SOFTWARE DESIGN
COSC 4353/6353

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OUTLINE

- What are Design Patterns?
- Why Design Patterns?
- Example
- Design Pattern Types

TOOLKIT, FRAMEWORK, AND DESIGN PATTERN

A toolkit is a library of reusable classes designed to provide useful, general-purpose functionality

E.g., Java APIs (awt, util, io, net, etc)

A framework is a specific set of classes that cooperate closely with each other and together embody a reusable design for a category of problems

E.g., Struts, JSF, WCF, WPF, etc.

A design pattern describes a general recurring problem in different domains, a solution, when to apply the solution, and its consequences

E.g., Factory, Façade, Singleton etc.

TOOLKIT, FRAMEWORK, AND DESIGN PATTERN

A framework embodies a complete design of an application

A pattern is an outline of a solution to a class of problems

A framework dictates the architecture of an application and can be customized (e.g. Entity)

When one uses a framework, one reuses the main body of the framework and writes the code it calls.

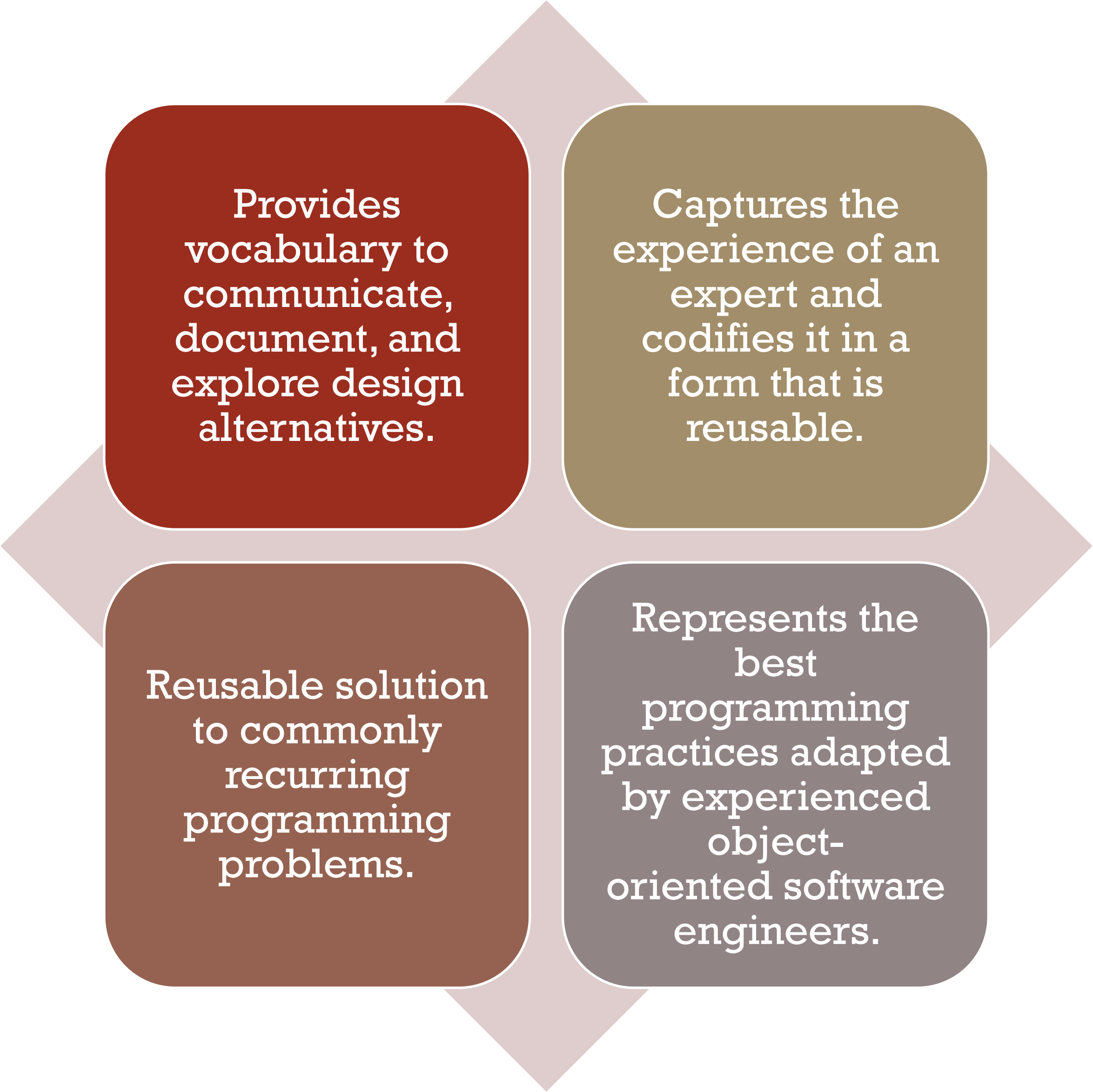
When one uses a toolkit, one writes the main body of the application that calls the code in the toolkit.

