Object-Oriented Programming
An Overview
Contents

• OOP and software productivity
• Features and characteristics of OOP
• Major concepts of OOP
• OOP languages
• OOP and traditional design
• Advantages and disadvantages
What is Object-Oriented Programming

- A well-regarded and widely accepted programming technology
- Potential for much improved productivity
- Uses interacting program objects
- Objects are independent entities
- Objects respond to messages
Software Productivity Factors

- Modularity (separation of duties)
- Extensibility (responsive to future requirements)
- Modifiability (easy to make small changes)
- Flexibility (not cast in concrete)
- Maintainability (big savings)
- Reusability (don’t reinvent the wheel)
Software Engineering Techniques

- Data abstraction (hidden data representation)
- Program encapsulation (operations married to data)
- Software libraries (fixed reusable)
- Reusable Objects (flexible, reusable)
- Polymorphism (type-related generic operations)
- Maintenance automation
OOP Central Concepts

- Data abstraction
- Encapsulation
- Classification
- Inheritance
- Polymorphism
OOP Characteristics

- Class definitions
- Inheritance and class hierarchy
- Operator and Function overloading
- Generic classes
- Class libraries
OOP Languages

- Simula
- Modula
- Smalltalk
- Ada
- Objective-C
- CLOS (Common Lisp Object Standard)
- Standard C++
- Java
- Scripting languages: Perl, Javascript, Python
Traditional vs. OOP

- Procedural Programming:
  
  data structures + algorithms = Program

- OOP:
  
  objects + messages = Program
Class Definition

- Blueprint for building Objects
- Members: methods and fields
- private and public
- API—application programming interface
- relation with other classes
An Object

Public

Internal

working

interface

Method call
Inheritance Example

<table>
<thead>
<tr>
<th>Auto</th>
<th>Sedan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>2–4 Doors</td>
</tr>
<tr>
<td>Steering</td>
<td>4 Wheels</td>
</tr>
<tr>
<td>Breaks</td>
<td>Radio</td>
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<tr>
<td>Doors</td>
<td>Trunk</td>
</tr>
<tr>
<td>Wheels</td>
<td></td>
</tr>
<tr>
<td>Tires</td>
<td></td>
</tr>
</tbody>
</table>
Inheritance Example

**Sedan**
- 2–4 Doors
- 4 Wheels
- Radio
- Trunk

**Family Sedan**
- 4 Doors
- AC
- Automatic
- Big Trunk
- Fuel Economy
### Inheritance Example

<table>
<thead>
<tr>
<th>Sedan</th>
<th>Sports Sedan</th>
</tr>
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<tbody>
<tr>
<td>2–4 Doors</td>
<td>2 Doors</td>
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<tr>
<td>4 Wheels</td>
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<tr>
<td>Radio</td>
<td>Manual</td>
</tr>
<tr>
<td>Trunk</td>
<td>Tiny Trunk</td>
</tr>
<tr>
<td></td>
<td>Horse power</td>
</tr>
<tr>
<td></td>
<td>High Price</td>
</tr>
</tbody>
</table>
Inheritance Concepts

- Deriving new classes from old ones
- Single inheritance
- Partial inheritance
- Multiple inheritance
- Inheritance chain
Generic Classes

- Class definition for unspecified data
- Container class
- Flexible and reusable
Reusability Considerations

- Pipes / filter (ala UNIX): slow, restrictive
- Subroutine libraries: fast, inflexible
- Object libraries: flexible, and efficient
Design Approaches

- Ways to Break The Problem Down
- Procedural decomposition
- Data decomposition
- Object-oriented decomposition
Procedural Decomposition

- Also known as functional or traditional design
- Decompose the solution into major steps
- Decompose each major step further
- Decomposition procedural-oriented
Traditional Design Disadvantages

- Data and operations are separated
- No data abstraction or info hiding
- Not responsive to changes in problem space
- Inadequate for concurrent problems
Object-oriented Design Principle

- Identify interacting objects
- Characterize each object, establish attributes
- Identify the data and operations within each object
- Identify requests answered by each object
- Identity services required of other objects
- Establish relationships to other objects
- Group similar objects together
- Implement common super classes
- Implement different objects as classes
**Advantages**

- Responsive to changes
- Encapsulation
- Simplify Testing, debugging
- Easy to understand
- Avoid reinventing the wheel
- Easier to manage, to maintain
- Off-the-shelf software
Potential Disadvantages

- Over generalization
- Artificial class relations
- Unnecessary complications