Entity
&
Referential Integrity

MAJOR RULES ASSOCIATED WITH THE RELATIONAL MODEL

1. Each tuple is distinct and must be named
2. Each tuple is unique
3. Navigation in the relational model is through the value an attribute takes.
4. Tuples are presented independent of sequence.
5. Attributes may be presented in any sequence.

RELATIONAL CONSTRAINTS AND RELATIONAL DB SCHEMAS

Domain Constraints

A domain D is a set of atomic values. By atomic we mean that each value in the domain is indivisible as far as the relational model is concerned. If the atomic values divided into smaller pieces, they will lose their meanings.

For example for the attribute Turkey phone numbers, the domain can be specified as 11 digit (or if we ignore 0 at the beginning, 10 digit) phone numbers valid in Turkey.

Domain constraints specify that the value of each attribute A must an atomic value from the domain (A).

INTEGRITY RULES

ENTITY INTEGRITY

Entity Integrity Constraint

No attribute participating in the primary key of a base relation is allowed to accept null values.

Key Constraints on Null

A relation is defined as a set of tuples. By definition all elements of a set are distinct. According to uniqueness constraint, no two tuples can have same value in primary key. Also candidate keys can never have null values. (Candidate key values must be unique for every tuple in any relation instance of that relation schema). Sometimes some attributes may have the constraint for null values.

INTEGRITY RULES

REFERENTIAL INTEGRITY

It is used to maintain consistency among tuples of the two relations. If base relation R2 includes a **foreign key (FK)** matching the **primary key (PK)** of some base relation R1 (referenced relation), then every value of FK in R2 (Referencing relation) must either

a) Be equal to the value of PK in some tuple R1 or

b) Be wholly null. (Each attribute in that PK must be null)

R1 & R2 are not necessarily distinct.

A tuple in one relation that refers to another relation must refer on an **existing tuple** in that relation. This rule has two **IMPLICATIONS:**

1. A new **tuple can be inserted** or an existing tuple can be modified (as child record) only when the value of the foreign key in the tuple matches a value of the primary key of an existing tuple (as parent record).

2. a. An existing **tuple cannot be deleted** (parent record) if the value of its primary key matches that of a foreign key in another tuple (child record).

b. OR if ON DELETE or ON UPDATE is defined;

Existing tuple (parent) can be deleted together with all its child records (CASCADE)

Existing tuple (parent) is deleted and child record foreign key is updated with NULL value (SET NULL),

or with default value (SET DEFAULT)

WITH FOREIGN KEY CONSTRAINT YOU DEFINED THE REFERENTIAL INTEGRITY:

- You cannot insert any record with foreign key value which is not exist as a primary key in the referenced table
- You cannot delete a row that contains a primary key that is used as a foreign key in another table.

Managing Schema Objects

Violating Constraints

```
UPDATE employees
SET    department_id = 55
WHERE  department_id = 110;
```

```
Error starting at line 1 in command:
UPDATE employees
SET    department_id = 55
WHERE  department_id = 110
Error report:
SQL Error: ORA-02291: integrity constraint (ORA1.EMP_DEPT_FK) violated - parent key not found
02291. 00000 - "integrity constraint (%s.%s) violated - parent key not found"
*Cause:    A foreign key value has no matching primary key value.
*Action:   Delete the foreign key or add a matching primary key.
```

Department 55 does not exist.

Violating Constraints

You cannot delete a row that contains a primary key that is used as a foreign key in another table.

```
DELETE FROM departments
WHERE department_id = 60;
```

```
Error starting at line 1 in command:
DELETE FROM departments
WHERE department_id = 60
Error report:
SQL Error: ORA-02292: integrity constraint (ORA1.JHIST_DEPT_FK) violated - child record found
02292. 00000 - "integrity constraint (%s.%s) violated - child record found"
*Cause:    attempted to delete a parent key value that had a foreign
           dependency.
*Action:   delete dependencies first then parent or disable constraint.
```

Creating a Table Using a Subquery

- Create a table and insert rows by combining the `CREATE TABLE` statement and the `AS` *`subquery`* option.

```
CREATE TABLE table
            [(column, column...)]
AS subquery;
```

- Match the number of specified columns to the number of subquery columns.
- Define columns with column names and default values.

