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INFORMATION  
TECHNOLOGY

Creating & Populating the Database – Data  
Definition Language

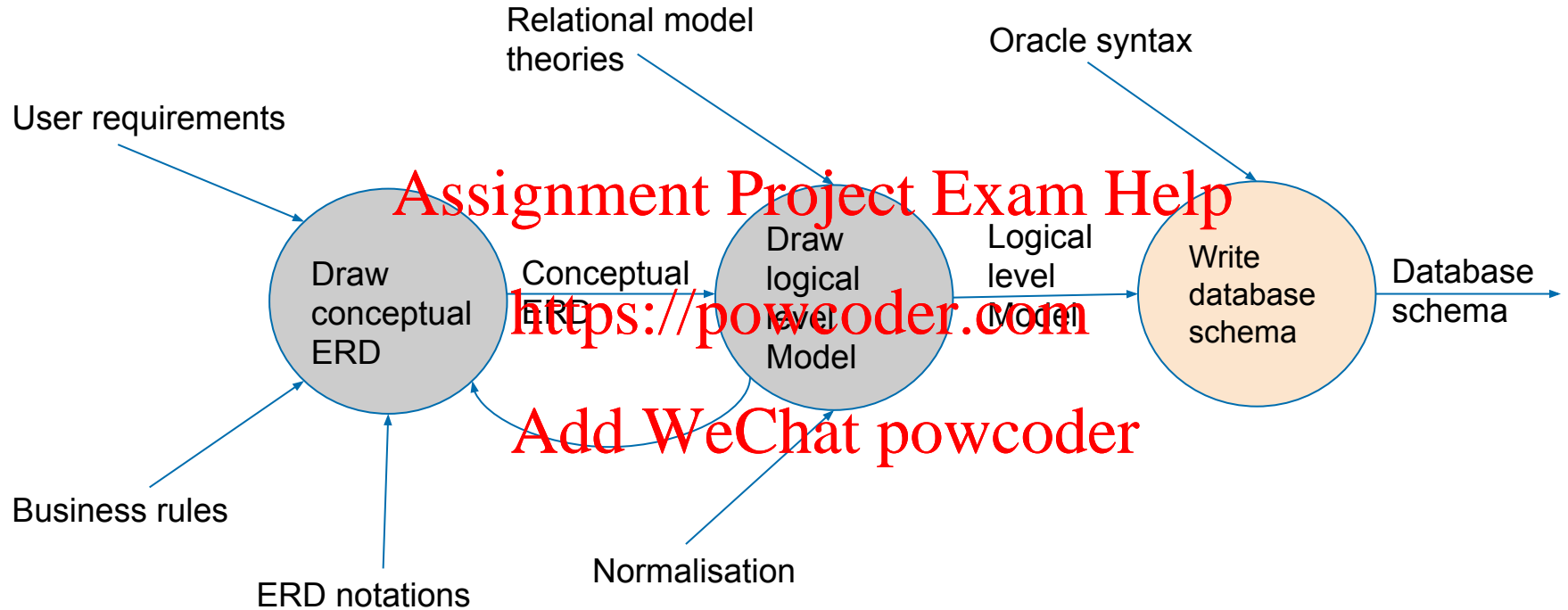
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# SQL general syntax

- A single statement is ended with SEMICOLON.
- Predefined KEYWORDS represent clauses (components) of a statement.
- Keywords are NOT case sensitive.
- Examples:

```
CREATE TABLE unit
(
    unit_code    CHAR(7) NOT NULL,
    unit_name    VARCHAR2(50) CONSTRAINT uq_unit_name UNIQUE NOT NULL,
    CONSTRAINT pk_unit PRIMARY KEY (unit_code)
);

SELECT * FROM unit;
```

# SQL Statements

- Data Definition Language (DDL)
    - Creating database structure
      - CREATE TABLE, ALTER TABLE, DROP TABLE
  - Data Manipulation Language (DML)
    - Adding and Manipulating database contents (rows)
      - INSERT, UPDATE, DELETE
    - Retrieving data from database
      - SELECT
  - Data Control Language (DCL)
    - Set permissions on objects
      - GRANT
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CREATE A TABLE (DDL)

