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1814ict/2814ict/7003ict/1011ICT: Data Management/ Database Design/ Applied Computing

Revision

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Entity Relationship Diagram (ERD)

ERD

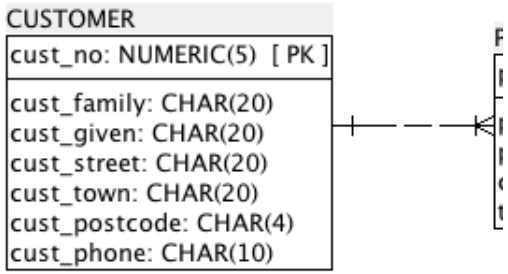
Expressed as a

DBMS Schema:

```
CREATE TABLE CUSTOMER (
    cust_no        INT(5) NOT NULL,
    cust_family    CHAR(20) NOT NULL,
    cust_given     CHAR(20) NOT NULL,
    cust_street    CHAR(20) NOT NULL,
    cust_town      CHAR(20) NOT NULL,
    cust_postcode  CHAR(4) NOT NULL,
    cust_phone     CHAR(10),
CONSTRAINT pk_CUSTOMER PRIMARY KEY
(cust_no)); …etc
```

Or,

Visually using ERD like structures:

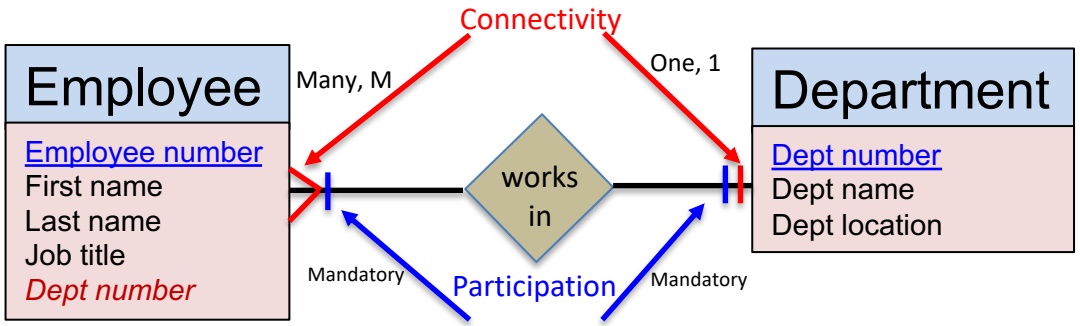


Summary of Keys

- **Super key**
  - Any key that uniquely identifies each row in an entity
- **Candidate key**
  - Minimal super key
- **Primary key**
  - Candidate key (chosen) to uniquely identify all other attributes in a given row
- **Secondary key**
  - Used only for data retrieval, cannot uniquely identity each row of the table
- **Composite key**
  - Key composed of more than one attribute
- **Key attribute**
  - Any attribute that is part of a key
- **Foreign key**
  - Values must match a primary key in a referenced (parent) table or be null

