

COURSE SYLLABUS

CMPT 364: AUTOMATA AND FORMAL LANGUAGES

Catalogue Description

Introduces the foundations of Computer Science. The theory of computation is explored through automata and formal languages. In particular, finite automata, grammars, Turing machines and applications to Computer Science such as dynamic modelling, computer architecture, lexical analysis and parsing are studied.

Prerequisite(s): CMPT 260 and 6 credit units in 200-level MATH or STAT.

Class Time and Location: Monday, Wednesday, Friday, 12:30pm - 1:20pm, GEOL 261.

Website: <https://moodle.cs.usask.ca/course/view.php?id=466>

Course announcements regarding assignments and examinations as well as lists of frequently asked questions and other information may and will be communicated to the class via this website. The student is responsible for reading this website regularly.

Instructor Information

Instructor Ian McQuillan

Contact: Email: mcquillan@cs.usask.ca,

Phone: (306) 966-2900

Location: Thorvaldson Building (Spinks) S423.

Course Objectives

The course objectives are as follows:

- to better understand the mathematical foundations of computer science,
- to gain experience with mathematical proofs generally,
- to understand the relationships between proofs and algorithms, and proofs of correctness of algorithms,
- to understand the notion of nondeterminism, and how it relates to determinism and computers,
- to understand the topics of regular languages, deterministic finite automata, nondeterministic finite automata, regular expressions, context-free grammars, pushdown automata, Turing Machines, undecidability, computational complexity, and other grammars,
- to gain an appreciation for applications of formal languages and automata.

Student Evaluation

Grading Scheme

Assignments	45%
Midterm Exam	20%
Final Exam	35%
Total	100%

The assignments will be due during class.

- Assignment 1: Friday January 20, 2017
- Assignment 2: Friday February 3, 2017
- Assignment 3: Friday March 3, 2017
- Assignment 4: Friday March 17, 2017
- Assignment 5: Friday March 31, 2016

The Midterm will be held Wednesday February 8, 2017 (tentatively to be held outside of class, at 7pm. The location will be announced during class and on the class website.)

Final Exam Scheduling

The Registrar schedules all final examinations, including deferred and supplemental examinations. Students are advised not to make travel arrangements for the exam period until the official exam schedule has been posted.

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

Textbook Information

Recommended Text

- John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 3rd Edition, Addison-Wesley, 2006.

Lecture notes will be provided online via the course website, however, lecture notes are not a substitute for attending class. Additional material and specific examples of concepts that are not present in the online lecture notes will be presented in class and only in class, thus, class attendance is essential to be successful in this course.

Lecture Schedule

Topic/Week/Date	Topic/Subtopics
Introduction to theoretical computer science	<ul style="list-style-type: none"> • Brief history of theoretical computer science • Overview of course
Mathematical preliminaries	<ul style="list-style-type: none"> • Review of sets, sequences, functions, graphs • Strings, languages • Proof by construction, contradiction, induction

<p>Regular languages</p>	<ul style="list-style-type: none"> • Deterministic finite automaton <ul style="list-style-type: none"> - Definition - Examples of DFA's and languages - Construction of a DFA from a computer program - Languages and automata versus inputs and algorithms - Applications: dynamic modelling, computer architecture, string matching • Nondeterministic finite automaton <ul style="list-style-type: none"> - Definition - Why silicon computers are not nondeterministic - Equivalence of languages accepted by nondeterministic finite automata to deterministic - ϵ-NFAs and equivalence to NFAs • Regular expressions <ul style="list-style-type: none"> - Definitions - Regular expression equivalence to finite automata - Applications: pattern matching, lexical analysis • Non-regular languages and the pumping lemma
<p>Context-free languages</p>	<ul style="list-style-type: none"> • Grammars and generators versus acceptors • History of grammars, natural languages, programming languages • Context-free grammars • Applications to parsing, markup, XML • Pushdown automata • Equivalence of pushdown automata to context-free grammars • Pumping Lemma
<p>Turing Machines</p>	<ul style="list-style-type: none"> • Deterministic turing machines <ul style="list-style-type: none"> - Definition - Examples - Turing machines as programs - Storage variants and equivalence • Random access machines and equivalence of Turing Machines to random access machines • Church-Turing Thesis and the universe • Nondeterministic Turing Machines • Brief introduction to undecidable problems • Brief introduction to computational complexity
<p>Grammars</p>	<ul style="list-style-type: none"> • Restrictions on type-0 grammars, context-sensitive, context-free and regular grammars and their equivalence to automata models.