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# Common ORACLE data types

- **Text:** CHAR(size), VARCHAR2(size)

- e.g., CHAR(10), VARCHAR2(10)

- CHAR(10) → 'apple' = 'apple '

- VARCHAR2(10) → 'apple' = 'apple'

- **Numbers:** NUMBER(precision, scale)

- Weight NUMBER(7) or NUMBER(7,0) → Weight = 7456123

- Weight NUMBER(9,2) → Weight = 7456123.89

- Weight NUMBER(8,1) → Weight = 7456123.9

- **Data/Time:** DATE, TIMESTAMP

- DATE can store a date and time (time to seconds), stored as Julian date

- TIMESTAMP can store a date and a time (up to fractions of a second)

- TIMESTAMP WITH TIME ZONE

# Column VS Table Level Constraints

TRAINING		
P	* train_code	CHAR (5)
	* train_desc	VARCHAR2 (100)
	* train_hrs	NUMBER (2)
	* train_active_months	NUMBER (2)

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```
CREATE TABLE training (  
  train_code          CHAR(5) NOT NULL,  
  train_desc          VARCHAR2(100) NOT NULL,  
  train_hrs           NUMBER(2) NOT NULL,  
  train_active_months NUMBER(2) NOT NULL,  
  CONSTRAINT training_pk PRIMARY KEY (train_code)  
);
```

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column constraints

table constraint

TRAINING	
P * train_code	CHAR (5)
* train_desc	VARCHAR2 (100)
* train_hrs	NUMBER (2)
* train_active_months	NUMBER (2)

TRAINING_COURSE	
PF * train_code	CHAR (5)
P * traincourse_date	DATE
F * trainer_id	NUMBER (3)

TRAINER	
P * trainer_id	NUMBER (3)
* trainer_rego	CHAR (12)
* trainer_fname	VARCHAR2 (25)
* trainer_lname	VARCHAR2 (25)
* trainer_category	CHAR (1)

```
CREATE TABLE training (
  train_code      CHAR(5) NOT NULL,
  train_desc      VARCHAR2(100) NOT NULL,
  train_hrs       NUMBER(2) NOT NULL,
  train_active_months NUMBER(2) NOT NULL,
  CONSTRAINT training_pk PRIMARY KEY ( train_code )
);
```

```
CREATE TABLE trainer (
  trainer_id      NUMBER(3) NOT NULL,
  trainer_rego    CHAR(12) NOT NULL,
  trainer_fname   VARCHAR2(25) NOT NULL,
  trainer_lname   VARCHAR2(25) NOT NULL,
  trainer_category CHAR(1) NOT NULL,
  CONSTRAINT trainer_pk PRIMARY KEY ( trainer_id )
);
```

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TRAINING		
P *	train_code	CHAR (5)
*	train_desc	VARCHAR2 (100)
*	train_hrs	NUMBER (2)
*	train_active_months	NUMBER (2)

TRAINING_COURSE		
PF *	train_code	CHAR (5)
P *	traincourse_date	DATE
F *	trainer_id	NUMBER (3)

TRAINER		
P *	trainer_id	NUMBER (3)
*	trainer_rego	CHAR (12)
*	trainer_fname	VARCHAR2 (25)
*	trainer_lname	VARCHAR2 (25)
*	trainer_category	CHAR (1)

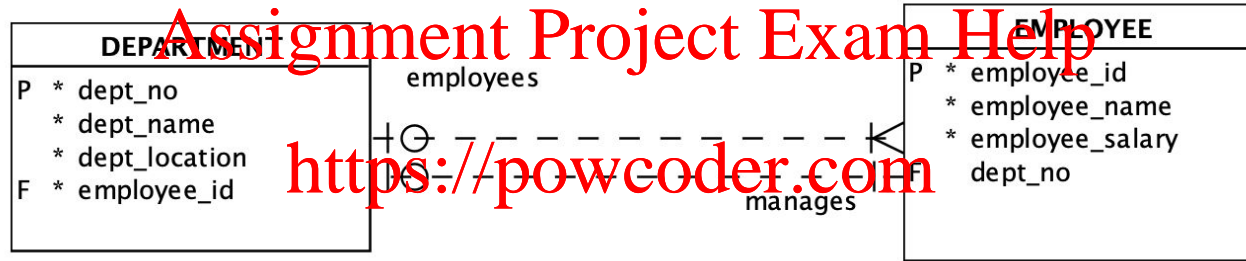
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```

CREATE TABLE training_course (
  train_code          CHAR(5) NOT NULL,
  traincourse_date    DATE NOT NULL,
  trainer_id          NUMBER(3) NOT NULL,
  CONSTRAINT training_course_pk PRIMARY KEY ( train_code, traincourse_date ),
  CONSTRAINT training_course_fk FOREIGN KEY (trainer_id )
    REFERENCES trainer ( trainer_id ),
  CONSTRAINT training_trainingcourse FOREIGN KEY ( train_code )
    REFERENCES training ( train_code )
);

