

Information Systems 3

ISY300B



Cape Peninsula
University of Technology

Entity Relationship (ER) Modelling

ER Introduction

- ER diagrams revised
- Introduction to advanced ER
 - Specialization
 - Aggregation
 - Generalization



ER diagrams revised

- ERM forms the basis of the ERD
- ERD depicts the databases main components
 - Entities
 - Attributes
 - Relationships



Entities

- Object of interest to the end user
- At ERM level the entity refers to the entity set (Table)
- In UML notation divided into three parts
 - The top (entity name)
 - The middle (description of the attributes)
 - The bottom (list of methods)



Attributes

- These are characteristics of entities
 - E.g.: Supplier entity includes: SID, SNAME, SADDRESS
 - Domains
 - Identifiers
 - Composite Key (Uses more than one attribute)
 - Composite and Simple Attributes
 - Single-Valued Attributes
 - Multivalued Attributes

Relationships

- This is an association between two entities
 - (Also referred to a participant)



Multiplicity

- This refers to the number of instances one entity that are associated with one instance of a related entity.



Multiplicities



Existence Dependence / Independence

- An entity is said to be existence- dependent if it can exist in the database only when it is associated with another related entity occurrence.
 - (Consists of a mandatory foreign key that cannot be null)
- When an entity can exist without being associated to another entity it is said to be existence-independent.

Relationship Strength

- Based on the how the primary key of a related entity is defined.
- Weak (Non Identifying Relationships) (pg. 167)
 - PK of the related entity does not contain the PK of the parent entity.
 - PK will the appear as a FK of the related entity.
- Strong(Identifying) Relationships (pg. 169)
 - PK of the related entity contains the PK of the parent entity.

