Subject:
Object-oriented analysis and design

Chapter 7: Design Patterns

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Design patterns

- **Introduction: Why a design pattern?**
- **History of design pattern**
- **What is a design pattern**
- **How we describe design pattern**
- **Classification of design pattern**
- **Example of design pattern**
- **Conclusion**

Why a design pattern

- Reusability: one of Wasserman's rules (1996) for an efficient and actual SE discipline
- Helping new designers to have a more flexible and reusable design
- Improving the documentation and maintenance of existing system by furnishing an explicit specification of class and object interactions and their intent

History of design pattern

- 1979:Christopher Alexander,architect, “The Timeless Way of Building”,Oxford Press
- 1987:OOPSLA (Object Oriented Programming System),Orlando, presentation of design pattern to the community OO by Ward Cunningham and Kent Beck
- 1995:Group of Four alias E.Gamma, R.Helm,R.Johnson and J.Vlissides : “Design Pattern:Elements of Reusable OO software”

What is a design pattern

- A design pattern is a descriptions of communicating objects and classes that are customized to solve a general design problem in a particular context

- A pattern is made by four elements:
  - name
  - problem
  - solution
  - consequences

Name of design pattern

- Describe a design problems and its solutions in a word or two
- Used to talk about design pattern with our colleagues
- Used in the documentation
- Increase our design vocabulary
- Have to be coherent and evocative

Problem

- Describes when to apply the patterns
- Explains the problem and its context
- Sometimes include a list of conditions that must be met before it makes sense to apply the pattern
- Have to occurs over and over again in our environment

Solution

- Describes the elements that make up the design, their relationships, responsibilities and collaborations
- Does not describe a concrete design or implementation
- Has to be well proven in some projects

Consequences

- **Results and trade-offs of applying the pattern**
- **Helpful for describe design decisions, for evaluating design alternatives**
- **Benefits of applying a pattern**
- **Impacts on a system's flexibility, extensibility or portability**

Description of design pattern

- Pattern name and classification
  - contains the essence of pattern
  - Become part of your design vocabulary
- Intent
  - What does the pattern do ?
  - What particular problem does it address ?

Description of design pattern

- Motivation
  - Illustrate a design problem and how the class and the object structures solve the problem
- Applicability
  - In which situations the pattern can be applied?
  - How can you recognize these situations?

Description of design pattern

- Structure
  - Graphical representation of the classes and their collaborations in the pattern
- Participants
  - Class
  - Objects
  - Responsibilities

Description of design pattern

- Collaborations
  - How the participants collaborate to carry out their responsibilities
- Consequences
  - How does the pattern support its objectives?
  - What are the trade-offs and results of using the pattern?

Description of design pattern

- Implementation
- Sample Code
- Known Uses
  - Examples of the pattern found in real systems

Description of design pattern

- Related Patterns
  - What design patterns are closely related to this one?
  - What are the important differences?

Classification of design patterns

- ***By purpose and by scope***
  - Creational patterns
    - Abstract the instantiation process
    - Make a system independent to its realization
    - Class Creational use inheritance to vary the instantiated classes
    - Object Creational delegate instantiation to an another object

Classification of design patterns

- Structural patterns
  - Class Structural patterns concern the aggregation of classes to form largest structures
  - Object Structural pattern concern the aggregation of objects to form largest structures

Classification of design patterns

- Behavioral patterns
  - Concern with algorithms and assignment of responsibilities between objects
  - Describe the patterns of communication between classes or objects
  - Behavioral class pattern use inheritance to distribute behavior between classes
  - Behavioral object pattern use object composition to distribute behavior between classes

Classification of design patterns

		purpose		
Scope	Class	**Creational**	**Structural**	**Behavioral**
		Factory Method	Adapter	Interpreter
				Template Method
	Object	Abstract Factory	Adapter	Chain of Responsibility
		Builder	Bridge	Command
		Prototype	Composite	Iterator
		Singleton	Decorator	Mediator
			Façade	Memento
			Flyweight	Observer
			Proxy	State
				Strategy
				Visitor

Example of design pattern

- **Singleton**
- **Composite**