

Course Number, Course Title and Semester Hours

CSC 462 Software Development/Capstone, 4sh (Offered Fall 2008)

Course Coordinator:

David J. Powell

Current Catalog Description

This capstone course combines a range of topics integral to the specification, design, implementation, and testing of a medium-scale software system. In addition to material on software engineering, the course includes material on human computer interaction and on professionalism and ethical responsibilities in software development.

Textbook

Head First Design Patterns, Eric Freeman and Elisabeth Freeman, O'Reilly, 2004, ISBN 0-596-00712-4

References

Coding Style Guide: The company that has written Java and the Java class libraries has established a standard for coding style and conventions. **This standard will be strictly enforced for project.**

JUnit tutorial is available from

<http://supportweb.cs.bham.ac.uk/documentation/tutorials/docsystem/build/tutorials/junit/junit.pdf>

Javadoc tutorial is available from

<http://supportweb.cs.bham.ac.uk/documentation/tutorials/docsystem/build/tutorials/javadoc/javadochome.html>

Course Goals

In this course, you will learn what design patterns are and how they help to solve common problems encountered in object oriented design and programming.

Prerequisites by Topic

Senior status. CSC 230 (Inheritance, Polymorphism, Swing GUI Fundamentals, Event Handling), CSC 335 (UML, OOD).

Major Topics Covered in the Course

1. SE 1. Software Design with focus on 15 Design Patterns.
2. SE 3. Software Tools and environments. Extensive time spent on JUnit testing, [tool](#) for UML generation (e.g. Omondo, ArgoUML or Poseidon) and Eclipse 3.4.
3. SE 2 Using APIs. Look closely at Java 6 libraries for design pattern implementations such as Applets, java.util.Observer and Observable, and java.util for Iterator.

Learning Objective/Outcomes with Cross Reference to CSC Program Outcomes

1. Use creational patterns to create objects. Program Outcome: 5, 8, 9, 10, 11
2. Use behavioral patterns to reduce complicated flow control and to simplify connections between objects. Program Outcome: 5, 8, 9, 10, 11
3. Use behavioral patterns to encapsulate algorithms and dynamically select them at run time. Program Outcome: 5, 8, 9, 10, 11

4. Use structural patterns to build complex, yet easy to use, composites from individual objects. Program Outcome: 5, 8, 9, 10, 11
5. Enhance the flexibility, adaptability, and maintainability of your code by using object patterns to replace inheritance with composition. Program Outcome: 5, 8, 9, 10, 11
6. Use Java 6 constructs for generic collections and advanced features of remote method invocation, reflection and serialization. Program Outcome: 10, 11
7. Use remote method invocation for client server application development. Program Outcome: 5, 8, 9, 11
8. Use standard test driven development practices. Program Outcome: 8, 11

Laboratory projects (specify number of weeks on each)

The course is heavily homework based. There are 8 homeworks. The homeworks are usually 1 week in duration with the exception of Homework 8. Homework 8 has two weeks duration and is larger in scope.

Estimate CSAB Category Content

	CO RE	ADVANC ED		COR E	ADVANC ED
Data Structures	_____	_____	Computer Architecture	_____	_____
Algorithms	_____	_____	Programming Languages	_____	.5
Software Design	1	2.5		_____	_____

The .5 advanced hours for programming languages was due to focus on reflection, generics and enumerations in java.

Oral and Written Communications

Every student is required to submit at least 0 written reports (not including exams, tests, quizzes, or commented programs) of typically 0 pages and to make one oral presentations of 10 minutes duration on model view controller implementation on a calculator problem.

Social and Ethical Issues

For a one hour lecture in the second class, I cover software copyright protection and how the use of proper documentation in the program file headers indicates date and owner of work.

Theoretical Content

The course covers Object Oriented Principles and Design Patterns over 28 periods.

Problem Analysis

Final project requires students to design a four way traffic intersection using design patterns and a GUI using model view controller.

The students have a five part homework that is built on an optimization framework. The students analyze the problem to implement the following patterns: Strategy, Observer, Singleton, Adapter, Factory and Proxy.

Solution Design

Final project requires students to use the following design patterns: Singleton, Factory, State, Mediator, Observer, Iterator and Strategy.

Course Assessment

Proposed changes from last offering in Fall 2007

Two small changes are made for this offering with respect to the final project based on the Fall 2007 student evaluations. The first change is that I will spend at least half of one class walking through the code and the background of the problem. Change 2 is that I will allow the students to work in pairs.