Creating a Table Using a Subquery

```
CREATE TABLE  dept80
  AS
    SELECT   employee_id, last_name,
             salary*12 ANNSAL,
             hire_date
    FROM     employees
    WHERE    department_id = 80;
```

```
table DEPT80 created.
```

```
DESCRIBE dept80
```

```
Name                          Null     Type
----------------------------- -------- -------------
EMPLOYEE_ID                            NUMBER(6)
LAST_NAME                     NOT NULL VARCHAR2(25)
ANNSAL                                 NUMBER
HIRE_DATE                     NOT NULL DATE
```

Dropping a Table

- Moves a table to the recycle bin
- Removes the table and all its data entirely if the `PURGE` clause is specified
- Invalidates dependent objects and removes object privileges on the table

```
DROP TABLE dept80;
```

```
table DEPT80 dropped.
```

`ALTER TABLE` Statement

Use the `ALTER TABLE` statement to:

- Add a new column
- Modify an existing column definition
- Define a default value for the new column
- Drop a column
- Rename a column
- Change table to read-only status

Read-Only Tables

You can use the `ALTER TABLE` syntax to:

- Put a table into read-only mode, which prevents DDL or DML changes during table maintenance
- Put the table back into read/write mode

```
ALTER TABLE employees READ ONLY;

-- perform table maintenance and then
-- return table back to read/write mode

ALTER TABLE employees READ WRITE;
```

ALTER TABLE Statement

Use the ALTER TABLE statement to add, modify, or drop columns:

```
ALTER TABLE table
ADD         (column datatype [DEFAULT expr]
            [, column datatype]...);
```

```
ALTER TABLE table
MODIFY      (column datatype [DEFAULT expr]
            [, column datatype]...);
```

```
ALTER TABLE table
DROP (column [, column] …);
```

Adding a Column

- You use the `ADD` clause to add columns:

```
ALTER TABLE dept80
ADD         (job_id VARCHAR2(9));
```

```
table DEPT80 altered.
```

- The new column becomes the last column:

	EMPLOYEE_ID	LAST_NAME	ANNSAL	HIRE_DATE	JOB_ID
1	145	Russell	14000	01-OCT-96	(null)
2	146	Partners	13500	05-JAN-97	(null)
3	147	Errazuriz	12000	10-MAR-97	(null)
4	148	Cambrault	11000	15-OCT-99	(null)
5	149	Zlotkey	10500	29-JAN-00	(null)

Modifying a Column

- You can change a column's data type, size, and default value.

```
ALTER TABLE dept80
MODIFY      (last_name VARCHAR2(30));
```

```
table DEPT80 altered.
```

- A change to the default value affects only subsequent insertions to the table.

Dropping a Column

Use the `DROP COLUMN` clause to drop columns that you no longer need from the table:

```
ALTER TABLE  dept80
DROP (job_id);
```

```
table DEPT80 altered.
```

