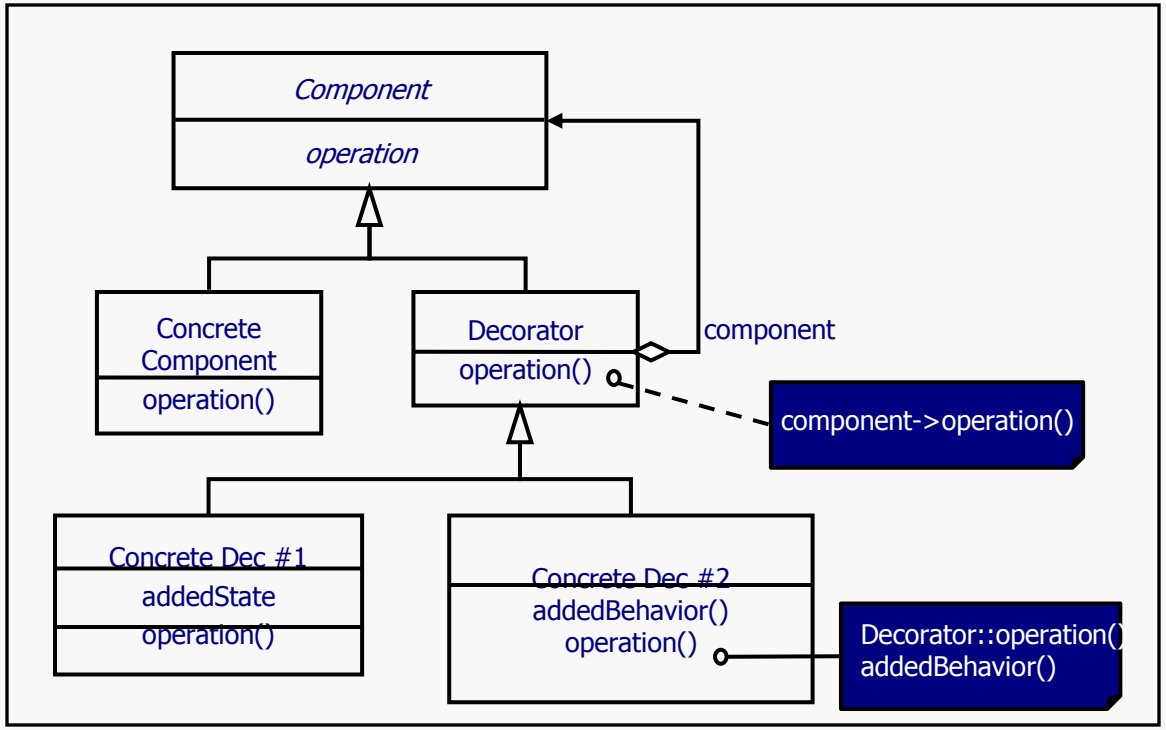
Engineering of Software Subsystems Course Overview



Up to this point you have only spent a little time talking about software design in general.

That is about to change because this course is about

Design

But we must digress to handle an administrative matter.

- Do you have an active account in the SE domain?
- Can you login to the machine?
- Do you have access to your section's *myCourses* website 4010-362-xx?
- Can you access the 362 course information on the SE web server?

http://www.se.rit.edu/~se362

By this point you each have some procedure that you follow to create an object-oriented design.

- What procedure do you follow?
- Go to the ~se362 website schedule for the first class. Open the Design Process document and capture your process in one or two sentences for each question.
- Deposit this in the Design Process dropbox.

You have learned low-level OOP design in CS courses and some larger design in SE361.

- CS1 – 3: first principles of OOP
  - ***Find the nouns → objects/state***
  - ***Find the verbs → behaviors; methods/functions***
  - ***Encapsulation, inheritance***
  - ***Programming***
- SE361: larger design problem
  - ***Some design principles and trade-offs***
  - ***Introduction to design patterns***
  - ***Introduction to static and dynamic modeling***

This course discusses standard patterns of structure and interaction between classes.

- Standard *patterns* of structure and interaction between classes
  - ***Design patterns***
- How to apply them to your application
  - ***Deal with subsystems at the higher level of abstraction provided by the patterns***
- What to do when it does not fit exactly
  - ***Evaluate options and analyze the trade-offs***

At the code level you know some standard patterns.

- How do you walk through an array in Java?

```
for (i = 0; i < array.length; i++) {
      // use the array element
}
```

Our level of discussion for this course is a small subsystem of 3 to 10 classes.

