

Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

SE 3310B: Theoretical Foundations of Software Engineering
Course Outline 2018

Description: An introduction to the theoretical foundations of Software Engineering including formal languages, automata theory, computability, and computational complexity. This course examines fundamental questions of software engineering including: What is computation? How hard (or easy) is it to compute various types of problems? What are the fundamental limits to what can and cannot be computed?

Instructor: Prof. Aleksander Essex.
TEB 235, 519-661-2111 ext. 87290, aessex@uwo.ca
Consultation hour: One weekly office hour, or by appointment
<https://whisperlab.org/teaching/theory-of-computation>

Academic Calendar Copy: <http://www.westerncalendar.uwo.ca/2015/pg960.html#36476>

Contact Hours: 3 lecture hours, 2 tutorial hours, 0.5 course.

Antirequisite: Computer Science 3331A/B, 3340A/B

Prerequisites: Registration in third year of Software Engineering program

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 100%.

Required Textbook: Michael Sipser. *Introduction to the Theory of Computation*, 3rd Edition, Cengage Learning, 2012.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	2/2	Use of Engineering Tools	Impact on Society and the Environment	
Problem Analysis	3/2	Individual and Team Work	Ethics and Equity	
Investigation	3/3	Communication Skills	Economics and Project Management	
Design		Professionalism	Life-Long Learning	

Notation: x/y , where x is the cognitive level (1: Remember, 2: Understand, 3: Apply) at which the attribute is assessed and y is the academic level (1: Beginner, 2: Intermediate, 3: Advanced) at which the attribute is assessed.

Topics and Specific Learning Objectives

1. Regular Languages

At the end of this section, students will be able to:

- a. Construct deterministic finite automata and non-deterministic finite automata to recognize various regular languages
- b. Construct regular expressions that generate various regular languages
- c. Prove a language non regular

2. Context-free Languages

At the end of this section, students will be able to:

- a. Construct pushdown automata that recognize various context-free languages
- b. Construct context-free grammars that generate various context-free languages
- c. Prove a language non context-free

3. Recursively Enumerable Languages

At the end of this section, students will be able to:

- a. Construct deterministic and non-deterministic Turing machines to recognize various recursively enumerable languages

4. Undecidability and Computability

At the end of this section, students will be able to:

- a. Understand the difference between Turing recognizable and Turing decidable languages
- b. Understand the difference between decidability and undecidability

5. Complexity Theory

At the end of this section, students will be able to:

- a. Understand the theoretic and practical relationships between several important computational complexity classes: P, NP, NP-Complete, NP-Hard, BQP, and BPP
- b. Understand the significance of the greatest open problem in computing: Does $P=NP$?
- c. Be able state important theoretic and real-world problems in each of these classes
- d. Gain a basic insight into the difference between classical and quantum computers

Evaluation

Course Component	Weight
Assignments	20%
Midterm Test	30%
Final Examination	50%

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination as well as on the laboratory. A final examination or laboratory mark < 50% will result in a final course grade of 48% or less.

Homework Assignments: There will be 4 assignments worth 5% each, which will be submitted electronically via OWL. Specific instructions and due dates will appear on the assignment. Email submissions will not be accepted.

Midterm Test: A midterm test will be held during the Tutorial session.

Final Examination: The final examination will be take place during the regular examination period.

Late Submission Policy: Assignments are due at 23:55 (Eastern Time) on their respective due dates. The assignment submission form in OWL will be configured to accept submissions *up to 48 hours* past the original due date. There will be no mark deductions for submissions made during this grace period, however course personnel will not give assistance on assignments after the due date. After the 48-hour grace period has elapsed, OWL will no longer accept submissions, and a mark of *zero* (0) will be recorded for un-submitted assignments. Email submissions are not accepted.

Use of English: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance: Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Missed Midterm Examinations: If a student misses a midterm examination, the exam will not be rescheduled. The student must follow the Instructions for Students Unable to Write Tests and provide documentation to their department within 24 hours of the missed test. The department will decide whether to allow the reweighting of the test, where reweighting means the marks

normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices: Electronic devices are permitted during lectures so far as, in the discretion of the instructor, they do not distract or disrupt the learning of others. Electronic devices are not permitted during exams and tests.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for making themselves aware of any information that is posted about the course, including regularly checking their Western e-mail and the course web site:

<https://whisperlab.org/teaching/theory-of-computation>

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services: Office of the Registrar, <http://www.registrar.uwo.ca/>
Student Development Centre, <http://www.sdc.uwo.ca/>
Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>
USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.