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ORACLE SQL Tuning

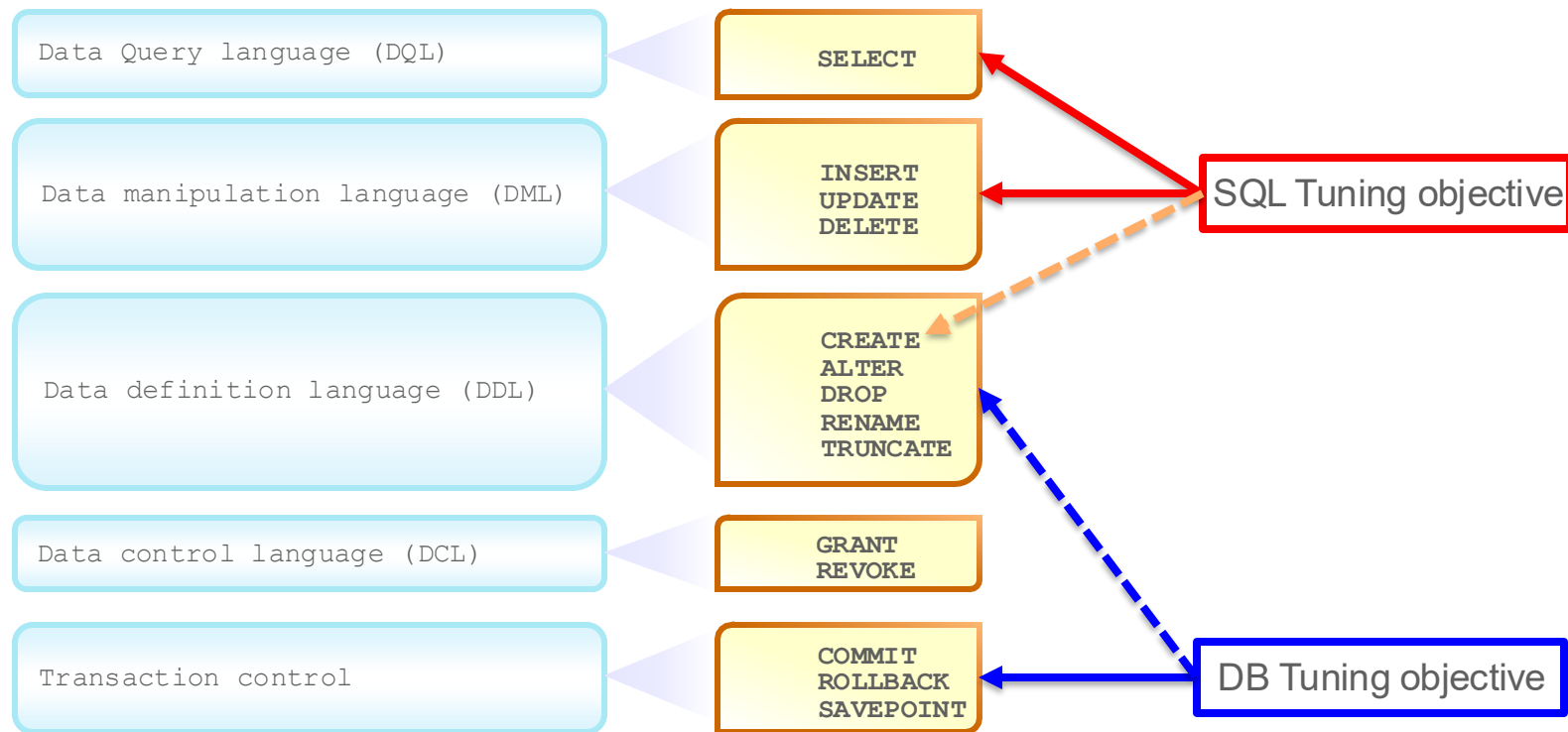
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CSS Global Delivery, DB

Oracle Academy - Octoberber, 2025

A woman with long brown hair and glasses, wearing a brown leather jacket and a blue patterned scarf, is sitting at a wooden table in a library or study. She is holding a black smartphone to her ear with her left hand and looking down at an open book on the table with her right hand. The background is slightly blurred, showing other people and bookshelves.

