1. Consider the following two transactions: T_1 and T_2. Which of the following schemes, using shared and exclusive locks, satisfy the requirements for strict two phase locking for the above transactions?

(A) S1	(A) S2	(B) S1	(B) S2
S1 : lockS(A);	S2 : lockS(B);	S1 : lockX(A);	S2 : lockx(B);
read(A);	read(B);	read(A);	read(B);
lockS(B);	lockS(A);	lockX(B);	lockx(A);
read(B);	read(B);	read(B);	read(A);
if $A = 0$	if $B \neq 0$	if $A = 0$	if $B \neq 0$
then$B \leftarrow B + 1$;	then$A \leftarrow A + 1$;	then$B \leftarrow B + 1$;	then$A \leftarrow A - 1$;
write(B);	write(A);	write(B);	write(A);
commit;	commit;	commit;	unlock(A)
unlock(A);	unlock(B);	unlock(A);	commit;
unclock(B);	unclock(A);	commit;	commit;
unclock(B);	unclock(B);	unclock(B);	unclock(B);

(C) S1 : lockS(A);

read(A);

lockX(B);

read(B);

if $A = 0$

then$B \leftarrow B + 1$;

write(B);

unlock(A);

commit;

unclock(B);

S2 : lockS(B);

read(B);

lockX(A);

read(A);

if $B \neq 0$

then$A \leftarrow A - 1$;

write(A);

unlock(A);

commit;

unclock(B);

(D) S1 : lockS(A);

read(A);

lockX(B);

read(B);

if $A = 0$

then$B \leftarrow B + 1$;

write(B);

unlock(A);

unclock(B);

commit;

S2 : lockS(B);

read(B);

lockX(A);

read(A);

if $B \neq 0$

then$A \leftarrow A - 1$;

write(A);

unclock(A);

unclock(B);

commit;

(A) A (B) B **(C) C** (D) D

2. Assume that Ti requests a lock held by Tj.
The following table summarizes the actions taken for wait-die and wound-wait scheme:

	Wait – die scheme	Wound – wait scheme
Ti is younger than Tj	W	X
Ti is older than Tj	Y	Z

Fill correct status of Ti and Tj at W, Y, X, and Z respectively.

(A) Ti aborts, Ti waits, Ti waits, and Tj waits respectively.

(B) Ti dies, Ti waits, Ti waits, and Tj aborts respectively.

(C) Ti waits, Ti dies, Ti waits, and Tj aborts respectively.

(D) None of these

3. In wait-die scheme, transactions T1 and T2 have timestamps 10 and 15 respectively. If T2 requests a data item held by T1 then

A. T2 will be rolled back B. T2 will wait C. T1 will be rolled back D. T1 will wait

4. In a wound-wait scheme, transactions T1 and T2 have time stamp 2 and 5 respectively. If T1 requests a data item held by T2, then T1 will be rolled back.

A. True **B. False**

5.Consider the following schedule. All the locks are exclusive, and between the lock L and unlock U operations, the corresponding data item is first read and then written.

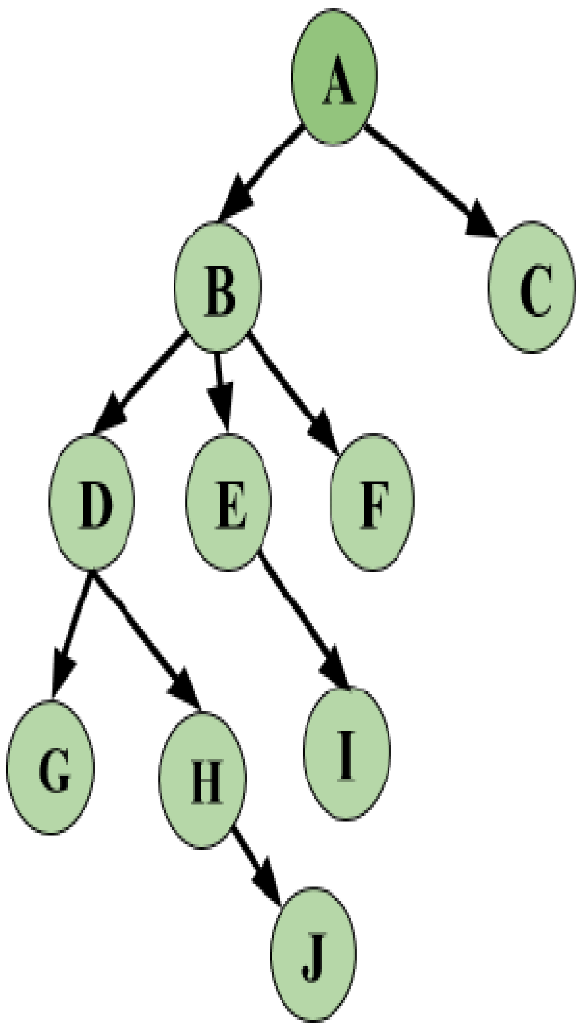
S: L1(A); L3(D); L1(B); U1(A); L2(C); L2(B); L1(D); L2(B); L3(C); L4(A); L4(C); L5(A);The schedule will result in a deadlock. **A. True** B. False