```

# Problems here?



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## Alternative (BETTER) method of defining FKs

```
CREATE TABLE training_course (  
  train_code      CHAR(5) NOT NULL,  
  traincourse_date DATE NOT NULL,  
  trainer_id      NUMBER(3) NOT NULL,  
  CONSTRAINT training_course_pk PRIMARY KEY ( train_code, traincourse_date )  
);
```

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```
ALTER TABLE training_course  
  ADD  
    ( CONSTRAINT trainer_trainingcourse FOREIGN KEY ( trainer_id )  
      REFERENCES trainer ( trainer_id ),  
      CONSTRAINT training_trainingcourse FOREIGN KEY ( train_code )  
      REFERENCES training ( train_code ));
```

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# Referential Integrity

- To ensure referential integrity, SQL defines three possible actions for FKs in relations when a deletion of a primary key occurs:
  - RESTRICT (Oracle No Action basically equivalent)
    - Deletion of tuples is NOT ALLOWED for those tuples in the table referred by the FK (the table containing PK) if there is corresponding tuple in the table containing the FK.
  - CASCADE
    - A deletion of a tuple in the table referred by the FK (the table containing PK) will result in the deletion of the corresponding tuples in the table containing the FK.
  - NULLIFY
    - A deletion of a tuple in the table referred by the FK (the table containing PK) will result in the update of the corresponding tuples in the table containing the FK to NULL.



# Referential Constraints SQL Data Modeller

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The screenshot displays the SQL Data Modeller interface. On the left, a database schema is shown with three tables: **TRAINING**, **TRAINING\_COURSE**, and **CUST\_TRAIN**. **TRAINING** has attributes *train\_code*, *train\_desc*, *train\_hrs*, and *train\_active\_months*. **TRAINING\_COURSE** has attributes *train\_code*, *traincourse\_date*, and *trainer\_id*. **CUST\_TRAIN** has attributes *ct\_id*, *cust\_id*, *train\_code*, *traincourse\_date*, *ct\_exam\_date*, and *ct\_date\_expire*. Relationships are indicated by lines with crow's foot notation: **TRAINING** to **TRAINING\_COURSE** (labeled 'applies\_to'), **TRAINING\_COURSE** to **CUST\_TRAIN** (labeled 'completed'), and **CUST\_TRAIN** to **CUSTOMER** (labeled 'complete').

On the right, the 'Relation Properties - training\_dronet' dialog is open, showing the 'General' tab. The 'Name' field is 'training\_dronetype'. The 'Source Cardinality' section shows 'Source' as 'TRAINING' and 'Source key' as 'TRAINING.TRAINING PK'. The 'Name on Source' field is 'applies\_to'. The 'Source Entity Synonym' is 'TRAINING'. The 'Source to Target Cardinality' is '1 to \*'. The 'Source Optional' checkbox is unchecked. The 'Transferable' checkbox is checked. The 'Dominant Role' is 'None'. The 'Identifying' checkbox is unchecked. The 'Delete Rule' dropdown menu is open, showing options: 'NO ACTION', 'CASCADE', 'SET NULL', and 'RESTRICT'. The 'NO ACTION' option is currently selected.

# What Referential Integrity Constraint to implement?

- Use the model to decide on what referential integrity constraint to implement.
  - Mandatory vs Optional participation.

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- The constraints must be decided at the design phase.

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## ALTER TABLE

- Used to change a tables structure.
- For example:

- Adding column(s).
- Removing column(s).
- Adding constraint(s).
- Removing constraint(s).

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```
ALTER TABLE TRAINER
```

