Problems Solved:

31	32	33	34	35

Name:

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Problem 31. Let a language $L = L(T) \subseteq \{0,1\}^*$ be given by the code of a Turing machine $\langle T \rangle$. It is known that $\varepsilon \in L$.
Let S_0 be the set of Turing machines of the form $(Q, \{0, 1, X, \sqcup\}, \sqcup, \{0, 1\}, q_0, \emptyset)$.
Let S_1 be the set of Turing machines of the form $(Q, \{0, 1, X, \sqcup\}, \sqcup, \{0, 1\}, q_0, Q)$.
Is it decidable whether $L = L(M)$ and $M \in S_0$? That is: Is there a Turing machine D_0 such that it takes a word w as input and returns "yes" if $w = \langle M \rangle$ for a TM $M \in S_0$ with the property $L(M) = L$, and returns "no" otherwise?
What is the answer, if you replace S_0 by S_1? Justify your answers.

Problem 32. Let Σ be an alphabet and A be a language over Σ ($A \subseteq \Sigma^*$). Let also A be semi-decidable, but not decidable. Prove that the complement of A, i. e., $\bar{A} = \Sigma^* \setminus A$, is not decidable.

Problem 33. Let L be a finite language over an alphabet $\{0, 1\}$. Is the following problem (with input $\langle M \rangle$)

> For a Turing maschine M it holds $L(M) \supseteq L$.

in general semi-decidable? Is it also in general decidable? Justify your answers.

Problem 34. Which of the following problems are decidable? In each problem below, the input of the problem is the code $\langle M \rangle$ of a Turing machine M with input alphabet $\{0, 1\}$.

(a) Does M have at least 4 states?

(b) Is $L(M) \subseteq \{0, 1\}^*$?

(c) Is $L(M)$ recursive?

(d) Is $L(M)$ finite?

(e) Is $10101 \in L(M)$?

(f) Is $L(M)$ not recursively enumerable?

(g) Does there exist a word $w \in L(M)$ such that M does not halt on w?

Justify your answer.

Problem 35. Show that the Acceptance Problem is reducible to the restricted Halting problem. First explain clearly which Turing machine you have to construct to prove this statement and then give a reasonably detailed description of this construction.