Assignment 5 Solution

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Part I: Problem 1

Set up the table, its schema, cardinality just use the question statement in problem 2:
Schema: Student(SID, firstname, lastname, GPA, program)
With the following facts:
1. this table contains more than 1 million records;
2. (firstname, lastname) is a candidate key for this table;
3. students are evenly distributed across 20 programs;
4. GPA of all the students form a normal distribution around 3.0 with a standard deviation of 1.0.
Case where answering a database query with an index is strictly slower than scanning through the whole file:
Use the non-cluster Btree, put index on (program, GPA), find all the lastname for students with specific GPA range from all the programs.

Part I: Problem 2

1.

```
CREATE INDEX IDX1 ON Student(lastname) USING HASH;
```

2.

```
CREATE INDEX IDX2 ON Student(GPA) USING BTREE;
```

3.
Notes for this problem: each answer query also with the example:
1. single program point lookup: find the specific program. such as "CS".
2. single program range: find the list of programs with specific index range as they got "index on".
3. point lookup on both: find the records of students who got program in "CS" and with specific GPA 4.0.
4. range on both: find the records of students with given program range and given GPA range.
5. range on program and point lookup on GPA: find the records of student in range of progran with given GPA, such as 4.0 GPA.
6. point lookup on program and range on GPA: find the records of students in specific program with given range of GPA.

Part I: Problem 2

4.

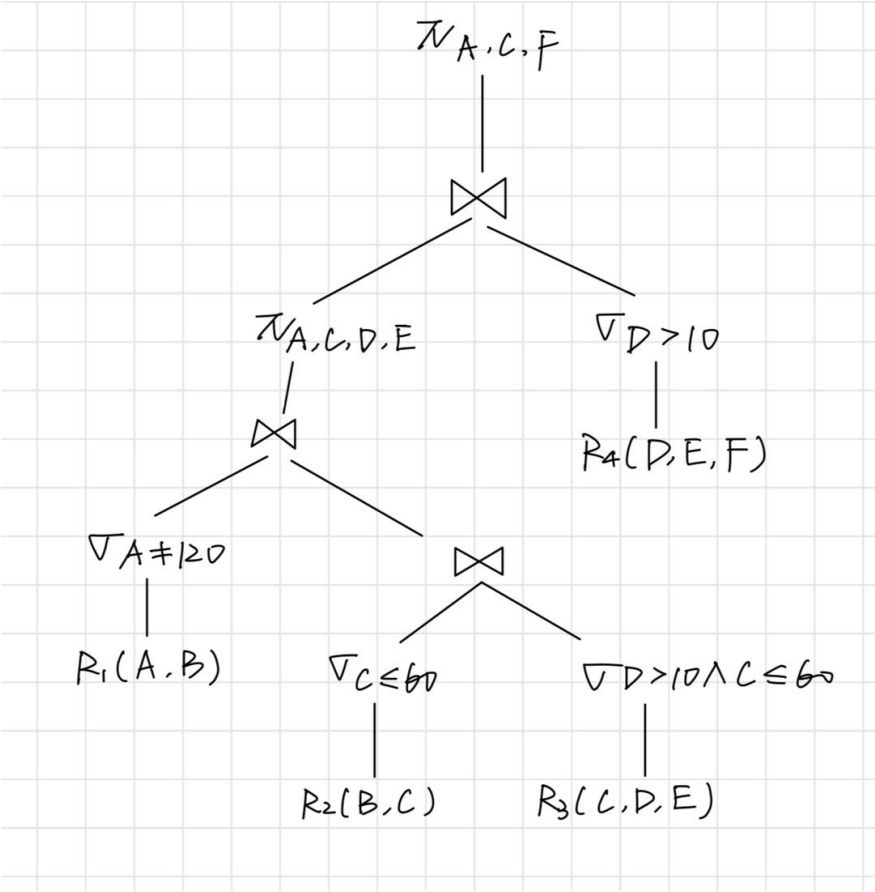
```
CREATE INDEX IDX1 ON Student(program, GPA) USING BTREE
```

We need BTREE for GPA to accelerate the requirement (a) and (c).

```
CREATE INDEX IDX2 ON Student(firstname, lastname) USING HASH
```

The full name is just a simple point look up, so HASH makes more sense here.