SQL Tuning – general considerations

SQL Statement types

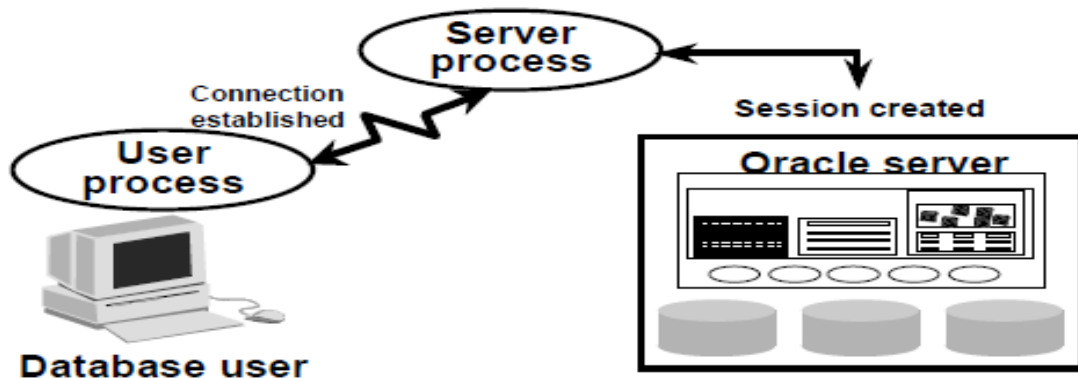


SQL Tuning goal

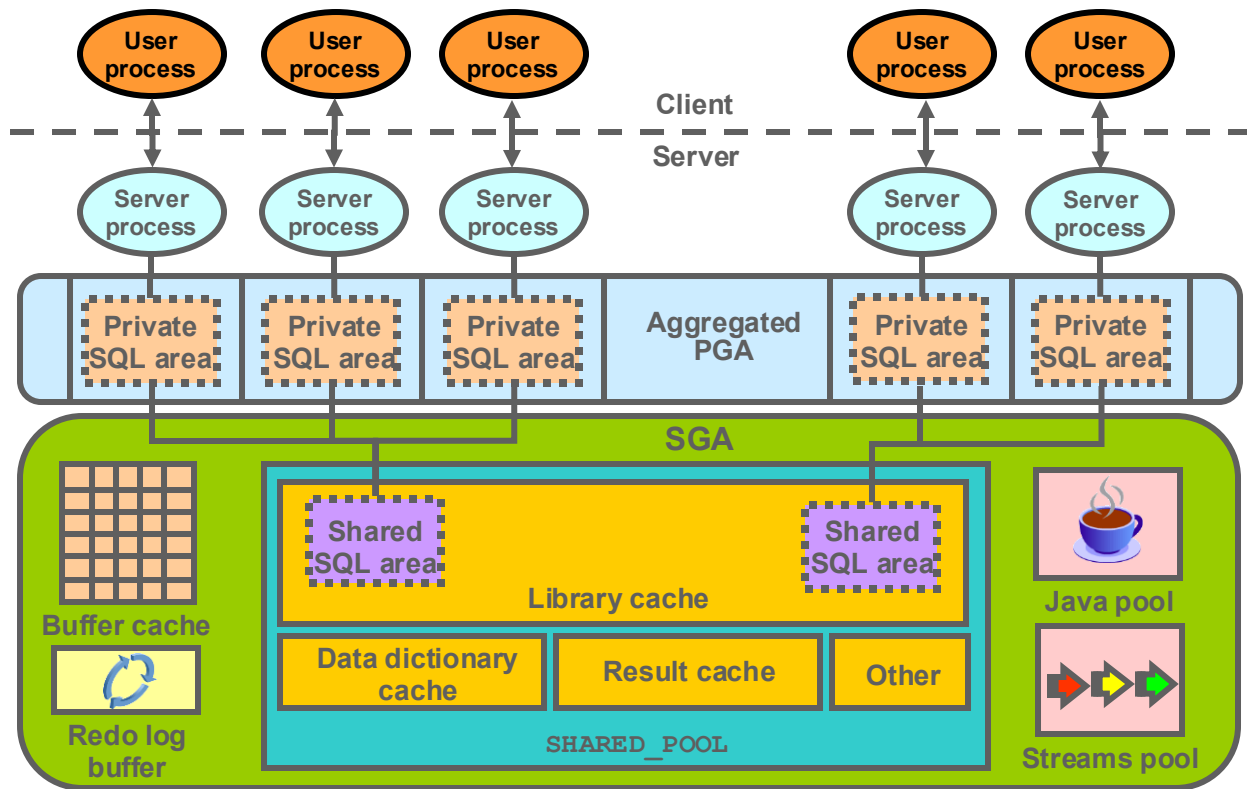
- Reduce overall resource consumption
- A **resource** could be:
 - Memory (consumed)
 - CPU (used)
 - IO operations (IO = Input **O**utput)
 - Time:
 - Elapsed time
 - Parse time
 - Fetch time
 - Total response time
 - Etc.
 - Other

Oracle Process types

- A **server** process is a program that directly interacts with the Oracle server.
 - It fulfills calls generated and returns results.
- A **client** process is a program running locally on client permanently connected with server process.



