ENGG*4450 Large-Scale Software Architecture Engineering

Fall 2018
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 05, 2018

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1 Course Details

1.1 Calendar Description

This course introduces the students to the analysis, synthesis and design of large-scale software systems at the architectural level. This is in contrast to the algorithmic and data structure viewpoint of most software systems. Large-scale software systems are complex, execute on many processors, under different operating systems, use a particular or many language(s) of implementation, and typically rely on system layers, network connectivity, messaging and data management and hardware interfacing. The material covered includes architectural styles, case studies, architectural design techniques, formal models, specifications and architectural design tools. The laboratory sessions will expose the students to analyzing and redesigning an existing large-scale software system.

Pre-Requisite(s): (CIS*2420 or CIS*2520), ENGG*2100

1.2 Course Description

This course caps a series of several software development and programming courses that started with CIS*1500 and included courses on object oriented design, algorithms and data structures. This course introduces software engineering processes and tools to deal with the complexity involved in designing, implementing and testing of large scale software systems that may involve tens or hundreds of developers. We will emphasize open-source and distributed development models.

"Software development is no longer bound by time zones or national borders. Projects of all kinds – academic, commercial, and open source may have their GUI designers in Boston, their database team in Bangalore, and their testers in Budapest and Buenos Aires. Working effectively in such teams is challenging: it requires strong communication skills, and makes proper use of coordination tools such as version control and ticketing systems more important than ever." – Undergraduate Capstone Open Source Projects

1.3 Timetable

Lectures:
Tuesday 14:30 - 15:50 MCKN 121
Thursday 14:30 - 15:50 MCKN 121

Laboratory:

Section 01 Wednesday 11:30 - 13:20 THRN 1313
Section 02 Friday 14:30 - 16:20 THRN 1313

1.4 Final Exam

Monday, December 10, 11:30 - 13:30

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2 Instructional Support

2.1 Instructor(s)

Petros Spachos
Email: petros@uoguelph.ca
Telephone: +1-519-824-4120 x54012
Office: RICH 2505
Office Hours: Tuesday, 16:00 - 17:00

Wednesday, 12:00 - 13:00

2.2 Instructional Support Team

Lab Technician: Joel Best Information Technology Manager
Email: jbest@uoguelph.ca
Office: THRN 1416

2.3 Teaching Assistant(s)

Teaching Assistant: Evan Fallis
Email: efallis@uoguelph.ca

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3 Learning Resources

3.1 Required Resource(s)

Course Website (Website)
https://courselink.uoguelph.ca
Course material, news, announcements, and grades will be regularly posted to the ENGG*4450 CourseLink site. You are responsible for checking the site regularly.

Required Resources (Textbook)
There is no required textbook for the course.

3.2 Recommended Resource(s)

Recommended Resources (Textbook)

You will find it useful to consult a UML reference book from time to time. The following book is recommended:

- Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, 3rd edition, Addison-Wesley, 2003.

The following text is also a useful reference (for those who like textbooks):

- Bernd Bruegge and Allen H. Dutoit, “Object-Oriented Software Engineering”, 3rd edition, Prentice Hall, 2010.

The above books are on reserve at the library. You will need to refer to other books and readings throughout the course – we will provide pointers as needed.

3.3 Additional Resource(s)

Lecture Information (Notes)

All of the lecture notes will be posted on the web page as the term progresses.

Lab Information (Other)

The handouts for all the lab sessions will be provided within the lab section. All types of resources regarding tutorials, links to web pages, etc. can be found in this section.

Assignments (Notes)

Download the assignments according to the schedule given in this handout.

Exams (Notes)

Some final exams of previous years are posted as samples. The solutions are also posted for your convenience.

Miscellaneous Information (Other)

Other information related to Large-scale Software Architecture Engineering will be posted on the course website.

