

Entity Relationship Diagrams

Grade 11
2018

Learning objectives

- Define the connections between tables in database
- Create an entity-relationship (ER) model

Assessment criteria

- Determines relationships between tables in a database
- Creates "entity-relationship" diagram

Vocabulary

| | |
|----------------------|-----------------------|
| | |
| Vehicle (['vi:ɪkl]) | Транспортное средство |
| Degree | Степень |
| Accommodates | вместать |
| Appears on | появляется |
| borrowers | заемщики |

Introduction

Relationships between entities can be represented using **Entity-Relationship diagrams**

Any system can be represented as a collection of one or more 'objects', 'things' or '**entities**'.

For example a school is made up of one or more buildings each of which contain classrooms, each classroom has a number of desks, chairs and so on. The School system can be represented as a collection of entities, each of which have a relationship with one another.

Key terms

Entity: an object, person, event or thing of interest to an organisation and about which data is recorded.

Relationship: an association or link between two entities.

Degree of relationship: between two entities refers to the number of entity occurrences of one entity which are associated with just one entity occurrence of the other, and vice versa.

Key terms

Entity occurrence: the details of one instance of the entity.

Key point

ORDER is a reserved word in SQL. Do not use it as an entity name. Choose some other name when you build the database.

When we get many-to-many relationships, we need to analyse the scenario further. One order is typically made up of several single-item orders. So, in fact, we have another entity, ItemOrder. The diagram now looks like Fig. 5.1.6

Databases will probably store data about a variety of things. For example, if we look at the tables required for an online store:

Staff
Products
Receipts
Customers

When we start to describe each of them we notice that they are related to each other.

For example:

The Receipt table records which product a customer has bought, and which date it was purchased on.

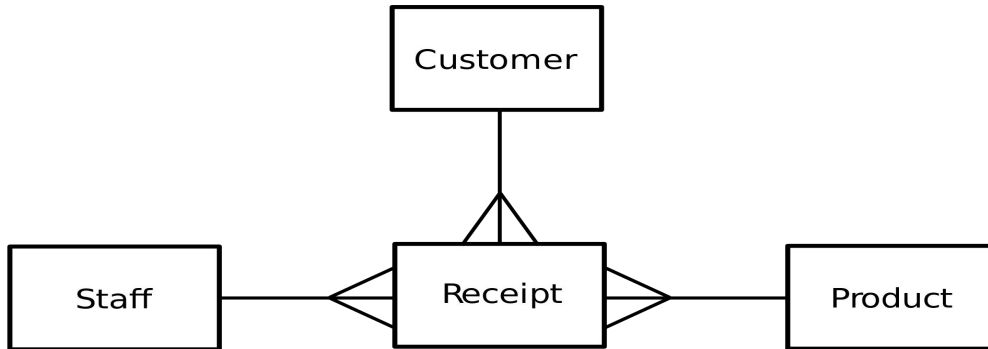
This describes the Receipt record, and looking at its structure we see that the primary keys from other tables are included in it.

```
Receipt(CustomerID, ProductID, DateTime, Total, StaffID)
```

In other words we could say:

```
A receipt has one customer  
A customer can have many receipts  
A receipt has one product  
A product can be part of many receipts  
A receipt was created by one staff member  
A staff member can create many receipts
```

We can then draw this diagram like so



There are four possible **degrees** of relationship.

One-to-one (1:1)



One-to-many (1:n)



Many-to-one (n:1)

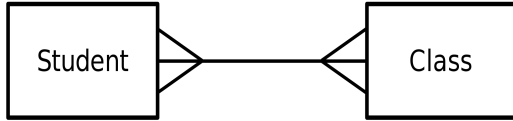


Many-to-many (m:n)



QQQ

Describe the following relationships



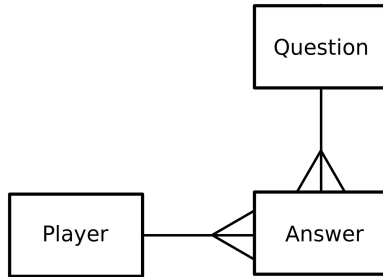
Answer:

A student has many classes
A class has many students



Answer:

A league has many teams
A team is only in one league



Answer:

- A player answers many questions
- A question can be answered many times
- Each answer is only applicable to one question
- A player can give many answers
- Each answer has only one player contributing

QQQ

- The relationship between a father and a child

Father--<Child

- The relationship between an owner and a cat

Cat >---< Owner (even though an Owner may own more than one cat, a cat might have more than one owner)

- The relationship between a car and a driver

Car --- driver (a car can only be driven by one driver, a driver can only drive one car at one time)

- The relationship between a unicycle and a wheel

wheel --- unicycle

- The relationship between a house and a postcode

House >--- Postcode (a house is assign one postcode, but that same postcode might be assigned to many houses)

Example-1

A company provides some of its **employees with a company car**.

- The company keeps a record of the **employee's name** and **unique employee Number**.
- The company records the **registration number** of the car and the **model** and **maker**.

What are the entities about which data is stored?