Part II: Problem 1



Part II: Problem 2

$P(R_1) = 50000/200 = 250$; $P(R_2) = 30000/200 = 150$; $P(R_3) = 10000/200 = 50$;
$P(R_1 \bowtie R_2) = 10000/200 = 50$; $P(R_1 \bowtie R_3) = 4000/200 = 20$; $P(R_2 \bowtie R_3) = 1000/200 = 5$;
$P(R_1 \bowtie R_2 \bowtie R_3) = 500/200 = 2.5$;

1.
cost = $P(R_1) + \frac{P(R_1)\cdot P(R_3)}{B-1} + OUT(R_1 \bowtie R_3) + P(R_1 \bowtie R_3) + \frac{P(R_1 \bowtie R_3)\cdot P(R_2)}{B-1} + OUT(R_1 \bowtie R_2 \bowtie R_3)$
= 250 + 1250 + 40 +300 + 2.5
= 1842.5 = 1843

2. every physical cases
1. $R_1 \bowtie R_2$ **first, then** R_3**:**
cost = $P(R_1) + \frac{P(R_1)\cdot P(R_2)}{B-1} + OUT(R_1 \bowtie R_2) + P(R_1 \bowtie R_2) + \frac{P(R_1 \bowtie R_2)\cdot P(R_3)}{B-1} + OUT(R_1 \bowtie R_2 \bowtie R_3)$
= 250 + 3750 + 50 + 50 + 250 + 2.5
= 4352.5 = 4353

2. $R_2 \bowtie R_1$ **first, then** R_3**:**
cost = $P(R_2) + \frac{P(R_1)\cdot P(R_2)}{B-1} + OUT(R_1 \bowtie R_2) + P(R_1 \bowtie R_2) + \frac{P(R_1 \bowtie R_2)\cdot P(R_3)}{B-1} + OUT(R_1 \bowtie R_2 \bowtie R_3)$
= 150 + 3750 + 50 + 50 + 250 + 2.5
= 4252.5 = 4253

3. $R_1 \bowtie R_3$ **first, then** R_2 **cost =** $P(R_1) + \frac{P(R_1)\cdot P(R_3)}{B-1} + OUT(R_1 \bowtie R_3) + P(R_1 \bowtie R_3) + \frac{P(R_1 \bowtie R_3)\cdot P(R_2)}{B-1} + OUT(R_1 \bowtie R_2 \bowtie R_3)$
= 250 + 1250 + 40 +300 + 2.5
= 1842.5 = 1843

4. $R_3 \bowtie R_1$ **first, then** R_2**:**
cost = $P(R_3) + \frac{P(R_1)\cdot P(R_3)}{B-1} + OUT(R_1 \bowtie R_3) + P(R_1 \bowtie R_3) + \frac{P(R_1 \bowtie R_3)\cdot P(R_2)}{B-1} + OUT(R_1 \bowtie R_2 \bowtie R_3)$
= 50 + 1250 + 40 +300 + 2.5
= 1642.5 = 1643

5. $R_2 \bowtie R_3$ **first, then** R_1**:**
cost = $P(R_2) + \frac{P(R_2)\cdot P(R_3)}{B-1} + OUT(R_2 \bowtie R_3) + P(R_2 \bowtie R_3) + \frac{P(R_2 \bowtie R_3)\cdot P(R_1)}{B-1} + OUT(R_1 \bowtie R_2 \bowtie R_3)$
= 150 + 750 + 5 + 5 + 125 + 2.5
= 1037.5 = 1038

6. $R_3 \bowtie R_2$ **first, then** R_1**:**
cost = $P(R_2) + \frac{P(R_2)\cdot P(R_3)}{B-1} + OUT(R_2 \bowtie R_3) + P(R_2 \bowtie R_3) + \frac{P(R_2 \bowtie R_3)\cdot P(R_1)}{B-1} + OUT(R_1 \bowtie R_2 \bowtie R_3)$
= 50 + 750 + 5 + 5 + 125 + 2.5
= 937.5 = 938

Because $938 < 1038 < 1643 < 1843 < 4253 < 4353$**,** $R_3 \bowtie R_2$ **first, then** R_1 **is the best plan.**