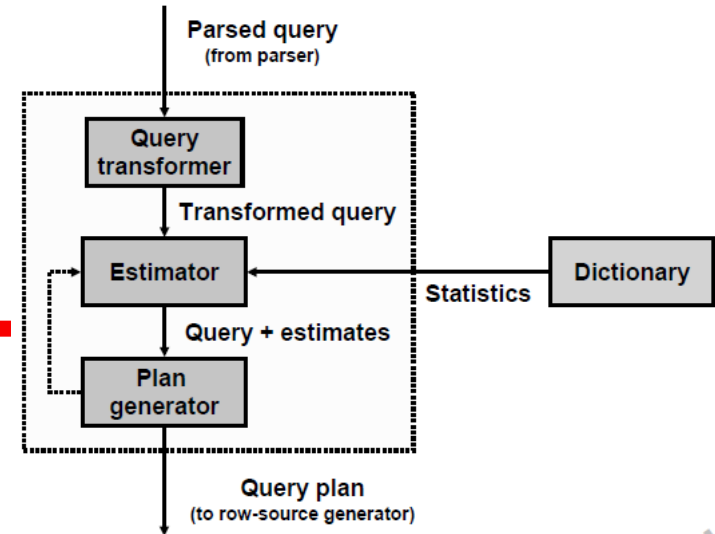
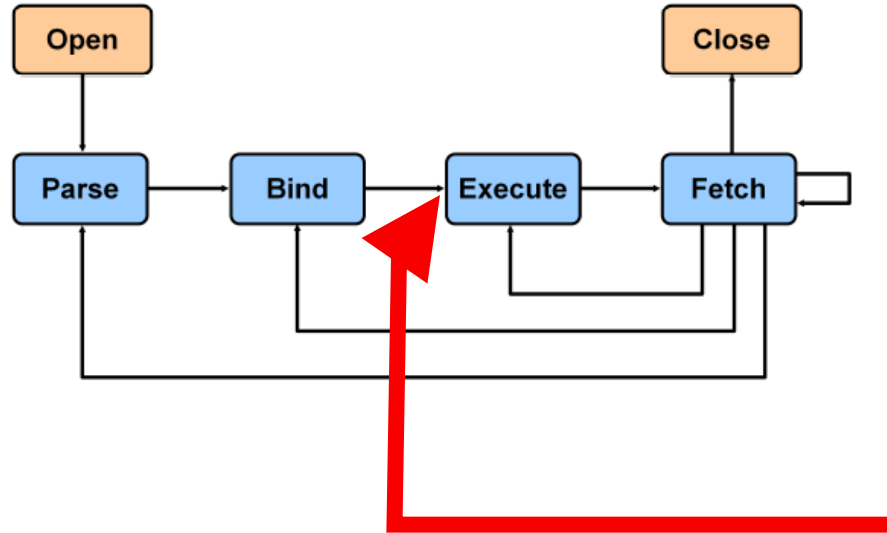
SQL Statement Representation



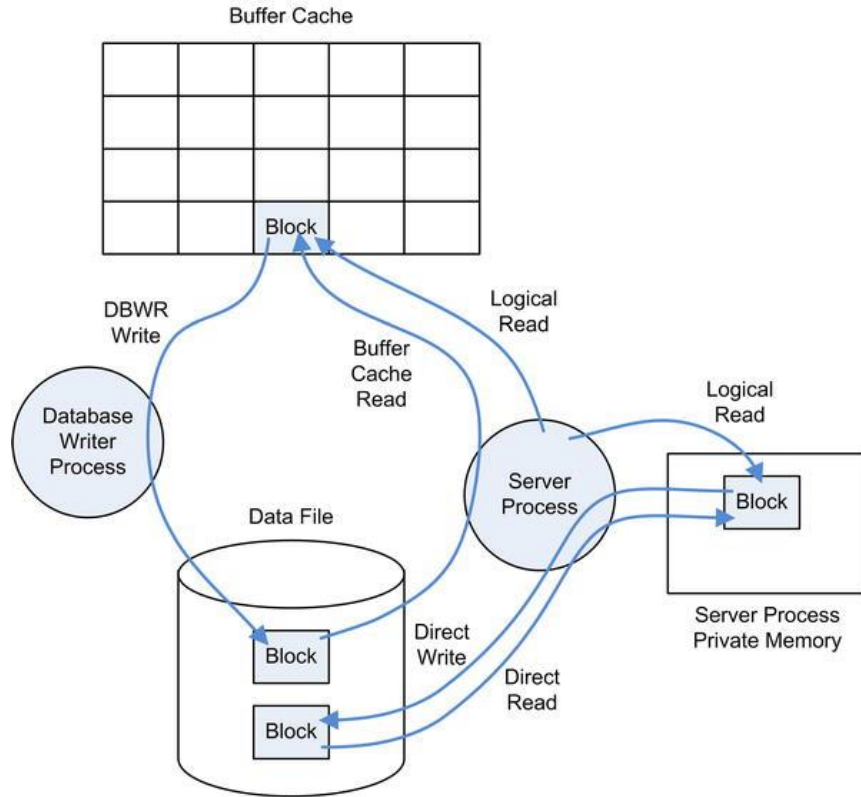
A woman with long brown hair and glasses, wearing a brown leather jacket over a blue patterned scarf, is sitting at a wooden desk. She is holding a black smartphone to her ear with her left hand and looking down at a large open book or document on the desk with her right hand. The background is a blurred office or study environment with other people and desks.

