# 9. Entity-Relationship Model

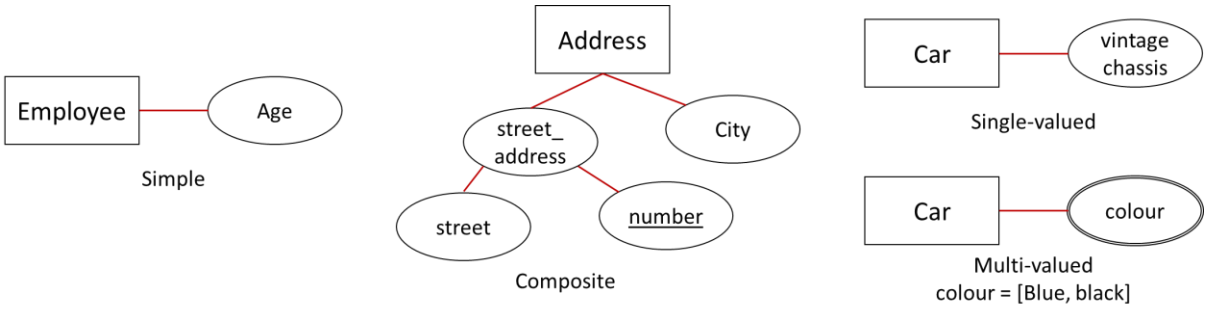
COMP1531 • KC Notes • Images sourced from Aarthi Natarajan

## 8.1 Designing a database

- **Data modelling**: high level abstract stage of database application development
- Two data models:
  - **Logical**: an **abstract** model – **conceptual**-level, e.g. ER Model, OO Model
  - **Physical**: **record-based** model – **implementation**-level, e.g. relational model
- Entity-relationship data modelling: view the world as a **collection of interrelated entities**
  - **Entity**: an **object of interest** in the real world, distinguishable from other objects
  - **Attribute**: data item or property of interest
  - **Entity-set/entity-type**: **set of entities with the same set of attributes**
  - **Relationship**: relates two or more entities
    - E.g. Joe (entity) **is enrolled in** (relationship) COMP1531 (entity)
  - **Relationship set**: set of similar relationships
    - **Degree**: number of entities involved in relationship
    - **Cardinality**: number of associated entities on each side of the relationship
- Entity is **like an object instance**, entity set is **like a class**, methods not covered in ER

## 8.2 Attributes

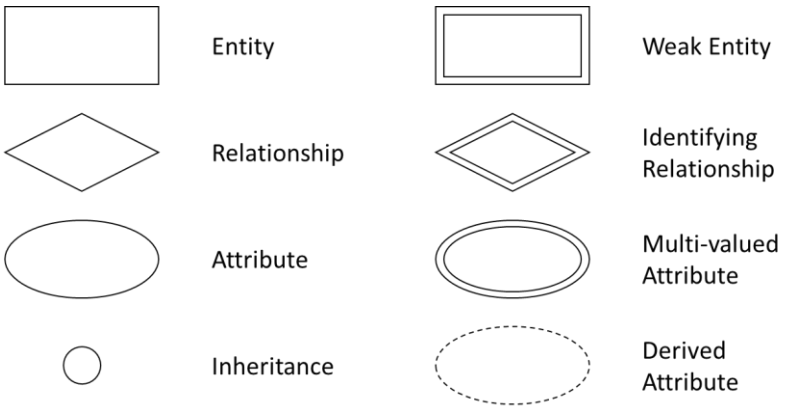
- Attributes in ER model can be:
  - **Simple** – attributes cannot be broken into smaller subparts
  - **Composite** – can have a hierarchy of attributes
  - **Single-valued** – has one value for each entity
  - **Multi-valued** – has **a set** of values for each entity, e.g. colour, degrees

