# CSE105 Closed Book Quiz, Thursday, Nov. 11, 1999

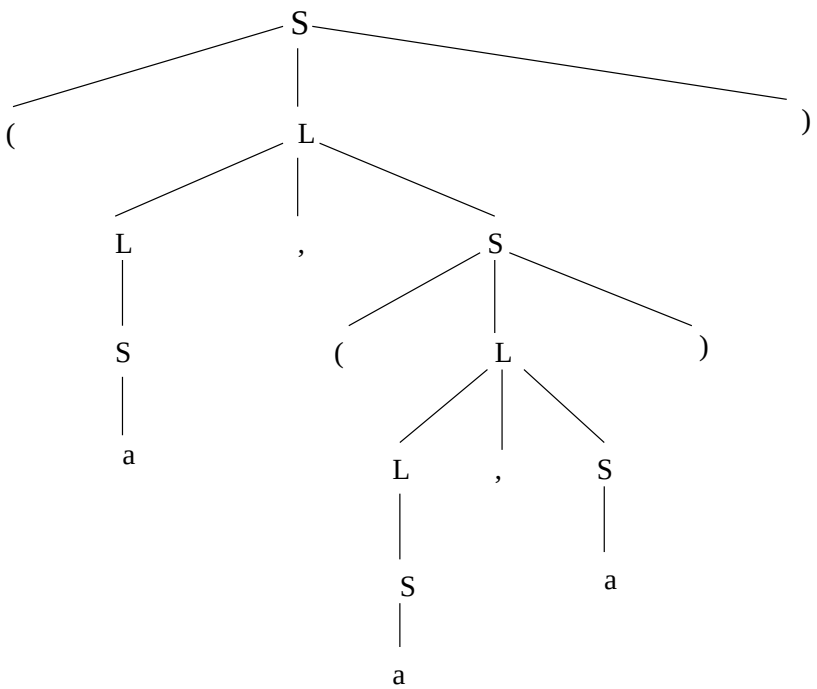
1. Construct a CFG for the language

   $\{a^n b^{2n} \mid n \geq 1\}$

   **S → aSbb | abb**

2. Draw a parse tree for the string **(a,(a,a))** using the CFG below. (Here, the nonterminals of the grammar are { **( ) , a** }, and the start variable is S)

   $S \to (L) \mid a$
   $L \to L, S \mid S$

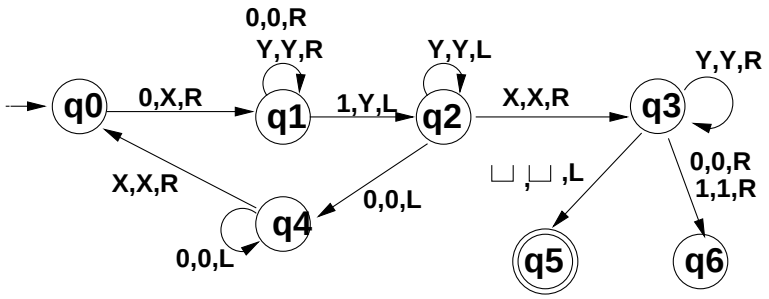


3. Given the Turing machine below for $\{0^n1^n \mid n \geq 1\}$, show the configurations of the Turing machine on input 0010, beginning with the start configuration.

**Q = {q0, q1, q2, q3, q4, q5, q6}**

**$\Sigma$ = {0,1}** **$\Gamma$ = {0,1, X, Y, $\sqcup$}**

**q0 start** **q5 accept** **q6 reject**




$q_0 0010 \sqcup$
$X q_1 010 \sqcup$
$X 0 q_1 10 \sqcup$
$X q_2 0 Y 0 \sqcup$
$q_4 X 0 Y 0 \sqcup$
$X q_0 0 Y 0 \sqcup$
$X X q_1 Y 0 \sqcup$
$X X Y q_1 0 \sqcup$
$X X Y 0 q_1 \sqcup$

**REJECT**

4. Fill in the blanks: A grammar is ambiguous if ....

**it can generate more than one distinct parse tree for the same string.**