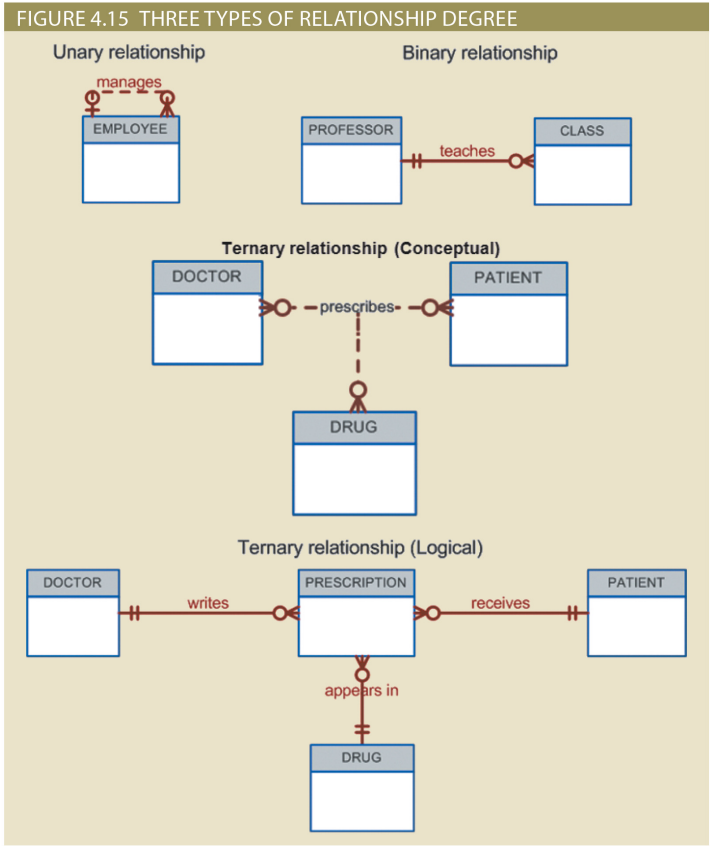
Relationship

- Connectivity specifies
  - The type of relationship between 2 entities: 1:1; 1:M; M:N
  - The maximum number of times an instance of an entity can be related to instances of the other entity in a relationship between 2 entities.
- Participation specifies the minimum number of times an instance of an entity can be related to instances of the other entity in a relationship between 2 entities: optional and mandatory.



Relationship Degree

- Indicates number of associated entities or participants
- **Unary relationship**
  - Association is maintained within a single entity
- **Binary relationship**
  - Two entities are associated
- **Ternary relationship**
  - Three entities are associated

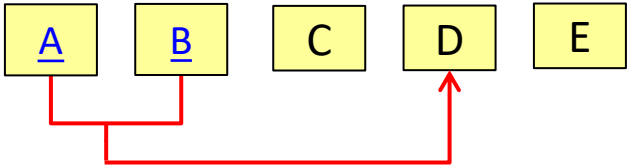


Dependency Summary

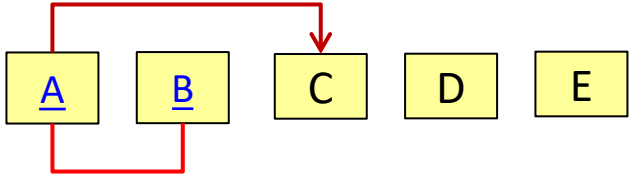
- **Functional**

- **Total**

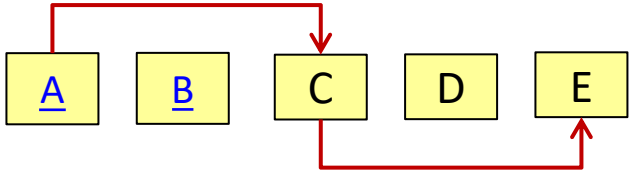
- **Full**



- **Partial**



- **Transitive**



Normalisation: From UNF to 3NF

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Conditions of 1NF:

- It is a valid relation (in particular, no null entries)
- A unique key (primary key) has been identified for each row
- All attributes are functionally dependent on all or part of the key

Conditions of 2NF:

- Relation is in 1NF and
- No partial dependency exists
  - So, if the primary key is a composite key, partial dependency may exist and we need to remove partial dependency to convert to 2NF
  - If the primary key is NOT a composite key, the table is already in 2NF!

Conditions of 3NF:

- Relation is in 2NF and
- No transitive dependency exists
  - So, if NO transitive dependency exists in a table, the table is already in 3NF!

Writing SQL Statement

Create a new database

- Syntax:

  CREATE DATABASE [IF NOT EXISTS] *db_name;*

- Example:

  CREATE DATABASE DB_Week7;

  or

  CREATE DATABASE **IF NOT EXISTS** DB_Week7;

- USE DB_Week7;

- SHOW TABLES;

- The IF NOT EXISTS option is useful if you are using a script to create a database. This determines if it already exists, if it does not the database is created.

- If you are doing this on the command line you should then use the USE command to indicate that you will be working with the new database.

- What does SHOW TABLES result?

Inserting Data into Tables

- The INSERT command is used to insert data into tables
- Can be:
  - One row at a time
  - Multiple rows
  - Using data from other tables

- **Insert – Syntax 1** (in all columns - no column listing required)

```
INSERT INTO tbl_name VALUES (val1,val2,...)
```

Staff table:

StaffID	StaffName	DateOfBirth	Salary
1	Buffy Summers	1987-09-15	27000.00

- Example:

```
INSERT INTO staff VALUES (NULL, 'Buffy Summers', '1987-09-15', 27000);
```

  - '**NULL**' here is a dummy place holder for the AUTONUMBER

UPDATE

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- **Example 1:** Update Staff Name details

```
UPDATE Staff
SET StaffName = 'Buffy Winters'
WHERE StaffId = 1
```

  - It updates the name for the staff with the id of 1!

