1

Explain the Recursion Theorem intuitively in English. If it helps your explanation, you may refer to other models of computation or programming languages.

2

Which of these languages does Rice's Theorem tell us is undecidable? For each language, explain why it does or does not apply.

(a) $\{\langle M \rangle \mid L(M) \subseteq \{0^{2^n} \mid n \in \mathbb{N}\}$ and M has an even number of states$\}$

(b) $\{\langle M \rangle \mid L(M)$ contains $\langle M \rangle\}$

(c) $\{\langle M \rangle \mid L(M)$ contains some ww for $w \in \{0,1\}^*\}$

(d) $\{\langle M \rangle \mid M$ decides the language from part (c)$\}$

3

Describe two distinct Turing machines M and N such that on empty input M outputs $\langle N \rangle$, and on empty input N outputs $\langle M \rangle$.

4

Let t be a function that interchanges the states q_{accept} and q_{reject} in the description of a Turing machine. Give an example of a fixed point for t. That is, give a Turing Machine M such that $L(M) = L(t(M))$.

5

Include a References section. Cite all sources that you used and people, including yourself, that you collaborated with on this homework.