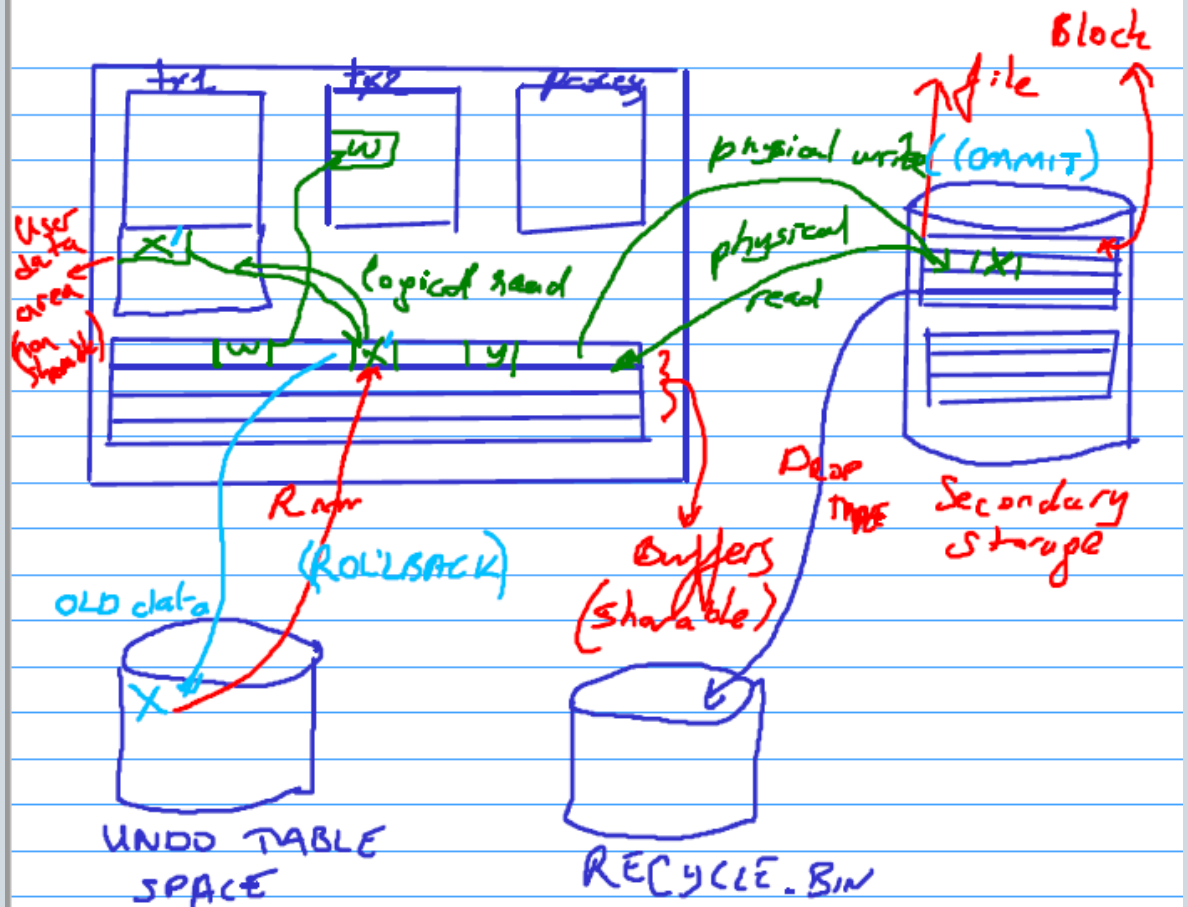
	EMPLOYEE_ID	LAST_NAME	ANNSAL	HIRE_DATE
1	145	Russell	14000	01-OCT-96
2	146	Partners	13500	05-JAN-97
3	147	Errazuriz	12000	10-MAR-97
4	148	Cambrault	11000	15-OCT-99
5	149	Zlotkey	10500	29-JAN-00

SET UNUSED Option

- You use the SET UNUSED option to mark one or more columns as unused.
- You use the DROP UNUSED COLUMNS option to remove the columns that are marked as unused.

```
ALTER TABLE  <table_name>
SET    UNUSED(<column_name> [ , <column_name>]) ;
OR
ALTER TABLE  <table_name>
SET    UNUSED COLUMN <column_name> [,<column_name>];
```

```
ALTER TABLE <table_name>
DROP  UNUSED COLUMNS;
```



DROP TABLE xx; ⇒ Recycle bin!
Flash back

DROP TABLE xx PURGE; ⇒ ~~X~~ Recycle!
cannot be flashed back!

