Systems Analysis & Design
CS183 Spring Semester 2008

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Course Textbook:
Systems Analysis and Design With UML 2.0
An Object-Oriented Approach, Second Edition

Chapter 2:
Introduction to Object-Oriented Systems Analysis & Design with the Unified Modeling Language

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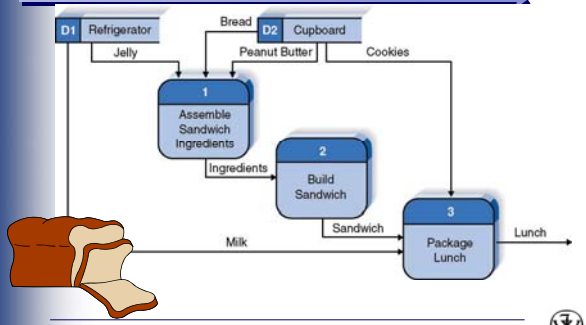
Objectives

- Understand the basic characteristics of object-oriented systems.
- Be familiar with the Unified Modeling Language (UML),V.2.0.

Non-Object-Oriented…

- Process models
  - Based on behaviour and actions
- Data Models
  - Based on static (fixed) representations of data

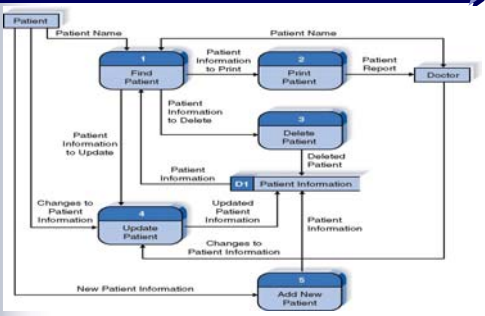
A "Simple" Process for Making Lunch



Process Modelling:

Data Flow Diagrams

Reading a DFD



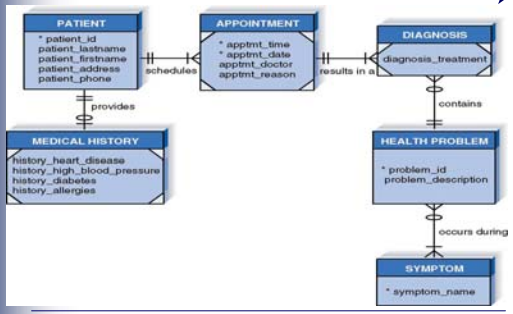
Data Modelling:

Entity-Relationship Diagrams (ERDs)

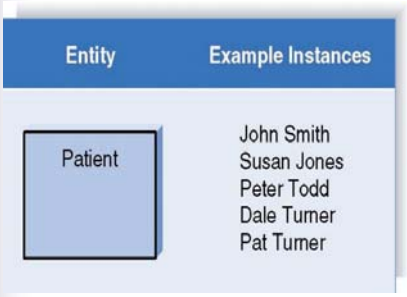
What Is an ERD?

- A picture showing the information created, stored, and used by a business system.
- Entities generally represent people, places, and things of interest to the organization.
- Lines between entities show relationships between entities.

An ERD Example



Entities and Instances



Object-Oriented Approaches

- Combine processes and data
- Are more ‘natural’

Basic Characteristics of Object Oriented Systems

- Classes and Objects
- Methods and Messages
- Encapsulation and Information Hiding
- Inheritance
- Polymorphism

Helpful Hint….’Compile’

- C Classes
- O Objects
- M Methods and Messages
- P Polymorphism
- I Inheritance
- (Last, but not least)
- E Encapsulation

Classes and Objects

- Class – Template to define specific instances or objects
- Object – Instantiation of a class
- Attributes – Describes the object
- Behaviours – specify what object can do

Classes and Objects

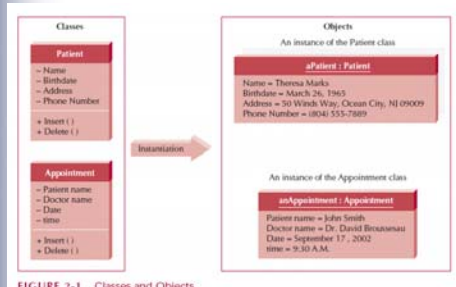


FIGURE 2-1 Classes and Objects

Methods and Messages

- Methods implement an object’s behaviour
  - Analogous to a function or procedure
- Messages are sent to trigger methods
  - Procedure call from one object to the next

Messages and Methods

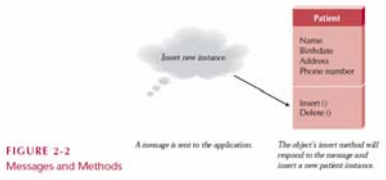


FIGURE 2-2
Messages and Methods

Encapsulation and Information Hiding

- Encapsulation
  - combination of data and process into an entity
- Information Hiding
  - Only the information required to use a software module is published to the user
- Reusability is the Key Point
  - an object is used by calling methods

