

This is a 50-minute in class closed book exam. All questions are straightforward and you should have no trouble doing them. Please show all work and write legibly. Grading will take into account the clarity of your answer.

1. Write a regular expression denoting all strings of 0's and 1's in which if there are two adjacent 0's in the string, then there will also be two adjacent 1's somewhere in the string. Give a brief English explanation as to how your regular expression works.

2. State the pumping lemma for regular sets. Prove that the set $\{a^i b^j \mid i > j > 0\}$ is not regular using the pumping lemma for regular sets.

3. Let $M = (Q, \Sigma, \delta, q_0, F)$ be a finite automaton and let $P = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$ be a pushdown automaton that accepts by final state. Construct a new pushdown automaton $P_3 = (Q_3, \Sigma, \Gamma_3, \delta_3, q_{03}, Z_{03}, F_3)$ such that $L(P_3) = L(M) \cap L(P)$ by specifying each of $Q_3, \Gamma_3, \delta_3, q_{03}, Z_{03}$, and F_3 .

4. Prove that the class of context-free languages is not closed under complement. By proof we mean give a convincing argument in clear and concise English. If you use some languages which obviously are context free you do not need to prove that they are context free. If you use the fact that some language is obviously not context free, you do not need to prove that it is not context free.

5. Let L be a set of strings contained in $(a+b)^*$. Use h, h^{-1} and intersection with a regular set to delete every copy of the substring aab in each string of L .