SQL statement

SQL Statement processing phases



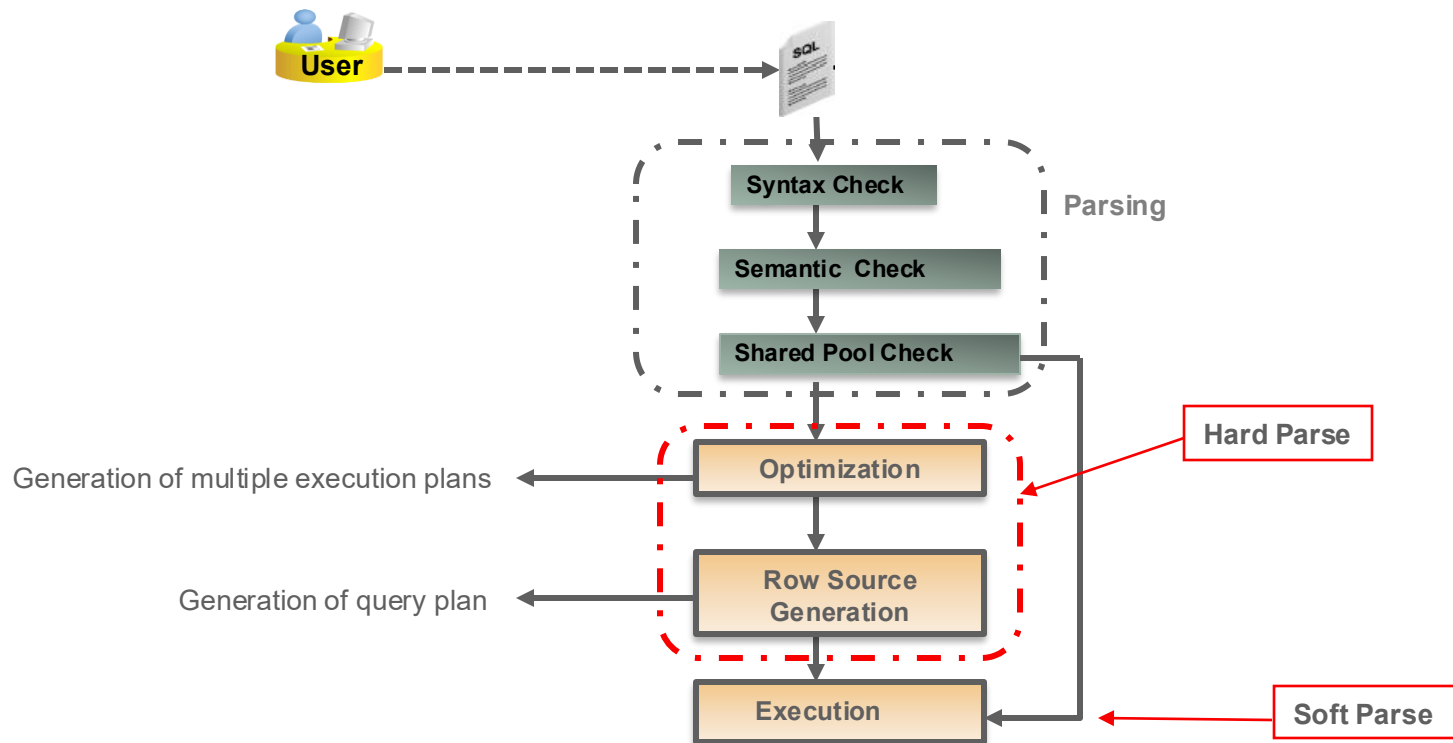
Typical SQL Statement flow



A woman with long brown hair and black-rimmed glasses is sitting at a wooden desk in a modern office. She is wearing a brown leather jacket over a blue and black patterned scarf. She is holding a black smartphone to her ear with her left hand and looking down at a large open book or portfolio on the desk with her right hand. In the background, another person is sitting at a desk, and there are large windows letting in natural light.

