COMPSCI/SFWRENG 2FA3

Discrete Mathematics with Applications II

Winter 2020

Course Outline

Dr. William M. Farmer

McMaster University

Revised: January 5, 2020

Note: This course outline contains important information that may affect your grade. You should retain it and refer to it throughout the semester, as you will be assumed to be familiar with the rules specified in this document.

Instructor

Dr. William M. Farmer
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Office Hours: To see me, please send me an email message with some times you are free.

Teaching Assistants (TAs)

Musa Al-hassy	`alhassm@mcmaster.ca`	Grad TA	T02
Lekhani Ray	`rayl1@mcmaster.ca`	Grad TA	T04, T05
Akram Elwazani	`elwazana@mcmaster.ca`	Undergrad TA	T01, T03
Meijing Li	`lim147@mcmaster.ca`	Undergrad TA	T01, T03
Kumail Naqvi	`naqvis8@mcmaster.ca`	Undergrad TA	T04
Shyam Shah	`shahs1@mcmaster.ca`	Undergrad TA	T02, T05

Schedule

Lectures	TueWedFri	12:30–01:20	HSC 1A1
Tutorial T01	Fri	10:30–11:20	T13 105
Tutorial T02	Thu	12:30–01:20	T13 107
Tutorial T03	Tue	10:30–11:20	T13 106
Tutorial T04	Thu	03:30–04:20	T13 105
Tutorial T05	Mon	12:30–01:20	T13 107

Course Web Site

This course will be administered via Avenue to Learn. Go to

`http://avenue.mcmaster.ca/`

to access the course's Avenue to Learn page. Please send only normal email to the instructional staff; do not send mail via Avenue.

Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster email accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the Instructor

It is the student's responsibility to be aware of the information on the course's Avenue to Learn page and to check regularly for announcements.

Calendar Description

"Finite state automata and grammars, predicate logic and formal proofs, models of computation, complexity, modular arithmetics, and their applications to computing."

Mission

The *mission* of the course is to (1) teach students to read and write traditional-style (informal) proofs, and (2) provide students a foundational understanding of recursion, induction, and predicate logic, (3) introduce students to the theory of automata and formal languages.

Major Topics

1. Mathematical proof.
2. Recursion and induction.
3. Predicate logic.
4. Finite automata and regular expressions.
5. Push-down automata and context-free languages.
6. Turing machines and computability.

Learning Objectives: Postcondition

A *learning objective* for a course is something the student is expected to know and understand or to be able to do. The *precondition* of a course is the set of learning objectives that the student is expected to have achieved before the start of the course. The *postcondition* of a course is the set of learning objectives that the student is expected to have achieved by the end of the course.

Course Precondition

1. Students should know and understand:

    a. The syntax of propositional and predicate logic.
    b. The basic semantics of mathematical expressions.
    c. Types as used in mathematical expressions.
    d. Elementary formal proofs.
    e. Basic concepts about integers, sets, functions, relations, and graphs.

2. Students should be able to:

    a. Translate natural-language mathematical statements into logical expressions.
    b. Produce formal proofs about elementary properties concerning propositional logic, integers, sets, functions, relations, and graphs.
    c. Prove elementary properties using induction.

Course Postcondition

1. Students should know and understand:

    a. Mathematical proof.
    b. Recursion and induction.
    c. Syntax and semantics of first-order logic.
    d. Axiomatic theories.
    e. Finite automata and regular expressions.
    f. Push-down automata and context-free languages.
    g. Turing machines and computability.

2. Students should be able to:

    a. Write traditional-style proofs using LaTeX.
    b. Prove statements by different forms of induction.

c. Formulate axiomatic theories.

d. Construct finite automata, pushdown automata, and Turing machines.

e. Construct regular sets and context-free grammars.

Required and Recommended Resources

1. Textbook 1: R. Hammock, *Book of Proof*, Second Edition, Richard Hammock, 2016. ISBN-13: 978-0989472111. **Recommended.**

2. Textbook 2: Dexter C. Kozen, *Automata and Computability* [abbreviated AC], Springer, 1997. ISBN-13: 978-0387949079. **Required.**

3. Equipment: An iClicker+ remote. **Required.**

4. Course management system: Avenue to Learn. **Required.**

5. Collaborative software: Discord. **Required.**

Work Plan

The work plan for each week will consist of 5 hours of homework, two 1-hour lectures, a 1-hour discussion session (during the Friday lecture time), and a 1-hour tutorial (9 hours in total). The 5 hours of homework will by done by the student outside of class. The lectures will be given by the Instructor; the discussion sessions will be lead by the Instructor; and the tutorials will be lead by the TAs. The Instructor will present in the lectures the key ideas about the course material. The Instructor and the students will discuss in the discussion sessions the course material. The students will work on exercises in the tutorials and on assignments on their own outside of class.