Staff table:

StaffID	StaffName	DateOfBirth	Salary
1	Buffy Winters	1987-09-15	27000.00
2	Buffy Summers	1987-09-15	27000.00
3	Teddy Bear	1983-12-03	87125.02
4	John Smith	1972-09-20	25000.00
5	Jane Doe	1969-01-25	55000.00
6	Jacek Jones	1984-10-19	35000.00
7	Teddy Bear	1983-12-03	87125.02
8	Fred Smith	1956-06-30	25125.02

- **Example 2:** Update Staff Salaries up by 10%

```
UPDATE Staff
SET Salary = 1.1 * Salary;
```

  - It updates all staff salary by 10% increase!

Staff table:

StaffID	StaffName	DateOfBirth	Salary
1	Buffy Winters	1987-09-15	29700.00
2	Buffy Summers	1987-09-15	29700.00
3	Teddy Bear	1983-12-03	95837.52
4	John Smith	1972-09-20	27500.00
5	Jane Doe	1969-01-25	60500.00
6	Jacek Jones	1984-10-19	38500.00
7	Teddy Bear	1983-12-03	95837.52
8	Fred Smith	1956-06-30	27637.52

DELETE

- **Example 1:**

```
DELETE
FROM Staff
WHERE StaffID = 1;
```

  - It deletes all the records with the staff id of 1

Staff table:

StaffID	StaffName	DateOfBirth	Salary
2	Buffy Summers	1987-09-15	29700.00
3	Teddy Bear	1983-12-03	95837.52
4	John Smith	1972-09-20	27500.00
5	Jane Doe	1969-01-25	60500.00
6	Jacek Jones	1984-10-19	38500.00
7	Teddy Bear	1983-12-03	95837.52
8	Fred Smith	1956-06-30	27637.52

Staff with ID 1 no longer exists!

- **Example 2:**

```
DELETE
FROM Staff2
WHERE Salary > 80000;
```

  - It deletes all the records with the staff salary of more than 80000

Staff2 table:

StaffId	StaffName	DateOfBirth	Salary
1	Buffy Summers	1987-09-15	27000.00
2	Buffy Summers	1987-09-15	27000.00
4	John Smith	1972-09-20	25000.00
5	Jane Doe	1969-01-25	55000.00
6	Jacek Jones	1984-10-19	35000.00
8	Fred Smith	1956-06-30	25125.02

Staff with IDs 3 & 7 no longer exists!

ALTER: ADD | MODIFY | DROP column(s)

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- **ADD**

  ALTER TABLE Staff
  ADD Address VARCHAR(30);

  - It adds a new column to the table staff

- **MODIFY**

  ALTER TABLE Staff3
  MODIFY Salary INT(11);

  - It changes the data type of the column Phone

- **DROP**

  ALTER TABLE Staff
  DROP COLUMN Address;

  - It deletes the column ‘address’ from the table staff

Staff table:

StaffID	StaffName	DateOfBirth	Salary	Address
2	Buffy Summers	1987-09-15	29700.00	NULL
3	Teddy Bear	1983-12-03	95837.52	NULL
4	John Smith	1972-09-20	27500.00	NULL
5	Jane Doe	1969-01-25	60500.00	NULL
6	Jacek Jones	1984-10-19	38500.00	NULL
7	Teddy Bear	1983-12-03	95837.52	NULL
8	Fred Smith	1956-06-30	27637.52	NULL

+ Options

Staff3 table:

StaffID	StaffName	DateOfBirth	Salary
1	Buffy Summers	1987-09-15	27000
2	Buffy Summers	1987-09-15	27000
3	Teddy Bear	1983-12-03	87125
4	John Smith	1972-09-20	25000
5	Jane Doe	1969-01-25	55000
6	Jacek Jones	1984-10-19	35000
7	Teddy Bear	1983-12-03	87125
8	Fred Smith	1956-06-30	25125

Staff table:

StaffID	StaffName	DateOfBirth	Salary
2	Buffy Summers	1987-09-15	29700.00
3	Teddy Bear	1983-12-03	95837.52
4	John Smith	1972-09-20	27500.00
5	Jane Doe	1969-01-25	60500.00
6	Jacek Jones	1984-10-19	38500.00
7	Teddy Bear	1983-12-03	95837.52
8	Fred Smith	1956-06-30	27637.52

Address column does not exists anymore!

