

CS 620 – Theory of Computation – Fall 2009

Instructor: Marc Pomplun

Assignment #4

Posted on December 2 – due by December 10, 7:00pm

Question 1: Ordering with Post-Turing

- a) Write a Post-Turing program (you can use macros) using an alphabet $A = \{a, b, c\}$ that computes the following function f :

$$f(x, y) = a, \text{ if } x < y \\ = b, \text{ otherwise}$$

Here, $x < y$ means that the string x precedes the string y in alphabetical order. For example, it is true that $abba < ba$, $aaa < aab$, $cc < ccc$, and $bbbc < bbcb$.

You get bonus points if you write a program that computes f strictly.

- b) Write down the list of successive tape configurations that your program generates during the computation of $f(\text{caba}, \text{cabba})$.

Question 2: Turing Sort

Build a Turing machine on the alphabet $A = \{a, b\}$ that computes a function $f(x)$ strictly. $f(x)$ sorts the symbols in the input string in the order a, b. For example,

- $f(bba) = abb$
- $f(bbab) = abbb$
- $f(aababbabb) = aaaabbbbb$
- $f(0) = 0$

Hint: The bubble sort algorithm may be the easiest one to implement as a Turing machine.

Write down the Turing machine in quadruple notation and as a state transition diagram. Also give the sequence of configurations during the computation of $f(aba)$.

Whoever builds the Turing machine with the fewest internal states that correctly computes f will get some bonus points!