SQL phases details

SQL Statement Processing phases



Oracle Optimizer

- Determines the most efficient execution plan for a statement
- Optimizer:
 - Evaluates expressions and conditions
 - Uses objects and system's statistics
 - Decides how to access data
 - Decides how to join tables
 - Decides which access path is most efficient

Query Estimator: COST

- Cost is the optimizer's best estimate of the number of standardized IOs it takes to execute a particular statement.
- Cost unit is a standardized single-block random read:
 - 1 cost unit = 1 SRd (SRd = Single Read)
- Example:
 - If a plan costs 1,000, the optimizer computes that it should take as long as 1,000 single-block reads.
 - Remember that it is an estimation.

Query Estimator: Selectivity & Cardinality

- Selectivity is the estimated proportion of a row set retrieved by a particular predicate or combination of predicates.

$$\text{Selectivity} = \frac{\text{Number of rows satisfying a condition}}{\text{Total number of rows}}$$

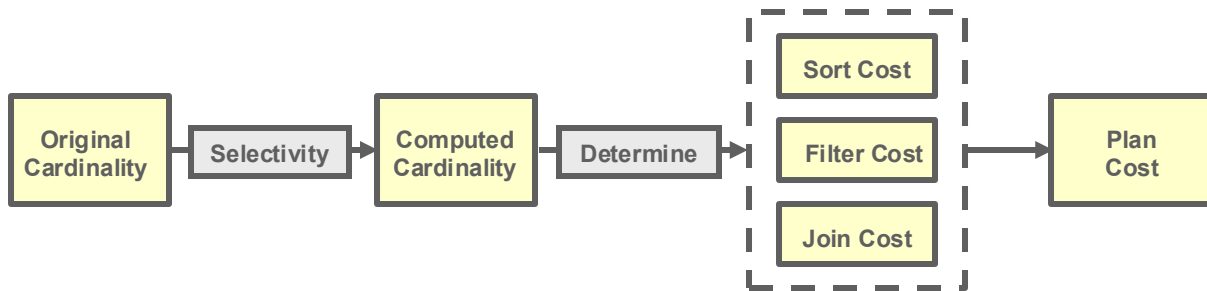
- Expected number of rows retrieved by a particular operation in the execution plan:

$$\text{Cardinality} = \text{Total number of rows} * \text{Selectivity}$$

- Selectivity is expressed as a value between 0.0 and 1.0 (or between 0 and 100%):
 - High selectivity: Small proportion of rows
 - Low selectivity: Big proportion of rows
- Selectivity computation:
 - If no statistics: Use dynamic statistics.
 - If no histograms: Assume even distribution of rows.

Importance of Selectivity & Cardinality

- **Selectivity affects the estimates of I/O cost.**
- Selectivity affects the sort cost.
- **Cardinality is important to determine join, filter, and sort costs.**
- If incorrect selectivity and cardinality are used, the optimizer estimates the plan cost incorrectly.



Plan Generator

```
select e.last_name, d.department_name
from   employees e, departments d
where  e.department_id = d.department_id;
```

```
Join order[1]:  DEPARTMENTS[D]#0  EMPLOYEES[E]#1
NL Join:  Cost: 41.13  Resp: 41.13  Degree: 1
SM cost: 8.01
HA cost: 6.51
```

Best:: JoinMethod: Hash

Cost: 6.51 Degree: 1 Resp: 6.51 Card: 106.00

```
Join order[2]:  EMPLOYEES[E]#1  DEPARTMENTS[D]#0
NL Join:  Cost: 121.24  Resp: 121.24  Degree: 1
SM cost: 8.01
HA cost: 6.51
```

Join order aborted

Final cost for query block SEL\$1 (#0)

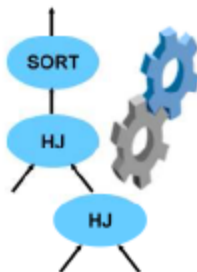
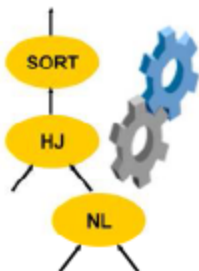
All Rows Plan:

Best join order: 1

+-----+						
Id	Operation	Name	Rows	Bytes	Cost	
+-----+						
0	SELECT STATEMENT				7	
1	HASH JOIN		106	6042	7	
2	TABLE ACCESS FULL	DEPARTMENTS	27	810	3	
3	TABLE ACCESS FULL	EMPLOYEES	107	2889	3	
+-----+						

Oracle Execution Plan

An execution plan is a set of steps that optimizer performs when executes an SQL statement and performs an operation



Reading an Execution Plan

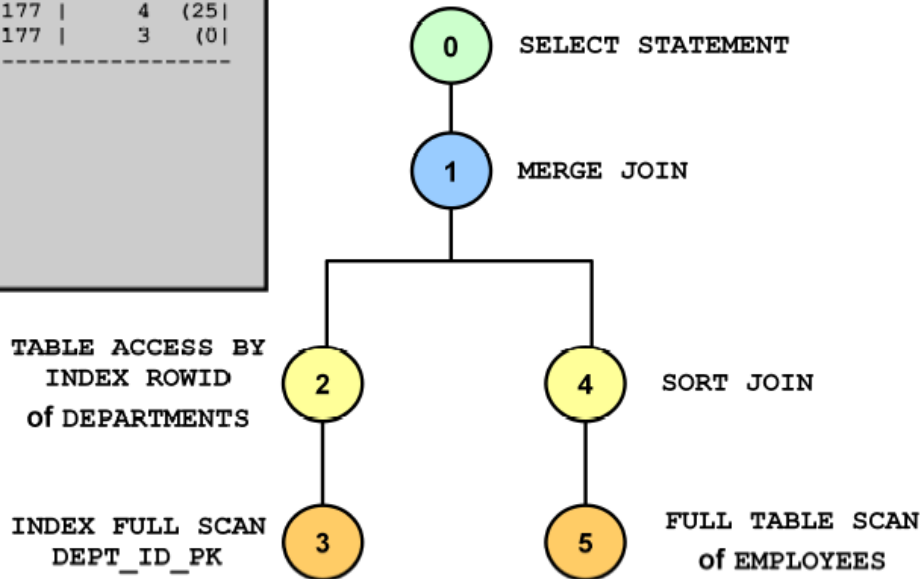
Plan hash value: 1343509718

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		106	2862	6 (17)
1	MERGE JOIN		106	2862	6 (17)
2	TABLE ACCESS BY INDEX ROWID	DEPARTMENTS	27	432	2 (0)
3	INDEX FULL SCAN	DEPT_ID_PK	27		1 (0)
* 4	SORT JOIN		107	1177	4 (25)
5	TABLE ACCESS FULL	EMPLOYEES	107	1177	3 (0)

Predicate Information (identified by operation id):

4 - access("E"."DEPARTMENT_ID"="D"."DEPARTMENT_ID")
filter("E"."DEPARTMENT_ID"="D"."DEPARTMENT_ID")

18 rows selected.



A woman with long brown hair and glasses is sitting at a wooden desk in a library or study. She is wearing a brown leather jacket over a blue and black patterned scarf. She is holding a black smartphone to her ear with her left hand and looking down at an open book on the desk with her right hand. In the background, there are other people sitting at desks, and the room has large windows and bookshelves.

SQLs: Access paths and join methods

Main Structures and Access Paths

Structures

Access Paths

Tables

1. Full Table Scan
2. ROWID Scan
3. Sample Table Scan

Indexes

4. Index Scan (Unique)
5. Index Scan (Range)
6. Index Scan (Full)
7. Index Scan (Fast Full)
8. Index Scan (Skip)
9. Index Scan (Index Join)
10. Using Bitmap Indexes
11. Combining Bitmap Indexes

Join Methods

A join:

- Defines the relationship between two row sources
- Is a method of combining data from two data sources
- Is controlled by join predicates, which define how the objects are related
- Join methods:
 - Nested loops
 - Sort-merge join
 - Hash join
 - Cartesian join

```
SELECT e.ename, d.dname
FROM dept d, emp e
WHERE e.deptno = d.deptno
AND e.job = 'ANALYST' OR e.empno = 9999;
```