⇒ DELETE .
FROM DEPT80; ⇒ UNDO TABLE SPACE
· COMMIT / ROLLBACK

⇒ TRUNCATE DEPT80; → Not stored into UNDO
DDL ⇒ implicit commitment * cannot be rolled back!

The **SET UNUSED** option marks one or more columns as unused so that they can be dropped when the demand on system resources is lower. Specifying this clause does not actually remove the target columns from each row in the table (that is, it does not restore the disk space used by these columns).

Therefore, the response time is faster than if you executed the DROP clause.
Unused columns are treated as if they were dropped, even though their column data remains in the table's rows. After a column has been marked as unused, you have no access to that column.

A SELECT * query will not retrieve data from unused columns. In addition, the names and types of columns marked as unused will not be displayed during a DESCRIBE statement, and you can add to the table a new column with the same name as an unused column.

The SET UNUSED information is stored in the USER_UNUSED_COL_TABS dictionary view.

Adding a Constraint Syntax

Use the ALTER TABLE statement to:

- Add or drop a constraint, but not modify its structure
- Enable or disable constraints
- Add a NOT NULL constraint by using the MODIFY clause

```
ALTER TABLE  <table_name>
ADD [CONSTRAINT <constraint_name>]
type (<column_name>);
```

Adding a Constraint

Add a `FOREIGN KEY` constraint to the `EMP2` table indicating that a manager must already exist as a valid employee in the `EMP2` table.

```
ALTER TABLE emp2
MODIFY employee_id PRIMARY KEY;
```

```
table EMP2 altered.
```

```
ALTER TABLE emp2
ADD CONSTRAINT emp_mgr_fk
  FOREIGN KEY(manager_id)
  REFERENCES emp2(employee_id);
```

```
table EMP2 altered.
```

ON DELETE Clause

- Use the `ON DELETE CASCADE` clause to delete child rows when a parent key is deleted:

```
ALTER TABLE emp2 ADD CONSTRAINT emp_dt_fk
FOREIGN KEY (Department_id)
REFERENCES departments(department_id) ON DELETE CASCADE;
```

```
table EMP2 altered.
```

- Use the `ON DELETE SET NULL` clause to set the child rows value to null when a parent key is deleted:

```
ALTER TABLE emp2 ADD CONSTRAINT emp_dt_fk
FOREIGN KEY (Department_id)
REFERENCES departments(department_id) ON DELETE SET NULL;
```

```
table EMP2 altered.
```

Deferring Constraints

Constraints can have the following attributes:

- DEFERRABLE or NOT DEFERRABLE
- INITIALLY DEFERRED or INITIALLY IMMEDIATE

```
ALTER TABLE dept2
ADD CONSTRAINT dept2_id_pk
PRIMARY KEY (department_id)
DEFERRABLE INITIALLY DEFERRED
```

Deferring constraint on creation

```
SET CONSTRAINTS dept2_id_pk IMMEDIATE
```

Changing a specific constraint attribute

```
ALTER SESSION
SET CONSTRAINTS= IMMEDIATE
```

Changing all constraints for a session

You can defer checking constraints for validity until the end of the transaction. A constraint is **deferred if the system does not check whether the constraint is satisfied, until a COMMIT statement is submitted.** If a deferred constraint is violated, the database returns an error and the transaction is not committed and it is rolled back. If a constraint is immediate (not deferred), it is checked at the end of each statement. If it is violated, the statement is rolled back immediately. If a constraint causes an action (for example, DELETE CASCADE), that action is always taken as part of the statement that caused it, whether the constraint is deferred or immediate. Use the SET CONSTRAINTS statement to specify, for a particular transaction, whether a deferrable constraint is checked following each data manipulation language (DML) statement or when the transaction is committed. To create deferrable constraints, you must create a nonunique index for that constraint.

