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!

Please do not write in this space:

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MIDTERM, CPSC 421/501, NOVEMBER 5, 8:30PM-9:30PM

JOEL FRIEDMAN

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

You may use the textbook and all material on our course website; you may use any amount of printed notes. You may not use any other books or other 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] Let $S = \{a, b, c\}$, and let $f \colon S \to \mathrm{Power}(S)$ be any function with $f(c) = \{a, c\}$. Let $T = \{s \in S \mid t \notin f(t)\}$. Explain why $f(c) \neq T$. (You have to explain this directly, without appealing to any theorems discussed in class.)

(2) [10 points] Use the Myhill-Nerode theorem to determine the minimum number of states in a DFA recognizing $L = \{a, a^3\}$. 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 $\Sigma = \{a, b\}$ described by $ab \cup (ba)^*$, 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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