THE UNIVERSITY OF BRITISH COLUMBIA
CPSC 421/501: MIDTERM EXAMINATION – November 5th, 2020

Important notes about this examination

1. You have **60** minutes to complete this examination, plus 5 extra minutes to upload the exam.
2. The exam is open book and can use any ~~handwritten notes~~. printed note sheets.
3. Students are not allowed to use the internet to access material except for material on this section's website.
4. Good luck!

Student Conduct during Examinations

1. Each examination candidate must be prepared to produce, upon the request of the invigilator or examiner, his or her UBCcard for identification.
2. No questions will be answered in this exam. If you see text you feel is ambiguous, make a reasonable assumption, write it down, and proceed to answer the question.
3. No examination candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination. Should the examination run forty-five (45) minutes or less, no examination candidate shall be permitted to enter the examination room once the examination has begun.
4. Examination candidates must conduct themselves honestly and in accordance with established rules for a given examination, which will be articulated by the examiner or invigilator prior to the examination commencing. Should dishonest behaviour be observed by the examiner(s) or invigilator(s), pleas of accident or forgetfulness shall not be received.
5. Examination candidates suspected of any of the following, or any other similar practices, may be immediately dismissed from the examination by the examiner/invigilator, and may be subject to disciplinary action:
   i. speaking or communicating with other examination candidates, unless otherwise authorized;
   ii. purposely exposing written papers to the view of other examination candidates or imaging devices;
   iii. purposely viewing the written papers of other examination candidates;
   iv. using or having visible at the place of writing any books, papers or other memory aid devices other than those authorized by the examiner(s); and,
   v. using or operating electronic devices including but not limited to telephones, calculators, computers, or similar devices other than those authorized by the examiner(s)—(electronic devices other than those authorized by the examiner(s) must be completely powered down if present at the place of writing).
6. Examination candidates must not destroy or damage any examination material, must hand in all examination papers, and must not take any examination material from the examination room without permission of the examiner or invigilator.
7. Notwithstanding the above, for any mode of examination that does not fall into the traditional, paper-based method, examination candidates shall adhere to any special rules for conduct as established and articulated by the examiner.
8. Examination candidates must follow any additional examination rules or directions communicated by the examiner(s) or invigilator(s).

Please do not write in this space:

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MIDTERM, CPSC 421/501, NOVEMBER 5, 9:30AM-10:30AM

JOEL FRIEDMAN

60 minute exam, plus 5 minutes to upload your solutions to Gradescope.

You may use the textbook and materials on our course website; you may use any amount of printed notes. You may not use any other books or online material.

You must leave your Zoom video camera on (but leave yourself muted) for the duration of the exam and while uploading your solutions to Gradescope. Be ready to present your student ID.

(1) [5 points] Give an NFA recognizing the language $ab^* \cup (b^2)^*$; i.e., give a state diagram for the NFA and explain how your NFA works.

(2) [10 points] Use the Myhill-Nerode theorem to determine the minimum number of states in a DFA recognizing the language described by $(a, b)^*ab$ (i.e., whose 2nd to last and last symbols are, respectively, a and b). Then give a DFA accepting this language in that number of states and explain how your DFA works.

(3) [10 points] Give a Turing machine that recognizes the language over $\Sigma = \{a\}$ given by

$$L = \{a^n \mid n \bmod 4 \text{ is } 2\} = \{a^2, a^6, a^{10}, \ldots\},$$

and explain how your Turing machine works. Clearly indicate what is your work tape, Γ, and which states are your initial state, accept state, and reject state.

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