

Due at the start of class Tuesday, May 12, 2009.

Problem 1. Write a DFA for the following sets (using the conventions in Dr. Gasarch's lecture):

1. $\{(x, y) \mid x = y + 1\}$
2. $\{(x, X) \mid x + 2 \in X\}$

Problem 2. Which of the following problems are decidable, Turing enumerable (semi-decidable), or undecidable. Justify directly.

- a. To determine, given a Turing machine M , a state q , and a string w , whether M ever reaches state q , when started on input w .
- b. To determine, given a Turing machine M and a symbol a , whether M ever writes the symbol a when started on the empty input.
- c. To determine, given a Turing machine M , whether M ever writes a nonblank symbol when started on the empty input.
- d. To determine, given a Turing machine M and a string w , whether M ever moves the tape head to the left when started with input w .
- e. To determine, given two Turing machines, whether one accepts the complement of the language of the other.
- f. To determine, given two Turing machines, whether there is any string on which each halts.
- g. To determine, given a Turing machine M , whether the language accepted by M is finite.