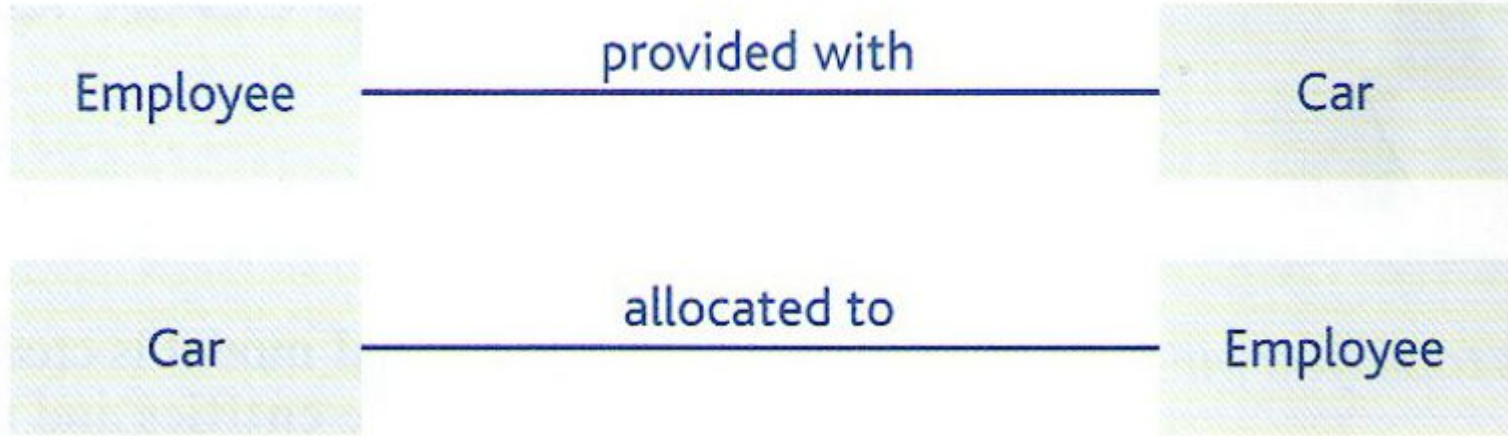
Employee, Car.

What is the relationship between Employee and Car?

A car is allocated to a single employee.

An employee is provided with a single car.

Answer



Example-2

Consider the simple example **of patients** assigned to **hospital wards**. Each patient is assigned a **unique patient ID**. The following details are recorded about each patient:

- patient name**

- date of birth**

Each ward has a **unique name**. The **number of beds** is recorded for each ward.

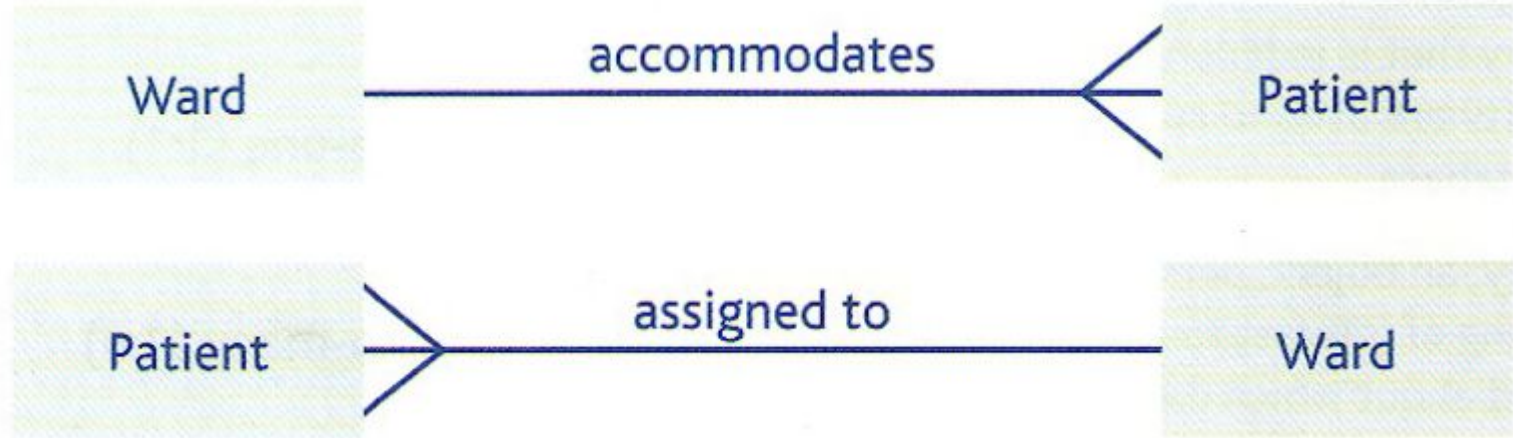
What are the entities about which data are stored?

Ward, Patient.

What is the relationship between a Ward and Patient?

Each patient is allocated to a single ward.

Answer



Exercise

Let's look at the scenario of an organisation that wants to set up online ordering facilities. Here are the data requirements for the underlying database:

Each product item is assigned a **unique item code** and has an item description.

The **quantity** in stock of **each item** is recorded.

The **unit price** of each stock item is stored.

Each order is assigned a **unique order number**.

For each order, the **customer name, delivery address** and **e-mail address** are recorded.

For each order, the **order date** is recorded.

An order may consist of **one or more different items**.

The quantity of an item ordered may be **more than one**.

Customers details will **not be stored for future orders**.

Two example orders are shown and part of the online catalogue.

