Universität Koblenz-Landau
FB 4 Informatik

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Exercises for

Advances in Theoretical Computer Science

Exercise Sheet 3

Due at 06.11.12, 09:00 s.t.

Exercise 3.1

Decide for each of the following problems if it is decidable or not. Justify your answer.

a) $P_1 := \{n \in \mathbb{N} \mid \mathcal{M}_n \text{ does not hold on empty input}\}$

b) $P_2 := \{n \in \mathbb{N} \mid L(\mathcal{M}_n) = \emptyset\}$

c) $P_3 := \{n \in \mathbb{N} \mid L(\mathcal{M}_n) \text{ is a finite language}\}$

d) $P_4 := \{(m,n) \in \mathbb{N} \times \mathbb{N} \mid L(\mathcal{M}_m) \cap L(\mathcal{M}_n) = \emptyset\}$

e) $P_5 := \{(m,n) \in \mathbb{N} \times \mathbb{N} \mid L(\mathcal{M}_m) \subseteq L(\mathcal{M}_n)\}$

f) $P_6 := \{(n,w) \in \mathbb{N} \times \Sigma^* \mid$ For input w, $\mathcal{M}_n$ does not reach another configuration after $s, \#w\underline{\#}$ where the head is on a blank $(\#)\}$

g) $P_7 := \{(n,w,s) \in \mathbb{N} \times \Sigma^* \times \mathbb{N} \mid \mathcal{M}_n$ halts on input w after at most s steps $\}$

Remarks:

- *$\mathcal{M}_n$ denotes the Turing Machine with Gödel number n.*
- *$L(\mathcal{M})$ is the language accepted by the Turing Machine $\mathcal{M}$ (i.e. the set of all words accepted by $\mathcal{M}$).*
- *You are allowed to use the undecidability of the Halting Problems.*
- *If you have proven the (un-)decidability of P_i, you may use this result for the other tasks.*

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The submission of the solutions is not compulsory. If you want to submit your solutions, please do so until 06.11.12, 09:00 s.t.. Joint solutions prepared by up to three persons are allowed. Please do not forget to write your name on your solution.
Submission possibilities:

- By e-mail to mbender@uni-koblenz.de with the keyword "Homework ACTCS" in the subject.
- Put it in the box in front of Room B 222.