

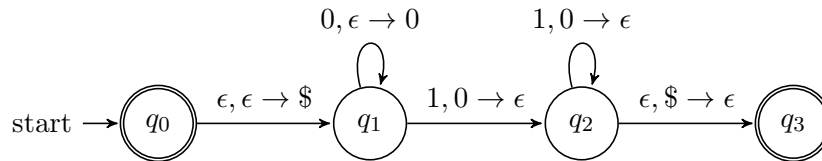
Homework 3–CSC 320 Fall 2015

Due in class on Friday November 13

1. Convert the following CFG to a PDA using the construction given in class

$$\begin{aligned} S &\rightarrow aAbS \mid bBaS \mid \epsilon \\ A &\rightarrow aAbA \mid \epsilon \\ B &\rightarrow bBaB \mid \epsilon \end{aligned}$$

2. Convert the following PDA to a CFG using the construction given in class



3. A *TM with stay put instead of left* is similar to an ordinary TM, but the transition function has the form

$$\delta : Q \times \Gamma \rightarrow Q \times \Gamma \times \{R, S\}$$

At each step, the machine can move to the right or stay on the currently scanned square. Show that this TM model is *not* equivalent to the standard model. What class of languages does this model recognize?

4. For each of the following operations, give a high-level explanation of why the decidable languages are closed under the operation
 - (a) Concatenation
 - (b) Intersection
 - (c) Complement
5. Give a high level description of an algorithm to show that

$$L_{nb} = \{\langle M \rangle \mid M \text{ when started on the blank tape, eventually writes a nonblank symbol}\}$$

is decidable. (HINT: If M has m states, how many moves will it take before you can tell?)

6. Let u, v be strings. We will write $u \prec v$ if u (strictly) precedes v in the standard string ordering: $\epsilon \prec 0 \prec 1 \prec 00 \prec 01 \dots$. An enumerator E *respects* \prec if for any strings u and v that it enumerates, if it outputs u before it outputs v then it must be the case that $u \prec v$. Prove the following: a language L is Turing-decidable *if and only if* it is enumerated by an enumerator that respects \prec .