Table 2. Part of online catalogue

| Catalogue | | | |
|-------------|-------------------|------------|-----------|
| Description | Quantity in stock | Unit price | Item code |
| Ring binder | 342 | 1.50 | 1234 |
| Hole punch | 275 | 2.79 | 2189 |
| Stapler | 59 | 2.99 | 3456 |
| . | . | . | . |
| . | . | . | . |
| . | . | . | . |
| Divider | 187 | 0.50 | 8967 |
| Scissors | 47 | 1.99 | 9684 |

Table 1. Example of an order

| | | | |
|--|---------------------|-----------------------|-------------------|
| Order number | 012367 | | |
| Deliver to | Confirmation e-mail | | |
| Fred Bloggs 1, High Street Anytown | FredBloggs@NT.co.uk | | |
| Order date | 01/05/2009 | | |
| Order summary | | | |
| Item code | Description | Order quantity | Unit price |
| 1234 | Ring binder | 3 | 1.50 |
| 3456 | Stapler | 1 | 2.99 |
| 8967 | Divider | 4 | 0.50 |

Table 3. Example of an order

| | | | |
|-------------------------------------|---------------------|-----------------------|-------------------|
| Order number | 034231 | | |
| Deliver to | Confirmation e-mail | | |
| Joe Smith 7, The Lane Anytown | JoeSmith@NT.co.uk | | |
| Order date | 03/05/2009 | | |
| Order summary | | | |
| Item code | Description | Order quantity | Unit price |
| 3456 | Stapler | 4 | 2.99 |
| 9684 | Scissors | 2 | 1.99 |

Cont.

What are the entities about which data are stored? **Item, Order.**

What is the relationship between **Item** and **Order**? An order consists of one or more items. An item may appear in one, none or several orders.

When the **degree** of a relationship is **not obvious**, look at some of the I Key terms entity occurrences in one list and link them with the members of the Entity occurrence: the details of one other list as in Tables 1 to 3. This shows that the relationship between instance of the entity.

Item and Order is many-to-many

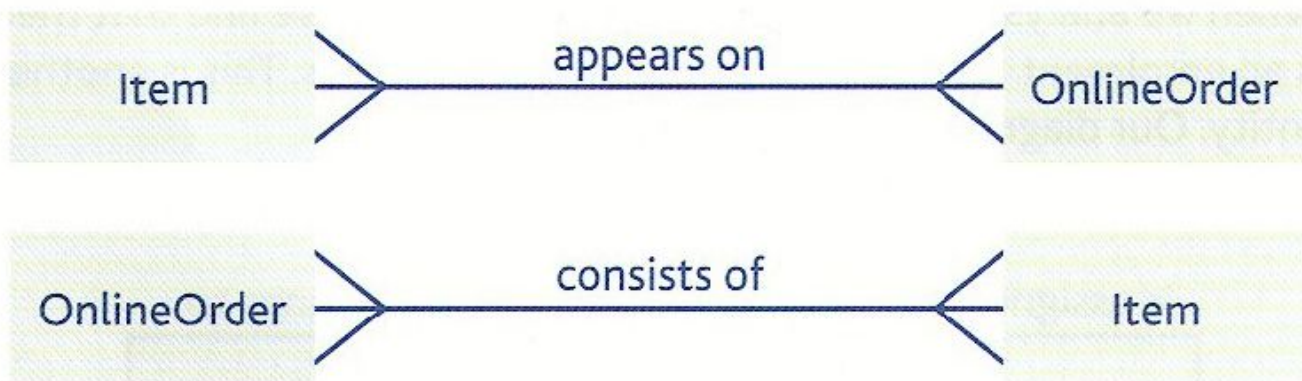
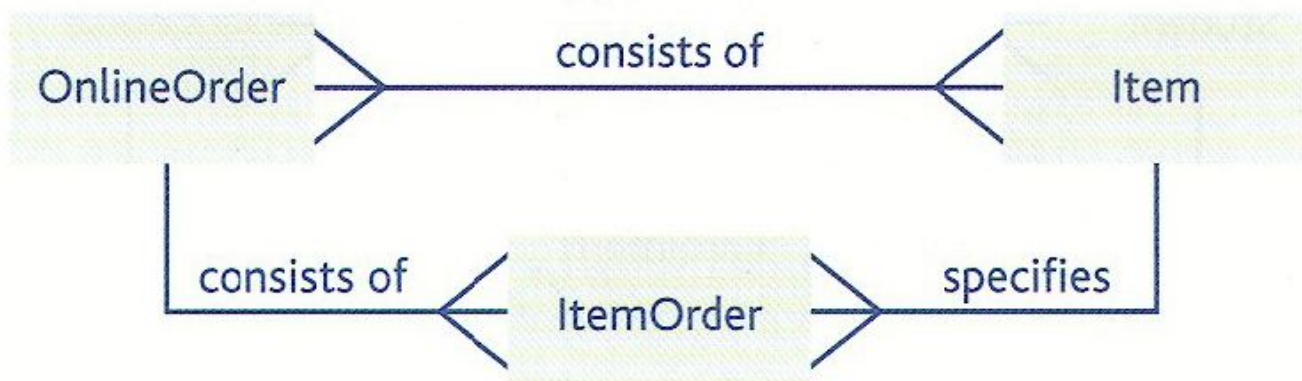


Fig. 5.1.5 *Entity-relationship diagram for many-to-many relationships*



Exercise (Group work)

Let's look at the scenario of a college that enroll students for **AS** and **A2** courses. Here are the data requirements:

- *Each course is assigned a **unique course code** and has a **course name**.*
- *Each student is assigned a **unique student ID** and has their **name, address and date of birth** recorded.*
- *Each student enrolls on **one or more courses**.*
- *The students enrolled on a course will be assigned to one of several sets taught by different teachers.*
- *Teachers Are assigned **unique initials**.*

The data constraint for this database is that teacher details will not be stored.