The students are expected to participate in the lectures and tutorials by asking questions and answering clicker questions. During the discussion sessions, students will be selected from a randomized class list and asked questions about the material covered in the lectures and reading assignments for the week. The student's answer will be given a mark ≤ 4. A mark of 2 is considered a full mark; a mark of 3 is a full mark plus a 50% bonus; and a mark of 4 is a full mark plus a 100% bonus. If a student is asked a question during a discussion session, the student will receive a mark of 0 if the student is not present and a mark of ≥ 2 if the student is present. Each student who receives a mark of 0 will be given the opportunity to replace the mark by answering another question on a subsequent date, if possible. At the end of each week, each student is required to submit to a discussion forum on Avenue a short paragraph (2–4 sentences) describing something from the week's lectures, discussion session, or tutorials that was (1) especially meaningful or memorable to the student or (2) not understood by the student. These *meaningfuls and memorables (M&Ms)* are intended to help students to reflect on what they are learning and to give the Instructor

feedback on what the students are experiencing in the course. Finally, each student is required to submit a bio sheet about herself using the Instructor's bio sheet as a model.[1]

There will be weekly assignments consisting of problems requiring mathematical constructions and traditional-style proofs written using the LaTeX documentation preparation system. The assignments will be marked by the TAs. There will be an opportunity to receive bonus marks by doing optional extra credit assignments.

There will be two midterm tests, one on Wednesday, February 5, 2020 at 19:00–21:00 PM and another on Wednesday, March 11, 2019 at 19:00–21:00 PM. The final exam, which is cumulative, will be 2.5 hours long. It will test accumulative knowledge and will take place on the date scheduled by the University. The midterms and final exam are multiple choice and *closed book* (which means you may not refer to any notes or books during the exam period).

The midterm tests will be done in a two-stage manner. Each student will take the test twice. For the first stage the student will do the test by herself without help from anyone. For the second stage the student will do the test again with help from any of the students in the testing room. 90 minutes will be allotted for the first stage and the remaining 30 minutes for the second stage. The first stage test counts for 85% of the test mark and the second stage counts for 15%.

Midterm Course Review

In the middle of the term, the students will have the opportunity to complete a survey on Avenue about how the course is going. In addition, each student will be invited to attend a course review session in which she can ask the Instructor questions about the course and give feedback directly to the Instructor. Attendance is optional, but each student who participates in one of the course review sessions will received a 1.0 percentage point bonus. The feedback that is received from the course survey and course review sessions may be used to modify how the course is working.

End-of-Term Course Evaluation

Near the end of the term, each student will have the opportunity to evaluate online the effectiveness of this course. The feedback that is received from the course evaluation is very valuable to the Instructor and will be used to improve the course in subsequent years.

Clickers

A clicker system is for real-time, in-class feedback. This course will be using the iClicker+ system, and all students taking this course are required to use

[1] I would like to thank Dr. Lydell Wiebe for communicating the bio sheet idea to me.

iClicker+ remotes. Students are expected to do the following:

1. Purchase the following iClicker+ remote from the McMaster bookstore:

   iClicker+ (ISBN-13: 9781498603058).

   You only need one iClicker+ for all your classes. You must have your own iClicker+; iClicker+s may not be shared among students.

2. You must register your iClicker+ at

   `https://www.iclicker.com/remote-registration-form-for-classic`

   to receive credit for clicker questions. Use your MacID where the "Student ID" is requested. *Do not use your student number.*

3. Bring the iClicker+ to all lectures, discussion sessions, and tutorials.

4. Maintain the iClicker+ in working order throughout the course.

5. Attach a label to your iClicker+ with your name so that you will not confuse your iClicker+ with someone else's.

6. Record the serial number of your iClicker+ in case it is rubbed off.

7. Failure to follow the policies related to iClicker+s may result in confiscation of the device(s).

Students are required to attend and participate in the lectures, discussion sessions, and tutorials. The iClicker+ system will be used by the Instructor during lectures and discussion sessions to assess understanding and also to measure participation. (See the Marking Scheme below for how the lecture and discussion session is factored into your final grade.) *Using another student's iClicker+ or lending an iClicker+ to someone to whom the iClicker+ is not registered will be considered as academic dishonesty.*

Academic Integrity

You are expected to exhibit honesty and use ethical behavior in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behavior can result in serious consequences, e.g., the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at

`http://www.mcmaster.ca/academicintegrity/`.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g., the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

Although you are allowed to receive help from the instructional staff and other students, your work must be your own! Moreover, any key ideas in your work that you obtained from other students must be acknowledged. Plagiarism and copying will not be tolerated! If it is discovered that you plagiarized or copied, it will be considered as academic dishonesty.

