**ITEC 630**

*Information Systems Analysis, Modeling, and Design*

***Lecture Notes***

**Data-Oriented Analysis**

**Conceptual Data Modeling and the E-R Model**

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**Learning objectives**

1. Learn the definitions of data-oriented analysis terms
2. Learn the conceptual data model and the entity relationship (ER) modeling
3. Understand the business rules applicable to the logical data model
4. Understand rules and style guidelines for creating ERDs.
5. Learn how to create an ERD.

**Overview**

This week lecture presents entity relationship (ER) diagramming, one of the most common data modeling techniques used in industry. This data model describes the data that flow through the business processes in an organization. In the previous phases, the data model presents the logical organization of data without indicating how the data are stored, created, or manipulated. In the design phase, the data model is changed to reflect exactly how the data will be stored in databases and files.

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**DEFINITION OF DATA-ORIENTED ANALYSIS TERMS**

***An Entity-Relationship Diagram (ERD)***

* An ERD describes the normalized data environment and data scope of the application.
* For data modeling, the major activity is the creation and refinement of an ERD.

***An Entity Type or Entity***

* An entity is some person, object, concept, application, or event from the real world about which we want to maintain data.
* All entities are drawn on the ERD as rectangles.
* There are three kinds of entities: fundamental, attributive, and associative.
* A fundamental entity is independent of all other entities and can be defined without thinking about other entities.
* An attributive entity is an entity whose existence *depends* on the presence of a fundamental entity.
* Attributive entities contain repeating information relating to a fundamental entity.
* An associative entity is used to simplify and define complex relationships between entities.

***Relationships and Cardinalities***

* A relationship is a mutual association between two or more entities.
* It is shown as a line connecting the entities.
* A relationship has cardinality, or the number of the relationship.
* Cardinalities may be one-to-one, one-to-many, or many-to-many.
* Cardinality is shown on a diagram by crows' feet to indicate a 'many' relationship and a single line to indicate a singular relationship.

***Refinement of an ERD***

* The refinement of an ERD consists of two activities:
* Attributes (fields or data items) are defined, and
* The ERD is normalized.
* Attributes are named properties or characteristics of an entity which take on values.

***Normalization***

* Normalization is the refinement of data relationships to remove repeating information, partial key dependencies, and non-key dependencies.
* Normalization can be directly applied to the ERD by examination of the relationship cardinalities and the attributes of entities.
  + For *m:n* relationships, and for entities with repetitive information in the entity, we create (or validate) attributive entities.
  + For an *m:n* relationship, the relationship is promoted to create an associative entity (or relationship entity). The cardinalities of *m:n* are reversed to create two *1:m* relationships.
* ***Definition of Data-Oriented Analysis Terms***

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**Read the "DEFINITION OF BUSINESS AREA ANALYSIS TERMS" section in Chapter 9 (pages 329-338).**

**CONCEPTUAL DATA MODEL**

Conceptual data model is a detailed model that captures the overall structure of organizational data that is independent of any database management system or other implementation considerations.

* ***Introduction***

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* ***Conceptual Data Modeling***

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* ***Information Gathering for Conceptual Data Modeling***

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**INTRODUCTION TO E-R MODELING**

* An entity-relationship data model (E-R model) is a detailed, logical representation of the entities, associations, and data elements for an organization or business area.
* An entity-relationship diagram (E-R diagram) is a graphical representation of an E-R model.
* An entity type is a collection of entities that share common properties or characteristics.
* An entity instance (instance) is a single occurrence of an entity type.
* An attribute is a named property or characteristic of an entity that is of interest to the organization.
* A Candidate key is an attribute (or combination of attributes) that uniquely identifies each instance of an entity type.
* An identifier is a candidate key that has been selected as the unique, identifying characteristic for an entity type.
* A multivalued attribute is an attribute that may take on more than one value for each entity instance.
* A repeating group is a set of two or more multivalued attributes that are logically related.
* ***Introduction to E-R Modeling***

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**CONCEPTUAL DATA MODELING AND THE E-R MODEL**

* The degree of a relationship is the number of entity types that participate in that relationship.
* A unary relationship is a relationship between the instances of one entity type. It is also called a recursive relationship.
* A binary relationship is a relationship between the instances of two entity types. This is the most common type of relationship encountered in data modeling.
* A ternary relationship is a simultaneous relationship among instances of three entity types.
* The Cardinality of a relationship is the number of instances of entity B that can be associated with each instance of entity A.
* An associative entity is an entity type that associates the instances of one or more entity types and contains attributes that are peculiar to the relationship between those entity instances.
* ***Conceptual Data Modeling and the E-R Model***

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**BUSINESS RULES**

* Business rules are specifications that preserve the integrity of the logical data model.
* A domain is the set of all data types and values that an attribute can assume.
* A triggering operation (or trigger) is an assertion or rule that governs the validity of data manipulation operations such as insert, update, and delete.
* ***Business Rules***

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**DEVELOP ENTITY-RELATIONSHIP DIAGRAM**

***Rules for Entity-Relationship Diagram***

The steps to building an entity relationship diagram (ERD) are as follows:

1. Define fundamental entities and their primary keys.

2. Define the relationships between the fundamental entities.

3. Identify all attributes of entities, including primary keys.

4. Add attributive entities, where needed, to simplify one-to-many relationships.

5. Promote all many-to-many relationships to define associative entities.

6. Normalize the fundamental entities, analyzing if there are other entities which are hidden in the current definitions. Place new entities in the ERD. Define the new entities' attributes and primary keys.

7. Analyze the entities and their relationships to determine if a class structure is needed. If some instances of entities have identifiable differences in processing, data stored, or relationship participation, classes probably are needed.

* ***Develop ERD***

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**Click “The New Software Engineering.pdf” link to view the file.**

**Read the "Develop Entity-Relationship Diagram” section in Chapter 9 (pages 339-344).**

**References**

1. J.B. Dixit and Raj Kumar (2007). Structured System Analysis and Design, Laxmi Publications. <http://library.books24x7.com.ezproxy.umuc.edu/toc.aspx?bookid=30713>

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