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```
ADD (CONSTRAINT chk_trainercategory CHECK  
      (trainer_category IN ( 'C', 'F' )),  
      trainer_nocourses number(3) DEFAULT 0 NOT NULL);
```

# Referential Integrity Definition - Example

```
ALTER TABLE training_course  
  DROP CONSTRAINT training_trainingcourse;
```

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```
ALTER TABLE training_course  
  ADD  
    ( CONSTRAINT training_trainingcourse FOREIGN KEY ( train_code )  
      REFERENCES training ( train_code ) ON DELETE CASCADE );
```

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# DELETING A TABLE

- Use the DROP statement.
- Examples:

- `DROP TABLE training_course PURGE;`
- `DROP TABLE trainer CASCADE CONSTRAINTS PURGE;`

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**ADDING TUPLES/ROWS TO A TABLE (DML)**  
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# INSERT

- Adding data to a table in a database.
- SYNTAX:

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

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```
INSERT INTO training VALUES ('C0001', 'Starter Drone Training 1', 8, 24);
```

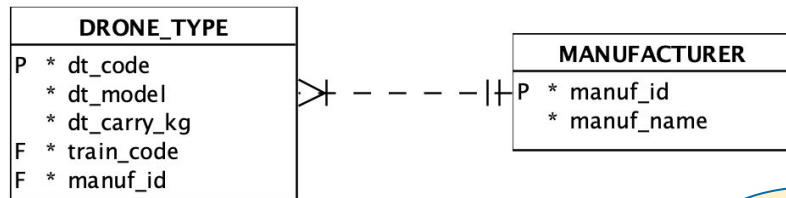
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```
INSERT INTO trainer (trainer_id, trainer_rego, trainer_fname, trainer_lname,
trainer_category) VALUES (312, 'DR523412-314', 'Thomas', 'Price', 'F');
```

```
INSERT INTO training_course VALUES ('C0001', '20-Oct-2020', 312);
```

*Role of: to\_date and to\_char*

# COMMIT and ROLLBACK



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How to determine

```
INSERT INTO manufacturer VALUES (12, 'DJI');
```

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```
INSERT INTO drone_type VALUES('DJIT', 'DJI Trello', 5, 'C0001', 12);
```

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**COMMIT** makes the changes to the database permanent.

**ROLLBACK** will undo the changes.

## Using a SEQUENCE

- Oracle supports auto-increment of a numeric PRIMARY KEY.
  - SEQUENCE.
- Steps to use:

- Create sequence

```
CREATE SEQUENCE manuf_seq  
INCREMENT BY 1;
```

- Access the sequence using two built-in variables (pseudocolumns):
    - NEXTVAL and CURRVAL

