CSU 670

August 28, 2003

Software Development — Syllabus Fall 2003
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The syllabus is subject to change based on class reaction.

`http://www.ccs.neu.edu/research/demeter/course/topics-covered/topics-covered`

contains a good overview of computer science topics covered in this course. Six of nine important areas are touched. Three fundamental computer science processes are touched: theory, abstraction and design. And 5 of 12 recurring computer science concepts are touched.

This course provides state-of-the-art techniques and concepts for software development with a focus on proper separation of concerns. We will review the history of software development and encounter different techniques for separation of concerns like functions and objects. We will identify limitations in current software development practice that lead to bad separation of concerns. We will touch on general-purpose aspect-oriented techniques (AspectJ) that lead to better separation of concerns. Then we will identify limitations in those general-purpose techniques and point to special purpose aspect-oriented techniques. We will use the Demeter Method as an example of a special purpose aspect-oriented technique.

The goal of proper separation of concerns in software development is to make programs look like designs.

The course will also cover the people skills needed in agile software development. How do you write requirements so that customers can understand them; how to do small iterations in the development cycle to give customers feedback; how to do design reviews with your peer software developers; etc.

The course will also teach you very strong pattern matching skills that are needed for proper separation of concerns.

You learn the Demeter Method for object-oriented software development which will hopefully make you at least 4 times as productive as a Java software developer compared to software

development without the method. In the first few weeks you learn the method which you apply in the remaining weeks to your project. The project will be done in groups.

Assume that you could do your project in 200 hours of Java programming without using a good method. Instead of working hard, we will work smart. We will spend 50 hours on learning the Demeter Method and then you spend 50 hours on doing your project in Java using the Demeter Method. Since you will be at least 4 times as productive, you will still finish your 200 hour project in 50 hours only. Instead of spending 200 hours on the course, which would be excessive, you can accomplish the same in a total of 100 hours AND learn very useful object-oriented technology.

Designing and programming will be done in a structure-shy, grammar-based, object-oriented style. All assignments and the project will be written directly or indirectly in Java.

This course does not have Java as a prerequisite, however you are expected to learn a small subset of Java from the recommended text book or from another good Java book of your choice.

The lectures gradually introduce you to programming adaptively. First we program adaptively in pure Java using the DJ library. Hw 1 and hw 2 exercise this knowledge. In later homeworks and the project we use a small extension to Java to write our adaptive programs as behavior files. Structure will be defined by class dictionaries similar to XML schemas. Behavior files allow us in many cases to keep information about one concern in one file. The code will be spread automatically into multiple Java classes.

1. Week: Introduction to adaptive software development. The bus simulation example.

   - Pattern: Structure-shy Traversal.
     http://www.ccs.neu.edu/research/demeter/adaptive-patterns/pattern-lang-conv file: Structure-Shy-Traversal.html
   - Pattern: Selective Visitor.
     http://www.ccs.neu.edu/research/demeter/adaptive-patterns/pattern-lang-conv file: Selective-Visitor.html
   - Pattern: Class Graph (Class dictionaries and Unified Modeling Notation.)
     http://www.ccs.neu.edu/research/demeter/adaptive-patterns/pattern-lang-conv file: Class-Graph.html
   - Overview of pattern language, see: http://www.ccs.neu.edu/research/demeter/adaptive-patterns/pattern-lang-conv file: pattern-language-for-AP.html

   AP book chapters: selections from 1-4. UML Distilled: chapter 1: Introduction, and class diagram chapter 4: The essentials.

2. Week:

- Pattern: Structure-Shy Object
  http://www.ccs.neu.edu/research/demeter/adaptive-patterns/pattern-lang-conv file: Structure-Shy-Object.html
- Pattern: Growth Plan
  http://www.ccs.neu.edu/research/demeter/adaptive-patterns/pattern-lang-conv file: Growth-Plan.html

Writing simple adaptive programs using traversals and visitors. Introduction to DJ. Class dictionary design.

AP book chapters: selections from 5-8. UML Distilled: class diagram chapter 5: Advanced Concepts

3. Week:

   Strategy graphs. Decoupling classes: Law of Demeter Relationship to adaptive software. DJ continued. The class dictionary notation (graphical and textual). Design rule checking of class dictionaries. Class dictionaries as customizers for adaptive programs.

   AP book chapters: selections from 8-11. UML Distilled: chapter 6: Interaction Diagrams

4. Week:

   Visitor pattern. Adaptive Programming. Traversal strategies overview. More complex uses of visitors: multiple visitors and nested visitors. Improving the reusability of software designs. Parameterized class definitions.

   AP book chapters: selections from 10-12. UML Distilled: chapter 9: Activity Diagrams.

5. Week: Traversal strategies in detail. The Demeter Method for AP. Design notations for behavior. Growth Plan pattern. Developing a growth plan for implementation and testing. Design with maintenance in mind.

   AP book chapters: 13. UML Distilled: chapter 2: An Outline Development Process

6. Week: Midterm. Testing of adaptive, object-oriented software. UML Distilled: chapter 11: UML and Programming

7. Week: Class dictionary design and class dictionary transformations. The 11 kinds of class dictionaries. Project program design and implementation.

8. Week: Project program design and implementation.

9. Week: Project program design and implementation. Collaborations and adapters. Personalities. Further design patterns for adaptive object-oriented software development.

   http://www.ccs.neu.edu/research/demeter/adaptive-patterns/

10. Week: A comparison of object-oriented software development methodologies.

11. Exam week: Final.