Lecture 2
Intro. To Software Engineering and Object-Oriented Programming (1/2)

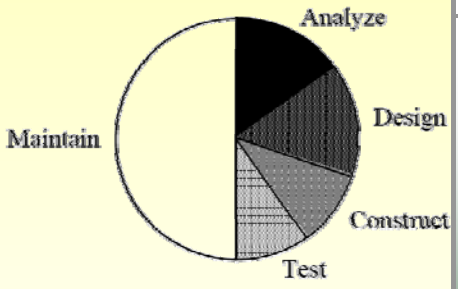
What Is Good Software(Program)?

Software Crisis

- rapid increases in computer power and the complexity of the problems (SW).
- Software technology can not follow the complexity.
- the difficulty of writing correct, understandable, and verifiable computer programs
- SW Symptoms
  - Unmanageable
  - difficult to maintain
  - Over-budget.
  - Over-time (late)
  - Poor quality
  - Software often did not meet requirements.
- Cause : complexity

Software Life Cycle

1. Requirement Analysis
   - Problem specification
2. Design
   - Program structure
   - Module specification
3. Implementation
4. Test
   - unit test
   - integration test
5. Maintenance



Fred Brooks states that over 90% of the costs of a typical system arise in the maintenance phase, and that any successful piece of software will inevitably be maintained.

Software Engineering

- Definition
  - The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software
  - The establishment and use of sound engineering principles in order to economically obtain software that is reliable and works efficiently
- Goals
  - produce a correct, efficient, and reliable software
  - Minimize the cost of software development and maintenance

Goals of SE

- Maintainability
  - the ability to easily make changes, enhancements, or improvements.
- Dependability
  - the ability to rely on the software to function properly when needed.
- Efficiency
  - the ability for software to use computing resources effectively (mainly space and time).
- Usability
  - the ability for the end user to easily and effectively put the software to proper use.

Software Properties

- **Modularity** – divide and conquer.
- **Encapsulation** – hide the implementation.
- **Localization** – collect similar things together.
- **Abstraction** – simplifying complex reality.
- **Uniformity** – make everything look similar.
- **Completeness** – do everything required.
- **Confirmability** – be able to prove that the software works properly.

Programming Methodology

- Unstructured Programming
- Procedural Programming
- Modular(Structured) Programming
- Object Oriented Programming

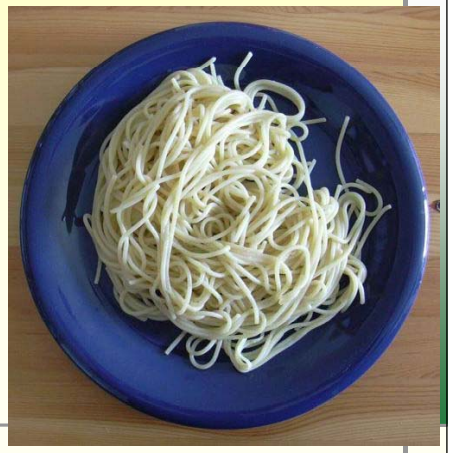
Unstructured Programming

- Consists of only one main program.
- a sequence of commands or statements
- Only global data
- Use goto statement

- Disadvantage
  - If there is the same statement sequence?

Spaghetti Code

- Code with complex and tangled structure
  - With goto's jumping all over the place
  - Almost impossible to understand
  - Hard to follow the flow
  - Difficult to modify



Procedural Programming

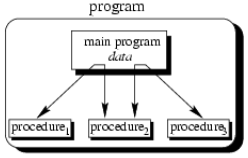
- The abuses of spaghetti code led to structured programming languages to support procedural programming

- Program
  - A sequence of procedure calls
- Procedure
  - the same seqeunce of statements

- More structured : reduce repetition
- More error-free

- Structured Programming
  - Top-down approach
  - Divide and conquer
  - Functional decomposition

Figure 2.3: Procedural programming. The main program coordinates calls to procedures and hands over appropriate data as parameters.



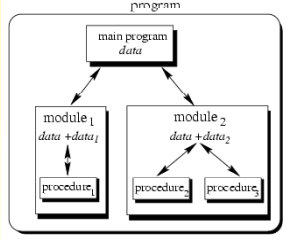
Modular Programming

- SW is composed of separate parts (module)

- procedures of a common functionality are grouped together into separate *modules*

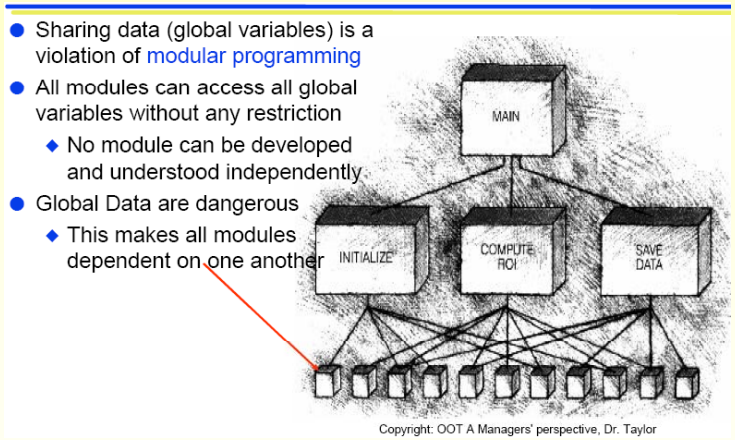
- module
  - Program uses modules through interface.
  - Interface : visible, implementation : hidden
  - Improve maintainability

Figure 2.4: Modular programming. The main program coordinates calls to procedures in separate modules and hands over appropriate data as parameters.