Update, delete data and drop table

- **Additional DML:**
  - UPDATE
  - DELETE

```
UPDATE Staff
SET Salary = 1.1 * Salary;
```

```
DELETE
FROM Staff2
WHERE Salary > 80000;
```

- **Additional DDL:**
  - DROP table
  - ALTER table
    - ADD column
    - MODIFY column
    - DROP column

```
DROP TABLE Staff2;
```

```
ALTER TABLE Staff
ADD  Address VARCHAR(30);
```

```
ALTER TABLE Staff3
MODIFY Salary INT(11);
```

```
ALTER TABLE Staff
DROP COLUMN Address;
```

- **Constraints**
  - Entity integrity
  - Referential integrity
  - NOT NULL
  - UNIQUE
  - DEFAULT
  - CHECK

```
CREATE TABLE IF NOT EXISTS DEPARTMENT(
        DepartmentID        INT PRIMARY KEY
AUTO_INCREMENT,
        DepartmentName      VARCHAR(30),
        Budget              DOUBLE,
        ManagerID           INT NOT NULL,
        FOREIGN KEY (ManagerID) REFERENCES
Staff(StaffID)
) ENGINE=InnoDB;
```

```
CREATE TABLE CUSTOMER (
CUS_CODE        NUMBER          PRIMARY KEY,
CUS_LNAME       VARCHAR(15)     NOT NULL,
CUS_FNAME       VARCHAR(15)     NOT NULL,
CUS_INITIAL     CHAR(1),
CUS_AREACODE    CHAR(3)         DEFAULT '615'    NOT NULL
                                CHECK(CUS_AREACODE IN
                                ('615','713','931')),
CUS_PHONE       CHAR(8)         NOT NULL,
CUS_BALANCE     NUMBER(9,2)     DEFAULT 0.00,
CONSTRAINT CUS_UI1 UNIQUE (CUS_LNAME, CUS_FNAME));
```

Select Statement

- **General Syntax**

```
SELECT [ALL | DISTINCT | DISTINCTROW ] select_expr [, select_expr ...]
FROM table_references
[WHERE where_condition]
[GROUP BY {col_name | expr | position} ]
[HAVING where_condition]
[ORDER BY {col_name | expr | position} [ASC | DESC], ...]
[LIMIT {[offset,] row_count | row_count OFFSET offset}]
```

CONCAT, CAST functions

- **CONCAT**
  - Merge columns in your table output: Show staff and their date of birth into one column.

```
SELECT CONCAT(StaffName, ' was born on ', DateOfBirth)
AS 'Staff date of birth'
  FROM Staff;
```

Staff date of birth
Buffy Winters was born on 1987-09-15
Teddy Bear was born on 1983-12-03
John Smith was born on 1972-09-20
Jane Doe was born on 1969-01-25
Jacek Jones was born on 1984-10-19
Mohammad Awrangjeb was born on 1977-11-21
Rupam Deb was born on 1980-10-21
Md Polash was born on 1981-11-25
Teddy Bear was born on 1983-12-03
Fred Smith was born on 1956-06-30

- **CAST**
  - Convert the data type: Change budget from DOUBLE to DECIMAL(9,2). Also, rename the budget column as ‘Annual Budget’ and show the output in descending order of the ‘Annual Budget’.

```
SELECT DepartmentName, CAST(Budget AS DECIMAL(9,2)) AS
'Annual Budget'
FROM DEPARTMENT
ORDER BY 'Annual Budget' DESC;
```

DepartmentName	Annual Budget
Sales	5005000.00
Marketing	509000.00
Finance	650000.00
Accounting	360000.00
Human Resource	550000.00

GROUP BY

- **How does it work?**
  - Make groups based on the column value: StaffID in this case
  - If the rows are not ordered, no problem: MySQL still group them
  - Apply, any conditions that come in **HAVING clause**!
  - Then, apply any aggregate function!

  - For example, for this SELECT statement:

```
SELECT StaffID, COUNT(DepartmentID) AS '# of department',
        SUM(PercentageTime) AS 'Total time fraction'
FROM workallocation
GROUP BY StaffID;
```

    - First, make groups based on staffID
    - No, HAVING clause, so nothing happen
    - Finally, apply COUNT() and SUM() functions!
    - So, the output looks like:

StaffID	# of department	Total time fraction
1	2	1
2	1	1
3	3	1
4	2	1
5	2	1
6	3	1
7	1	1
8	2	1
9	2	1
10	4	0.9