Inheritance

- Superclasses or general classes are at the top of a hierarchy of classes
- Subclasses or specific classes are at the bottom
- Subclasses inherit attributes and methods from classes higher in the hierarchy

Class Hierarchy

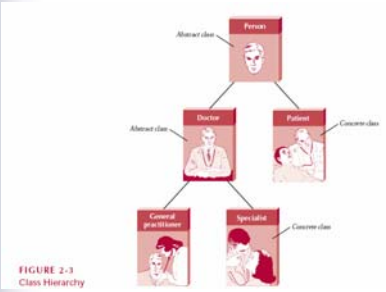


FIGURE 2-3
Class Hierarchy

Inheritance

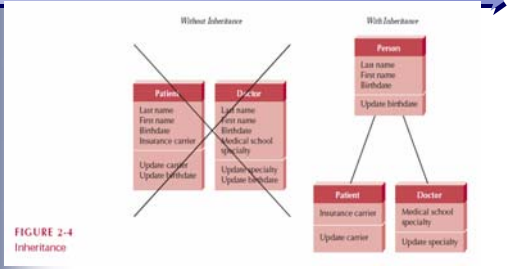


FIGURE 2-4
Inheritance

Polymorphism

- A message can be interpreted differently by different classes of objects
- e.g. A 'Create_Record' message is essentially the same thing, but causes 'Create_Patient_Record' by a 'Patient_Database' object, or 'Create_Doctor_Record' by a 'Healthcare_Staff_Database' object

Polymorphism & Encapsulation

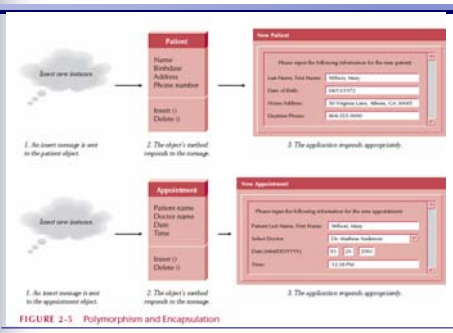


FIGURE 2-5 Polymorphism and Encapsulation

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Benefits of the Object Approach

Concept	Supports	Leads to
Classes, objects, methods, and messages	A more realistic way for people to think about their business Highly cohesive units that contain both data and processes	Better communication between user and analyst/developer Reusable objects Benefits from having a highly cohesive system (see cohesion in Chapter 13)
Encapsulation and information hiding	Loosely coupled units	Reusable objects Fewer ripple effects from changes within an object or in the system itself Benefits from having a loosely coupled system design (see coupling in Chapter 13)
Inheritance	Allows us to use classes as standard templates from which other classes can be built	Less redundancy Faster creation of new classes Standards and consistency within and across development efforts Ease in supporting exceptions
Polymorphism and Dynamic Binding	Minimal messaging that is interpreted by objects themselves	Simpler programming of events Ease in replacing or changing objects in a system Fewer ripple effects from changes within an object or in the system itself
Use-case driven and use cases	Allows users and analysts to focus on how a user will interact with the system to perform a single activity	Better understanding and gathering of user needs Better communication between user and analyst
Architecture centric and functional, static, and dynamic views	Viewing the evolving system from multiple points of view	Better understanding and modeling of user needs More complete depiction of information system
Iterative and incremental development	Continuous testing and refinement of the evolving system	Meeting real needs of users Higher quality systems

FIGURE 2-6 Benefits of the Object Approach

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The Unified Modelling Language, Version 2.0

- Functional Diagrams
- Structure Diagrams
- Behaviour Diagrams
  - Developers
    - Grady Booch
    - Ivar Jacobson
    - James Rumbaugh

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Functional Diagrams

- Activity Diagrams
  - Illustrate business workflows
- Use-Case Diagrams
  - Capture business requirements
  - Illustrates interaction between system and environment

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Structure Diagrams

- Class diagrams
  - relationship between classes
- Object diagrams
  - Relationships between objects

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Behaviour Diagrams

- Interaction Diagrams ....
  - Sequence diagrams
    - Show Time-based ordering and behaviour of objects and their activities
- State Machines ...
  - Behavioural State Machines (Statechart diagrams)
    - Examines behaviour of one class/object

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Object Oriented Systems Analysis and Design

- Use-case driven
- Iterative and Incremental
- Often associated with PHASED Development (a RAD methodology)

Basic Method for Development of Object Oriented Systems

- Identifying business value
- Analyze feasibility
- Develop workplan
- Staff the project
- Control and direct project
- Requirements determination
- Functional modelling
- Structural modelling
- Behavioural modelling
- Moving on to design

Summary

- Process oriented (Data flow diagrams) and Data oriented (Entity relationship diagrams)
- Basic characteristics of Object Oriented Systems Analysis and Design
- Introduction to Unified Modelling Language and the Unified Process