What are the entities about which data are stored?

Course, Student, Set.

What is the relationship between Course and Student?

A student may enrol on one or more courses.

A course may be taken by one or more students.

What is the relationship between Course and Set? A course may consist of one or more sets. A set belongs to just one course.

What is the relationship between Student and Set? Students are assigned to one or more sets and each set will consist of one or more students

Answer

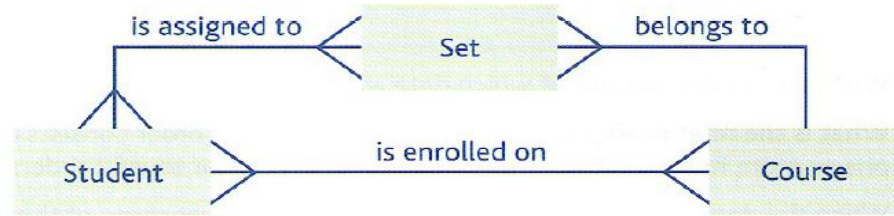


Fig. 5.1.7 Students are assigned to one or more sets and each set will consist of one or more students

When we analyse the many-to-many relationship, we find that there is an enrolment for each course the student chooses. This is another entity. Our diagram now looks like Fig. 5.1.8.

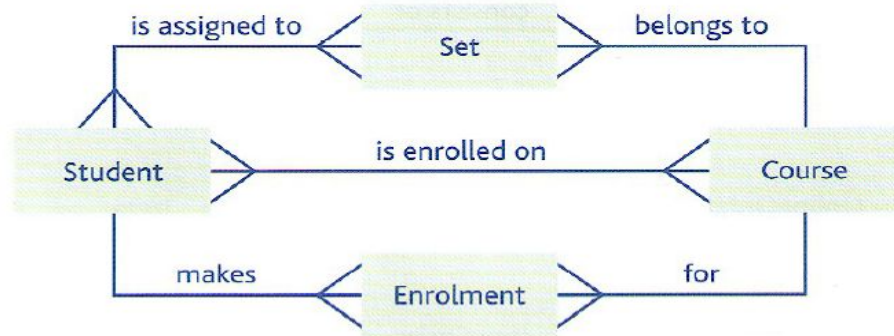


Fig. 5.1.8 There is an enrolment for each course the student chooses

Questions

1. A blind person may be given a guide dog. A guide dog will look after just one blind person and a blind person will only have one guide dog.

Draw an entity-relationship diagram to represent this relationship.

2. Every car registered in the UK has a unique registration number and one registered keeper. The Driver and Vehicle Licensing Agency (DVLA) records the keeper's name and address. One person may keep several vehicles. Draw an entity-relationship diagram to represent this Relationship.

3. A lending library lends out books to borrowers. Each borrower may borrow several books. There may be more than one copy of popular books. The library records names and addresses of borrowers and each borrower has a unique borrower ID. Each book title is identified by its ISBN. Each book copy is identified by a unique accession number. Draw an entity-relationship diagram to represent this system.

- (c) The database design has three tables to store the qualifications and grades each student has attained. The following is a sample of the data from each table.

STUDENT

| StudentID | FirstName | LastName | Tutor |
|-----------|-----------|----------|-------|
| 001AT | Ahmad | Tan | 11A |
| 003JL | Jane | Li | 11B |
| 011HJ | Heather | Jones | 10A |

QUALIFICATION

| QualCode | Level | Subject |
|----------|-------|------------------|
| CS1 | IGCSE | Computer Science |
| MT9 | IGCSE | Maths |
| SC12 | IGCSE | Science |

STUDENT-QUALIFICATION

| QualCode | StudentID | Grade | DateOfAward |
|----------|-----------|-------|-------------|
| SC12 | 011HJ | A | 31/8/2014 |
| SC12 | 003JL | C | 31/8/2014 |
| CS1 | 003JL | B | 31/8/2014 |

- (i) Draw an Entity-Relationship (E-R) diagram to show the relationships between these three tables. [2]

- (ii) State the type of relationship that exists between **STUDENT** and **STUDENT-QUALIFICATION**. [1]

.....[1]

10

- (iii) Describe how the relationship between **QUALIFICATION** and **STUDENT-QUALIFICATION** is implemented. [2]

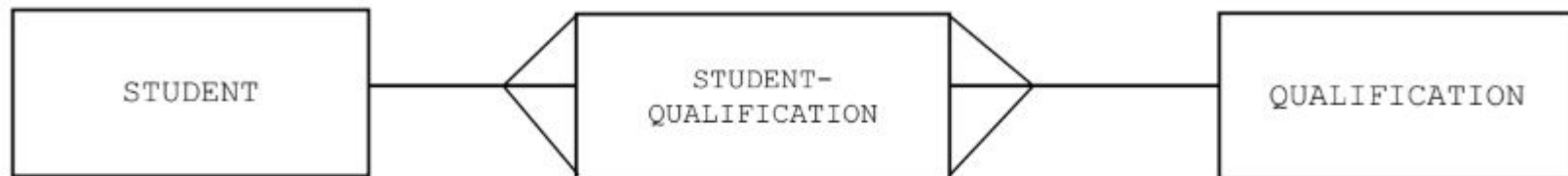
.....

