Object-Oriented Design

IT4GIS

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Topics

- During the balance of this semester, we will pursue and follow two learning threads
  - Object-relational databases
  - The Geo-Web
- These two threads are interwoven

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To understand Object-Relational Databases…

- We need to understand both *relational concepts* and
- *Object-oriented concepts* (this week)

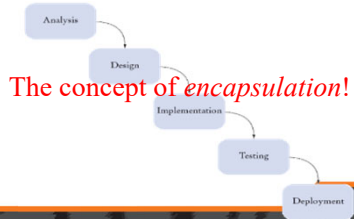Pocatello | Idaho Falls | Meridian | Twin Falls

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The Early Days…

- Computer programming from the caveman era

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Why…Object-Oriented

- A brief history of computer programming…
- Early *waterfall* programming

Analysis

Design

The concept of *encapsulation*!

Implementation

Testing

Deployment

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Today's Goals

- We will dissect "Object-Oriented" design and learn what it really is and how it relates to object-relational databases.
- At its core, we need to know
  - What is a CLASS
  - What is an OBJECT

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What is a CLASS?

- A *class* is a computer construct representing a concept bound in a cohesive package
  - Some are concrete (i.e., real world)
    - Bank account
    - Rental item
    - Database item
    - Pile
  - Others are abstract
    - Scanner
    - Stream
    - Math

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Discovering CLASSES

- Simple Rule:
  - Look for *nouns* in descriptions
  - Obviously not all nouns are classes
  - But at least this approach can allow one to create a list of *candidate classes*

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What is an OBJECT

- An *instance* of a CLASS
- That contains meaningful data
- OBJECTS occupy memory space at runtime
  - If not, they are CLASSES
  - For example: data type vs. double

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A Little Quiz…

- #1 Class or Object?

Dog

Dog is a generalization of Scooby-Doo

Scooby-Doo

A Little Quiz (cont'd)…

- #2 Class or Object?

The concept of *subclass*!

Dog

Animal

*Dog is a subclass of the Animal class
Animal is a generalization of Dog*

Scooby-Doo

A Little Quiz (cont'd)…

- #3 Class or Object?

Animal

The concept of *polymorphism*!

Bird

Dog

Questions so far…

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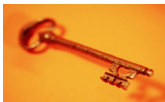UNIVERSITY

Key Points
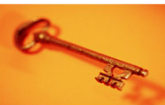
- Many classes already exist and are at our disposal when we design a database
- We use *inheritance* to add capabilities
  - A *subclass* inherits from its *superclass*
  - i.e., a *child* inherits from its *parent*

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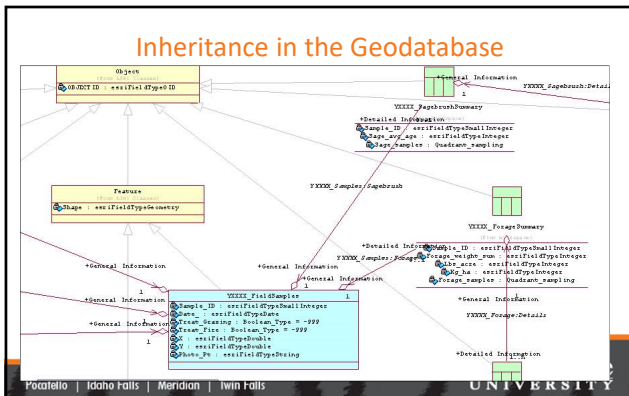UNIVERSITY

Additional Key Concepts

- Identify behaviors and relationships between classes
  - Inheritance
  - Aggregation
  - Dependency
- Understand *class attributes* and *object properties*

Note: a Class attribute is not to be confused with the attributes/fields of a table.

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5

Inheritance in the Geodatabase

Defining a CLASS

- After a CLASS has been identified we can *Define*:
  - Its *behavior* (i.e., *Methods (verbs))*
  - And its *attributes*

BEHAVIOR

Relationships Between CLASSES

- A key behavior is the relationship or interaction between classes
- We have learned about inheritance as one (1) type of relationship that may exist between classes
- There are three (3) important relationship types

Inheritance

Aggregation

Dependency

1- Inheritance

- *Is-a* relationship
- Relationship between a more specialized class (*subclass*) and a generalized class (*superclass*)
- Every…
  - Savings account *is a* bank account
  - DVD rental *is a* rental
  - Dog *is a* mammal
  - Parcel *is a* polygon

2- Aggregation

- *Has-a* relationship
  - Each Dog *has a* Paw (dog is not a generalization of paw!)
- One class (Appendages) contains references to another class (Dog)
- Each line *has a* vertex (actually, at least two vertices (nodes))
- FYI… Aggregation is also known as Composition (one class is composed of things from another class(es))

7

Example

- Car **is a** Vehicle – Inheritance

- Car **has a** set of Tires – Aggregation
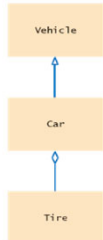
Figure 6
UML Notation for
Inheritance and Aggregation

Vehicle

Car

Tire

3- Dependency

- Dependency occurs when a class uses or relies on another class
- This is a *Uses* relationship
  - Example: an application may depend on the `Scanner` class to read input
  - ArcGIS depends upon the `Mouse` class to enable user interaction

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Class Diagram

BankAccount

Attributes

balance

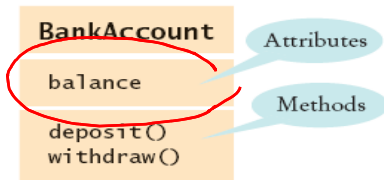Methods
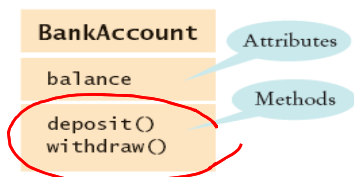
deposit()
withdraw()

What type of Method behaviors are these?

