CMPT 470/816 – Advanced Software Engineering

Course Outline

Meeting Times

Lectures: Tuesday & Thursday at 10-11:20am in Thorvaldson 205A

Instructors

Class Instructor: Nathaniel Osgood, Thorvaldson 280.6, 966-6102, *osgood@cs.usask.ca*
Office Hours: After Thursday's class (11:30-12:30pm) and by appointment

Texts

There is no textbook for the class. The following books contain many points of overlap with elements in different sections of the course:

Liskov B., Guttag J. 2001 *Program development in Java : Abstraction, specification, and object-oriented design*.

Chiusano P., Bjarnason R. *Functional Programming in Scala.* Manning Publications, Shelter Harbor, NY. 2015.

Martin, R.C.. 2009. *Clean code: a handbook of agile software craftsmanship.* Pearson Education.

Course Contents

This course builds on the understanding of software engineering presented in CMPT 370 and (to a lesser degree) CMPT 371. *The focus is on using safe, rigorous, flexible and versatile techniques for quality software engineering using current technologies and techniques.* The topics covered are not comprehensive, but are intended to complement those covered in undergraduate software engineering courses, particularly those at the University of Saskatchewan. Discussion will address basic software architecture and design, techniques for achieving encapsulation, modularity and abstraction of multiple types, rigorous and safe use of type and class hierarchies, aspect-oriented programming, the language-software engineering interface, and debugging.

Students who are interested in the other – and at least equally important – set of influences on the quality of software projects that extend from human dynamics, behaviour and management should consider taking or auditing CMPT 371, which focuses on discussion of those issues.

All students must be properly registered in order to attend lectures and receive credit for this course.

Workload

Students' grades will be determined by a combination of assignments, results of an exploratory investigation into a topic in software engineering of the student's choosing (mandatory for graduate students), the final exam (mandatory for undergraduates) and class participation. Undergraduate students interested in pursuing term projects may choose to hand in their term project as half of the final mark; graduate students who would like to balance their term project grade with other indications of mastery

make take the exam for half of the term project mark. We encourage students to consider conducting term projects in groups of 2-4 people (or larger upon instructor agreement).

The due dates and weighting for submissions differ for CMPT 470 and 816; each is described below:

For Undergraduate Students (in CMPT 470):

Default CMPT 470 option:

Deliverable	**% Mark**	**Due Date**
Problem set 1	12%	Feb 5
Problem set 2	12%	Mar 8
Problem set 3	12%	Apr 6
At home exercises for "flipped classroom"	27%	Throughout term
Final Exam (undergraduates only)	32%	TBD
Participation	5%	N/A

CMPT 470 project option (by request):

Deliverable	**Additional info**	**% Mark**	**Due Date**
Exploratory topic phase 1	Introductory proposal statement	0%	Jan 22
Problem set 1		6%	Feb 5
Exploratory topic phase 2	Intermediate report (sources, high-level outline)	0%	Feb 15
Problem set 2		6%	Mar 8
Problem set 3		6%	Apr 6
Exploratory topic phase 3	Exploratory project final report	28%	Apr 6
At home exercises for "flipped classroom"	*See description below*	18%	Throughout term
Final Exam (undergraduates only)		32%	TBD
Participation		4%	N/A

For Graduate Students (in CMPT 816):

Deliverable	**Additional info**	**% Mark**	**Due Date**
Exploratory topic phase 1	Introductory proposal statement	0%	Jan 22
Problem set 1		12%	Feb 5
Exploratory topic phase 2	Intermediate report (sources, high-level outline)	0%	Feb 15
Problem set 2		12%	Mar 8
Problem set 3		12%	Apr 6
Exploratory topic phase 3	Exploratory project final report	36%	Apr 6
At home exercises for "flipped classroom"	*See description below*	24%	Throughout term
Participation		4%	N/A

For the take-home exercises, the **goal is to engage seriously with the exercise**, with marks being "Pass" or "Fail". ***A pass will be granted as long as it appears that you have grappled seriously with the problem (regardless as to whether you provide a complete or even partial solution).*** The results should be handed in via moodle by class time.

In order to provide additional opportunity for students to develop understanding through discussion of course material, and reflecting the importance attached to in-class discussion, a significant fraction (8%) of students' grades will be based on class participation. In recognition of differences in communication styles and interests among students, this participation score will also reflect interaction in office hours, and discussions following class.