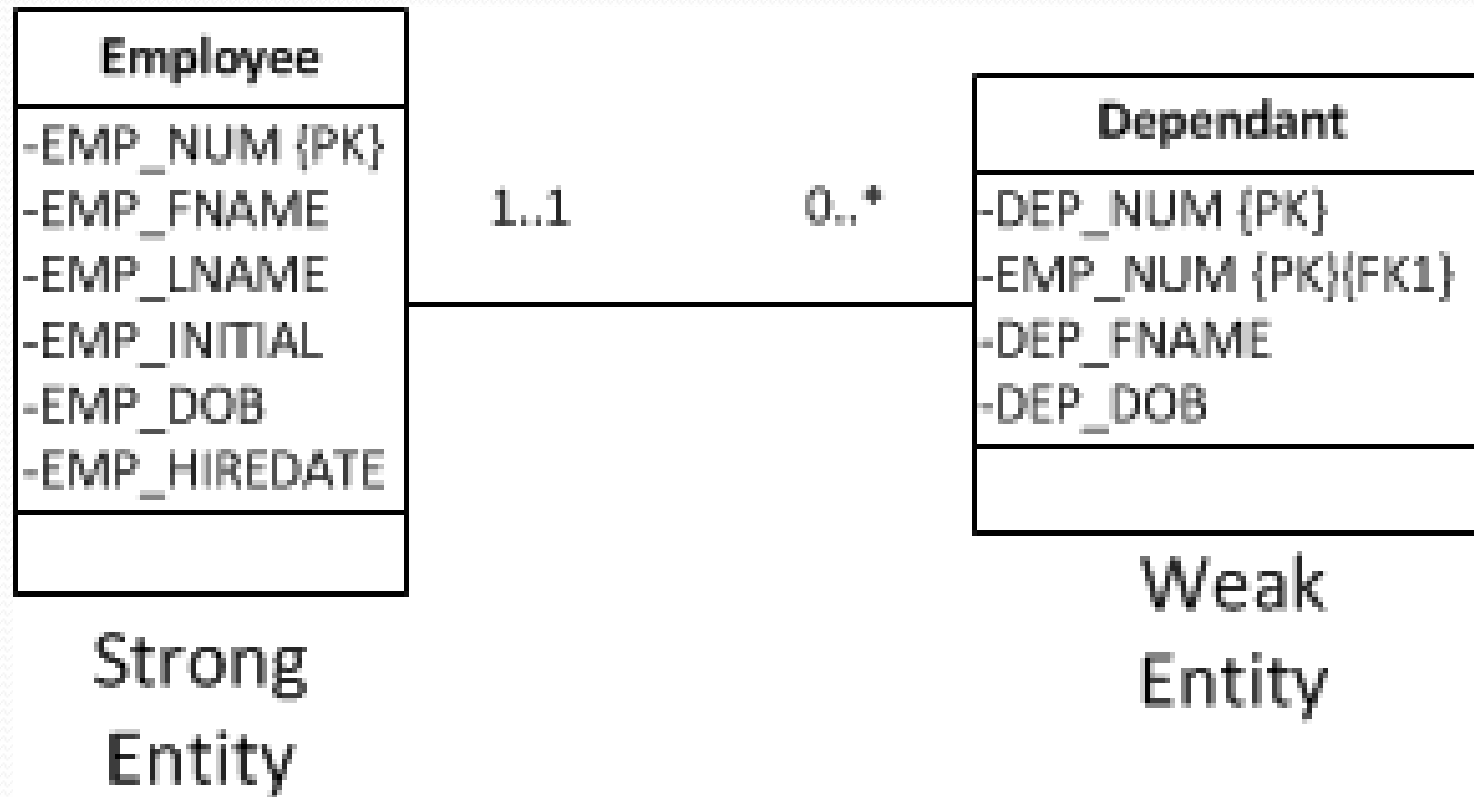


Weak Entities

- It is existence-dependent (It cannot exist without the entity with which it has a relationship)
- It has a primary key that is partially or totally derived from the parent entity in the relationship.



Weak Entities



Relationship Participation

- Optional or Mandatory Participation
 - Optional one entity occurrence does not require a corresponding entity occurrence
 - Mandatory – an entity occurrence requires a corresponding entity occurrence in a particular relationship.



Relationship Degree

- This indicates the number of entities or participants associated with a relationship.
 - Unary relationship exists when an association is maintained with a single entity
 - Binary relationship exists when two entities are associated
 - A ternary relationship exists when three entities are associated

Recursive Relationship

- As was mentioned a recursive relationship is one in which a relationship can exist between occurrences of the same entity set.



Developing and ER Diagram

- Create a detailed narrative of the organisations description of operations
- Identify the business rules based on the descriptions of operations
- Identify all main entities from the business rules
- Identify all main relationships between entities from the business rules
- Develop and initial ERD



Developing and ER Diagram

- Determine the multiplicities and the participation of all relationships
- Identify the primary and foreign keys
- Identify all attributes
- Revise and review the ERD



Advanced Data Modeling



Cape Peninsula
University of Technology

Extended Entity Relationship Model

- Entity supertypes and entity subtypes
 - Supertypes
 - Entity types that has a relationship with one or more subtypes and it contains attributes that common to its subtypes.
 - Subtypes
 - These are subgroups of the supertype entity and have unique attributes, but they will be different from each subtype.



Specialisation Hierarchy

- The specialization hierarchy depicts the arrangement of higher-level entity supertypes (parent entities) and lower-level entity subtypes (child entities)
- Sometimes describes as an “IS-A” relationships



Inheritance

- This enables a subtype entity to inherit the attributes and relationships of the supertype.



Subtype Discriminator

- A subtype discriminator is the attribute in the supertype entity that determines to which entity subtype each occurrence is related. (Figure 6.2)



Disjoint and Overlapping constraints

- Disjoint subtypes (Non-overlapping subtypes) contain a unique subset of the supertype entity set
- Overlapping subtypes (non-disjoint subtypes) are subtypes that contain non-unique subsets of a supertype entity set.



Completeness Constraint

- This type of constraint specifies whether each entity supertype occurrence must also be a member of at least one subtype.
 - **Partial completeness** – means that not every supertype is a member of a subtype
 - **Total completeness** – means that every supertype is a member of a subtype

