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计算理论
P1

1. a regular expression: $(1+0)^* 000 (0+1)^*$

2. Firstly, it is straightforward to get a grammar for $L(aab^*ab)$.
Then, it is easy to get a grammar for $L((aab^*ab)^*)$

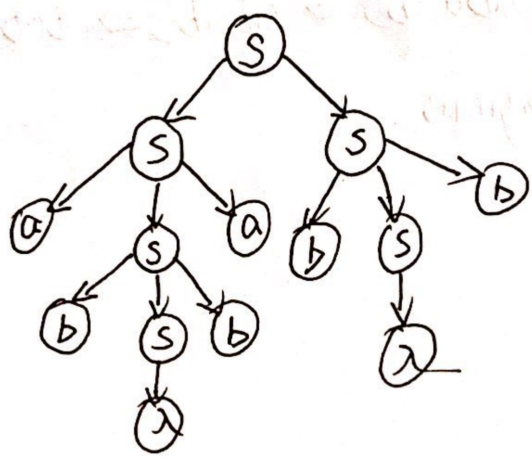
$S \to aaA \mid \lambda$
$A \to bA \mid B$
$B \to ab \mid abS.$

3. Suppose L is regular and we are given m, then we pick $w = a^m b^m c^{2m}$ in L
Now because $|xy|$ cannot be greater than m, it is clear that the $y = a^k$ is the only possible choice for some $k \geq 1$. Therefore, by the pumping Lemma

$$w_i = a^{m-(i-1)k} b^m c^{2m} \in L, \quad \text{for all } i = 0, 1, \ldots$$

However, $w_0 = a^{m+k} b^m c^{2m} \notin L$ because $m+k+m > 2m$.
Therefore L is not regular.

4.
$S \to aS_1BB$
$S_1 \to aS_2BB$
$S_2 \to aS_2BB \mid \lambda$
$B \to b$

5.


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P2

6. In this grammar, the B is useless because it keeps generating B. Except it, C is useless too. Because C is exceptional.

Then the grammar:

$$S \to aA \mid a.$$

$$A \to aaA \mid aa.$$

7. An equivalent grammar in the Chomsky normal form:

$$S \to S_aS_b \mid KT$$

$$T \to S_aT \mid K \mid \lambda.$$

$$K \to S_bS$$

$$S_a \to a$$

$$S_b \to b$$

8. The string abab can be derived by either:

$$S \Rightarrow aSbS \Rightarrow abS \Rightarrow abaSbS \Rightarrow ababS \Rightarrow abab,$$

Or

$$S \Rightarrow aSbS \Rightarrow abSaSbS \Rightarrow abaSbS \Rightarrow ababS \Rightarrow abab.$$

Therefore, the grammar is ambiguous.