Design patterns are integral parts of frameworks and toolkits

WHAT ARE DESIGN PATTERNS?

- A reusable solution for common occurring problems
- A description or template for how to solve a problem
- Formalized best practices to speed up the development process
- Provide tested, proven development paradigms
- OOP/OOD compatible
- Documented in a platform independent format

WHY DESIGN PATTERNS?



Provides vocabulary to communicate, document, and explore design alternatives.

Captures the experience of an expert and codifies it in a form that is reusable.

Reusable solution to commonly recurring programming problems.

Represents the best programming practices adapted by experienced object-oriented software engineers.

WHY DESIGN PATTERNS?

- ✓ Effective software design requires consideration of:
  - short term and long term issues
  - improved code readability
  - ease of implementation and reproducible results
- DP facilitates achieve reliable and flexible code
- Patterns turn into components
- Resolves known issues and can capture unknowns

EXAMPLES

THE INTERMEDIARY PATTERN

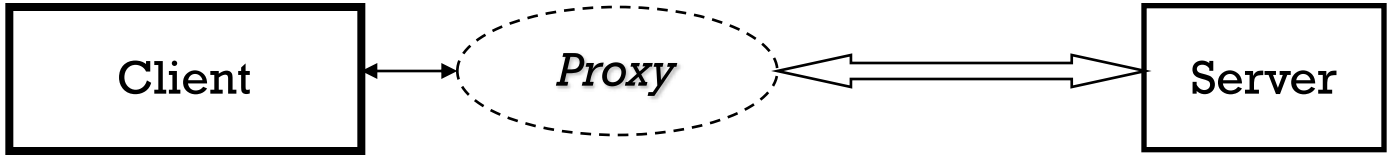
A client interacts with an intermediary

The requested services are carried out by the server/worker.

PROXY

Intermediary acts like a transmission agent

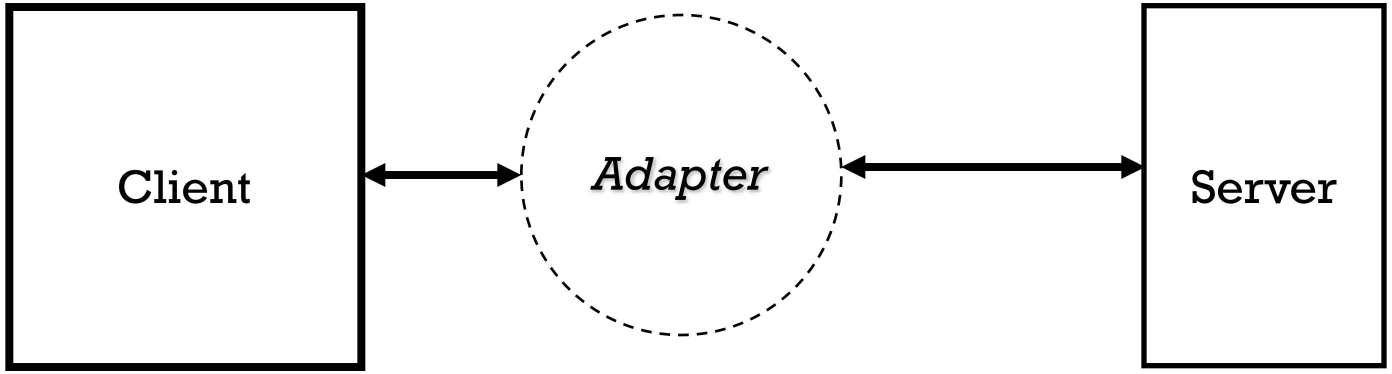
A *proxy*, in its most general form, is a class functioning as an interface to something else.



