

CSE 200
Computability and Complexity
Homework 1

Due by email (both to russell@cs.ucsd.edu and jiawei+cse200@ucsd.edu
) sometime January 14.

January 7, 2019

1. Let f be a non-decreasing, positive integer-valued function over the positive integers. Prove that if $f(n+1) \in O(f(n))$, then there is a $c > 0$ so that $f(n) \in O(c^n)$, i.e., f is at most exponential.
2. Consider the family of languages L_n that contain only binary strings of length n . Give as close upper and lower bounds as you can for the worst case number of states a deterministic finite automaton might need to recognize a language $L \in L_n$. Your upper and lower bounds might not be an exact match. (Hint: one method for the lower bound is to use a counting argument, comparing the number of languages in L_n to the number of s state finite automata. Another method is to think about exactly when two substrings of length $n - k$ can go to the same state in the FSM.)
3. Say that you are downloading a large file of size F bits, but you do not know how large F is. It takes time $O(S)$ to initialize S bits of memory. If you initialize S memory, and $S < F$, after time $O(S)$, the downloading process crashes and you need to restart. Show how to download the file in $O(F)$ time.