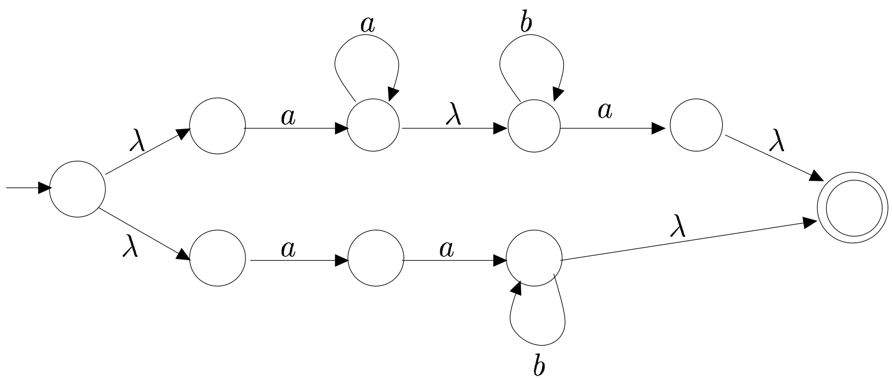
CSCI 2400 – Models of Computation

Solutions to the Practice Midterm Exam

1.



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

3.

$$
\begin{aligned}
S &\rightarrow aaB|\lambda \\
B &\rightarrow bB \\
B &\rightarrow abS
\end{aligned}
$$

The production $S \rightarrow aaB$ corresponds to the first substring aa in the expression $(aab^*ab)^*$. The variable B generates the middle b^* and the last ab. The production $B \rightarrow abS$ implements the outmost star operation.

4. From the definition of the symmetric difference, (using set diagrams) we observe that:

$$L_1 \ominus L_2 = (L_1 \cup L_2) \cap \overline{(L_1 \cap L_2)}.$$

From Theorem 4.1, we know that the regular languages are closed under union, intersection, and complement. Therefore, we have that the language $L_1 \ominus L_2$ is regular, as needed.

5. 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, $1 \le p \le m$ (since $|y| \ge 1$). Now, we pump up y once and we obtain the string $xyyz = a^{m+p}b^5c^m$. By the pumping lemma, we have that $a^{m+p}b^5c^m$ is in the language L. However, $a^{m+p}b^5c^m$ can not be in the language L since $m + p \ne m$. Therefore, we have a contradiction, and thus the language L is not be regular.