I. Apply Graph based Protocol; convert the following transactions into conflict serializable schedule.

T1`:Lock X(A) , Lock X(B),Lock X(E), Lock X(D), Lock X(G), Unlock X(B), Unlock X(E), Unlock X(D),Unlock X(G), Unlock X(A);

T2: Lock X(D), Lock X(H), Unlock X(D), Unlock X(H);

T3: Lock X(B),Lock X(E), Unlock X(B), Unlock X(E);



VI. Suppose a deadlock occurs in the schedule S given below. S: L1(A); L3(D); L1(B); U1(A); L2(C); L2(B); L1(D); L2(B); L3(C); L4(A); L4(C); L5(A); A transaction that causes the least number of cascading rollbacks is decided to be chosen as victim, then which of the following transaction cannot be chosen as a victim?

A. T3 B. T2 **C. T1** D. Cannot be decided

[T1 will cause cascading rollback, if aborted as T4 is reading item A which was written by T1].

VII. Consider the Survey database and **answer the Questions**:

1. Identify the attributes suitable for Bitmap index and write their bitmap values.
2. Find all single Females who own their home using Bitmap index.

Eid	Name	Gender	Marital Status	Children Y/N	Income	Home Owner
1	Abinand	M	Married	Y	1,00,000	No
2	Arasi	F	Single	N	50,000	Yes
3	Bavana	F	Divorced	Y	1,50,000	No
4	Chitra	F	Married	Y	80,000	Yes
5	Duruv	M	Widowed	N	90,000	Yes
6	Manikandan	M	Single	N	1,00,000	No
7	Suresh	M	Married	Y	1,20,000	Yes

8. Consider the following log sequence of two transactions on a bank account, with initial balance 12000, that transfer 2000 to a mortgage payment and then apply a 5% interest.

1. T1 start
2. T1 B old=12000 new=10000
3. T1 M old=0 new=2000
4. T1 commit
5. T2 start
6. T2 B old=10000 new=10500
7. T2 commit

Suppose the database system crashes just before log record 7 is written. When the system is restarted, which one statement is true of the recovery procedure? A. We must redo log record 6 to set B to 10500

B. We must undo log record 6 to set B to 10000 and then redo log records 2 and 3.

C. We need not redo log records 2 and 3 because transaction T1 has committed.

D. We can apply redo and undo operations in arbitrary order because they are idempotent

9. Consider the transaction involving two bank accounts x and y.
read(x); x := x – 50; write(x); read(y); y := y + 50; write(y)
The constraint that the sum of the accounts x and y should remain constant is that of

A. Atomicity **B. Consistency** C. Isolation D. Durability

10. Consider the following sequence of log records in the log file before the system crashed:
(Start T1), W1 (A, 3, 4), W1 (B, 1, 2), (commit T1),
(start T2), W2 (B, 2, 7), W2 (A, 4, 8), system crash

Which of the following would be the recovery sequence in the immediate database modification scheme?

A. Undo T2 {A: =4, B: =2}, Redo T1 {A: =4, B: =2}
B. Redo T1 {A: =4, B: =2}, Undo T2 {A: =4, B: =2}
C. Redo T1 {A: =4, B: =2}, Redo T2 {B: =7, A: =8}
D. Undo T2 {A: =4, B: =2}, Undo T1 {B: =1, A: =3}

11. Consider the following log file, created in a basic check pointing recovery protocol environment:

(start T1); (W1,A,2,3); (start T2); (W2,B,4,5); (W1,B,5,6); (start T3); (commit T1); (W3,A,3,6);

(Checkpoint, T3,T2); (start T4); (W4,A,6,7); (W3,A,7,9); (W4,B,6,7); (commit T4); (start T5); (W5,A,9,4);

If the system crashes now, what is the correct order of recovery operations using undo-list and redo-list?

