Object Relationships

UML Class diagrams

Software Engineering Design
Lecture 4

UML Class Diagrams

- Describe the static structure of the system
  - classes,
  - class attributes,
  - associations between classes,
  - association roles and multiplicity

*classes*: features and facts about the problem domain which matter in the system we are building to support it

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UML First Pass: Class Diagrams

Class diagrams represent the structure of the system

Class diagrams are used:
- during requirements analysis to model problem domain concepts
- during system design to model subsystems and interfaces
- during object design to model classes.

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Classes

- A *class* represents a concept.
- A class encapsulates state (*attributes*) and behavior (*operations*).
- Each attribute has a *type*.
- Each operation has a *signature*.
- The class name is the only mandatory information.

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Instances

- An *instance* represents a phenomenon.
- The name of an instance is underlined and can contain the class of the instance.
- The attributes are represented with their *values*. 
Actor vs. Instances

- What is the difference between an actor and a class and an instance?
  - Actor:
    - An entity outside the system to be modeled, interacting with the system ("Pilot")
  - Class:
    - An abstraction modeling an entity in the problem domain, inside the system to be modeled ("Cockpit")
  - Object:
    - A specific instance of a class ("Joe, the inspector").

Exercise: Class Diagrams

- A book is composed of a number of parts
- Each part is composed of a number of chapters
- Chapters are composed of sections
- Draw a class diagram representing a book. Focus only on classes and relationships

Associations

- Associations denote relationships between classes
- A is associated with B is: A has to know about B
- The multiplicity of an association end denotes how many objects the source object can legitimately reference.

1-to-1 and 1-to-Many Associations

- 1-to-1 association
- 1-to-many association

Exercise 2: Class Diagram Attributes

- Extend your book class diagram to include the following attributes
  - a book includes a publisher, publication date and an ISBN
  - a part includes a title and a number
  - a chapter includes a title, a number and an abstract
  - a section includes a title and a number

Aggregation

- An aggregation is a special case of association denoting a "consists of" hierarchy.
- The aggregate is the parent class, the components are the children class.
Composition
- A solid diamond denotes *composition*, a strong form of aggregation where components cannot exist without the aggregate.

Generalization
- Generalization relationships denote inheritance between classes.
- The children classes inherit the attributes and operations of the parent class.
- Generalization simplifies the model by eliminating redundancy.

Exercise 3
- Create a class diagram to depict a house with a number of rooms. The house will have a floor area, a garage, a kitchen, and a number of exterior doors and windows. All rooms will have dimensions (length and width). Some rooms will be bedrooms; others will be bathrooms, toilets, or games rooms.