3.4 Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements and/or changes will be posted to the course website. **It is your responsibility to check the course website regularly.**

Electronic communication should be limited to the **course forum**, however topics of a personal and confidential nature (e.g. marks) should be emailed to the instructor: petros@uoguelph.ca. As per university regulations, all students are required to check their mail.uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

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4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Analyze client requirements and formulate use cases.
2. Reverse engineer a design through code inspection and reverse engineering tools.
3. Produce design specifications according to standards (e.g. UML).
4. Describe and compare different software development methodologies.
5. Master version control and concepts such as branching and merging.
6. Apply verification and validation strategies to software development.
7. Concisely and articulately communicate through written documentation for software projects.
8. Analyze risk in software projects.
9. Work effectively as part of a medium to large development team.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge Base	2, 5
1.1	Recall, describe and apply fundamental mathematical principles and concepts	2, 5
1.2	Recall, describe and apply fundamental principles and concepts in natural science	2, 5
1.3	Recall, describe and apply fundamental engineering principles and concepts	2, 5
1.4	Recall, describe and apply program-specific engineering principles and concepts	2, 5
2	Problem Analysis	1, 3
2.1	Formulate a problem statement in engineering and non-engineering terminology	1, 3
2.2	Identify, organize and justify appropriate information, including assumptions	1, 3
2.3	Construct a conceptual framework and select an appropriate solution approach	1, 3
2.4	Execute an engineering solution	1, 3

#	Outcome Set Name	Course Learning Outcome
2.5	Critique and appraise solution approach and results	1, 3
3	Investigation	1, 2, 4
3.1	Propose a working hypothesis	1, 2, 4
3.2	Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system)	1, 2, 4
3.3	Analyze and interpret experimental data	1, 2, 4
3.4	Assess validity of conclusions within limitations of data and methodologies	1, 2, 4
4	Design	1, 2, 3, 6, 7
4.1	Describe design process used to develop design solution	1, 2, 3, 6, 7
4.2	Construct design-specific problem statements including the definition of criteria and constraints	1, 2, 3, 6, 7
4.3	Create a variety of engineering design solutions	1, 2, 3, 6, 7
4.4	Evaluate alternative design solutions based on problem definition	1, 2, 3, 6, 7
4.5	Develop and refine an engineering design solution, through techniques such as iteration, simulation and/or prototyping	1, 2, 3, 6, 7
5	Use of Engineering Tools	2, 3, 5, 6
5.1	Select appropriate engineering tools from various alternatives	2, 3, 5, 6
5.2	Demonstrate proficiency in the application of selected engineering tools	2, 3, 5, 6
5.3	Recognize limitations of selected engineering tools	2, 3, 5, 6
6	Individual & Teamwork	9
6.1	Describe principles of team dynamics and leadership	9
6.2	Understand all members' roles and responsibilities within a team	9
6.3	Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude	9
6.4	Apply strategies to mitigate and/or resolve conflicts	9
6.5	Demonstrate leadership through, for example, influencing team vision and process, promoting a positive team culture, and inspiring team members to excel	9
7	Communication Skills	1, 3, 7, 9
7.1	Identify key message(s) and intended audience in verbal or written	1, 3, 7, 9

#	Outcome Set Name	Course Learning Outcome
	communication as both sender and receiver	
7.2	Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode	1, 3, 7, 9
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	1, 3, 7, 9
7.4	Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references	1, 3, 7, 9
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions	1, 3, 7, 9
9	Impact of Engineering on Society and the Environment	1, 6, 8
9.1	Analyze the safety, social, environmental, and legal aspects of engineering activity	1, 6, 8
9.2	Evaluate the uncertainties and risks associated with engineering activities	1, 6, 8
9.3	Anticipate the positive and negative impacts of introducing innovative technologies to solve engineering problems	1, 6, 8
11	Economics and Project Management	6
11.1	Apply project management techniques and manage resources within identified constraints	6
11.2	Identify risk and change management techniques, in the context of effective project management	6
11.3	Estimate economic impact and feasibility of an engineering project or design using techniques such as cost benefit analysis over the life of the project or design	6