[2]

Answer

(c) (i) **One mark** for each correct relationship.

[2]



(ii) **One-to-many**

[1]

(iii) **Two points** from:

[2]

- The primary key in the QUALIFICATION table is QualCode.
- The foreign key in the STUDENT-QUALIFICATION table is QualCode.
- The primary key of QUALIFICATION is also included in QualCode.

The database design is as follows:

SHOP(ShopID, ShopName, Location, RetailSpecialism)

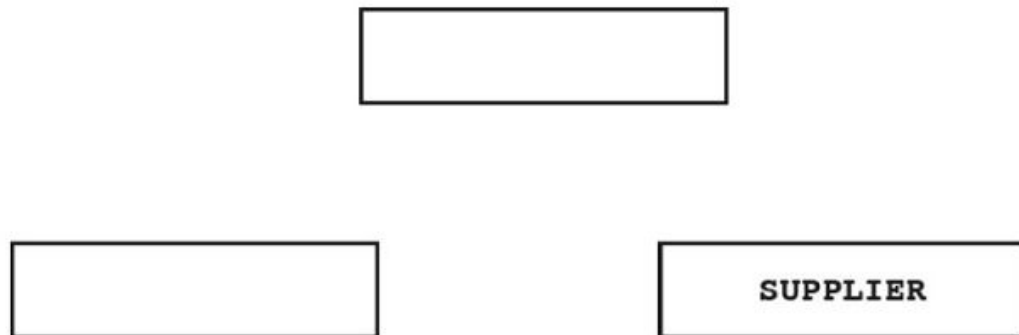
SUPPLIER(SupplierID, SupplierName, ContactPerson, RetailSpecialism)

SHOP-SUPPLIER(ShopID, SupplierID)

The SHOP-SUPPLIER table stores the suppliers that each shop has previously used.

Primary keys are not shown.

(b) (i) Label the entities and draw the relationships to complete the revised E-R diagram.



Many-to-many relationship



- | | |
|---|---|
| Both entities correctly labelled | 1 |
| Correct relationship between SHOP and SHOP-SUPPLIER | 1 |
| Correct relationship between SUPPLIER and SHOP-SUPPLIER | 1 |

- 2 A company writes applications (apps) for smartphones. The company has a relational database, PURPLEGAME, which stores the information for one of its online game apps.

The database has three tables to store player's details, dates when they have logged into the app and in-app purchase details.

LOGIN(LoginID, PlayerID, Date)

PURCHASE(PurchaseID, PlayerID, PurchaseDate, Cost)

PLAYER(PlayerID, PlayerName, SkillLevel)

- (a) Draw the entity-relationship (E-R) diagram to show the relationships between the three tables.

Answer

1 mark for each correct relationship



- (b) The database design has three tables to store the classes that students attend.

STUDENT(StudentID, FirstName, LastName, Year, TutorGroup)

CLASS(ClassID, Subject)

CLASS-GROUP(StudentID, ClassID)

Primary keys are not shown.

There is a one-to-many relationship between **CLASS** and **CLASS-GROUP**.

- (i) Describe how this relationship is implemented.

.....

[2]

- (ii) Describe the relationship between **CLASS-GROUP** and **STUDENT**.

.....[1]

Formative assessment 1

ERD Notations

Notation of Peter Chen

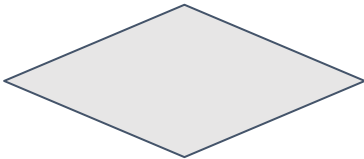
An entity is represented by a rectangular box and named using a noun



Entity (**noun**)

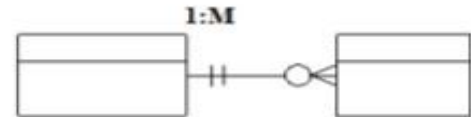
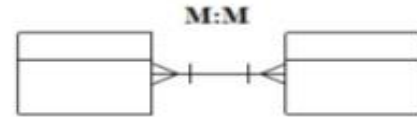
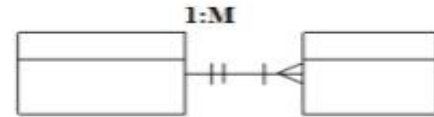
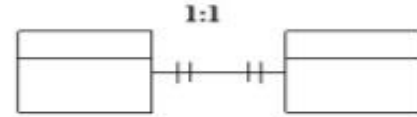


Attributes (**adjective**)