Difference Between INITIALLY DEFERRED and INITIALLY IMMEDIATE

INITIALLY DEFERRED	Waits to check the constraint until the transaction ends
INITIALLY IMMEDIATE	Checks the constraint at the end of the statement execution

```
CREATE TABLE emp_new_sal (salary NUMBER
        CONSTRAINT sal_ck
        CHECK (salary > 100)
        DEFERRABLE INITIALLY IMMEDIATE,
        bonus NUMBER
        CONSTRAINT bonus_ck
        CHECK (bonus > 0 )
        DEFERRABLE INITIALLY DEFERRED );
```

```
table EMP_NEW_SAL created.
```

Dropping a Constraint

- Remove the manager constraint from the `EMP2` table:

```
ALTER TABLE emp2
DROP CONSTRAINT emp_mgr_fk;
```

```
table EMP2 altered.
```

- Remove the `PRIMARY KEY` constraint on the `DEPT2` table and drop the associated `FOREIGN KEY` constraint on the `EMP2.DEPARTMENT_ID` column:

```
ALTER TABLE dept2
DROP PRIMARY KEY CASCADE;
```

```
table DEPT2 altered.
```

Disabling Constraints

- Execute the `DISABLE` clause of the `ALTER TABLE` statement to deactivate an integrity constraint.
- Apply the `CASCADE` option to disable dependent integrity constraints.

```
ALTER TABLE emp2
DISABLE CONSTRAINT emp_dt_fk;
```

```
table EMP2 altered.
```

Enabling Constraints

- Activate an integrity constraint that is currently disabled in the table definition by using the ENABLE clause.

```
ALTER TABLE       emp2
ENABLE CONSTRAINT emp_dt_fk;
```

```
table EMP2 altered.
```

- A UNIQUE index is automatically created if you enable a UNIQUE key or a PRIMARY KEY constraint.

Cascading Constraints

- The `CASCADE CONSTRAINTS` clause is used along with the `DROP COLUMN` clause.
- The `CASCADE CONSTRAINTS` clause drops all referential integrity constraints that refer to the `PRIMARY` and `UNIQUE` keys defined on the dropped columns.
- The `CASCADE CONSTRAINTS` clause also drops all multicolumn constraints defined on the dropped columns.

Assume that the `TEST1` table is created as follows:

```
CREATE TABLE test1 (
  col1_pk NUMBER PRIMARY KEY,
  col2_fk NUMBER,
  col1 NUMBER,
  col2 NUMBER,
  CONSTRAINT fk_constraint FOREIGN KEY (col2_fk) REFERENCES test1,
  CONSTRAINT ck1 CHECK (col1_pk > 0 and col1 > 0),
  CONSTRAINT ck2 CHECK (col2_fk > 0));
```

An error is returned for the following statements:

`ALTER TABLE test1 DROP (col1_pk);` —`col1_pk` is a parent key.

`ALTER TABLE test1 DROP (col1);` —`col1` is referenced by the multicolumn constraint, `ck1`.

Cascading Constraints

Example:

```
ALTER TABLE emp2
DROP COLUMN employee_id CASCADE CONSTRAINTS;
```

```
table EMP2 altered.
```

```
ALTER TABLE test1
DROP (col1_pk, col2_fk, col1) CASCADE CONSTRAINTS;
```

```
table TEST1 altered.
```

Renaming Table Columns and Constraints

Use the RENAME COLUMN clause of the ALTER TABLE statement to rename table columns.

a

```
ALTER TABLE marketing RENAME COLUMN team_id
TO id;
```

```
table MARKETING altered.
```

Use the RENAME CONSTRAINT clause of the ALTER TABLE statement to rename any existing constraint for a table.

b

```
ALTER TABLE marketing RENAME CONSTRAINT mktg_pk
TO new_mktg_pk;
```

```
table MARKETING altered.
```

MANIPULATING DATA
-DATA INSERTION-

Adding a New Row to a Table

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

	70	Public Relations	100	1700

New row

Insert new row into the DEPARTMENTS table.