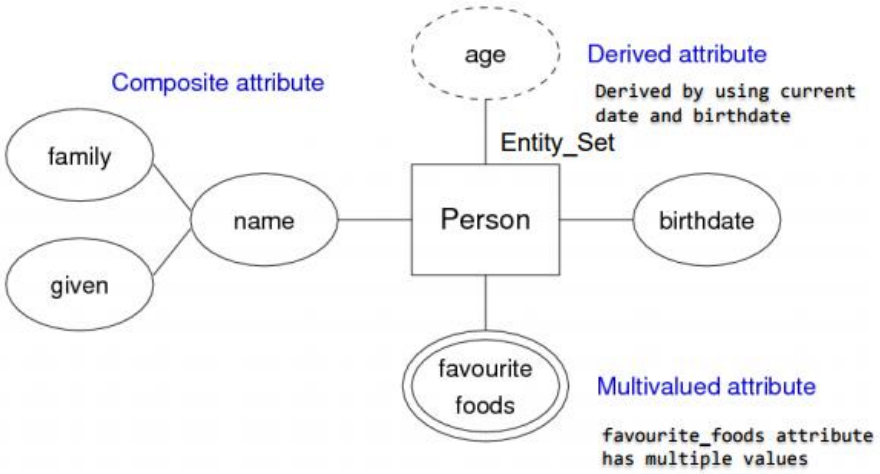



- If two entities **have the same set of attribute values**, they are regarded as the same entity
  - Define a **superkey** to make each entity distinct
    - E.g. SSN (primary key) or [name + address] (candidate key)

