Peter Chen, who developed entity-relationship modeling and published his work in 1976, was one of the pioneers of using the entity relationship concepts in software and information system modeling and design. The Chen ERD notation is still used and is considered to present a more detailed way of representing entities and relationships.

Entities

An entity is represented by a rectangle which contains the entity's name.

In the Chen notation, we distinguish **types of entities**:

1. **entity**

2. **weak entity** – an entity that cannot be uniquely identified by its attributes alone. The existence of a weak entity is dependent upon another entity called the owner entity. The weak entity's identifier is a combination of the identifier of the owner entity and the partial key of the weak entity.

3. **associative entity** – an entity used in a many-to-many relationship (represents an extra table). All relationships for the associative entity should be many
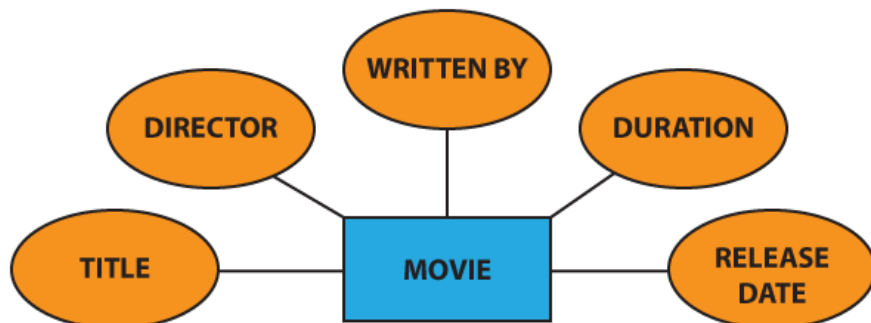
Attributes

In the Chen notation, each attribute is represented by an **oval** containing atributte's name:

Attributes are linked to the entity with straight lines:

There are some specific **types of attributes**:

1. **key attribute** – an attribute that uniquely identifies a particular entity. The name of a key attribute is underscored:

For example, since the Vehicle Identification Number (VIN) is a unique code used to identify individual vehicles (no two vehicles have the same VIN), "VIN" can be considered as the key attribute for the "CAR" entity:
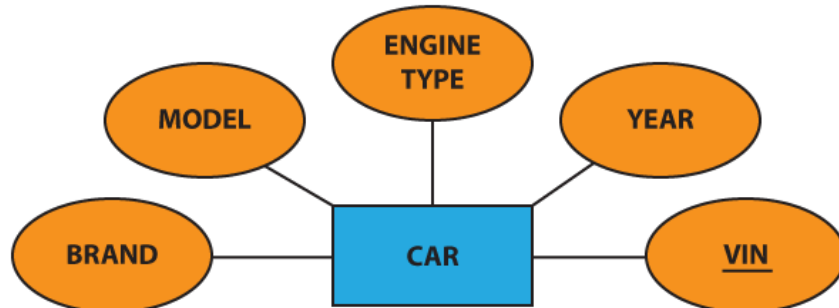

2. **partial key attribute (discriminator)** – an attribute that, when combined with the key attribute of the owner entity, provides a unique identification for the weak entity. We underline the discriminator with a dashed line:

3. **multivalued attribute** – an attribute that can have many values (there are many distinct values entered for it in the same column of the table). Multivalued attribute is depicted by a dual oval:

For example, each user can have several different hobbies, therefore the "hobby" can be considered as a multivalued attribute for the "user" entity:
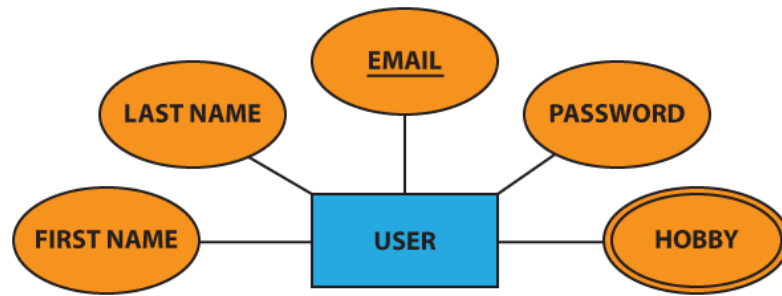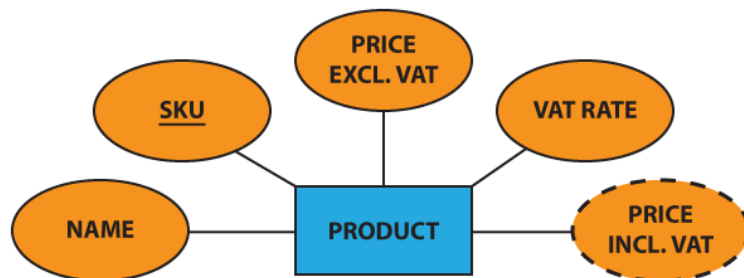
4. **derived attribute** (or computed attribute) – an attribute whose value is calculated (derived) from other attributes. The derived attribute may or may not be physically stored in the database.

In the Chen notation, this attribute is represented by dashed oval:

For example, having given the price excluding VAT and the VAT rate, we can calculate the price including VAT:

Some attributes can be further subdivided into smaller parts. For example, the attribute "address" can be subdivided into street name, street number, apartment number, city, state, zip code, and country.