A. Redo: {(T4,A:=7);(T4,B:=7)}; Undo: {(T5,A:=9);(T3,A:=7);(T2,no op)}

B. Redo:{(T4,A:=7);(T3,A:=9);(T4,B:=7);(T5,A:=4)}

C. Undo: {(T5,A:=9);(T3,A:=7);(T2,no op)}; Redo:{(T4,A:=7);(T4,B:=7)}

D. Undo:{(T5,A:=9);(T4,B:=6);(T3,A:=7);(T4,A:=6)}

12. Consider a simple checkpointing protocol and the following set of operations in the log.
(start, T4); (write, T4, y, 2, 3); (start, T1); (commit, T4); (write, T1, z, 5, 7); (checkpoint); (start, T2); (write, T2, x, 1, 9); (commit, T2); (start, T3); (write, T3, z, 7, 2);
If a crash happens now and the system tries to recover using both undo and redo operations, what are the contents of the undo list and the redo list?

(A) Redo: T2 ; Undo: T3, T1;

(B) Redo: T2, T4 ; Undo: T3, T1;

(C) Redo: T2, T4, T3; T1 ; Undo: none;

(D) Redo: T2 ; Undo: T3, T1, T4;

13. Assume a basic checkpointing recovery protocol. Suppose the following schedule is being run:
(start, T1); (W1, A, 1200, 1000); (commit, T1); (checkpoint); (start, T2); (W2, B, 1500, 1800); (start, T3); (W3, A,1000, 500); (start, T4); (W4, C, 3000, 4000); (W3, D, 3000, 2000); (commit, T3); (W2, A, 500, 1500);

Suppose the schedule crashes at this point. What are the undo and redo lists in the correct order?

A. Undo List: T4, T2; Redo List: T1
B. Undo List: T2, T4; Redo List: T3
C. Undo List: T4, T2; Redo List: T1, T3
D. Undo List: T4, T2; Redo List: T3

14. Which of the following transaction(s) follow 2-phase locking protocol?

1.lock1(a) read1(a) lock2(b) write2(b) lock1(c) unlock2(b) unclock1(c) lock2(c) unlock1(a)

2. lock1(a) lock1(b) unlock1(a) lock2(a) write2(a) unlock2(a) unlock1(b)

3.lock1(a) lock2(b) lock1(c) lock3(d) unlock2(b) lock3(b) unlock1(a) unlock3(d) unlock1(c) lock3(c)

A. Only 1 **B. Only 2** C. Only 1 and 3 D. None of them

15. Consider the following schedule. All the locks are exclusive, and between the lock L and unlock U operations, the corresponding data item is first read and then written.

S: L1(A); L3(D); L1(B); U1(A); L2(C); L2(B); L1(D); U2(B); L3(C); L4(A); L4(C); L5(A);

The schedule will result in a deadlock.

A. True **B. False**

16. Consider the following transaction schedules S1 and S2. Choose the correct option that holds for the schedules S1 and S2.

T1	T2
read (A)	
A:=A-50	
write (A)	
	read (B)
	B: =B+50
	write (B)
read (B)	

S1

T1	T2
read(A)	
A:=A-50	
write (A)	
	read (A)
	A: =A+50
	write (A)
read (A)	

S2

a) S1 is serializable, S2 is non-serializable.

b) S1 is non-serializable, S2 is serializable

c) Both S1 and S2 are serializable.

d) Both S1 and S2 are non-serializable

17. There are two schedules S1 and S2 with the same set of transactions. **Which of the following are incorrect for view serializability to occur.**

a) If in schedule S1, transaction Ti reads the initial value of (Q), then in schedule S2 also transaction Ti must read the initial value of (Q).

b) If in schedule S1 transaction Ti executes(Q) and that value was produced by transaction Tj , then in schedule S2 also transaction Ti must read the value of Q that was produced by the same write(Q) operation of transaction Tj .

c) The transaction that performs the final write(Q) operation in schedule S1 must also perform the first write(Q) operation in schedule S2.

d) The transaction that performs the final write(Q) operation in schedule S1 must also perform the final write(Q) operation in schedule S2.

18. Given the following two transactions identify which is valid for the transaction T1 and T2.

T1	T2
lock-X (A)	lock-S(A)
read (A)	read (A)
A:=A-0.2*A	unlock (A)
write (A)	lock-S (B)
lock-X (B)	read (B)
read(B)	unlock (B)
B:=B+0.2*A	display (A+B)
unlock(A)	
unlock(B)	

a) T2 follows Two phase locking protocol, T1 does not follow Two phase locking protocol.

b) T1 follows Two phase locking protocol, T2 does not follow Two phase locking protocol.

c) Both transactions T1 and T2 follow Two phase locking protocol.

d) Neither T1 nor T2 follow Two phase locking protocol.

