

## Entity Relationship Model (ERM)

- Basis of an entity relationship diagram (ERD)
- ERD depicts the:
  - Conceptual database as viewed by end user
  - Database's main components
    - ✓ Entities
    - ✓ Attributes
    - ✓ Relationships
- Entity - Refers to the entity set and not to a single entity occurrence

## Attributes

- **Multivalued attributes:** Attributes that have many values and require creating:
  - Several new attributes, one for each component of the original multivalued attribute
  - A new entity composed of the original multivalued attribute's components
- **Derived attribute:** Attribute whose value is calculated from other attributes
  - Derived using an algorithm

## Attributes

- Characteristics of entities
- **Required attribute:** Must have a value, cannot be left empty **NOT NULL**
- **Optional attribute:** Does not require a value, can be left empty
- Domain - Set of possible values for a given attribute
- **Identifiers:** One or more attributes that uniquely identify each entity instance

Table 4.2 - Advantages and Disadvantages of Storing Derived Attributes

	STORED	NOT STORED
Advantage	Saves CPU processing cycles Saves data access time (Data value is readily available Can be used to keep track of historical data)	Saves storage space Computation always yields current value
Disadvantage	Requires constant maintenance to ensure derived value is current, especially if any values used in the calculation change	Uses CPU processing cycles Increases data access time Adds coding complexity to queries

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## Attributes

- **Composite identifier:** Primary key composed of more than one attribute
- **Compound attribute:** Attribute that can be subdivided to yield additional attributes  
*eg. Address = Street + city + state + country*
- **Simple attribute:** Attribute that cannot be subdivided
- **Single-valued attribute:** Attribute that has only a single value
- **Multivalued attributes:** Attributes that have many values

## Relationships

- Association between entities that always operate in both directions
- **Participants:** Entities that participate in a relationship
- **Connectivity:** Describes the relationship classification
- **Cardinality:** Expresses the minimum and maximum number of entity occurrences associated with one occurrence of related entity

In Crow's Foot notation, 'bold' attributes are 'required' (can't be null).

## Existence Dependence

Existence dependence	Existence independence
<ul style="list-style-type: none"> <li>Entity exists in the database only when it is associated with another related entity occurrence</li> </ul>	<ul style="list-style-type: none"> <li>Entity exists apart from all of its related entities</li> <li>Referred to as a <b>strong entity</b> or <b>regular entity</b></li> </ul>

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Existence independence implies a strong entity; but, existence dependence (alone, ie. by itself) does NOT imply a weak entity (there needs to be one more condition, based on 'relationship strength', for it to become 'weak').

In other words, we need to look at where the FK in the dependent entity is located.

## Relationship Strength

### Weak (non-identifying) relationship

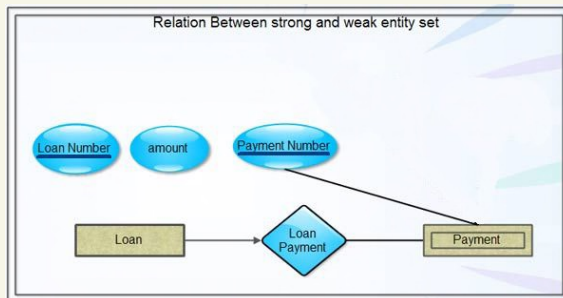
- Primary key of the related entity does not contain a primary key component of the parent entity

### Strong (identifying) relationships

- Primary key of the related entity contains a primary key component of the parent entity

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Payment cannot exist independent of Loan, AND needs Loan's key to be part of its own key, so it is a weak entity.

Figure 4.8 - A Weak (Non-Identifying) Relationship between COURSE and CLASS

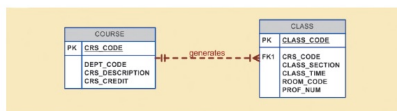
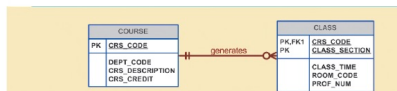


Figure 4.9 - A Strong (Identifying) Relationship between COURSE and CLASS



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## Weak Entity

### Conditions





- Existence-dependent
- Has a primary key that is partially or totally derived from parent entity in the relationship
- Database designer determines whether an entity is weak based on business rules

Note that a weak entity implies existence dependence, but existence dependence does not imply a weak entity!

## Relationship Degree

- Indicates the number of entities or participants associated with a relationship
- Unary relationship:** Association is maintained within a single entity
  - Recursive relationship:** Relationship exists between occurrences of the same entity set
- Binary relationship:** Two entities are associated
- Ternary relationship:** Three entities are associated

Table 5.2 - Specialization Hierarchy Constraint Scenarios

TYPE	DISJOINT CONSTRAINT	OVERLAPPING CONSTRAINT
Partial 	Supertype has optional subtypes. Subtype discriminator can be null. Subtype sets are unique.	Supertype has optional subtypes. Subtype discriminators can be null. Subtype sets are not unique. 
Total 	Every supertype occurrence is a member of only one subtype. Subtype discriminator cannot be null. Subtype sets are unique.	Every supertype occurrence is a member of at least one subtype. Subtype discriminators cannot be null. Subtype sets are not unique. 

## Extended Entity Relationship Model (EERM)

- Result of adding more semantic constructs to the original entity relationship (ER) model
- EER diagram (EERD):** Uses the EER model

## Inheritance

- Enables an entity subtype to inherit attributes and relationships of the supertype
- All entity subtypes inherit their primary key attribute from their supertype
- At the implementation level, supertype and its subtype(s) maintain a 1:1 relationship
- Entity subtypes inherit all relationships in which supertype entity participates
- Lower-level subtypes inherit all attributes and relationships from its upper-level supertypes

## Disjoint and Overlapping Constraints

- Disjoint subtypes:** Contain a unique subset of the supertype entity set
  - Known as **nonoverlapping subtypes**
  - Implementation is based on the value of the subtype discriminator attribute in the supertype
- Overlapping subtypes:** Contain nonunique subsets of the supertype entity set
  - Implementation requires the use of one discriminator attribute for each subtype