- Higher than what we've done before
  - ***Not specific data structures***
  - ***Not algorithmic approaches***
- Lower than whole architectures or frameworks
  - ***Not financial systems***
  - ***Not air-traffic control***
  - ***Not J2EE***

The next level of design requires an awareness of the principles that underlie “good” designs.

- All engineering is based on principles that have been learned over time and many applications and some failures.
- What software design principles have you seen?
- Go to the ~se362 website schedule for the first class. Open the Two Design Principles document and refresh your memory by answering the questions.
- Deposit this in the Two Design Principles dropbox.

There are some key object-oriented design concepts that we will stress.

- Increase cohesion where possible
- Decrease coupling where possible
- Behaviors follow data
- Prefer type (interface) inheritance over class (implementation) inheritance. “Program to the interface, not the implementation.”
- Prefer composition to inheritance
- Use delegation to “simulate” runtime inheritance.
- Law of Demeter “Only talk to your friends.”

What Are Patterns?

Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice.

Christopher Alexander

A pattern is a *general* solution to a *problem* in a *context*

- general -- outline of approach only
- problem -- a recurring issue
- context -- consider the expected design evolution

Patterns allow us to gain from the experience, and mistakes, of others.

- Design for re-use is difficult
- Experienced designers:
  - ***Rarely start from first principles***
  - ***Apply a working "handbook" of approaches***
- Patterns make this ephemeral knowledge available to all
- Support evaluation of alternatives at higher level of abstraction

The main classification for Gang-of-Four design patterns is by purpose of the pattern's intent.

- Creational: intention is mainly about creating objects
- Structural: intention is mainly about the structural relationship between the objects
- Behavioral: intention is mainly about the interactions between the objects

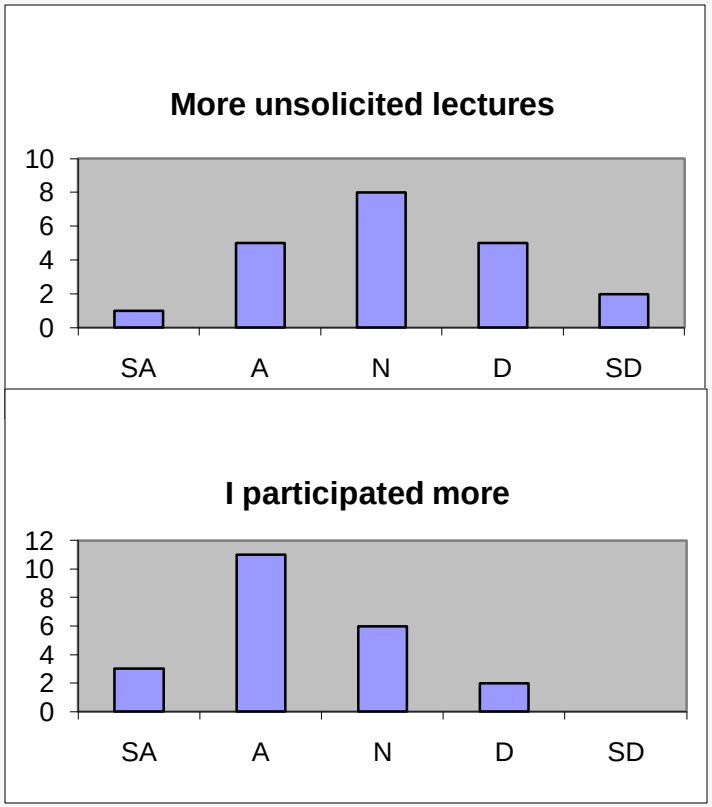
A second dimension for classification is binding time.

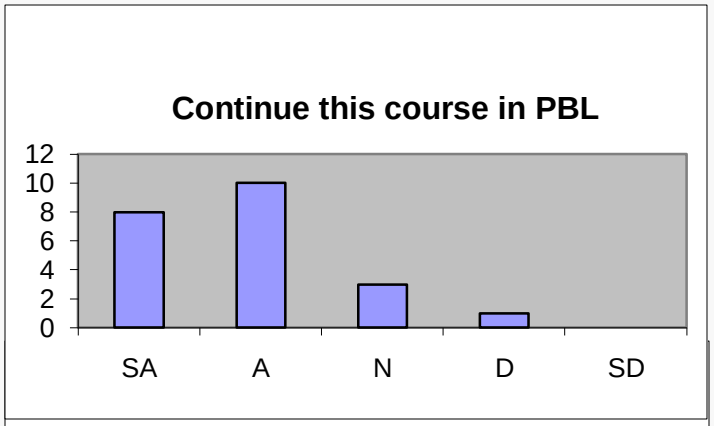
- Using inheritance is compile-time binding or class-based
- Using delegation or composition is run-time binding or object-based
- Creational
  - ***class => defer creation to subclasses***
  - ***object => defer creation to another object***
- Structural
  - ***class => structure via inheritance***
  - ***object => structure via composition***
- Behavioral
  - ***class => algorithms/control via inheritance***
  - ***object => algorithms/control via object groups***