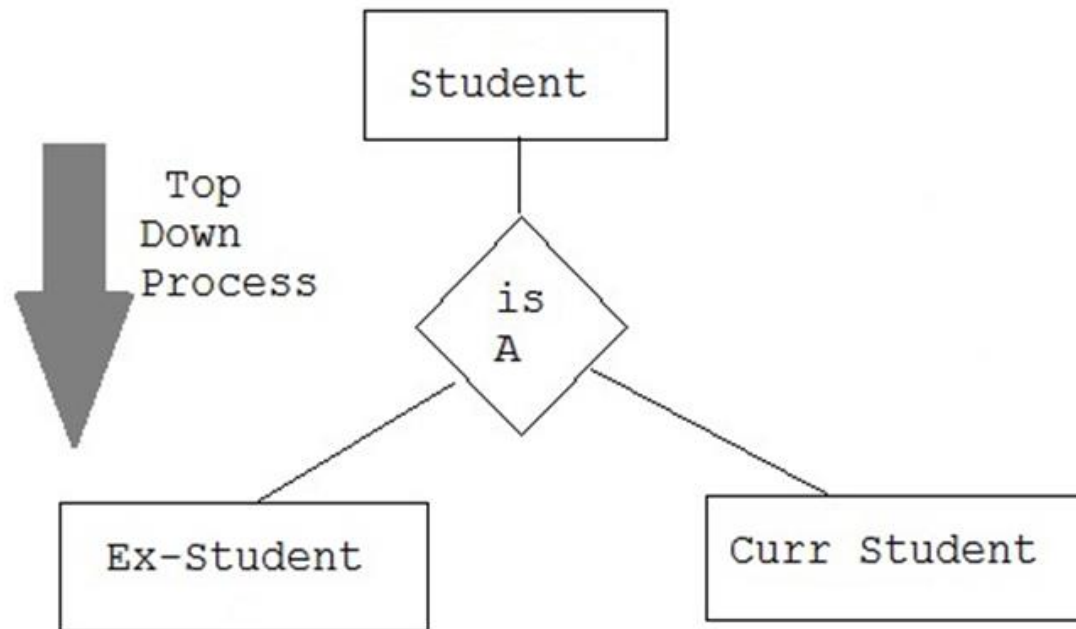


Specialization and Generalization

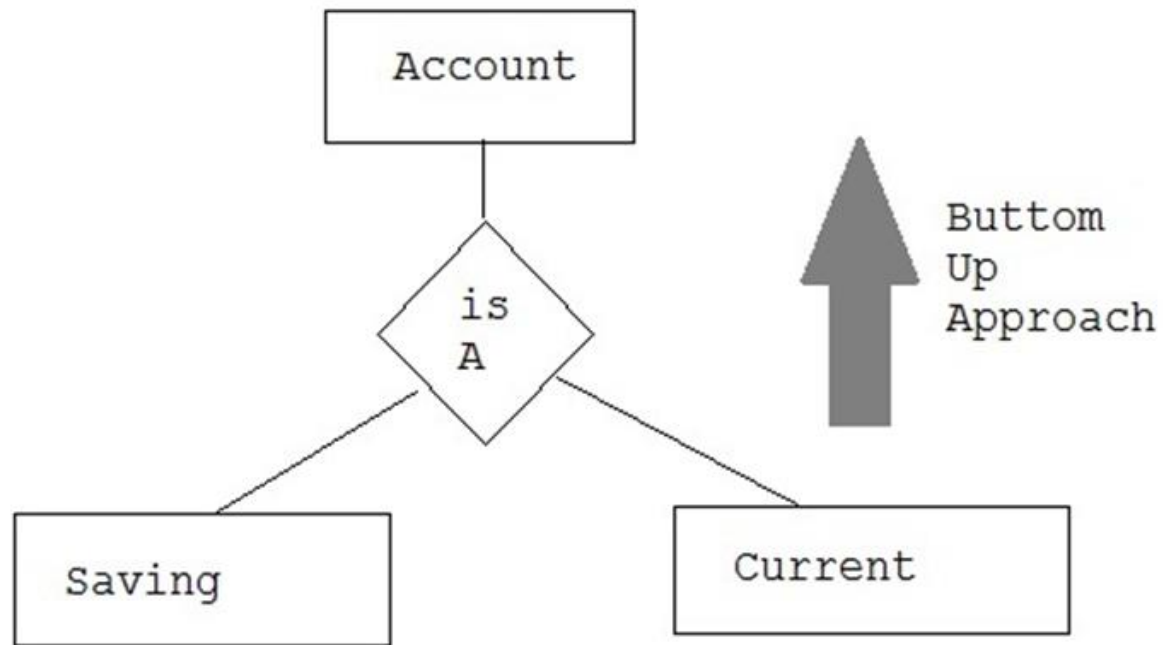
- Specialization is a top-down process of identifying lower level , more specific entity subtypes from a higher –level entity supertype.
- Generalization is the bottom-up process of identifying a higher level more generic entity supertype from the lower level entity subtypes.