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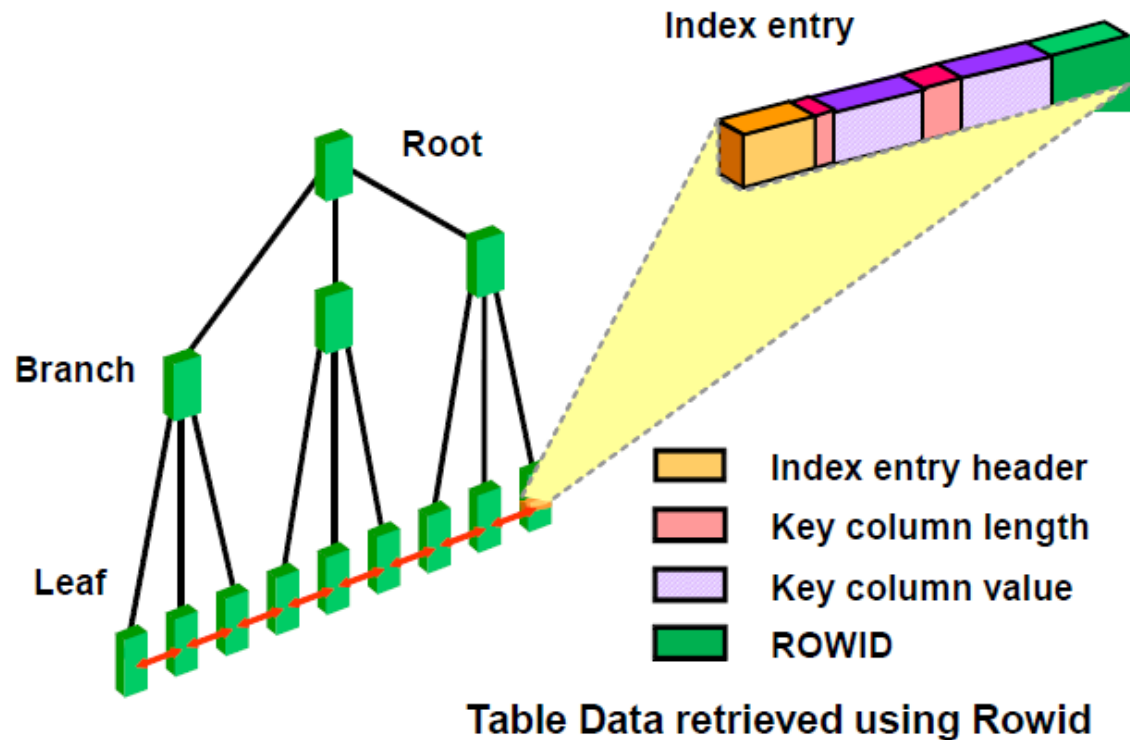
SQL: using indexes

Indexes types

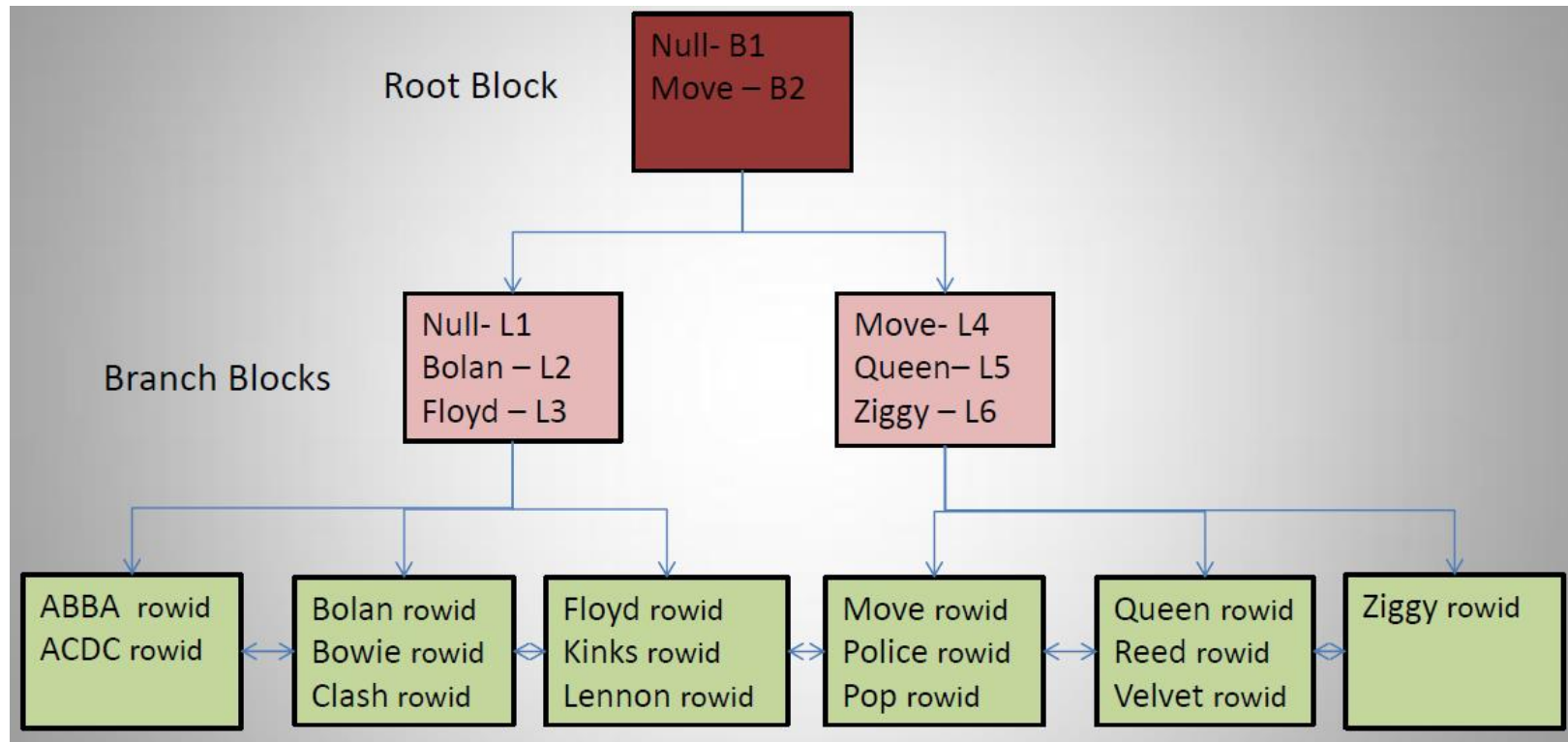
- B*Tree Index
- Bitmap Index
- Bitmap Join Index
- Function-Based Index
- Index-Organized Table IOT
- Application Domain Index