Students may be asked to defend their written work orally.

Discrimination

The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact their Department Chair and the Human Rights and Equity Services (HRES) office as soon as possible.

Accommodation for Missed Academic Work

A student who would like to receive accommodation for missed academic work due to an absence needs to complete a McMaster Student Absence Form (MSAF) on-line at

`http://www.mcmaster.ca/msaf/`.

When the MSAF tool asks you for the party who should receive your request for accommodation, enter `wmfarmer@mcmaster.ca`. MSAFs sent to any other email address will be ignored.

The accommodation for a missed assignment will be that the due date is moved forward in time exactly five days. The accommodation for a single missed midterm test will be that the midterm test is not required and the final exam is worth 55 points instead of 40. *MSAFs are not accepted for missed class participation marks in lectures (clicker questions) and discussion sessions (discussion session questions) or for missed M&Ms.*

Academic Accommodation for Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or email `sas@mcmaster.ca` . For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

Since the midterm tests will be delivered in a two-stage format, SAS students have three options:

1. Take the test with the non-SAS students without any accommodations.
2. Take the test at SAS without the second stage. Your mark will be the mark of your scan sheet.
3. Take stage one of the test at SAS and stage two with the non-SAS students. Your mark will be 85 of the mark of the stage-one scan sheet plus 15% of the mark of the stage-two scan sheet. In this case, you must arrange with SAS to complete your stage one at SAS at exactly 8:20 PM (on the day of the midterm test). At that time you will walk over to the testing rooms for the non-SAS students with your stage-two scan sheet and then start the second stage at 8:30 with the non-SAS students.

Academic Accommodation for Students based on RISO

Students requiring academic accommodation based on *religious, indigenous, or spiritual observances (RISO)* should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Course Modifications

The Instructor and University reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course web sites weekly during the term and to note any changes. Your McMaster email is the one with the address ending in `@mcmaster.ca`. This is a separate email address from your Avenue address.

Other Policy Statements

1. Significant study and reading outside of class is required.
2. The student is expected to participate in the discussions during lectures, discussions sessions, and tutorials.
3. Assignments and M&Ms may not be submitted late and the midterm tests may not be taken later without *prior* approval from the Instructor.
4. If there is a problem with the marking of an assignment, the student should first discuss the problem with the TA who marked it. An assignment mark will only be changed if the problem is reported within two weeks of the date that the assignment mark was posted on Avenue.
5. A student may not use his or her notes and books during the midterm tests and the final exam.
6. Cell phones may not be used during lectures, discussion sessions, and tutorials unless approved by the Instructor. They will be confiscated if used.
7. No electronic devices (calculators, cell phones, etc.) may be used during midterm tests and the final exam. They will be confiscated if they are within reach of a student, whether or not they have been actually used.
8. Email with a source address outside of McMaster University will not be read by the instructional staff.
9. Suggestions on how to improve the course and the Instructor's teaching methods are always welcomed.

Marking Scheme

The course grade will be based on the student's performance on class participation, assignments, midterm tests, and the final exam as follows:

Class participation	
a. Clicker questions	4%
b. Discussion session questions	4%
c. Meaningfuls and memorables (M&Ms)	4%
d. Bio sheet	1%
Assignments	20%
Midterm test 1	12%
Midterm test 2	15%
Final exam	40%
Total	**100%**
Course review session bonus	1%

Notes:

1. The Instructor reserves the right to adjust the marks for an assignment, midterm test, or final exam by increasing or decreasing every score by a fixed number of points.

2. Class participation is measured by the number of clicker questions answered, the answers given to the discussion session questions, and the number of M&Ms submitted. The *clicker questions mark* is the percentage of clicker questions answered by the student in the lectures. The *discussion session questions mark* is the average mark a student receives for questions that the Instructor asks her in the discussion sessions. The *M&Ms mark* is the percentage of acceptable weekly M&Ms that the student submitted. Submitted M&Ms must be professional and germane to the subjects studied to receive credit.

Course Schedule

The course schedule is given in a separate document entitled *Course Schedule*.