Specialization



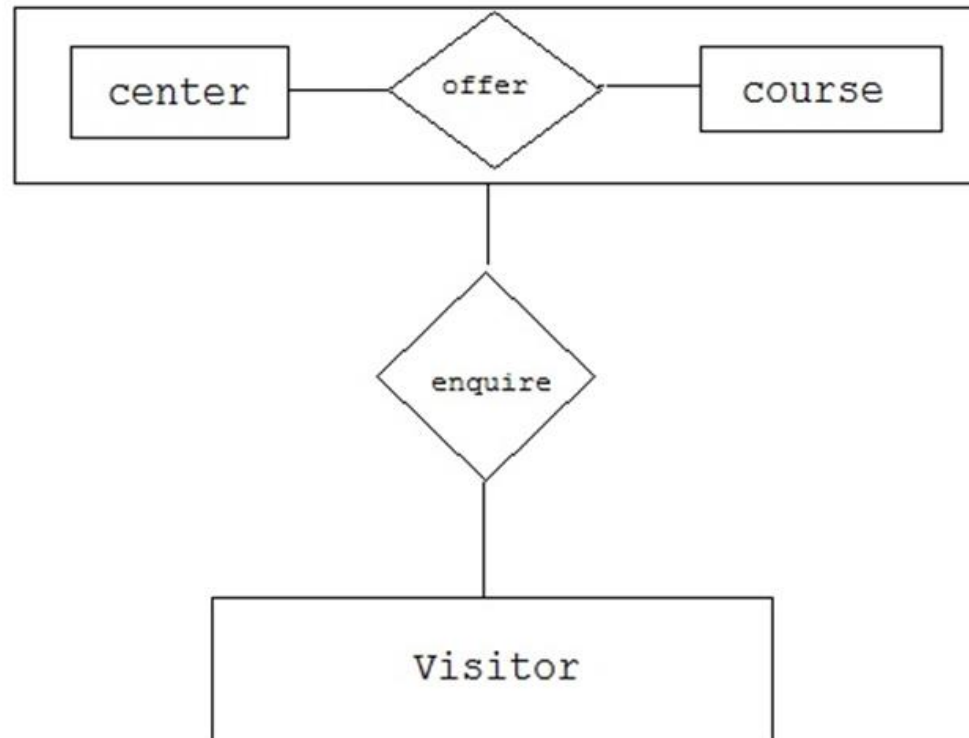
Generalization



Composition and Aggregation

- Aggregation – is used when an entity is composed of a collection of other entities. The relationship can be classified as a “has_a” relationship type.
 - Example:
 - A team has many players
 - A band has many musicians

Aggregation



Entity Clustering

- This is creating a virtual entity type, that represent multiple interrelated entities.



Entity Integrity: Selecting primary keys

- Natural Keys
 - These are real-world, generally accepted identifier used to distinguish-this is, uniquely identify-real-world objects
 - Example:
 - Class numbers to register classes, invoice numbers to identify specific invoices.



Primary Key Guidelines

- understand the function of the primary key.
 - this is to uniquely identify and entity instance or row with in a table.
 - primary keys and foreign keys are used to implement relationship amongst entities.



Primary Key Guidelines

- Unique Values
- Non intelligent
- No change over time
- Preferable single attribute
- Preferably numeric
- Security Compliant



Composite and Surrogate Keys

- **Composite key**

- A key that is composed of two or more attributes.
 - Used as identifiers of composite entities, where each primary key combination is allowed only once in a $^{*}:^{*}$ relationship
 - As identifiers of weak entities, where the weak entity has a strong relationship with the primary entity.

- **Surrogate key**

- A key with no business meaning.
 - This does not exist in the real world (in some instances)

Converting and advanced ER model into a database structure

- Step 1: Mapping of Regular Entity Types
 - Create a table for every regular entity and include all simple attributes
- Step 2: Mapping of Weak Entities
 - Create a table for each weak entity and include all simple attributes.
 - Create foreign keys of the primary key attributes that corresponds to the owner entity.
 - The primary key for the weak entity will be a combinations of and a partial key of the weak entity.



Converting and advanced ER model into a database structure

- Step 3: Mapping of 1:1 Relation Types
- Step 4: Mapping of Binary 1:N Relationships
- Step 5: Mapping of Binary M:N Relationship Types
 - Create a new relationship



References

- Learn Data Modeling. 2014. Supertypes and Subtypes. Pro Business Systems LLC. [Online] Available at: http://www.learndatamodeling.com/dm_super_type.php. Accessed 2 February 2014.
- Agile Data. 2014. Choosing a Primary Key: Natural or Surrogate?. Abisoft Inc. [Online] Available at: <http://www.agiledata.org/essays/keys.html#sthash.m8cLwwbX.dpu>. Accessed 2 February 2014
- Peter, R., Coronel, C. & Crockett, K. 2008. “Database Systems Design, Implementation and Management”. Chapter 5 and 6