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	70	Public Relations	100	1700
2	10	Administration	200	1700
3	20	Marketing	201	1800
4	50	Shipping	124	1500
5	60	IT	103	1400
6	80	Sales	149	2500
7	90	Executive	100	1700
8	110	Accounting	205	1700
9	190	Contracting	(null)	1700

INSERT Statement Syntax

- Add new rows to a table by using the INSERT statement:

```
INSERT INTO   table [(column [, column...])]
VALUES        (value [, value...]);
```

- With this syntax, only one row is inserted at a time.

Inserting New Rows

- Insert a new row containing values for each column.
- List values in the default order of the columns in the table.
- Optionally, list the columns in the `INSERT` clause.

```
INSERT INTO departments(department_id,
       department_name, manager_id, location_id)
VALUES (70, 'Public Relations', 100, 1700);
```

```
1 rows inserted
```

- Enclose character and date values within single quotation marks.

Inserting Rows with Null Values

- Implicit method: Omit the column from the column list.

```
INSERT INTO   departments (department_id,
                           department_name)
VALUES        (30, 'Purchasing');
```

```
1 rows inserted
```

- Explicit method: Specify the NULL keyword in the VALUES clause.

```
INSERT INTO   departments
VALUES        (100, 'Finance', NULL, NULL);
```

```
1 rows inserted
```

Inserting Special Values

The SYSDATE function records the current date and time.

```
INSERT INTO employees (employee_id,
                       first_name, last_name,
                       email, phone_number,
                       hire_date, job_id, salary,
                       commission_pct, manager_id,
                       department_id)
VALUES                 (113,
                       'Louis', 'Popp',
                       'LPOPP', '515.124.4567',
                       SYSDATE, 'AC_ACCOUNT', 6900,
                       NULL, 205, 110);
```

```
1 rows inserted
```

Inserting Specific Date and Time Values

- Add a new employee.

```
INSERT INTO employees
VALUES      (114,
             'Den', 'Raphealy',
             'DRAPHEAL', '515.127.4561',
             TO_DATE('FEB 3, 1999', 'MON DD, YYYY'),
             'SA_REP', 11000, 0.2, 100, 60);
```

```
1 rows inserted
```

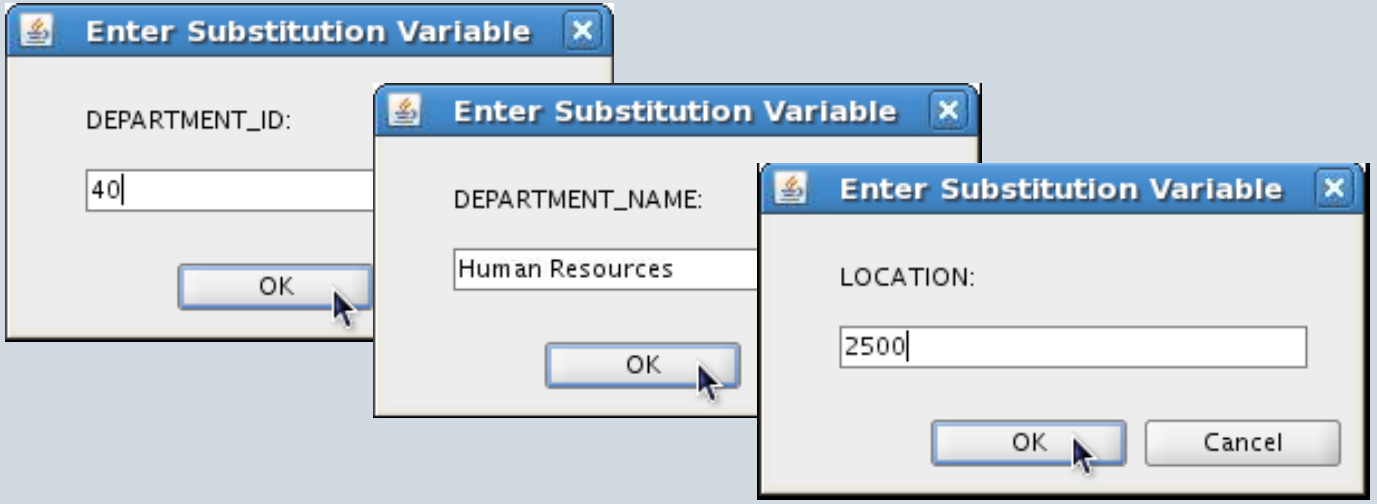
- Verify your addition.

