Assignment 1

Due: 24th October 2019 COMP 3602

Instructions:

1. This assignment can be done in groups comprising 1 student - 3 students
2. Each student must attach a signed plagiarism declaration to their submission
3. One submission per group
4. Write legibly or (preferably) typeset your assignment using LaTeX

Assignment 1

Due: 24th October 2019 COMP 3602

1. Draw DFAs for the following languages over $\Sigma = \{0, 1\}$

   (a) $\{0^n \vee 1^m \mid n \text{ is even}, m \text{ is odd } \}$

   (b) Any string that does not contain the substring 01

[10 marks]

2. Draw NFAs for the following languages over $\Sigma = \{0, 1\}$

   (a) Strings end in 1011

   (b) $\{101x101 \mid x \in \Sigma^*\}$

   (c) $\{x(ab)^n \mid x \in \Sigma^*, n \text{ is even } \}$

[10 marks]

3. Formally state the DFA for 1b

[10 marks]

4. Fomrally state the NFA for 2b

[10 marks]

5. Consider the case of a vending machine. Each item in the vending machine costs \$1.00 TTD. The machine accepts 1¢, 5¢, 10¢, 25¢, \$1.00. The machine dispenses snacks once a sequence of legal tender adds up to a sum greater than or equal to \$1.00. Draw a DFA that captures the functionality of this machine.

[10 marks]

6. Consider the following alphabet

$$\Sigma = \{\left[\begin{smallmatrix}0\\0\end{smallmatrix}\right], \left[\begin{smallmatrix}0\\1\end{smallmatrix}\right], \left[\begin{smallmatrix}1\\0\end{smallmatrix}\right], \left[\begin{smallmatrix}1\\1\end{smallmatrix}\right]\}$$

   An example of a string over this alphabet is $\left[\begin{smallmatrix}0\\0\end{smallmatrix}\right]\left[\begin{smallmatrix}1\\0\end{smallmatrix}\right]$.

   Each row in such a string can be considered a binary number. Show that

   Show that $C = \{w \mid w \in \Sigma^*, \text{ the first row in } w \text{ is greater than the second}\}$ is a regular language.

[10 marks]

7. Consider the set difference operation as applied to regular languages. Show that if L_1 is a regular language and L_2 is a regular language, then $L_1 - L_2$ is also regular. (Hint: You may assume that union, intersection, and complement are all closed under the set of regular languages)

   [10 marks]

8. Let $\Sigma = \{0, 1, +, =\}$. The language ADD is defined as follows:

   $$\{x = y + z \mid x, y, z \text{ are binary integers and } x \text{ is the sum of } y \text{ and } z\}$$

   Prove using the Pumping Lemma that ADD is not regular

   [20 marks]

9. Consider the following regular expressions over $\{a, b\}$. List for each two strings that will be recognized and two strings that will not be recognized

   - a^*b^*
   - $a(ba)^*bb$
   - $a^+ \cup b^*$
   - $(\epsilon \cup a)b$

   [10 marks]