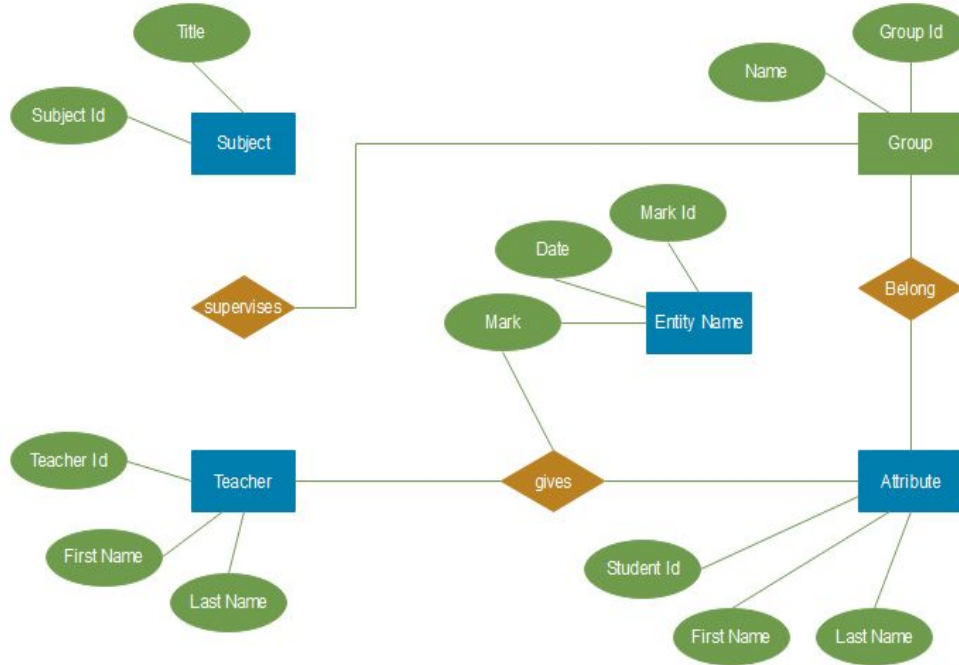
Relations(**verb**)

Notation of Martin (Crow's Foot)

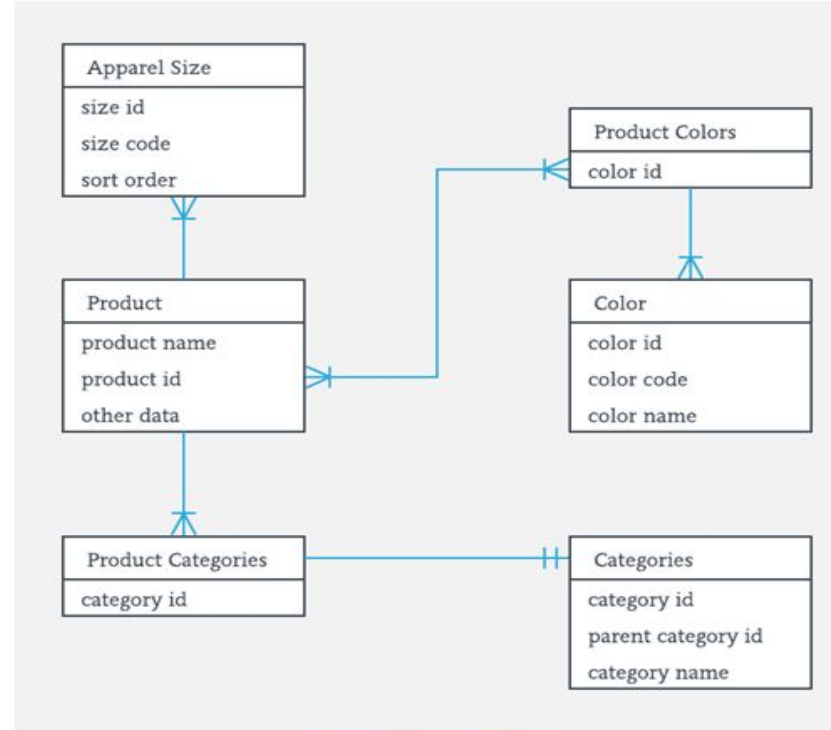


Notation

Notation of Peter Chen



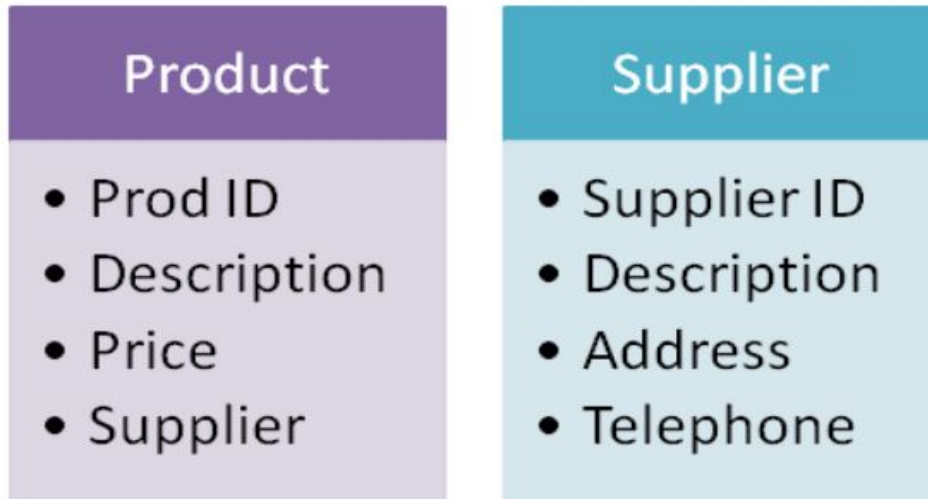
Notation of Martin (Crow's Foot)