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT
1	114	Den	Raphealy	DRAPHEAL	515.127.4561	03-FEB-99	SA_REP	11000	0.2

Creating a Script

- Use the & substitution in a SQL statement to prompt for values.
- & is a placeholder for the variable value.

```
INSERT INTO departments
            (department_id, department_name, location_id)
VALUES      (&department_id, '&department_name',&location);
```



Copying Rows from Another Table

- Write your `INSERT` statement with a subquery:

```
INSERT INTO sales_reps(id, name, salary, commission_pct)
  SELECT employee_id, last_name, salary, commission_pct
  FROM   employees
  WHERE  job_id LIKE '%REP%';
```

```
4 rows inserted
```

- Do not use the `VALUES` clause.
- Match the number of columns in the `INSERT` clause to those in the subquery.
- Inserts all the rows returned by the subquery in the table, `sales_reps`.

DROP TABLE … PURGE

```
DROP TABLE dept80 PURGE;
```

```
table DEPT80 dropped.
```

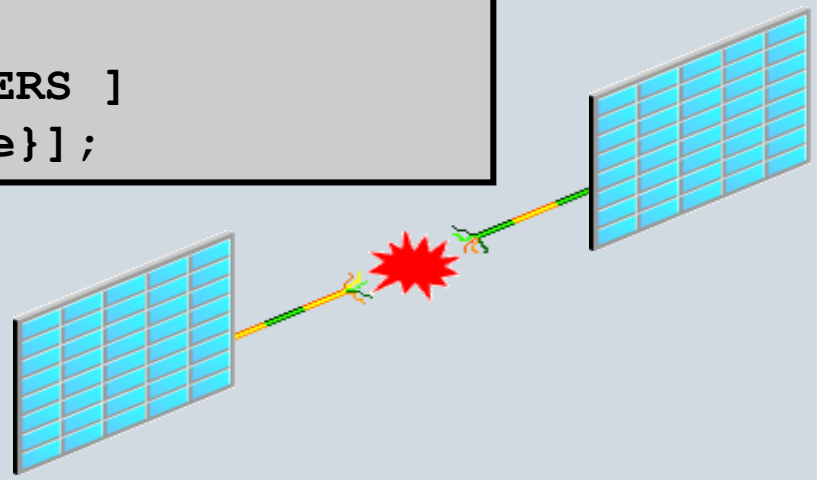
`FLASHBACK TABLE` Statement

- Enables you to recover tables to a specified point in time with a single statement
- Restores table data along with associated indexes and constraints
- Enables you to revert the table and its contents to a certain point in time or system change number (SCN)

FLASHBACK TABLE Statement

- Repair tool for accidental table modifications
  - Restores a table to an earlier point in time
  - Offers ease of use, availability, and fast execution
  - Is performed in place
- Syntax:

```
FLASHBACK TABLE[schema.]table[,
[ schema.]table ]...
TO { TIMESTAMP | SCN } expr
[ { ENABLE | DISABLE } TRIGGERS ]
[BEFORE DROP {RENAME TO table}];
```



Using the FLASHBACK TABLE Statement

```
DROP TABLE emp2;
```

```
table EMP2 dropped.
```

```
SELECT original_name, operation, droptime FROM
recyclebin;
```

ORIGINAL_NAME	OPERATION	DROPTIME
EMP2	DROP	2009-05-20:18:00:39

...

```
FLASHBACK TABLE emp2 TO BEFORE DROP;
```

```
table EMP2 succeeded.
```