Oracle Index Types

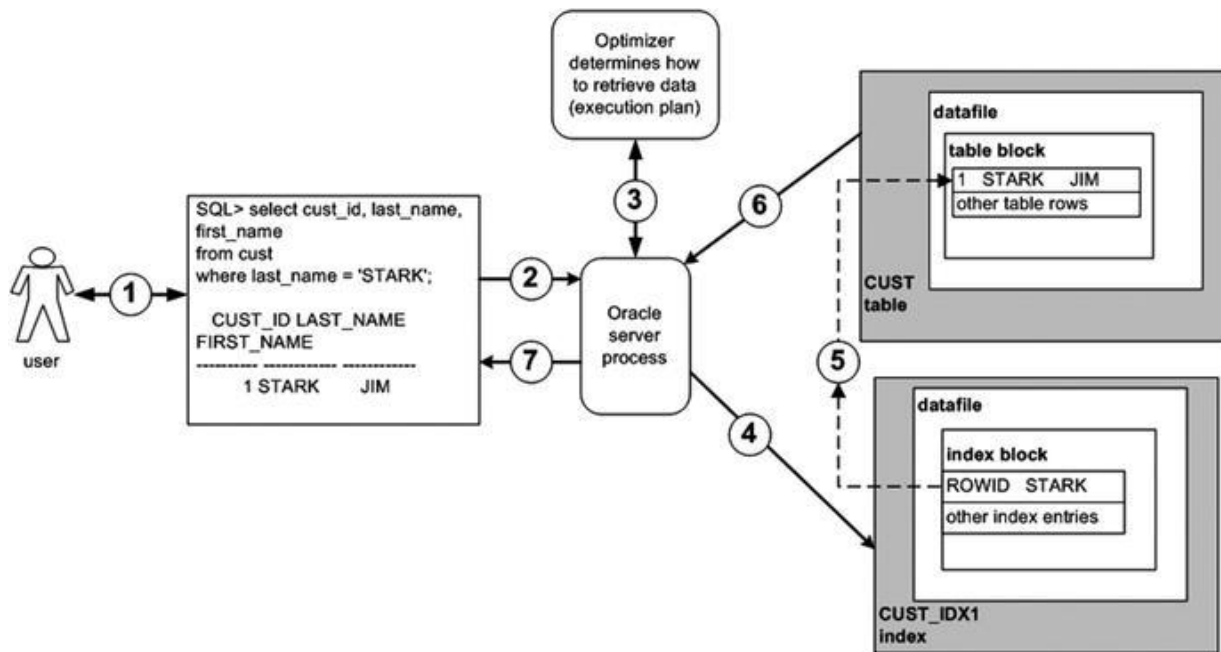
B*-Tree Indexes



B* Tree Index (B means BALANCED!)



How SQL use an index



How an SQL use an index (cont.)

To access a Table Row using an Index Range Scan we need to read:

- Index Root block and all branch
- Traverse the Index leaf blocks (ascending or descending).
- For each selected Index row read matching Table row by reading that Table block.



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