Policies

Late Assignments

Extensions on assignments will be granted only by the course instructor. As a general rule, individual requests for extensions on medical or compassionate grounds will only be considered if made prior to the due date of the assignment. All extension requests will require suitable documentation.

Missed Examinations

1. Students who miss an exam should contact the instructor as soon as possible. If it is known in advance that an exam will be missed, the instructor should be contacted before the exam.
2. "A student who is absent from a final examination due to medical, compassionate, or other valid reasons, may apply to the College of Arts and Science Undergraduate Students' Office for a deferred exam. Application must be made within three business days of the missed examination and be accompanied by supporting documents."

(<http://artsandscience.usask.ca/undergraduate/advising/strategies.php>)

Incomplete Course Work and Final Grades

"When a student has not completed the required course work, which includes any assignment or examination including the final examination, by the time of submission of the final grades, they may be granted an extension to permit completion of an assignment, or granted a deferred examination in the case of absence from a final examination.

Extensions past the final examination date for the completion of assignments must be approved by the Department Head, or Dean in non-departmentalized Colleges, and may exceed thirty days only in unusual circumstances. The student must apply to the instructor for such an extension and furnish satisfactory reasons for the deficiency. Deferred final examinations are granted as per College policy.

In the interim, the instructor will submit a computed percentile grade for the class which factors in the incomplete coursework as a zero, along with a grade comment of INF (Incomplete Failure) if a failing grade.

In the case where the student has a passing percentile grade but the instructor has indicated in the course outline that failure to complete the required coursework will result in failure in the course, a final grade of 49% will be submitted along with a grade comment of INF (Incomplete Failure).

If an extension is granted and the required assignment is submitted within the allotted time, or if a deferred examination is granted and written in the case of absence from the final examination, the instructor will submit a revised assigned final percentage grade. The grade change will replace the previous grade and any grade comment of INF (Incomplete Failure) will be removed.

A student can pass a course on the basis of work completed in the course provided that any incomplete course work has not been deemed mandatory by the instructor in the course outline and/or by College regulations for achieving a passing grade." (<http://policies.usask.ca/policies/academic-affairs/academic-courses.php>)

For policies governing examinations and grading, students are referred to the Assessment of Students section of the University policy "Academic courses: class delivery, examinations, and assessment of student learning" (<http://policies.usask.ca/policies/academic-affairs/academic-courses.php>)

Academic Honesty

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals subsection of the University Secretary Website and avoid any behaviour that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct,

http://www.usask.ca/university_secretary/honesty/StudentAcademicMisconduct.pdf,

as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals,

http://www.usask.ca/university_secretary/honesty/StudentNon-AcademicMisconduct2012.pdf.

Academic honesty is also defined and described in the Department of Computer Science statement on Academic Honesty:

<http://www.cs.usask.ca/students/academic-honesty/index.php>.

For more information on what academic integrity means for students see the Student Conduct & Appeals subsection of the University Secretary Website at:

http://www.usask.ca/university_secretary/pdf/dishonesty_info_sheet.pdf

Examinations with Disability Services for Students (DSS)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Disability Services for Students (DSS) if they have not already done so. Students who suspect they may have disabilities should contact DSS for advice and referrals. In order to access DSS programs and supports, students must follow DSS policy and procedures. For more information, check <http://www.students.usask.ca/disability/>, or contact DSS at 966-7273 or dss@usask.ca.

Students registered with DSS may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through DSS by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by DSS.

Student Supports

Student Learning Services (SLS) offers assistance to U of S undergrad and graduate students. For information on specific services, please see the SLS web site <https://www.usask.ca/ulc/>.

The Student and Enrolment Services Division (SESD) focuses on providing developmental and support services and programs to students and the university community. For more information, see the SESD web site <http://www.usask.ca/sesd/>.