Assignment and course marks will be assigned on an individual basis. It is acceptable for individuals in CMPT 470/816 to work in pairs for assignments or for the final project, but only one copy of the artifact should be handed in for both individuals (with a clear indication of the collaboration), with the other individual handling in a "stub" that indicates with whom they collaborated. A single mark will be assigned for the artifact. Any penalties resulting from shortcomings in perceived integrity or quality of the artifact (e.g., incomplete sections or plagiarism or other concerns regarding academic honesty) will apply to both collaborators. As noted above, term projects must be pursued in teams of 2-4 people (or larger upon instructor agreement).

Topic Plan

Lecture slides will be provided via the course website when possible but are not guaranteed for all classes. Readings from Evans and other excerpts distributed or available electronically are shown below. Additional readings and URLs will be shown in the notes for the topic in question.

A preliminary lecture schedule is included below. Please note that because of the emphasis on class discussion, the exact timing of particular lectures (and associated reading) is subject to change. Updated schedules will be distributed throughout the term.

Date	Topic
Jan 5	Introduction (class coverage & omission) Abstraction, Modularity, Interfaces: Motivation and Introduction. Abstraction domains: Scaffolding & Domain Logic, Encapsulation via Specification
Jan 10	Liskov Substitution Principle
Jan 12	Subtyping & Subclassing 1: Subtyping
Jan 17	Subclassing 2: Subclassing Risks & Subclassing Interfaces 1
Jan 19	Subclassing 3: Mixins & Scala Traits
Jan 24	Functional Abstraction: Brief Intro to Scala Syntax, Type Parameterization
Jan 26	Functional Abstraction 1 : Functional Decomposition and Advantages
Jan 31	Functional Abstraction 2: Higher order programming and Closures
Feb 2	Functional Abstraction 2: Pipelines
Feb 7	Functional Abstraction 2: Functional Error Handling
Feb 9	Functional Abstraction 2: Streams, Non-Strictness and Incremental Processing
Feb 11	Glimpse of functional abstraction in Java 8
Feb 16	Glimpse of functional abstraction in Python
Feb 21	February break
Feb 23	
Feb 28	Value objects (video)
Mar 2	Monads and Functional State Management 1
Mar 7	Monads and Functional State Management 2
Mar 9	Abstracting cross-cutting concerns: Aspect Oriented Programming 1 (video)
Mar 14	Abstracting cross-cutting concerns: Aspect Oriented Programming 2, capturing aspects functionally
Mar 16	Architectural Patterns 1: Inversion of control, dependency injection and plug-in architectures, captured imperatively and functionally
Mar 21	Architectural Patterns 2: Reflection
Mar 23	Metalinguistic abstraction: Domain specific languages 1
Mar 28	Metalinguistic abstraction: Domain specific languages 2
Mar 30	Debugging 1
Apr 4	Debugging 2
Apr 6	Debugging 3 & Wrap-up

Assignment Submission and Evaluation

All homework will be distributed via Moodle. Completed assignments and other deliverables are to be submitted via moodle by 12 midnight at the close of their respective due dates (also shown in the course outline). Take-home exercises must be submitted by class time, or may be submitted in person in class. Because feedback on the answers provided will be provided directly in the submitted file, it is important that you submit your homework in a plain text or PDF form.

By instructor discretion, 10% per day may be deducted from late problem sets or term project phases up to a maximum of seven days. Problem sets and term project phases received after seven days will not receive any credit. Under certain extenuating circumstances extensions may be granted. Please contact the instructor or tutor prior to the due-date if an extension is required. Failure to complete the assigned course work may result in failure of the course.

Collaboration among students on problem sets or term project phases to be completed individually is limited to discussing concepts and clarifying issues. Nonetheless, each student is expected to produce his or her own solutions to the homework problems. For a further discussion, please see the section on Academic Honesty. The instructor particularly wishes to emphasize in the strongest terms the importance of properly citing and quoting sources used for class projects. Failure to do so can result in failure of the course by the student. Students are expected to adhere to University of Saskatchewan Academic Honesty policy. More information can be found at http://www.usask.ca/honesty/pdf/dishonesty_info_sheet.pdf

In addition to the above, the course includes a final exam for undergraduates. Failure to write the final exam will also result in failure of the course.