

CSIT115 Data Management and Security

Database Design

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Database Design

Outline

Database Design Process

Database Domain

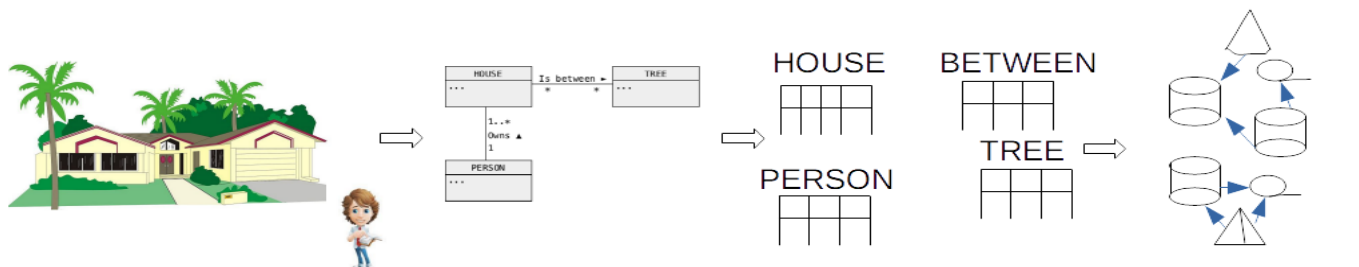
Database Schema

Object Modeling

Database Design Process

A simplified process of **database design** consists of the following stages:

- **Conceptual modeling**
- **Conceptual modeling** transforms a specification of a **database domain** into a **conceptual schema**
- **Logical design**
- **Logical design** transforms a **conceptual schema** into a **logical schema**, for example the headers of relational tables
- **Physical design**
- **Physical design** determines the implementation details and adds to a **logical schema** **schema persistent storage structures** that improve performance, for example the indexes, clusters, partitions, materialized views, and the others



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Database domain

Conceptual schema

Logical schema

Physical schema

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Database Domain

A **database domain** is a selected fragment of the real world to be described by the contents of a database

For example, a typical simple business domain can be described as a sequence of statements:

- A company would like to store and to maintain information about its suppliers and the parts shipped by the suppliers
- A supplier is described by a supplier name, date of birth, salary, and city he/she lives in
- A part is described by a part number, part name, colour and price
- A shipment is described by a supplier number, part name and the quantity of ordered parts
- A supplier is identified by its supplier number and a part is identified by its part number

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Database Schema

A **database schema** is a description of stored data expressed in the terms of a particular data abstraction level

- For example, a **conceptual schema** is a description of stored data expressed in the terms of **classes objects**, properties of objects, **identifiers** of classes of objects, **associations** between the classes of objects, **multiplicities** of attributes and associations and **generalization hierarchies**
- For example, a **logical schema** is a description of stored data expressed in the terms of **attributes**, **values of attributes**, **rows**, **columns**, **headers** and **tables**
- For example, a **physical schema** is a description of stored data expressed in the terms of **files**, **indexes**, **clusters**, **partitions**, **materializations**, **segments**, **extents** and **data blocks**

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Object Modeling

Object modeling is a special kind of conceptual modeling where a specification of a database domain is transformed into a simplified class diagram (conceptual schema)

Principles of object modeling:

- Contents of a database is quantised into discrete objects
- Objects are described by the attributes (properties) and operations (methods)
- Good news: we ignore the operations !
- Objects are identified by the values of selected attributes
- A class of objects is a group of homogeneous objects with common properties, common semantics and common identifiers

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Object Modeling

Examples:

- A **student** is an object, a **lecturer** is an object, a **lecture hall** is an object, a **shipment** is an object, an **accident** is an object, etc
- A student is described by the attributes **student number**, **first name**, **last name**, **date of birth**, etc
- A student is identified by a **student number**, a lecture hall is identified by **building number and room number**, a shipment is identified by a **supplier name**, **date**, and **time**, etc
- A group of students forms a class **STUDENT**, a group of lecturers forms a class **LECTURER**, a group of shipments forms a class **SHIPMENT**, etc

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Object Modeling

More **object modeling** concepts:

- A **link** a conceptual connection between two or more objects
- An **association** represents a group of homogeneous links with a common structure, common attributes, common semantics and common identifiers

Examples of **links**:

- James **talks to** Janusz
- Lecture 1 in CSIT115 **is in** building 3 room 2
- Peter **supplies** bolts **to** James

Examples of **associations**:

- **STUDENT Talks-to LECTURER**
- **LECTURE Is-in BUILDING**
- **SUPPLIER Supplies PART To MANUFACTURER**

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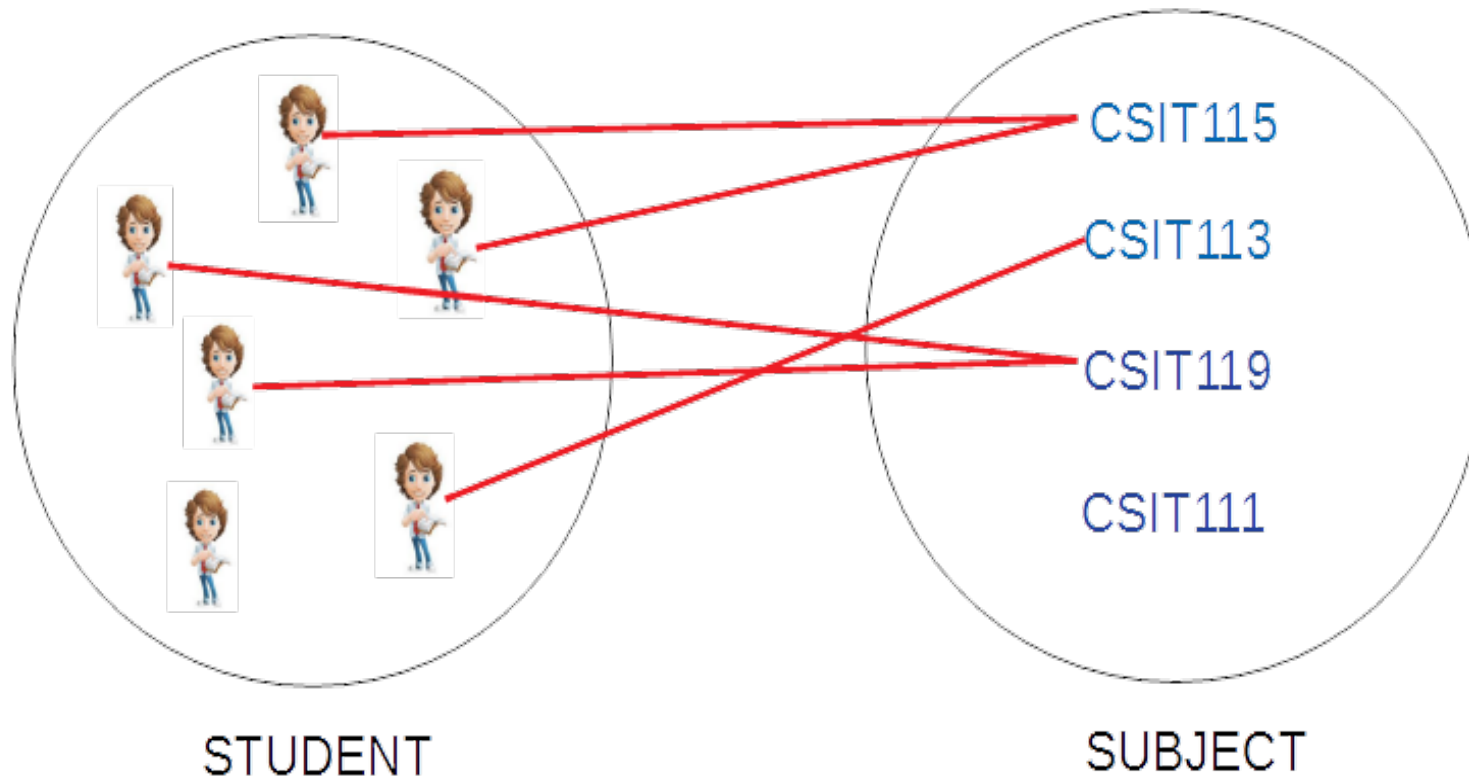
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Object Modeling

