North South University, Dept. of ECE

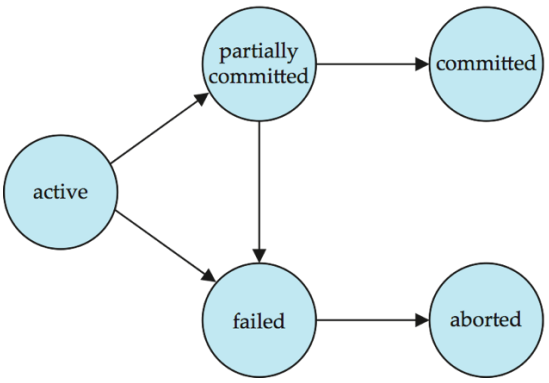
Sample questions

Q1:

a. Show the states of a transaction in a diagram and explain.
b. Transform the following concurrent schedule into a serial schedule by swapping of instructions.

T1	T2
READ(P)	
	READ(Q)
	WRITE (Q)
READ(Q)	
	WRITE(R)
	READ (P)
WRITE(Q)	
WRITE (P)	

a. Ans.



b. Ans.

T1	T2
	READ(Q)
	WRITE (Q)
	WRITE(R)
	READ (P)
READ(P)	
READ(Q)	
WRITE(Q)	
WRITE (P)	

Q2:

a. Explain how the query engine executes the conjunctive selection query using single index method.
b. The NSU student schema is

Student (id, name, thana, district, CGPA, tot-cred)

The SQL is: SELECT * FROM student WHERE name = 'Abdullah' AND district = 'Dhaka' AND tot-cred = 100

There are B+ tree indices on name, district and tot-cred. The heights of the indices are 3, 2 and 2 respectively. The number of tuples (pointers) for name='Abdullah', district = 'Dhaka' and tot-cred = 100 are 80, 200 and 60 respectively. Considering each tuple in separate block, find the costs of the SQL of conjunctive selection using single index method. The seek time is 10ms and block transfer time is 0.1ms. Which index will be used to process the query?

a. Ans.

Execution Setps:

1. The query engine evaluates the available indices and their **selectivity** (number of tuples matching the condition).
2. It chooses the index with the lowest **retrieval cost** (i.e., the smallest number of blocks to fetch the tuples).
3. The engine performs an **index scan** to retrieve matching records.
4. It applies **post-filtering** to ensure the retrieved records satisfy all query conditions.

b. Ans.

A4 (θ_1) Cost = (h_i + n) * (t_T + t_s) = (3 + 80) * (10 + 0.1) = 838.3 ms

A4 (θ_2) Cost = (h_i + n) * (t_T + t_s) = (2 + 200) * (10 + 0.1) = 2040.2 ms

A4 (θ_3) Cost = (h_i + n) * (t_T + t_s) = (2 + 60) * (10 + 0.1) = 62 ms

→The best index to use is **tot-cred** because it results in the lowest cost.

Q3:

a. Explain nested loop join algorithm to join two relations: student ⋈ takes.
b. The student and takes schema are:

Student (id, name, CGPA, street, city, year-admit)

Takes (id, course-id, semester, year)

The number of records and sizes of student and takes relation are as follows:

Relation	No. of records	No. of blocks
student	2000	200
takes	6000	60

Find the worst case and best-case cost of natural join operation student ⋈ takes using nested loop join.

a. Ans.

Nested-Loop Join Algorithm

for each tuple t_r **in** ***r*** **do begin**
for each tuple t_s **in** ***s*** **do begin**
test pair (t_r,t_s) to see if they satisfy the join condition θ
if they do,
add $t_r \bullet t_s$ to the result.
end
end

r is the **outer relation** and *s* the **inner relation** of the join.

Explanation:

1. Iterate through each tuple **`tr`** in R (outer relation)**.**
2. For each tuple **`tr`**, iterate through each tuple **`ts`** in S (inner relation)**.**
3. Check if the pair **`(tr, ts)`** satisfies the join condition **`θ`.**
4. If they match, concatenate **`tr`** and **`ts`** to form a joined tuple and add it to the result.
5. Repeat until all tuples in R and S are processed**.**

b. Ans.

Case-1: Worst Case

Block Transfers = $n_r * b_s + b_r$ = (2000 * 60) + 200 = 120200

Number of Seek = $n_r + b_r$ = 2000 + 200 = 2200

Case-2: Best Case

Block Transfers = $b_s + b_r = 60 + 200 = 260$

Number of Seek = 2

Q4:

a. The relational schema for student course registration are as follows:

Student (Sid, name, street, city. Mobile, email, CGPA, age)
Takes (course-id, Sid, semester, year, GP)
Write relational algebra and construct the execution tree for the following:

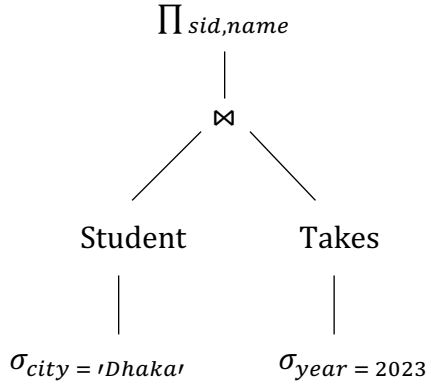
SELECT sid, name

FROM student inner join takes ON student.sid = takes.sid

WHERE city = 'Dhaka' AND year = 2023

b. Explain how this query will be executed using pipeline method.

Expression Tree



Explanation: Selection → Join → Projection

Q5:

a. You have been given a number of 4TB disks. An ecommerce system requires 20 TB of effective storage using RAID 1. Find the total number of disks required for this storage system. Student relation has blocks B1, B2, …… B10. Show the storage of these blocks to your storage system.

b. Explain clustering primary index with an example.

a. Ans.

D1	D2	D3	D4	D5
B1	B1’	B2	B2’	B3
B3’	B4	B4’	B5	B5’
B6	B6’	B7	B7’	B8
B8’	B9	B9’	B10	B10’

b. Ans.