] Suppose that we are using extendible hashing on a file that contains records with the following search-key values:

2, 3, 5, 11, 17, 19, 23, 29, 31.

Show the extendable hash structure for this file if the hash function is h(x) = x mod 64 and buckets hold two records. [Binary - Marks given if LSB is used instead of MSB too.]

Answer.

[MSB]

Bucket address: 0000 Bucket (local depth 4) - Keys 2 and 3

Bucket address: 0001 Bucket (local depth 4) - Keys 5

Bucket address: 0010 and 0011 Bucket (local depth 3) - Key 11

Bucket address: 0100 Bucket (local depth 4) - Keys 17 and 19

Bucket address: 0101 Bucket (local depth 4) - Key 23

Bucket address: 0110 and 0111 Bucket (local depth 3) - Keys 29 and 31

Remaining bucket address from 1000 to 1111 point to a single empty bucket with local depth 1.

[LSB]

Bucket address: 0000, 0010, 0100, 0110, 1000, 1010, 1100, 1110 Bucket (local depth 1) - Keys 2

Bucket address: 0001, 1001 Bucket (local depth 3) - Keys 17

Bucket address: 0111 and 1111 Bucket (local depth 3) - Keys 23, and 31

Bucket address: 0011 Bucket (local depth 4) - Keys 3, and 19

Bucket address: 1011 Bucket (local depth 4) - Key 11

Bucket address: 0101 and 1101 Bucket (local depth 3) - Keys 5, and 29