8

This is an Example of Dependency

- The Deposit CLASS interacts with the Bank Account class to modify the Balance attribute.

ATTRIBUTES

Class Diagram

BankAccount

balance — Attributes

deposit()
withdraw() — Methods

Attributes help define a given class and instantiate it into an object

9

Brainstorm….the Dog Class

- Name of the class =
- Methods=
  - Example of inheritance
  - Example of aggregation
  - Example of dependence
- Attributes?

Dog

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Instantiate into an *Object*
(to make into an instance)

- Three features characterize objects:
  - Identity: specific attribute (property) settings have been made for the class. This distinguishes it from all other objects.
  - State: Describes the data stored in the object WHERE DID THIS COME FROM?
  - Behavior: describes the method in the object's interface through which the object can be used (how do we make the dog bark?)

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Instantiating the Dog CLASS
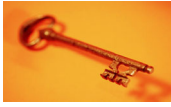
- CLASS (DOG)
- Attributes (Properties)
  - NAME = Scooby-Doo
  - HEIGHT = 36
  - WEIGHT = 145
- Methods
  - [Uses] bark- "Rooby roo"
  - etc.

Scooby-Doo

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10

Key Concepts

- Understand the difference between a CLASS and an OBJECT
- Understand new terms:
  - Encapsulation, polymorphism, superclass, subclass, behavior, attributes, instantiation
- Understand --and be able to differentiate-- the three types of behaviors

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Database Design Concepts and Practices

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Basic Steps in Database Design

- ☑ Understand and document the business' needs.
  - Problem statement
  - Business object types
  - Business relationships
  - Business constraints
- ☑ Create an ERM
- ☑ Data and process inventory
- ☑ Develop tuple types
- ☑ Tuple types to tables
- Integrity
- Implement the database

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11

Today's goal

- Become more familiar with database design.
- Learn to read and interpret a database design (aka, schema).

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Database Design

- Why spend so much time and effort?
  - Efficiency (speed, storage)
  - Client satisfaction
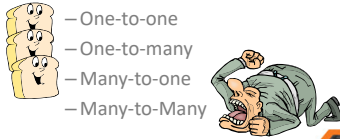 - Flexibility
  - Cost savings realized

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Design Considerations

- Basic steps (described earlier)
- Data types (Data Modeling)
- Normalization
- With >1 table, relationships <u>must</u> be examined

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Relationships

- Determine where relationships exist between tables
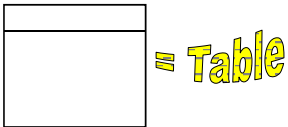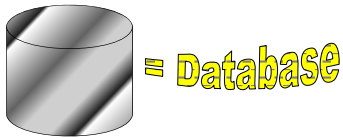- Determine the type of relationship that exists
  - One-to-one
  - One-to-many
  - Many-to-one
  - Many-to-Many

Generic Design Symbology

= Database

= Table

Generic Table Symbology

Parcels
Parcel_ID
TRS
Value
Zoning

← Table name

← Divider

← List of all attributes stored in this table as they will appear in the table

13
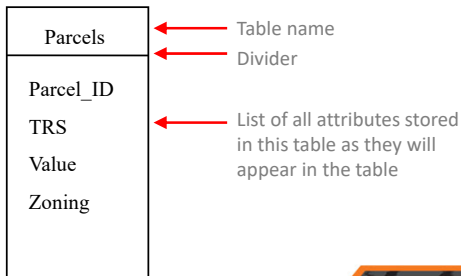
Generic Relationship Symbology

Table A

A_ID

Relate_field

Table B

B_ID

Relate_field
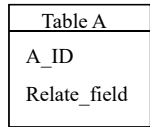
- Draw schema of RDB
- Determine relationship fields
- Connect
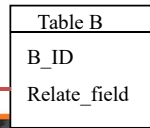
Symbolizing Relationship Type

Table A

A_ID

Relate_field

1..1

Table B

B_ID

Relate_field

1..M
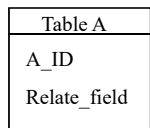
- One-to-one   1..1   1..1
- One-to-many   1..1   1..M
- Zero?
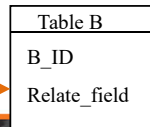
The Relationship Type…

- Also known as
  – Cardinality (ArcGIS terminology)
  – Multiplicity (UML terminology)

14

Object Oriented Design

How does it fit?

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Generalized Process

Inception

Elaboration

- Construction

- Transition

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Elaboration Exercise

You will be building a new database listing and describing all things that are RED in color. Let's start with a brainstorming list!

Top

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Professional Hints and Tips

- Getting ready for job interviews
  - Social Media
  - Dress for success

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Questions…

- Your assignment
  - Follow the ReadMe.txt document in this week's exercise folder.

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