Department of Computer Science **University of San Francisco**

Computer Science 411
Homework 11: Enumeration and Decision Problems
Fall 2015
Due 12/02/2015

1. Using the Turing Machine software, create a Turing Machine that enumerates each of the following languages:

   (a) $(a+b)^*$

   (b) $\{a^n b^n c^n : n > 0\}$

2. Question 5.4.2 from the text: Which of the following problems about Turing Machines are solvable,and which are undecidable? Explain your answers carefully – if your answer is that the problem is undedicable, then give a reduction that proves that it is undecidable (that is, do not use Rice's Theorem). If your answer is that the problem is decidable, describe how the problem could be solved.

   (a) To determine, given a Turing machine M and a state q, whether M will every reach a configuration with state q when started with the input w from its intial state

   (b) To determine, given a Turing machine M and two states p and q, whether there is any configuration with state p which yields a configuration with state q

   (c) To determine, given a Turing machine M and a state q, whether there is any configuration at all that yields a configuration with state q.

   (d) To determine, given a Turing machine M and a symbol a, whether M ever writes the symbol a when started on the empty tape.

   (e) To determine, given a Turing machine M, whether M ever writes a nonblank symbol when started on the empty tape.

   (f) To determine, given a Turing machine M and a string w, whether M ever moves its head to the left when started with input w.

   (g) To determine, given two Turing machines, whether one semi-decides the complement of the language decided by the other.

   (h) To determine, given two Turing machines, whether there is any string on whch they both halt.

   (i) To determine, given a Turing machine M, whether the langauge semi-decided by M is finie.