Items to be assessed, how they will be assessed and success criteria

The items to be assessed are based on course outcomes related to program outcomes 3 and 9. Program outcome 3 is “Students will choose and produce appropriate artifacts for the analysis, design and project management processes”. Program outcome 9 is “Students will be able to solve problems using procedural, functional and object oriented programming paradigms”. The items to be assessed for each program outcome are:

Program Outcome 3 will be assessed in terms of the following course learning outcomes:

1. Use creational patterns to create objects.
2. Use behavioral patterns to reduce complicated flow control and to simplify connections between objects
3. Use behavioral patterns to encapsulate algorithms and dynamically select them at run time.
4. Use structural patterns to build complex, yet easy to use, composites from individual objects.

The midterm exam will pose various problems to the students that will require them to choose the appropriate design pattern(s) from the creational, behavioral and structural design patterns listed in learning outcomes 1- 4 to solve the problems and to supply both UML and code for their design and implementation. I will consider a class average of 70 or better on the midterm exam to be successful.

Program Outcome 9 will be assessed in terms of the same four course learning outcomes but will be assessed against homework assignments.

1. Use creational patterns to create objects. (Homework 4)
2. Use behavioral patterns to reduce complicated flow control and to simplify connections between objects. (Homework 2)
3. Use behavioral patterns to encapsulate algorithms and dynamically select them at run time. (Homework 2 and 5)
4. Use structural patterns to build complex, yet easy to use, composites from individual objects. (Homework 3)

The learning outcomes are assessed by hands on practical application using Java 6 on the graded, individual homework assignments listed above. Each assignment has a grade rubric for the detailed evaluation of the specific pattern or design patterns emphasized on the assignment. I expect a 70% pass rate on each homework.

Assessment data and analysis

Program Outcome 3: The midterm had three questions that tested creational, behavioral and structural design patterns. The specific patterns tested were Decorator (structural), Command (behavioral), Singleton (creational) and Observer (behavioral). The overall midterm average of the nine students in the course was 85.03 which far exceeded the goal of 70. The distribution of grades is shown in Figure 1 and shows that eight of the nine students (88%) individually passed

the goal of 70 with one student performing poorly. Without question, this is the finest capstone class that I have had in the past four years. The average score on the test was approximately 17 points higher than the previous year. Program outcome 3 was clearly met.

Grade Distribution	
greater than 100	0
90 - 100	5
80 - 89	2
70 - 79	1
60 - 69	0
50 - 59	0
40 - 49	0
30 - 39	1
20 - 29	0
10 - 19	0
0 - 9	0
less than 0	0

Figure 1: Midterm Grade Distribution

Program Outcome 9: Table 1 shows the student averages on Homeworks 2, 3, 4 and 5. The students were very strong on hands on programming skills for creational, behavioral and structural design patterns. The individual scores were very high with all students on each homework meeting the goal of 70. The minimum class average on an assignment was 89.11 far exceeding the goal of 70. Program outcome 9 was clearly met.

Homework	Design Pattern(s)	Class Average
Homework 2	Strategy and Observer	93.67 (82.75 Low -100 High)
Homework 3	Decorator	89.11 (70 Low – 100 High)
Homework 4	Singleton and Factory	95.56 (74 Low – 100 High)
Homework 5	Adapter	94.33 (85 Low – 100 High)

Table 1: Class Averages on Homework Assignments 2-5

Proposed changes for next offering in fall 2009

No changes are proposed. This semester the change to using teams on the final project was very successful. The final project is at the end of the semester and the use of pairs helped motivate the students to put in the time and effort that they might not have done otherwise. I will repeat the use of teams on the final project for 2009.

I increased the difficulty of homework 6 and had the students develop a RMI proxy which had the client also act as a server and the server acting as a client to implement the Observer Design Pattern. I was very pleased with the student average of 92 as I taught only the RMI concepts and did not review how to implement the dual role of being both a client and a server. Instead I pointed them to a paper that discussed the implementation. My goal was to provide them a chance to demonstrate lifelong learning and the ability to use external sources to solve a problem. I was very pleased with the result.

I have used the same book for 4 years. It is a fantastic book but needs to be updated. The book was written when Java 1.4 was the latest release and the current release is now 1.6 which has features such as generics and enumerations that the book needs to incorporate. I plan to keep an

eye out for a new version. However, the book is so outstanding that if a new edition is not published then I would recommend using the old book for another year.