5 Teaching and Learning Activities

5.1 Lecture

Topic(s): Orientation

Topic(s): Modeling & UML

Topic(s): Modeling Software Behaviour

Topic(s): Showing the Architecture

Topic(s): Software Re-Engineering

Topic(s): Software Processes

Topic(s): Requirements Elicitation & Use-Case Driven Design

Topic(s): Estimation and Prioritization

Topic(s): Risk Management

Topic(s): Project Management

Topic(s): Requirements Analysis

Topic(s): From Requirements to Design

Topic(s): Robustness Analysis

Topic(s): Verification & Validation

Topic(s): Testing

Topic(s): Static Analysis

Topic(s): Managing Software Teams

Topic(s): Software Quality

Topic(s): User Interface/User Experience

Topic(s): DevOps

Topic(s): Course Review and Final Exam Preparation

5.2 Lab

Topic(s): Introduction to lab

Topic(s): Object-oriented analysis and design

Topic(s): Assignment 1 help session

Topic(s): Version control with Git

Topic(s): Assignment 2 help session

Topic(s): Code review

Topic(s): Assignment 3 help session (1)

Topic(s): Assignment 3 help session (2)

Topic(s): Lab test

Topic(s): Automated testing

Topic(s): Assignment 4 help session

Topic(s): Exam review help session

5.3 Other Important Dates

- Thursday, September 6th, 2018: First day of classes
- Monday, October 8th, 2018: Thanksgiving holiday
- Tuesday, October 9th, 2018: Fall study day, no classes
- Friday, November 2nd, 2018: 40th class day, last day to drop classes
- Wednesday, November 28th, 2018: Last day of classes
- Thursday, November 29th, 2018: Make up for study day (Tuesday schedule)
- Friday, November 30th, 2018: Make up for Thanksgiving day (Monday schedule)

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6 Assessments

6.1 Assessment Details

Assignments (35%)

A1: Reverse Engineering & Design Recovery (5%), due Oct 2, by PDF to CourseLink Dropbox class
A2: Implementing Change Requests (10%), due Oct 23, by PDF to CourseLink Dropbox
A3: Requirements Analysis (10%), due Nov 13, by PDF to CourseLink Dropbox
A4: Build and Test a New Feature (10%), due Dec 4, by PDF to CourseLink dropbox

You will work in teams of approximately 6-7 students for all assignments. Teams will be announced in the first or second week of the term. Each team will submit a single report for each assignment. All members of a team will receive the same grade for the assignment, except in exceptional circumstances at the discretion of the instructor. Detailed instruction on the content of each assignment will be distributed during the term.

Lab Test (20%)

Date: Wed, Nov 7 - Fri, Nov 9
The lab test will be held Wednesday November 7 and Friday November 9 in the regular lab session. It will test all material covered in lectures and labs to-date.
See section 5.2 below for more details on labs.

Case Study (5%)

Presented in groups of 2. Each pair will select a Case Study from Volume 1 and 2 of *The Architecture of Open Source Applications* (http://aosabook.org/) to present in class.

Final Exam (40%)

Date: Mon, Dec 10, TBA

6.2 Course Grading Policies

Passing Grade: The passing grade is 50%.

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor. See the undergraduate calendar

for information on regulations and procedures for Academic Consideration of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Missed Lab Test: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of any missed test will be added to the final exam weight. There will be no make-up lab tests.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a make-up lab.

Late Assignments: Due dates for the assignments are firm. Assignments must be submitted to CourseLink Dropbox, before the start of the lecture on the specified date (i.e. by 14:30). Late submissions of assignments will not be accepted.

Clarification About Grades: If you have questions about the grade your assignment received, please ask your TA. However, all requests for re-marking must be made to the instructor. Any item that is remarked will be re-marked entirely. Therefore it is strongly suggested that you thoroughly review your entire document before making a re-marking request. Re-marking requests will not be honoured more than one week after the document has been returned

6.3 Relationships with other Courses & Labs

Previous Courses:

- CIS*2520: Data structures & algorithms.
- ENGG*2100: Design practices.

Follow-on Courses:

- ENGG*4120 or ENGG*4170: Collaborative design project.

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7 School of Engineering Statements

7.1 Instructor's Role and Responsibility to Students

The instructor’s role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

7.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor

informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

7.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

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8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

8.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

8.6 Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

8.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.
