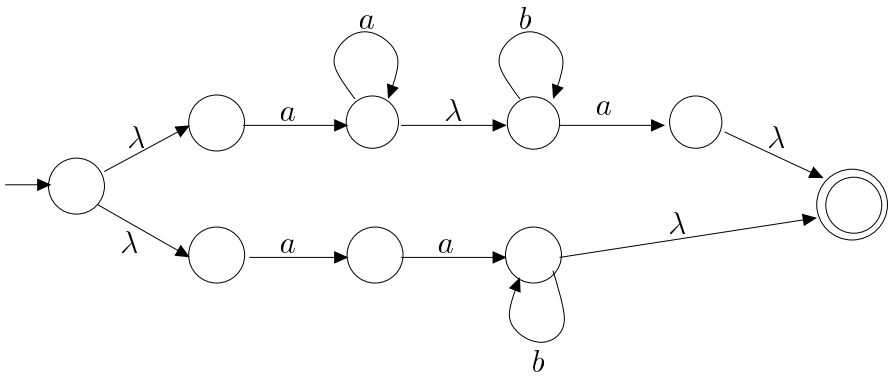
CSCI 2400 – Models of Computation, Section 3

Solutions to the Practice Midterm Exam

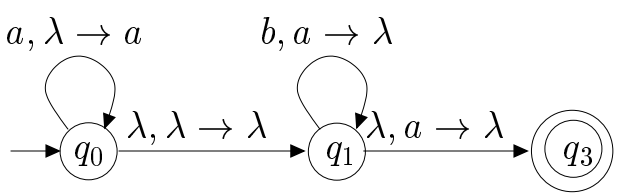
1.



2. $1(1+0)^*11(1+0)^* + 11(1+0)^*$

3. Let's assume for contradiction that L is a regular language. We apply the pumping lemma to L. Let m be the parameter of the pumping lemma. We choose to pump the string $a^m b^5 c^m$ which is in the language L. Since $xyz = a^m b^5 c^m$ and $|xy| \leq m$ we have that the string y is a substring of the first a^m. Therefore, the string y has the form $y = a^p$, for some integer p, $1 \leq p \leq m$ (since $|y| \geq 1$). Now, we pump up y once and we obtain the string $a^{m+p} b^5 c^m$. By the pumping lemma, we have that $a^{m+p} b^5 c^m$ is in the language L. However, $a^{m+p} b^5 c^m$ is not in the language L since $m + p \neq m$. Therefore, we have a contradiction, and thus the language L is not be regular.

4.



The initial stack symbol is \$. State q_0 reads the a's and pushes them into the stack. State q_1 reads the b's and pops an a from the stack for each input

b. Finally, state q_3 is the accept state which the automaton enters only if there is an a in the stack, which means that the numbers of a's was more than the number of b's.

5.

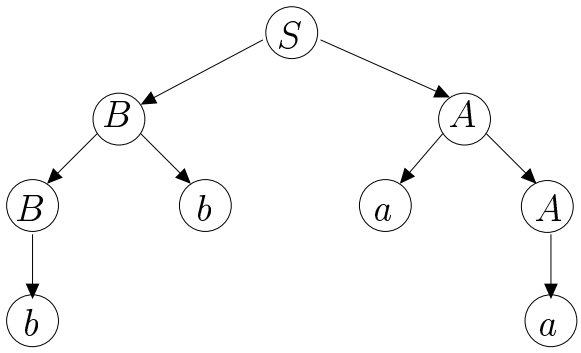
(a)

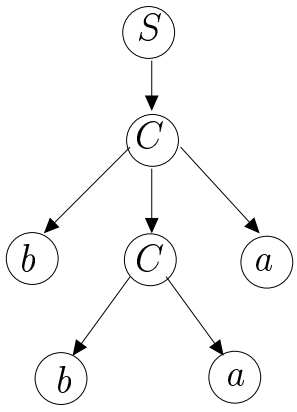
$$S \to aSa|bSb|A$$
$$A \to aAb|\lambda$$

(b)

$$S \Rightarrow aSa \Rightarrow abSba \Rightarrow abAba \Rightarrow abaAbba \Rightarrow abaaAbbba \Rightarrow abaabbba$$

6. Yes, the grammar is ambiguous. The reason is that there is string generated by the grammar that has two different derivation trees. This string is bbaa. The two derivation trees are:





7.

$$
\begin{aligned}
&S \to AV_1 \\
&V_1 \to T_b V_2 \\
&V_2 \to BT_a \\
&A \to AV_3 \\
&V_3 \to BT_a \\
&A \to a \\
&B \to BV_4 \\
&V_4 \to T_a A \\
&B \to b \\
&T_a \to a \\
&T_b \to b
\end{aligned}
$$