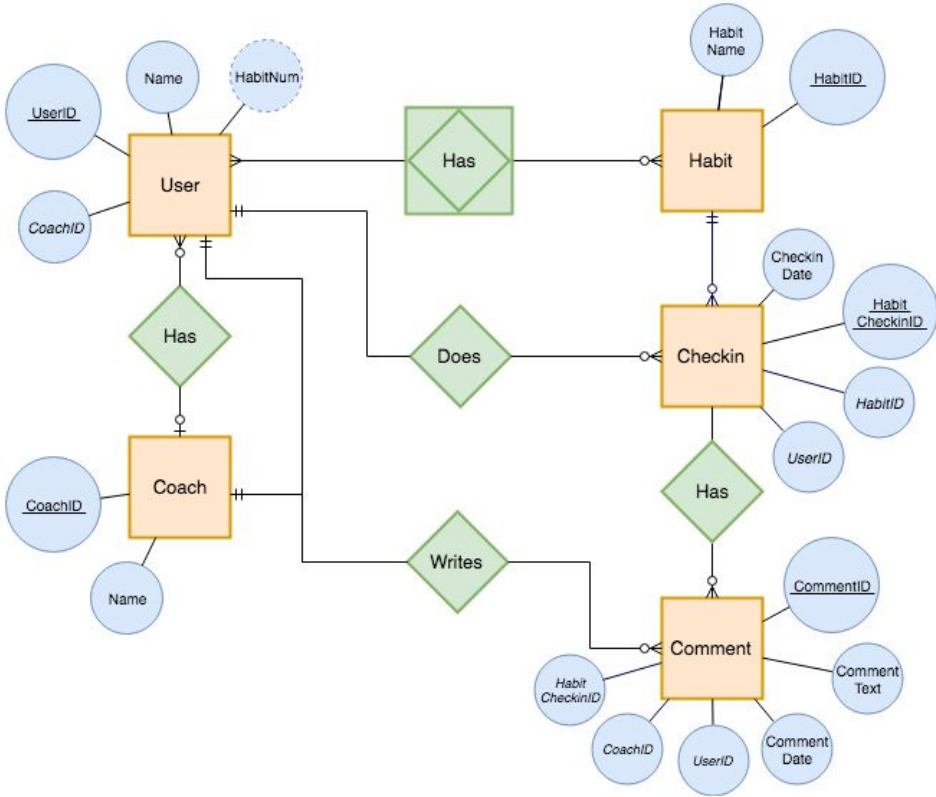
Attributes

A single word such as '**school**' only provides the very minimum of detail about the object - in your mind you be thinking about its size, buildings, name and so on. These are called its 'attributes'. An attribute describes one aspect of the entity.

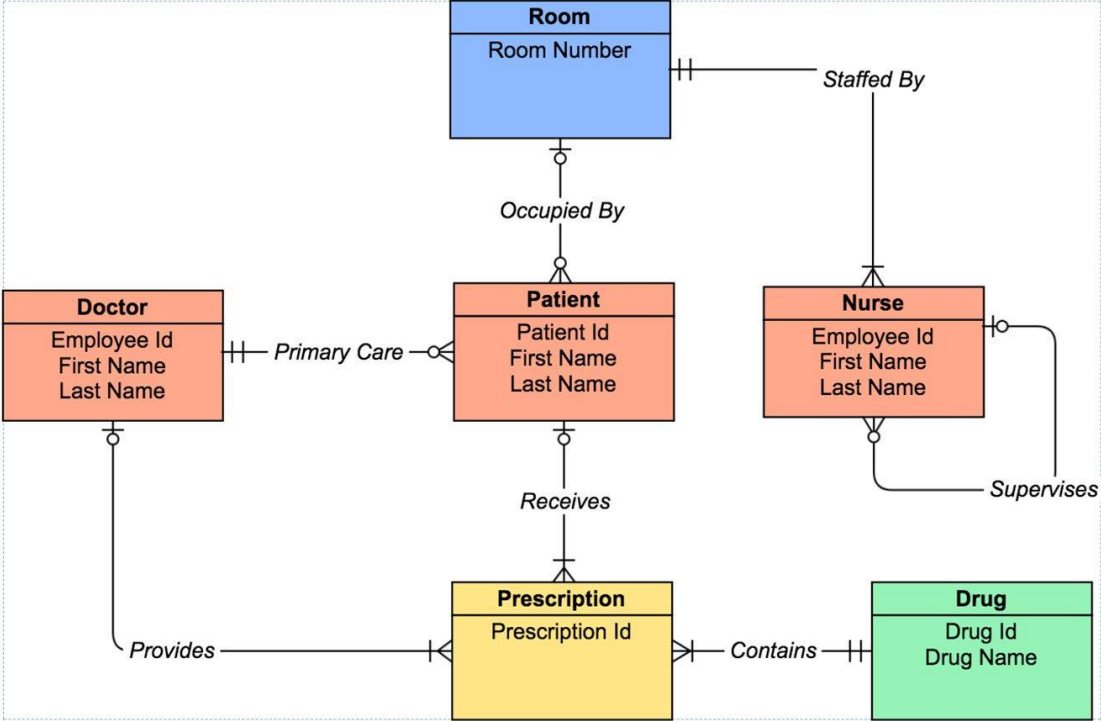
A set of attributes for two entities named Product and Supplier



