10 points

The problem below is to be done in groups of 2-3 students. The work is to be written up and turned in with all student names from the group on it.

1. (10 pts) Let's consider adding a Queue to our definition of a finite automaton.

   (a) (2 pts) A DFA is defined as a 5-tuple. Define a Queue Automaton formally as an n-tuple, n=?

   Be sure to state what all the parts are and give a formal definition of δ.

   (b) (3 pts) Write in sentences a description of an algorithm for recognizing the language $\{a^n b^n c^n \mid n > 0\}$ using the Queue Automaton.

   (c) (1 pts) Explain why adding a queue to a DFA is more powerful than adding a stack.

   (d) (4 pts) Prove that the Queue Automaton is equivalent to a standard Turing machine. (You must show two parts. Show that any Queue Automaton can be converted to a standard Turing machine, and that any standard Turing machine can be converted to a Queue Automaton.