Problem 1.

Are the following languages Turing decidable, Turing acceptable but not Turing-decidable, or not even Turing acceptable?

- $L = \{p(M)p(w) : M$ uses a finite number of tape cells when running on input $w\}$.
- $L = \{p(M)p(w)01^n0 : M$ uses at most n tape cells when running on input$w\}$.

Here, "using n cells" means that the head of the (deterministic) TM M reaches the n-th cell from the left during its computation. Justify your answer clearly: both exercises require careful thinking.

Solution

Problem 2.

Are the following languages Turing-decidable? Turing-acceptable but not Turing-decidable? Not even Turing-acceptable? For each answer, just give an intuitive explanation of your reasoning, no formal proof is required (just as in class, M is a generic deterministic Turing machine, w is a generic input string to it, and p is an encoding function).

- $\{p(M) : |L(M)| \leq 10\}$
- $\{p(M) : |L(M)| \geq 10\}$
- $\{p(M)p(w) : M \searrow w$ in 10 steps or less $\}$
- $\{p(M)p(w) : M \searrow w$ in 10 steps or more $\}$

Solution

Problem 3.

Use reduction to prove that the language

$$L = \{p(M_1)p(M_2) : L(M_1) \subseteq L(M_2)\}$$

is not decidable (M_1 and M_2 are Turing machines, of course).

Solution