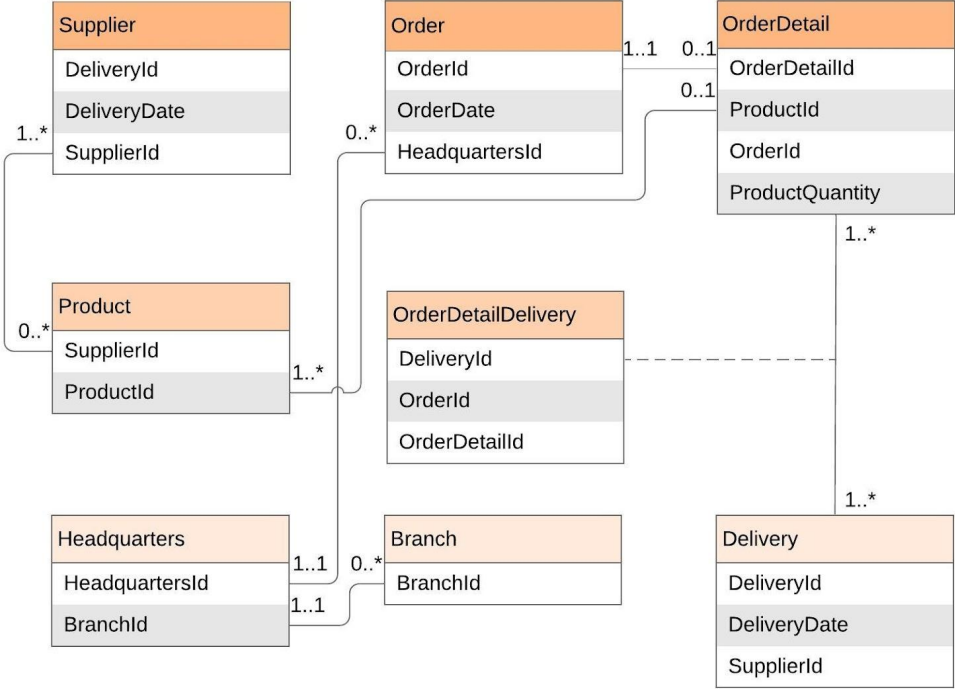
Example of Peter Chen



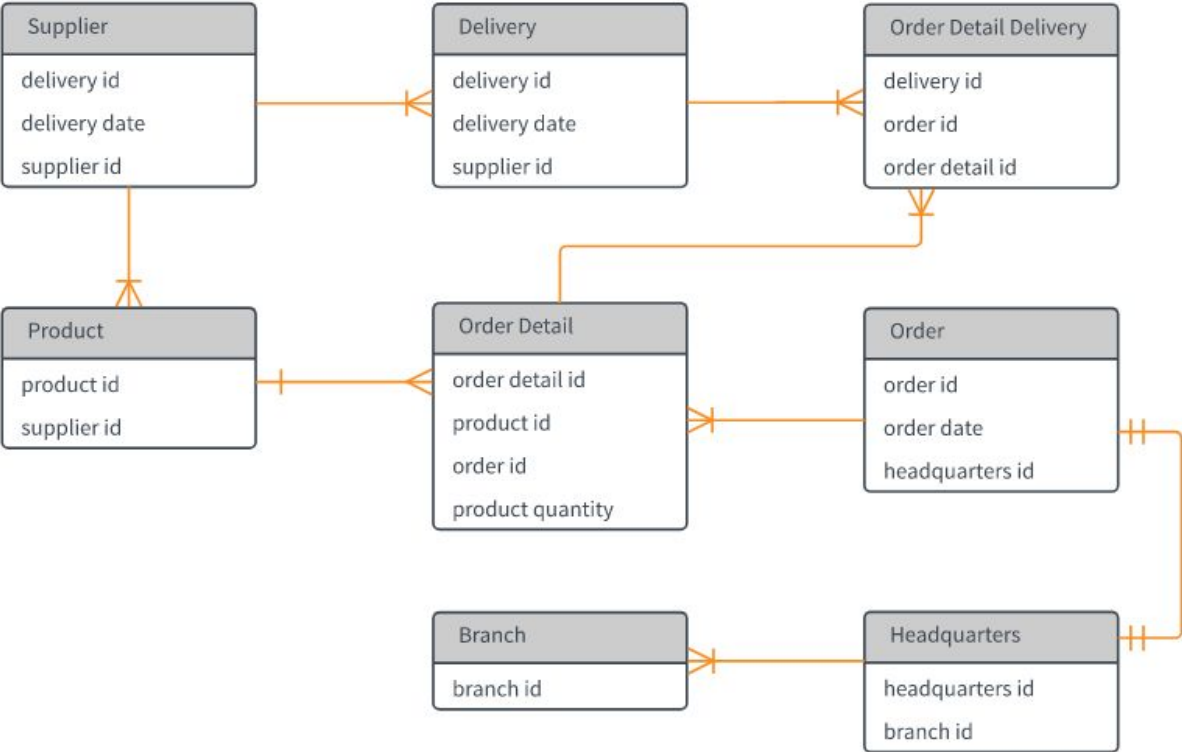
Example of Crow's Foot



Example of Crow's Foot



Example of Crow's Foot



Formative Assessment 2

Resources

Website: http://www.teach-ict.com/as_a2_ict_new/ocr/A2_G063/331_systems_cycle/analysis_tools/miniweb/pg3.htm

E-book: [AQA A2](#)

https://studme.org/77223/informatika/notatsiya_martina_crows_foot