These are called **composite attributes** and are depicted as follows:
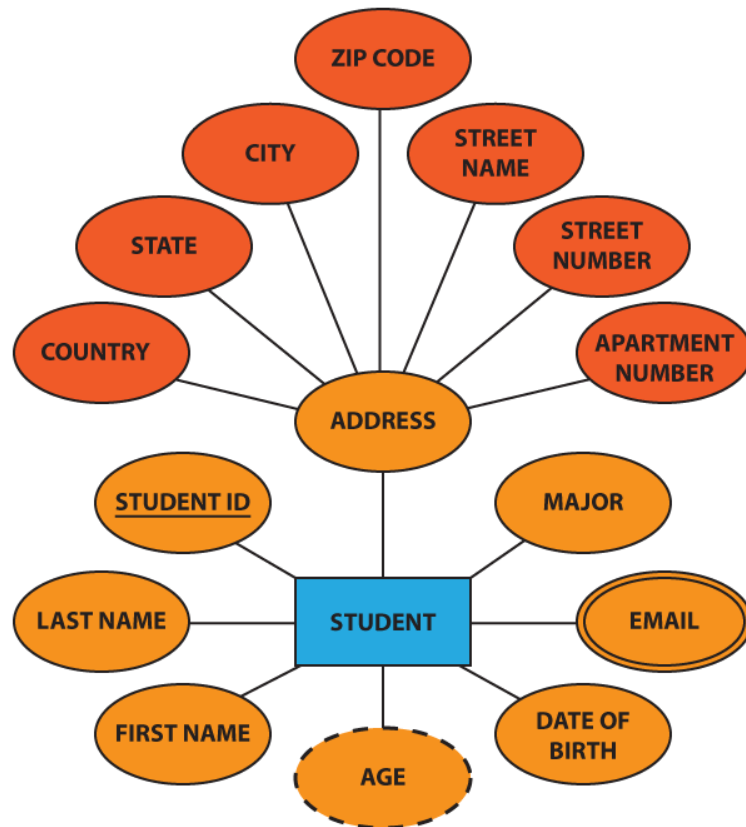
Relationships

In the Chen notation, a relationship is represented by a **diamond** (rhombus) containing the relationship's name.

Two kinds of relationship are distinguished:

1. **strong relationship** – a relationship where entity is existence-independent of other entities, and PK of Child doesn't contain PK component of Parent Entity. A strong relationship is represented by a single rhombus:

2. **weak (identifying) relationship** – a relationship where Child entity is existence-dependent on parent, and PK of Child Entity contains PK component of Parent Entity. This relationship is represented by a double rhombus:

Optionality of a relationship

1. Similarly to the Barker's notation, a **mandatory** relationship is represented by a solid line:

2. An **optional** relationship is represented by a dashed line like in Barker's notation:

Cardinality

The **degree of relationship** (**cardinality**) is represented by characters "1", "N" or "M" usually placed at the ends of the relationships:

- **one-to-one (1:1)**

  The employee can manage only one department, and each department can be managed by one employee only:

- **one-to-many (1:N)**

  The customer may place many orders, but each order can be placed by one customer only:

- **many-to-one (N:1)**

  Many employees may belong to one department, but one particular employee can belong to one department only:

- **many-to-many (M:N)**

  One student may belong to more than one student organizations, and one organization can admit more than one student:

Participation constraints

An entity set may participate in a relation either totally or partially.

- **Total participation** means that every entity in the set is involved in the relationship, e.g., each student must be guided by a professor
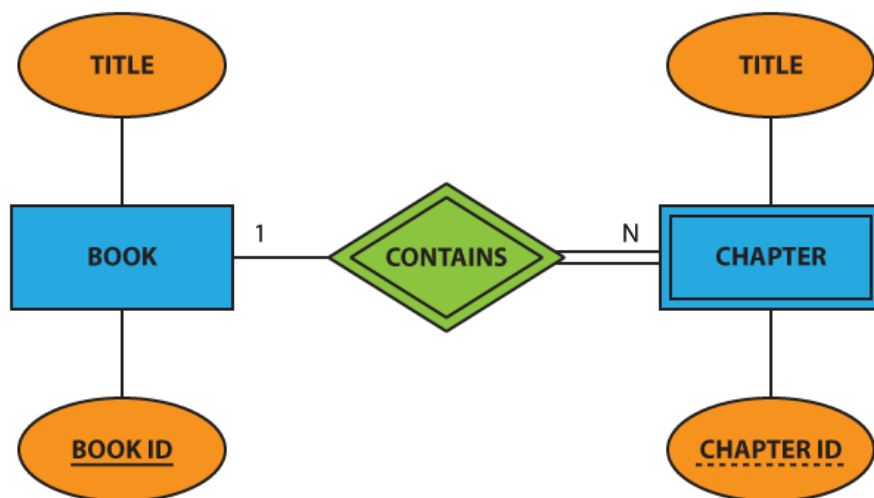
(there are no students who are not guided by any professor). In the Chen notation, this kind of relation is depicted as a double line.

- **Partial participation** means that not all entities in the set are involved in the relationship, e.g., not every professor guides a student (there are professors who don't). In the Chen notation, a partial participation is represented by a single line.

The relationship shown above means that each student, without exception, must be guided by one chosen professor, and one – but not every – professor can guide many students. So there is no student that is not guided by a professor, and on the other hand there can be professors who don't guide any students

with book and chapter (looks like in the Chen notation).