COMP 330 Winter 2021
Mid-term Examination

School of Computer Science
McGill University

Answers due by 13th February 2021 8:00am

This examination is open book. You have 60 minutes. There are 3 questions on two pages. Please write your answers in a pdf file and upload it. The upload will be under the assignments tab. Automata pictures can be hand drawn.

Question 1[40 points] In this question the alphabet is fixed as $\{a, b\}$.

- Write a regular expression for the language of strings containing a's only when they occur as part of a block of consecutive a's of *even length*. Thus the legal strings cannot contain an a by itself or a substring of 3 or 5 or 7 . . . consecutive a's. Thus *baabbb* is accepted, so is *aabaabaaaabbaabbaa* and so is *bbbbbbb* which has no consecutive pair of a's. However *baaab* is not allowed as this has three consecutive a's nor is *bababaab* or *baaaaab*. [20]

- Design a DFA (not an NFA) for this language. A picture is preferred. **You must show the dead state if there is one.** For full credit your machine must have no more than 3 states including the dead state (if there is one). [20]

Question 2[40 points] Show, using the pumping lemma, that the following language is not regular. The alphabet is $\Sigma = \{a, b\}$. I prefer answers formatted as a game against the demon.

$$L = \{a^i b^j | i - j = 2, i, j > 0\}.$$

Question 3[20 points]

Are the following statements true or false? No explanations are required. We have some fixed alphabet that we are working with.

1. If L is a non-regular language and R is a regular language then $L \cap R$ must be regular.
2. If L is a non-regular language and R is a regular language then $L \cap R$ cannot be regular.
3. For every regular language there is a unique minimal NFA.
4. When we run the minimization algorithm on a DFA we cannot be sure that it will always terminate.
5. If L_1 is an infinite regular language and L_2 is a finite language then the DFA to recognize L_1 must have more states that the DFA to recognize L_2.