TRANSLATOR / ADAPTER

Intermediary acts like a translator between the client and the server.

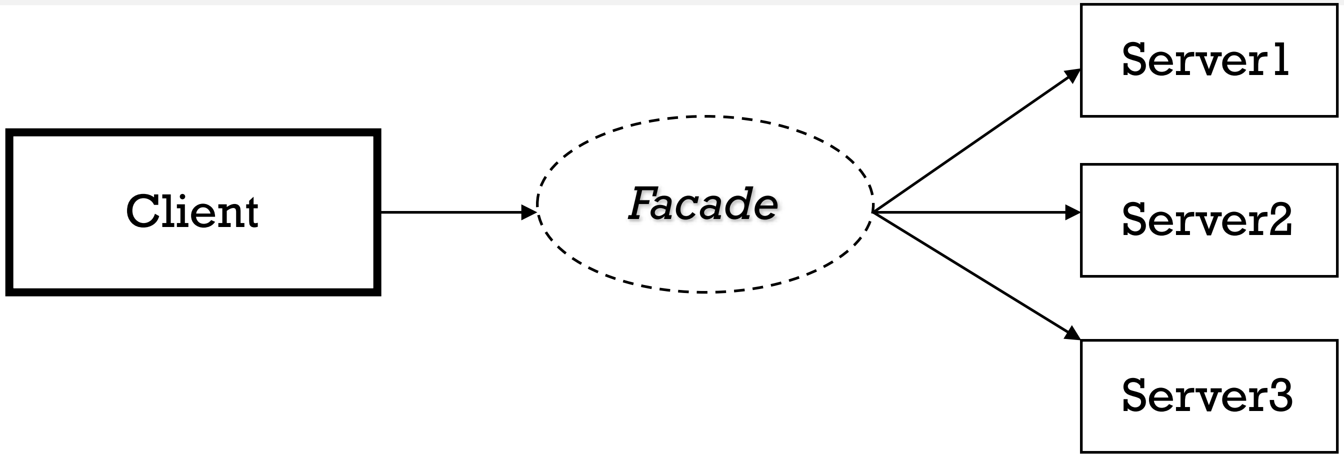
✓ E.g., Format/protocol conversions.



FACADE

Intermediary acts like a focal point distributing work to other agents.