19. Consider there are two schedules S1 and S2 as follows:

T1	T2
lock-X (A)	
read (A)	
write (A)	
unlock (A)	lock-S (B)
	read (B)
lock-S (B)	lock-X (A)
read (B)	read (A)
unlock (B)	unlock (A)
	unlock (B)

S1

T1	T2
lock-X(A)	
read(A)	lock-X(B)
	read(B)
	write(B)
lock-S(B)	lock-S(A)
read(B)	read(A)
unlock(A)	unlock(A)
unlock(B)	unlock(B)

S2

Identify the correct statement about which schedule suffers deadlock.

a) Both S1 and S2 will suffer deadlock.

b) S1 will suffer deadlock, S2 will not suffer deadlock.

c) S2 will suffer deadlock, S1 will not suffer deadlock.

d) Neither S1 nor S2 will suffer deadlock.

20. Identify the correct options about timestamp from the following:

a) Suppose Ti issues write(Q), then if TS(Ti)>R-timestamp(Q) then write operation is rejected and Ti is rolled back.

b) Suppose Ti issues write(Q), then if TS(Ti)<R-timestamp(Q) then write operation is rejected and Ti is rolled back.

c) Suppose Ti issues read(Q), then if TS(Ti) <W-timestamp(Q) then read operation is rejected and Ti is rolled back.

d) Suppose Ti issues read(Q), then if TS(Ti) >W-timestamp(Q) then read operation is rejected and Ti is rolled back

21. Consider the following two wait-for graphs.

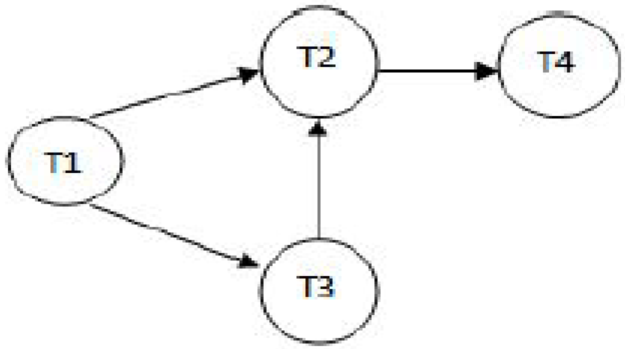


Figure 1:

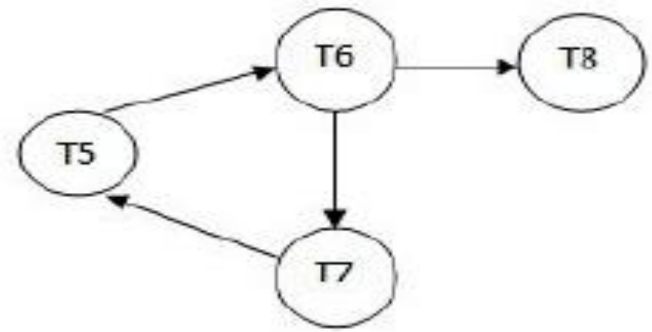


Figure 2:

Choose the option which stands valid for the above graphs.

a) Figure1 graph shows possibility of deadlock, Figure2 graph doesn't show possibility of deadlock.

b) Both graphs of Figure1 and Figure2 show possibility of deadlock

c) Neither graph of Figure1 nor Figure2 shows possibility of deadlock.

d) Figure1 graph does not show possibility of deadlock, Figure2 graph shows possibility of deadlock.

22. Which of these is not a Transaction control language(TCL) command?

a) ROLLBACK **b) UPDATE** c) COMMIT d) SAVEPOINT

23. Consider the log records of the following two schedules of transactions T0 and T1.

<T0 start>
<T0, A, 500, 400>
<T0, B, 600, 700>
<T0 commit>

(Point of Crash)

(i)

<T0 start>
<T0, A, 500, 400>
<T0, B, 600, 700>
<T0 commit>
<T1 start>
<T1, C, 1000, 900>

(Point of Crash)

(ii)

Identify the correct action required to be taken for recovery in the transaction schedules given above:

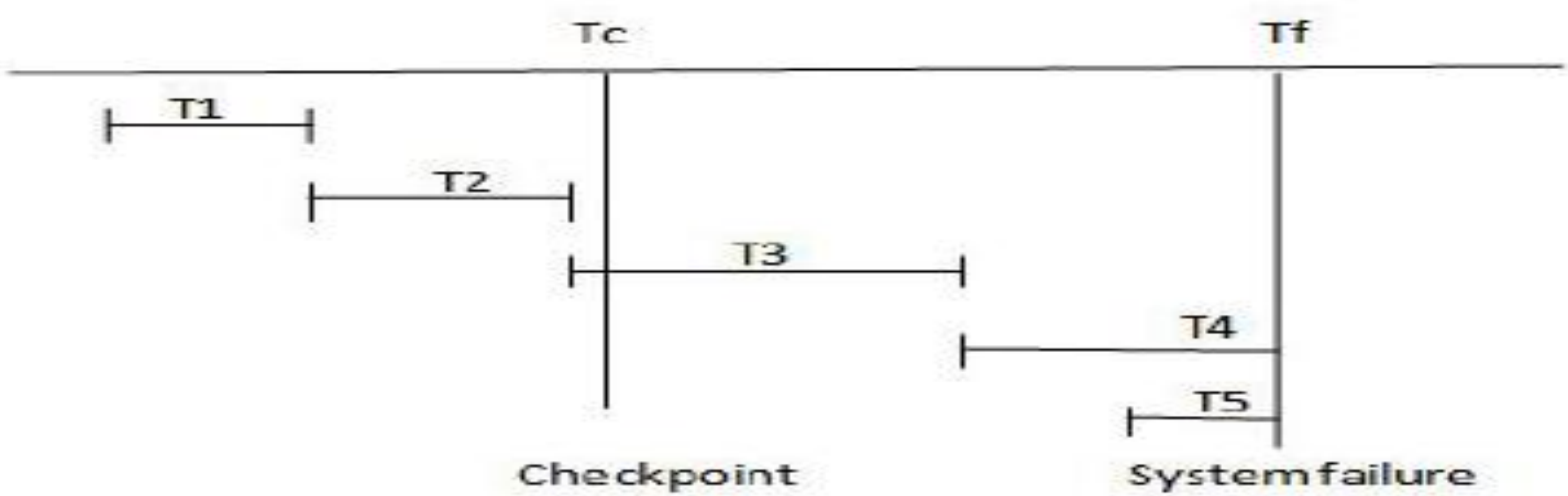
a) In (i) T0 must be undone restoring B to 600 and A to 500 and log records < T0;B; 600 > ;< T0; A; 500 >;< T0; abort > are written out.

b) In (i) T0 must be redone, setting A to 400 and B to 700.

c) In (ii) T0 must be redone, setting A to 400 and B to 700. T1 must be undone restoring C to 1000.

d) In (ii) T0 must be undone, setting A to 500 and B to 600. T1 must be redone restoring C to 900.

24. Consider the following transaction schedules having checkpoints.



a) T1; T2 can be ignored, T3 must be undone and restarted, T4; T5 must be redone.

b) T1; T2 must be redone, T3 can be ignored T4; T5 must be undone and restarted.

c) T1; T2 must be redone, T3; T4; T5 must be undone and restarted.

d) T1; T2 can be ignored, T3 must be redone, T4; T5 must be undone and restarted.

Query Processing

Query processing refers to the range of activities involved in extracting data from a database. The basic steps are:

1. Parsing and translation.
2. Optimization.
3. Evaluation.

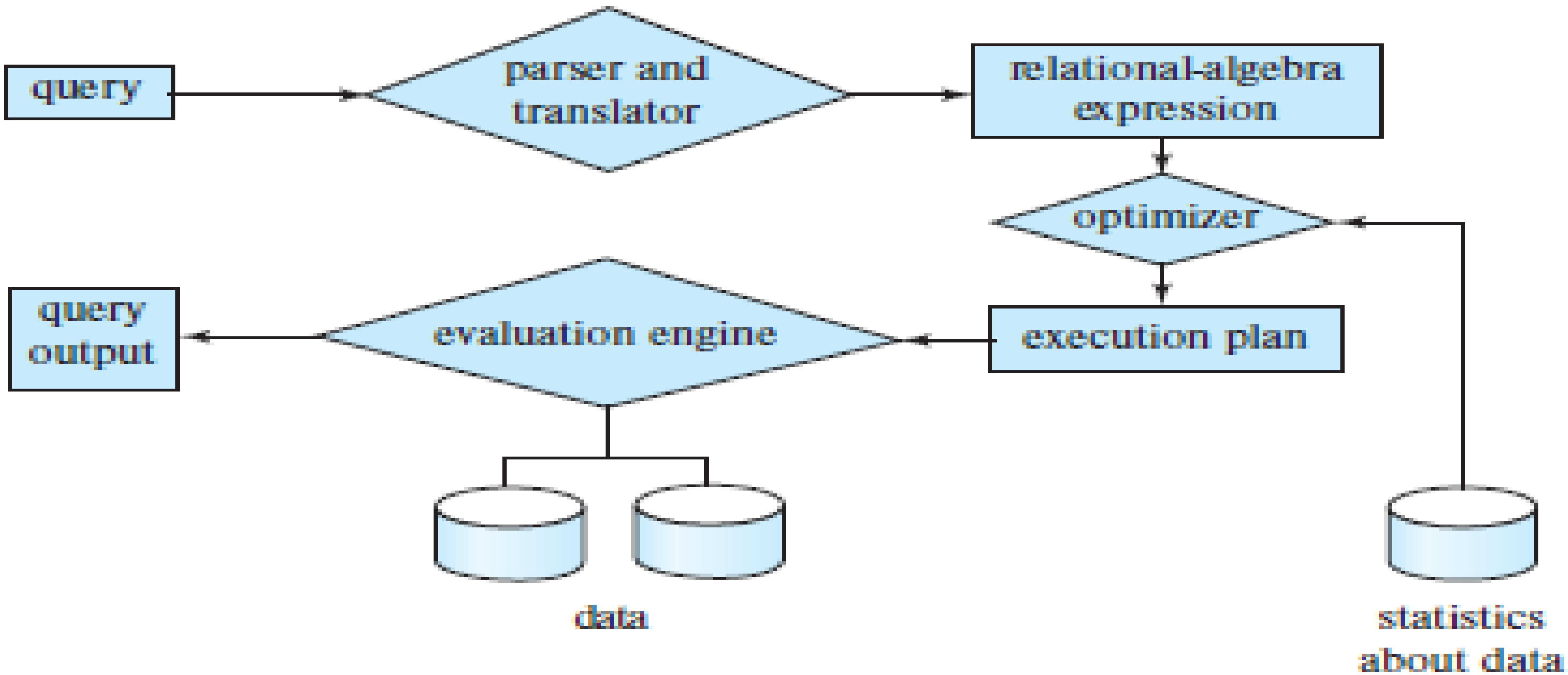


Figure 15.1 Steps in query processing.

The **parser checks the syntax of the user's query**, verifies that the relation names appearing in the query are names of the relations in the database, and so on. The system constructs a parse-tree representation of the query, which it then **translates into a relational-algebra expression**.

Each SQL query can itself be translated into a relational-algebra expression in one of several ways.

[Ex]: consider the query:

Select *salary* from *instructor* where *salary < 75000;*

This query can be translated into either of the following relational-algebra expressions:

- $\sigma_{salary<75000}(\Pi_{salary}(instructor))$
- $\Pi_{salary}(\sigma_{salary<75000}(instructor))$

A sequence of primitive operations that can be used to evaluate a query is a **query-execution plan** or **query-evaluation plan**. The **query-execution engine takes a query-evaluation plan, executes that plan, and returns the answers to the query.**

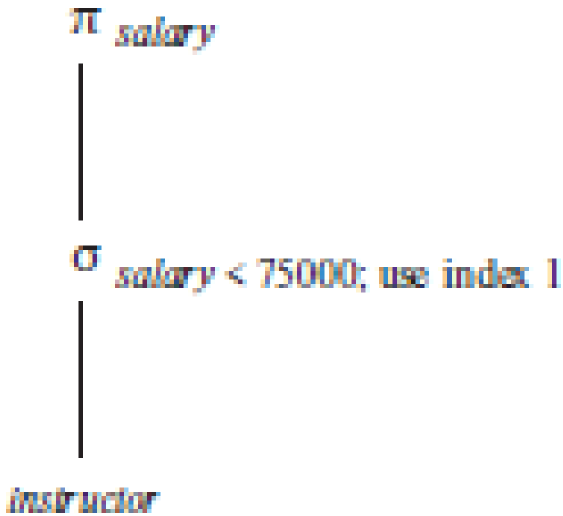


Figure 15.2 A query-evaluation plan.

The different evaluation plans for a given query can have different costs. The system to construct a query-evaluation plan that minimizes the cost of query evaluation; this task is called **query optimization.**