```
– INSERT INTO manufacturer  
VALUES (manuf_seq.nextval, 'DJI');
```

```
– INSERT INTO drone_type VALUES ('DJIT', 'DJI Trello', 5, 'C0001',  
manuf_seq.currval);
```

- Note sequence value cannot be relied on after a COMMIT/ROLLBACK



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**PUTTING THIS TO WORK**

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TRAINING_COURSE	
PF * train_code	CHAR (5)
P * traincourse_date	DATE
F * trainer_id	NUMBER (3)

DRONE	
P * drone_id	NUMBER (5)
* drone_pur_date	DATE
* drone_pur_price	NUMBER (7,2)
* drone_flight_time	NUMBER (6,1)
* drone_cost_hr	NUMBER (6,2)
F * dt_code	CHAR (4)

CUST_TRAIN	
P * ct_id	NUMBER (7)
UF * cust_id	NUMBER (4)
UF * train_code	CHAR (5)
UF * traincourse_date	DATE
ct_exam_date	DATE
ct_date_expire	DATE

RENTAL	
P * rental_no	NUMBER (6)
* rent_bond	NUMBER (6,2)
* rent_out	DATE
rent_in	DATE
F * drone_id	NUMBER (5)
F * ct_id	NUMBER (7)

CUSTOMER	
P * cust_id	NUMBER (4)
* cust_fname	VARCHAR2 (25)
* cust_lname	VARCHAR2 (25)
* cust_phone	CHAR (12)

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## Purple relation (FK constraints omitted)

```
CREATE TABLE drone (  
    drone_id          NUMBER(5) NOT NULL,  
    drone_pur_date    DATE NOT NULL,  
    drone_pur_price    NUMBER(7, 2) NOT NULL,  
    drone_flight_time  NUMBER(6, 1) NOT NULL,  
    drone_cost_hr      NUMBER(6, 2) NOT NULL,  
    dt_code           CHAR(4) NOT NULL  
);
```

```
CREATE TABLE training_course (  
    train_code        CHAR(5) NOT NULL,  
    traincourse_date  DATE NOT NULL,  
    trainer_id        NUMBER(3) NOT NULL  
);
```

-- PKs

```
ALTER TABLE drone ADD CONSTRAINT drone_pk PRIMARY KEY ( drone_id );
```

```
ALTER TABLE training_course ADD CONSTRAINT training_course_pk PRIMARY KEY ( train_code,  
                                                                              traincourse_date );
```

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```
CREATE TABLE customer (  
    cust_id      NUMBER(4) NOT NULL,  
    cust_fname   VARCHAR2(25) NOT NULL,  
    cust_lname   VARCHAR2(25) NOT NULL,  
    cust_phone   CHAR(12) NOT NULL  
);
```

```
CREATE TABLE rental (  
    rental_no    NUMBER(8) NOT NULL,  
    rent_bond    NUMBER(6, 2) NOT NULL,  
    rent_out     DATE NOT NULL,  
    rent_in      DATE,  
    drone_id     NUMBER(5) NOT NULL,  
    ct_id        NUMBER(7) NOT NULL  
);
```

```
CREATE TABLE cust_train (  
    ct_id        NUMBER(7) NOT NULL,  
    cust_id      NUMBER(4) NOT NULL,  
    train_code   CHAR(5) NOT NULL,  
    traincourse_date DATE NOT NULL,  
    ct_exam_date DATE,  
    ct_date_expire DATE  
);
```

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```
-- PKs
ALTER TABLE rental ADD CONSTRAINT rental_pk PRIMARY KEY ( rental_no );

ALTER TABLE customer ADD CONSTRAINT customer_pk PRIMARY KEY ( cust_id );

ALTER TABLE cust_train ADD CONSTRAINT cust_train_pk PRIMARY KEY ( ct_id );

-- FKs
ALTER TABLE cust_train
  ADD CONSTRAINT customer_custtrain FOREIGN KEY ( cust_id )
    REFERENCES customer ( cust_id );

ALTER TABLE cust_train
  ADD CONSTRAINT traincourse_custtrain FOREIGN KEY ( train_code,
                                                    traincourse_date )
    REFERENCES training_course ( train_code,
                                  traincourse_date );

ALTER TABLE rental
  ADD CONSTRAINT drone_rental FOREIGN KEY ( drone_id )
    REFERENCES drone ( drone_id );

ALTER TABLE rental
  ADD CONSTRAINT custtrain_rental FOREIGN KEY ( ct_id )
    REFERENCES cust_train ( ct_id );
```

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-- Other Constraints

```
ALTER TABLE cust_train  
    ADD CONSTRAINT cust_train_uq UNIQUE ( cust_id,  
                                          train_code,  
                                          traincourse_date );
```

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