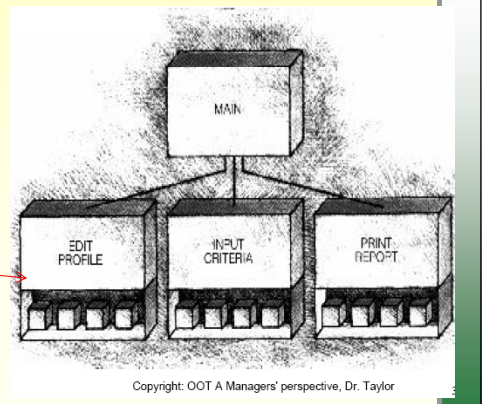
Don't use Global Variables

- Using global variables : unsafe!



Modularized Data

- Localize data inside the modules
- This makes modules more independent of one another
- Safe!

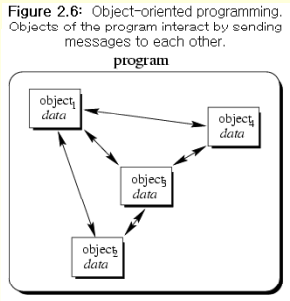


Problems of Procedural/Modular Programming

- Decoupled (seperation of) data and operations
- Doesn't work well in large systems
  - Difficult to debug, extend, and maintain
  - Code reuse limited
- Explicit creation and destruction
- Many others compared to OOP

OOP (Object Oriented Programming)

- Program consists of a set of interacting objects.
- Each object keeps its own state.
- Combine data and operation into an object

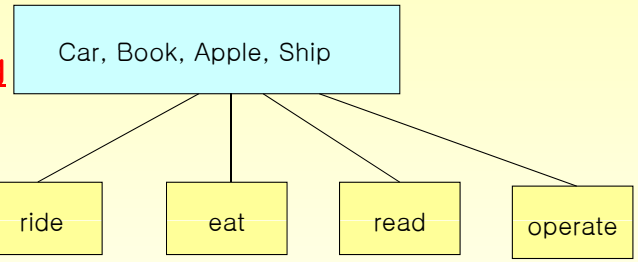


What is an Object?

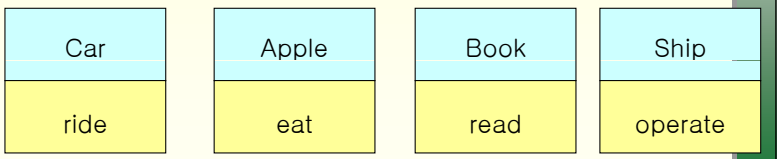
- Object is an instance of a class
- Objects have
  - identity
  - attribute
  - behavior (method)
  - relationships with other objects

Structured Programming vs OOP

Structured Programming



OOP

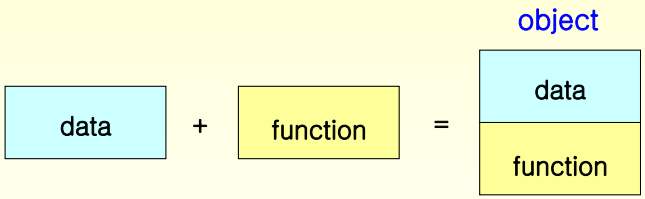


Structured Programming vs OOP

Structured Programming

data + function = program

OOP



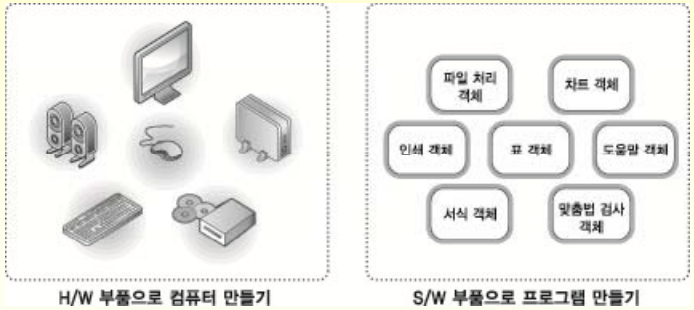
object + object = program

Views of OOP

- OOP does not consider the problem domain as just a flow of processings.
- OOP defines objects related to the problem domain and regards these objects communicate information each other (through message passing).
- On the other hand, structured programming treats data and operations independently even though they are related.

Software Components(부품화)

- In OO programs, an object works as a component(부품) of software
- Interface of an object should be well defined.



H/W 부품으로 컴퓨터 만들기 S/W 부품으로 프로그램 만들기

Why Object Oriented?

- Good for developing large software
- Maintainability
- Reuse software, not rewrite
- Increase
  - Programmer productivity
  - Quality of software
  - Understandability of software
  - Scalability (extensibility,reusability) of software
  - Lifetime (maintainability) of software