

February 1, 2018

Name: _____

ID #: _____

PHIL 379 Lec 01

Logic II

Winter 2018

Assignment 2

DUE IN CLASS AT 11:00 AM ON TUESDAY, FEBRUARY 6, 2018

1. Give an example of a two-place function that is not Turing computable and show why it is not Turing computable.

(3 marks)

2. Suppose that time is divided into discrete units 0, 1, 2,..... and that a Turing machine takes one unit of time to execute an instruction once. Show the configuration of the Turing machine M_1 at time 22, if M_1 is started at time 0 with input 4. It will help to draw a flowchart of M_1 . You do not need to show your calculations.

M_1 : $q_1S_1Lq_2, q_2S_0Lq_3, q_2S_1Lq_3, q_3S_0S_1q_3, q_3S_1Lq_4, q_4S_0S_1q_4, q_4S_1Rq_5, q_5S_0Rq_6, q_5S_1Rq_5, q_6S_0Lq_7, q_6S_1Rq_6, q_7S_0Lq_8, q_7S_1S_0q_7, q_8S_0Lq_{11}, q_8S_1Lq_9, q_9S_0Lq_{10}, q_9S_1Lq_9, q_{10}S_0Rq_2, q_{10}S_1Lq_{10}, q_{11}S_0Rq_{12}, q_{11}S_1Lq_{11}.$

(2 marks)

3. The Turing machine M_2 computes a two-place function g of positive integers. What is $g(3,2)$? It will help to draw a flowchart of M_2 . You do not need to show your calculations.

M_2 : $q_1S_0Rq_2, q_1S_1S_0q_1, q_2S_0Rq_{15}, q_2S_1Rq_3, q_3S_0Rq_4, q_3S_1Rq_3, q_4S_0Rq_4, q_4S_1S_0q_5, q_5S_0Rq_6, q_6S_0S_1q_{12}, q_6S_1Rq_7, q_7S_0Rq_8, q_7S_1Rq_7, q_8S_0S_1q_{10}, q_8S_1Rq_9, q_9S_0S_1q_{10}, q_9S_1Rq_9, q_{10}S_0Lq_{11}, q_{10}S_1Lq_{10}, q_{11}S_0Rq_4, q_{11}S_1Lq_{11}, q_{12}S_1Lq_{13}, q_{13}S_0Lq_{13}, q_{13}S_1Lq_{14}, q_{14}S_0Rq_1, q_{14}S_1Lq_{14}, q_{15}S_0S_1q_{16}, q_{15}S_1Lq_{17}, q_{16}S_1Rq_{15}, q_{17}S_0Rq_{18}, q_{17}S_1Lq_{17}.$

(2 marks)

4. A copying machine performs the following task: when started scanning the leftmost 1 of a single block of n 1s on an otherwise blank tape, it eventually halts scanning the left most 1 on a tape that has two blocks of n 1s separated by a single blank and the tape is otherwise blank. (i) Sketch the design of a copying machine. You do not need to write a complete instruction set. (ii) Use

this machine to show that if there is a Turing machine that computes a two-place function $g(x,y)$, then there must also be a Turing machine that computes the one-place function f , where $f(x)=g(x,x)$.

(3 marks)
