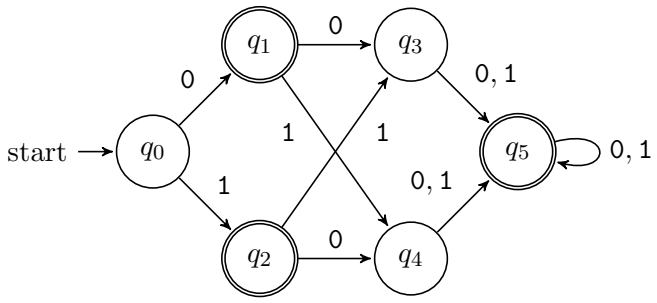
Homework 2–CSC 320 Spring 2017

Due by conneX submission, Sunday June 10 at 11:55pm

1. (a) (10 Marks) Using the state partitioning algorithm presented in class, find the minimal automaton equivalent to the following:



   (b) (10 Marks) What is the language recognized by this automaton ($\Sigma = \{0, 1\}$)?

2. Prove the each of the following languages are not regular. You may use the pumping lemma, or closure properties of the regular langauges.

   (a) (5 Marks) $\{0^n 1^m 0^n \mid m, n \geq 0\}$

   (b) (5 Marks) $\{0^m 1^n \mid m \neq n\}$

   (c) (5 Marks) $\{wtw \mid w, t \in \{0,1\}^+\}$ (HINT: One way to do this is to use closure under intersection to get a simpler pumping lemma proof.)

3. Give CFGs for the following languages over $\sigma = \{0, 1\}$

   (a) (5 Marks) $\{w \mid w = w^R\}$

   (b) (5 Marks) $\{w \mid w$ contains the same number of 0's and 1's$\}$

   (c) (5 Marks) $\{w \mid w = 0^n 1^n, n \geq 0\}$

4. (20 Marks) Give a CFG that generates the language

$$A = \{\mathtt{a}^i\mathtt{b}^j\mathtt{c}^k \mid i = j \text{ or } j = k \text{ where } i, j, k \geq 0\}$$

   Is your grammar ambiguous. Why or why not?

5. (20 Marks) Convert the following grammar into a grammar in Chomsky normal form:

$$E \to E + T \mid T$$
$$T \to T * F \mid F$$
$$F \to (E) \mid \textbf{num}$$

   Note: I already gave you the CNF in class. So this is an easy question!

6. (20 Marks) Using the CNF version of the grammar

$$E \to E * E \mid E + E \mid (E) \mid \textbf{id} \mid \textbf{num}$$

given in class, show the result of running the CYK algorithm on the string $w = (\textbf{id} + \textbf{num}) * \textbf{num}$. Just show the entries of the resutling table.

Note: I did not give the CNF in class. Use the following CNF grammar:

$$\begin{aligned} E &\to EA \mid EB \mid LD \mid \textbf{id} \mid \textbf{num} \\ A &\to ME \\ B &\to PE \\ D &\to ER \\ M &\to * \\ P &\to + \\ L &\to (\\ R &\to) \end{aligned}$$

7. (15 Marks) Is every grammar in CNF unambiguous? If your answer is "yes", provide a proof. If your answer is "no", provide a counterexample.