

**DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING****SOFTWARE ENGINEERING*****SE 3310 – Theoretical Foundations of Software Engineering*****Course Outline Fall 2025**

**COURSE 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?

**ACADEMIC CALENDAR:** SE 3310 A/B

[https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN\\_017644\\_1](https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_017644_1)

**PRE OR COREQUISITES:** Registration in the third year of the Software Engineering program

**ANTIREQUISITES:** Computer Science 3331A/B, 3340A/B

**CEAB ACADEMIC UNITS:** Engineering Science 100%

**INSTRUCTOR INFORMATION:**

**Name:** Aleksander Essex, Ph.D., P.Eng

**Office:** TEB 235

**Office Hours:** In most cases, directly after class. In special cases, by appointment.

**Phone:** 519-661-2111 ext. 87290

**Email:** aessex@uwo.ca

**CONTACT HOURS:**

**Timetable information is available at** <https://draftmyschedule.uwo.ca/>.

Lectures occur weekly starting Tuesday, September 9th. Tutorial sessions occur weekly starting on Friday, September 19th.

<b>LECTURE:</b>	Three hours: <b>Tuesdays</b> 5:30-6:30pm, <b>Wednesdays</b> 3:30-5:30pm
<b>TUTORIAL:</b>	Two hours: <b>Fridays</b> 3:30-5:30pm

**REQUIRED TEXT:** Michael Sipser. Introduction to the Theory of Computation, 3rd Edition, Cengage Learning, 2013. <https://faculty.cengage.com/works/9781133187790>

**GENERAL LEARNING OBJECTIVES (CEAB GRADUATE ATTRIBUTES)**

Knowledge Base	D	Engineering Tools		Impact on Society	
Problem Analysis	D	Individual & Teamwork		Ethics and Equity	
Investigation	I	Communication		Economics and Project Mgmt.	
Design		Professionalism		Life-Long Learning	

Notation: x represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Rating: I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e. g. no review).

**COURSE MATERIALS:** Weekly lecture notes will be available on the external course website. <https://whisperlab.org/theory-of-computation/>

Important dates and reminders are available on the OWL site. The material for this course will be taught in both lectures and tutorials; therefore, it is imperative that you attend each lecture and tutorial.

**UNITS:** SI

**COURSE TOPICS AND SPECIFIC LEARNING OUTCOMES:** This is a standard course in the theory of computation with some emphasis on applying the theory to practical software engineering situations, such as reasoning about broad technology trends like quantum computing and AI. Students will develop knowledge and skills that allow them to take an integrated approach to reasoning about the fundamental limits of software engineering.

The following table summarizes the course learning outcomes along with CEAB GAs where the GAs in bold indicate ones to be measured and reported annually.

	CEAB GA Indicators
<b>1. Regular Languages</b>	
a. Construct deterministic finite automata and non-deterministic finite automata to recognize various regular languages	PA1
b. Construct regular expressions to generate various regular languages	PA1
c. Prove a language is not regular (Pumping Lemma)	I1, I2, I3
<b>2. Context-free Languages</b>	
a. Construct pushdown automata to recognize various context-free languages	PA1
b. Construct context-free grammars to generate various context-free languages	PA1
<b>3. Recursively Enumerable Languages</b>	
a. Construct deterministic and non-deterministic Turing machines to recognize various recursively enumerable languages	PA1
<b>4. Undecidability and Computability</b>	
a. Understand the notion of Turing completeness and the difference between Turing recognizable and Turing decidable languages	KB4
b. Prove a language is undecidable (Turing's correspondence)	I1, I2, I3
<b>5. Complexity Theory</b>	
a. Understand the notions of worst-case running time and construct polynomial-time reductions between algorithms.	PA1
b. Understand the theoretic and practical relationships between several important computational complexity classes: P, NP, NP-Complete, NP-Hard, BQP, and BPP	KB4
c. Prove a given problem is in a given complexity class	I1, I2, I3
d. Understand the significance of the greatest open problem in computing: Does $P=NP$ ?	KB4
e. Be able state important theoretic and real-world problems in each of these classes	KB4
f. Gain a basic insight into the difference between classical and quantum computers	KB4