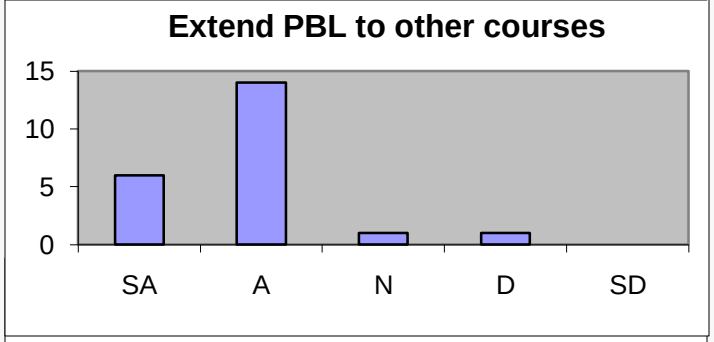
This course uses a problem-based learning methodology.

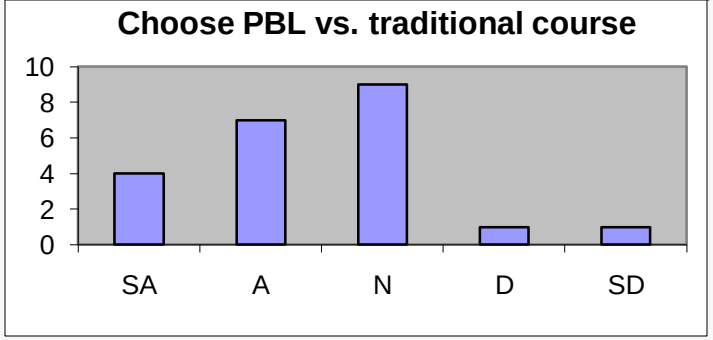
- Solving problems motivates your learning
- Lecturing is minimal and “on-demand” when requested by students
- This is better because
  - ***Learner actively engages the material***
  - ***Deeper learning when learner motivates need for knowledge***
  - ***More closely resembles true career situation***

The students were very positive about this teaching approach.









RIT Software Engineering

Other than wanting a passive experience the instructor can help you overcome PBL negatives.

- Negatives expressed or perceived by students
  - ***Thinking is hard***
  - ***Making mistakes is discouraging***
  - ***Not a passive sport anymore***
    - Identify needed knowledge
    - Initiate requests for additional guidance
  - ***Don't know enough to know what I don't know***
  - ***Not getting money's worth from the instructor***

Success in this course requires a different strategy than for other courses.

- Keep **all** work moving forward
  - ***Do not do questions and design serially!***
  - ***Questions are due first but …***
    - Less time is needed to do questions
    - If you only work on the questions until they are due you will never have enough time for the design and implementation work.
    - Work questions and design/implementation together
- Seek feedback every class
- Bring up the struggles for discussion
- Ask for lectures if that is your learning style

Course is divided into units with both individual and team activities.

- Individual activities
  - ***Unit 1 design activity***
  - ***Unit 2, 3, and 4 individual questions***
  - ***Unit 2, 3, and 4 quizzes***
  - ***Mid-term and final design exam***
  - ***Discussion participation***
- Team activities for units 2, 3, and 4
  - ***Answers to questions***
  - ***Design and implementation exercises***

Grading is divided into team and individual components by units.

Component	Percentage
Mid-Term Design	10
Final Exam	20
Unit 1 design problem	5
Unit quizzes (2 * 5)	10
Discussion participation	10
Unit questions (3 * 5)	15
Unit design/implementation exercises (3 * 10)	30

We start you off immediately thinking about the design of a software system.

- This class
  - ***Individually create a design for the stated problem***
  - ***Collaborate with others***
- Next class
  - ***Submit individual design at start of class***
  - ***Groups of students create a consensus design***
  - ***Designs will be presented***
  - ***Designs will be compared and contrasted***