Visualizations of **objects**, **links**, **classes**, and **associations**



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Object Modeling

More **object modeling** principles:

- A **generalization hierarchy** represents **Is-a-subset** relation between the classes of objects
- If a set of all objects in a class X is a subset of a set of all objects in a class Y then class Y is a **generalization** of class X
- In other words, if a class Y is a **generalization** of class X then a set of all objects in Y includes a set of all objects in X

Example of **generalization**:

- A class **STUDENT** is a generalization of classes **UNDERGRADUATE STUDENT** and **POSTGRADUATE STUDENT**
- This is so, because a set of all undergraduate students **is a subset of** a set of all students and a set of all postgraduate students is a **subset of** a set of all students
- In other words, a set of all students **includes** a set of all postgraduate students and it also **includes** a set of all undergraduate students

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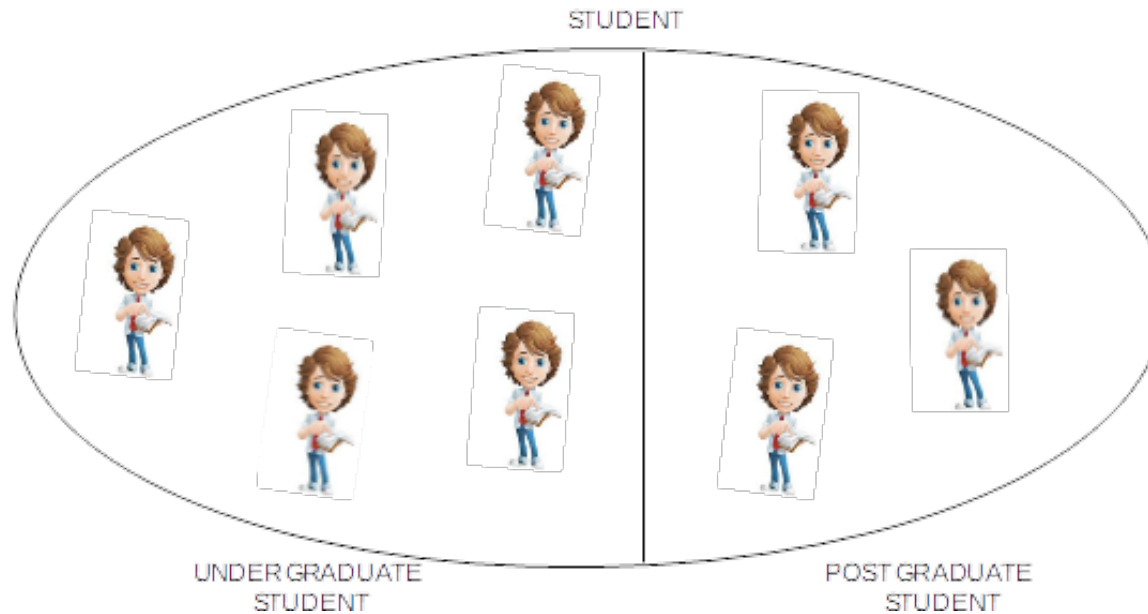
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Object Modeling

Visualizations of generalizations **UNDERGRADUATE STUDENT ISA STUDENT** and **POSTGRADUATE STUDENT ISA STUDENT**



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Object Modeling

Another example of **generalization**:

- A class **HUMAN** is a generalization of classes **STUDENT** and **LECTURER**
- This is so because a set of all students is a **subset of** a set of all humans and a set of all lecturers is a **subset of** a set of all humans
- In other words, a set of all humans **includes** a set of all students and it also **includes** a set of all lecturers

Yet another (... and it is my favorite ...) example of **generalization**:

- A class **BAT** is a generalization of classes **GREY-BAT**, **VAMPIRE-BAT**, and **BATMAN**
- This is so because a set of all grey bats is a **subset of** a set of all bats and a set of all vampire bats is a **subset of** a set of all bats and a set of all batmen is a **subset of** a set of all bats

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References

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