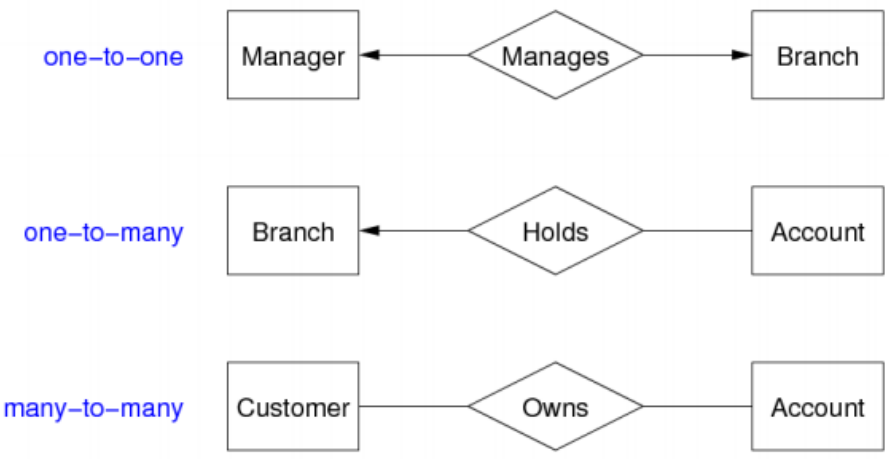
## 8.3 ER Diagrams

- **Visual symbols**



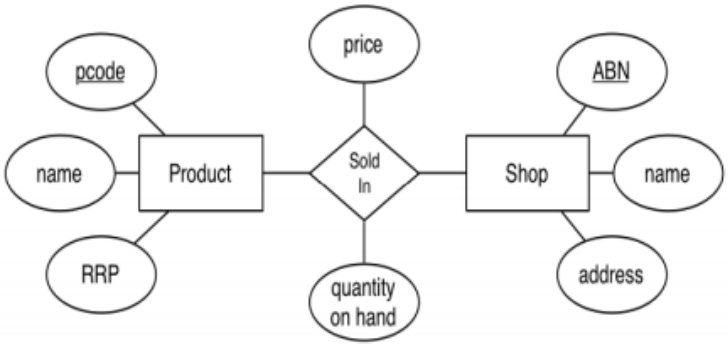




- **Cardinality**

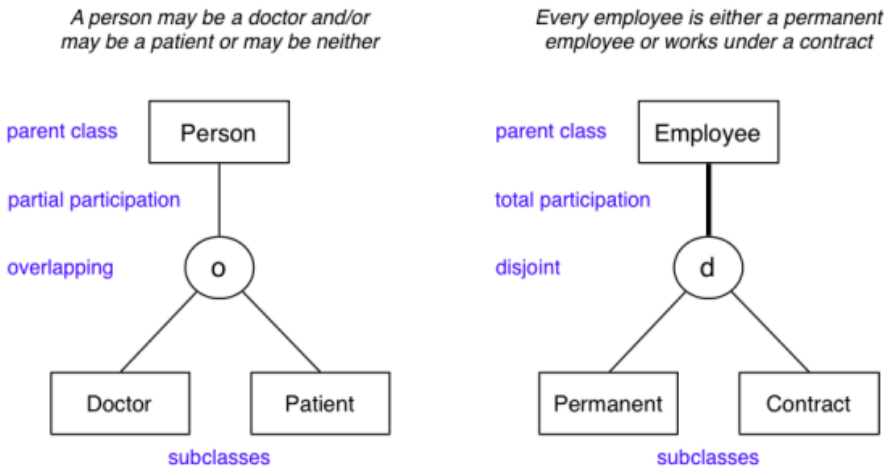


- **Level of participation constraint**
  - **Total**: **every entity in the entity set participates in $\geq 1$ relationship** in R
    - Every bank loan is associated with at least one customer
  - **Partial**: **some entities** in the entity set participate in relationships in R
    - Not every customer has a loan


- **Relationship has associated attributes**: price and quantity are related to products in a particular shop
- **Primary key attributes** are **underlined**




- **Weak entity set** has no key of its own, only exists due to association with strong entities
- **Subclass**: entity set that has **all attributes of base set** and plus its **own attributes**
  - **O**verlapping: entity **can be in multiple subclasses** (Doctor can be a Patient)
  - **D**isjoint: entity **cannot be** in multiple subclasses (MCQuestion can't be TextQuestion)
  - Total: **every entity has to be in a subclass** (Question must be MC/Text)
  - Partial: **not every entity** has to be in a subclass (Vehicle can be Vehicle or Car)

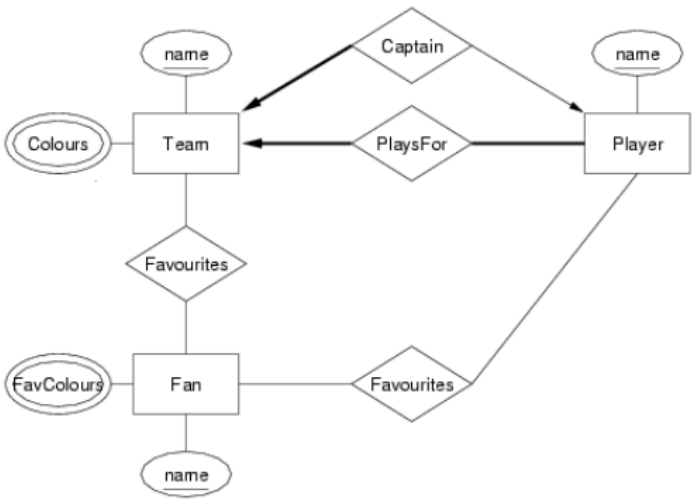


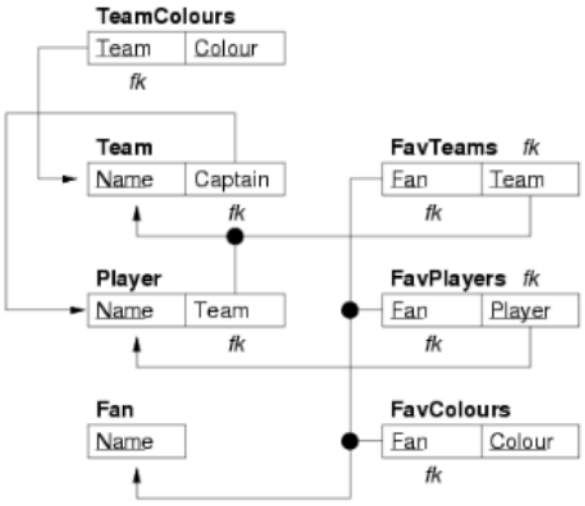
## 8.4 Mapping ER Designs to Relational Model

- There is a formal mapping from ER to relational model
    - Need to also **define concrete domains and constraints** for attributes

| | |
|---|---|
| ER **attribute** | relational **attribute** |
| ER **entity** | relational **tuple** |
| ER **entity-set** | relational **table** (relation) |
| ER **relationship** | relational **table** (relation) |
| ER **key** | relational **primary key** |

- Differences between relational and ER:
    - Relational uses **relations** to model entities and relationships
    - Relational has **no composite or multi-valued attributes** (atomic only)
    - Relational has **no object-oriented notions** (no subclasses and inheritance)




- In SQL Schema: player varchar(50) REFERENCES Player(name)