COMP 330 Autumn 2021
Mid-term Examination

School of Computer Science
McGill University

1pm - 1pm, 15th-16th Oct 2021

This examination is open book and notes. If you are using a result from the notes, just mention it, please do not copy it. There are 4 questions. Please upload your answers to myCourses. If you are asked to construct a DFA in any question you do **not** need to show dead states.

Question 1[10 points]
Suppose our alphabet is $\Sigma = \{a, b\}$. Give a regular expression for the set of all strings with at least 3 occurrences of a. Give a DFA to recognize this language. You will be penalized for solutions that use more than 4 states.

Question 2[10 points]
Show that the language consisting of as and bs appearing in any order, with the **sum of** number of as and the number of bs equal to a perfect power of 2 is **not** regular.

Question 3[20 points]
Suppose that the alphabet is $\{a, b\}$. Consider the language

$$L := \{a^n b^m | n = m \bmod 3\}.$$

Is L regular? If so, construct a DFA to recognize it, if not, give a proof using the pumping lemma to show that it is not.

Question 4[10 points]
Give an algorithm that takes as input a DFA and an NFA and decides whether the language recognized by the NFA is the language defined by the DFA. Use any algorithms covered in class as basic building blocks; *i.e.* you do not have to describe them