WorkAllocation table

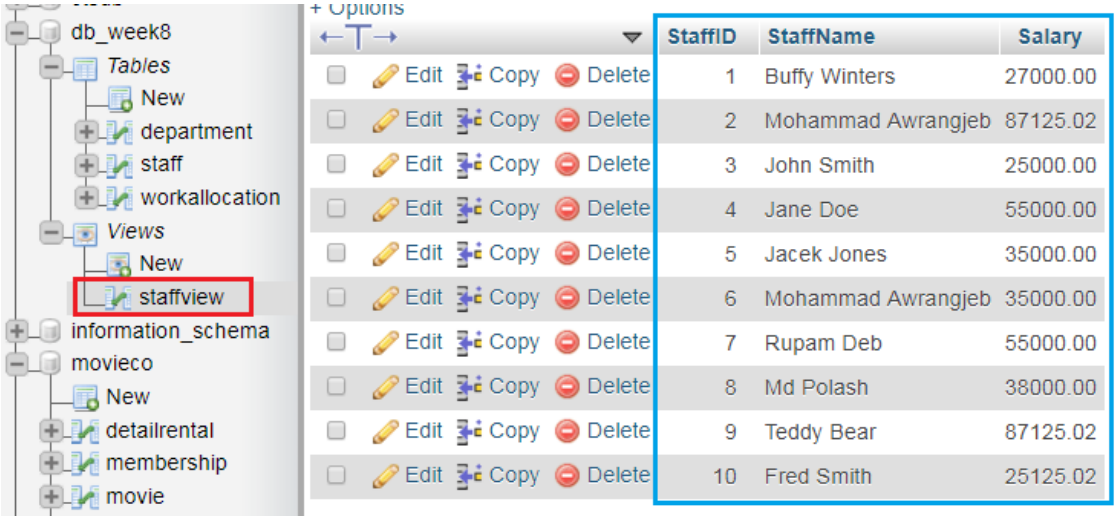
StaffID	DepartmentID	PercentageTime
1	2	0.7
1	5	0.3
2	1	1
3	2	0.3
3	3	0.2
3	4	0.5
4	4	0.3
4	5	0.7
5	3	0.7
5	4	0.3
6	3	0.4
6	4	0.3
6	5	0.3
7	5	1
8	2	0.4
8	3	0.6
9	4	0.5
9	5	0.5
10	1	0.4
10	3	0.2
10	4	0.2
10	5	0.1

View

Example:

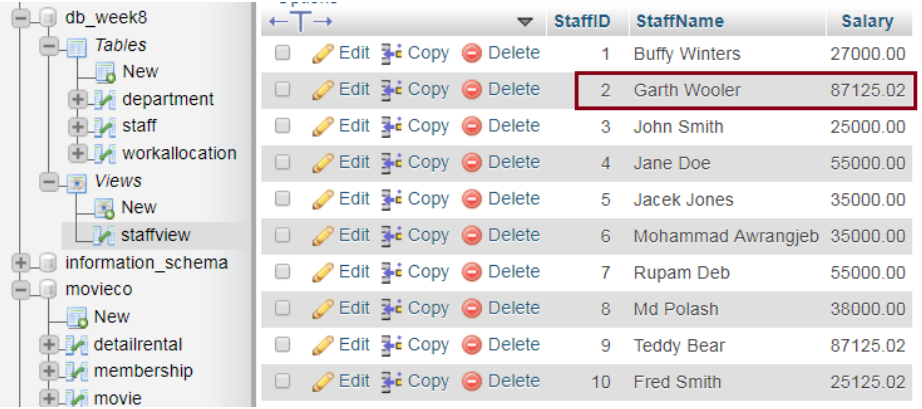
- For example, we create a view on staff table with staff name and salary

```
CREATE VIEW StaffView AS
SELECT StaffID, StaffName, Salary
FROM staff;
```



- Now change staff name with Staff

```
UPDATE staff
SET StaffName = 'Garth Wooler'
WHERE staffID = 2;
```



Subquery

- A subquery is a query that is embedded (or nested) inside another query
- Also known as a nested query or an inner query

- Syntax:

```
SELECT select_list
FROM   table
WHERE expr operator    (SELECT select_list
                       FROM   table);
```

Subquery with WHERE clause!

- The first query in the SQL statement is known as the outer query
- The query inside the SQL statement is known as the inner query
- The inner query is evaluated first and the output from this query is used as the input for the outer query
- The inner query is normally expressed inside parentheses

Final Exam Information

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There are six questions in the final exam, question sets will be given to the students randomly:

- **Two** questions on designing ERD (one basic and one advance)
- **Two** questions on writing SQL statement (one basic and one advance)
- **One** question on Advance Topics
- **One** question on Normalization

You can find the Practice Final Exam on the course homepage

Thank you.