**EVALUATION:**

Name	% Worth	Assigned	Due Date	CEAB GAs ASSESSED
Assignment 1	5%	Friday Sept. 12 <sup>th</sup>	Tuesday Sept. 23 <sup>th</sup>	I1-1
Assignment 2	5%	Friday Sept. 26 <sup>th</sup>	Tuesday Oct. 7 <sup>th</sup>	I3-1
Assignment 3	5%	Friday Oct. 17 <sup>th</sup>	Tuesday Oct. 28 <sup>th</sup>	
Assignment 4	5%	Friday Oct. 31 <sup>st</sup>	Tuesday Nov. 18 <sup>th</sup>	
Assignment 5	5%	Friday Nov. 21 <sup>st</sup>	Friday Dec. 5 <sup>th</sup>	
Midterm Test	25%		Friday Oct. 24 <sup>th</sup> (during tutorial hour)	KB4-1, PA1-1
Final Exam	50%	TBD	TBD	I2-1

Note that the dates listed above are **tentative** and may be adjusted if needed

**COURSE POLICIES:**

All work submitted must be of professional quality in the requested format. Material that is handed in dirty, illegible, disorganized, or in an unapproved format will be returned to the student for resubmission, and the late submission penalty will take effect. An additional penalty of 10% may be deducted for poor grammar, incoherence, or lack of flow in the written reports.

**ASSIGNMENTS:** There will be 5 assignments worth 5% each, which will be submitted online in Gradescope. Assignments are due at 11:55pm on the due date (listed above) but are subject to a flexible deadline (see Late Submission Policy below). Email submissions will not be accepted.

**LECTURES:** Attendance in the lecture sessions is mandatory; however, attendance is not formally tracked. Students who miss a lecture should consult the course lectures posted online.

**TUTORIALS:** Tutorials run every week. The tutorial sessions will be used to (1) discuss assignments and solution strategies, (2) take up solutions to completed assignments, (3) answer questions about the course material, and (4) hold the mid-term test. Electronic solutions to the assignments and midterm will not be provided; therefore, attendance in the tutorial sessions is essential for success in the course. Attendance in the tutorial sessions is mandatory; however, attendance is not formally tracked. Students who miss a tutorial session are expected to arrange with another classmate to obtain the tutorial notes.

**MIDTERM TEST:** A one-hour midterm test will take place during one of the weekly tutorial sessions. The specific examination room will be announced at a later date. The midterm is in-person and closed-book. No notes, calculators or electronic devices are permitted. The content

of the test will be structured considering these factors. The test will consist of a mixed combination of multiple-choice and short-answer questions. The midterm is a designated assessment, meaning formal supporting documentation will be required for any student missing the midterm. A missed midterm will not be rescheduled. Instead, the mark value will be re-weighted into the final exam. For more information, consult Western's policies on academic consideration: [https://registrar.uwo.ca/academics/academic\\_considerations/](https://registrar.uwo.ca/academics/academic_considerations/)

**FINAL EXAMINATION:** A two-hour final exam will take place during the regular examination period. The final exam is in-person and closed-book. No notes, calculators or electronic devices are permitted. The content of the exam will be structured considering these factors. The exam will consist of a mixed combination of multiple-choice and short-answer questions. The course grade will be calculated based on performance in each of the course components listed above. The course does not require a passing grade on the final exam to pass the course.

#### **LATE SUBMISSION POLICY:**

This course employs flexible deadlines for assignments. The assignment deadlines can be found in the course outline above. For each assignment, students are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 48 hours (2 days) past the deadline without academic penalty.

The end of the 48-hour flexible submission grace period will coincide with a tutorial session, during which the assignment solutions will be discussed. In fairness to other students, the assignment submission website will not accept assignments after the tutorial session begins. Unsubmitted assignments will receive a mark of zero (0). There are no make-up assignments or other extra-credit opportunities for unsubmitted assignments.

**As flexible deadlines are used in this course, requests for academic consideration will not be granted.** If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week before the posted deadline.

It is your responsibility (a) to know the assignment due dates, (b) to understand the course late submission policy, and (c) to manage your time appropriately, including building resilience in your schedule against unforeseen delays.

**ATTENDANCE:** Attendance is mandatory for all lectures and tutorials; however, attendance is not formally tracked. Please refer to the course policies above.

**FACULTY OF ENGINEERING POLICIES:**

Students must familiarize themselves with the policies of the Faculty of Engineering

<https://www.eng.uwo.ca/electrical/pdf/2025-UG-Policy-and-Procedures.pdf>