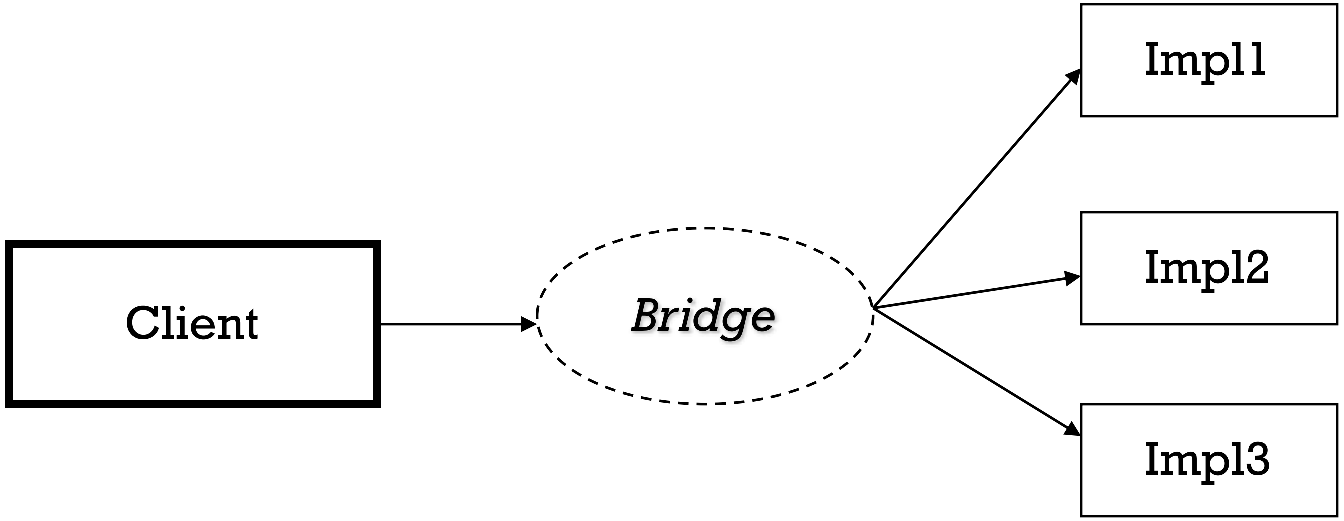
✓ E.g. telnet, ftp, … --> web-browser



BRIDGE/ABSTRACT FACTORY/HANDLE

- Intermediary defines the interface but not the implementation.

✓ E.g., Motif/Mac/Windows look and feel



DP STRUCTURE

Several sections defining:

a prototypical micro-architecture (classes and objects)

developers copy and adapt to their particular designs

solution to the recurrent problem described by the design pattern

PATTERNS – MUST HAVE

- Must explain why a particular situation causes problems
- Why the proposed solution is considered a good one
- Must define the boundaries and environments it is applicable in
- Must be a general approach with options

DP TYPES

- Based on the problem scope there are different types
- Creational
- Structural
- Behavioral
- Architectural

CREATIONAL

Creates object for you, rather than having you instantiate objects directly.

More flexibility in deciding which objects need to be created for a given case.

Abstract Factory	• groups object factories that have a common theme.
Builder	• constructs complex objects by separating construction and representation.
Factory	• method creates objects without specifying the exact class to create.
Prototype	• creates objects by cloning an existing object.
Singleton	• restricts object creation for a class to only one instance.

STRUCTURAL

These concern class and object composition

Defines ways to compose objects to obtain new functionality

Adapter

- allows classes with incompatible interfaces to work together by wrapping its own interface around that of an already existing class.

Bridge

- decouples an abstraction from its implementation so that the two can vary independently

Façade

- provides a simplified interface to a large body of code

Composite

- composes zero-or-more similar objects so that they can be manipulated as one object.

Flyweight

- reduces the cost of creating and manipulating similar objects

BEHAVIORAL

These concern how objects communicate with each other

Identifies common communication pattern

Chain of responsibility

- delegates commands to a chain of processing objects.

Command

- creates objects which encapsulate actions and parameters.

Interpreter

- implements a specialized language

Iterator

- accesses the elements of an object sequentially without exposing its underlying representation

State

- allows an object to alter its behavior when its internal state changes

ARCHITECTURAL

These address various issues in software engineering

Reusable solution to recurring problem in software architecture

Application	• create the composite architecture scalable, reliable, available and manageable
Data	• rules or standards that govern which data is collected, and how it is stored, arranged

HOMEWORK

Review class notes.

Additional reading:

Examples of Design Patterns

Start a discussion on Google Groups to clarify your doubts.