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Algorithms

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Exercises 7

1. **Turing machine simulation (NIVEAU I)**

   Given a Turing machine M accepting the language $L = \{0^n\,1^n \mid n \geq 1\}$ with accepting state q_4 and the next move function δ:

δ	0	1	X	Y	#
q_0	(q_1, X, R)	–	–	(q_3, Y, R)	–
q_1	$(q_1, 0, R)$	(q_2, Y, L)	–	(q_1, Y, R)	–
q_2	$(q_2, 0, L)$	–	(q_0, X, R)	(q_2, Y, L)	–
q_3	–	–	–	(q_3, Y, R)	$(q_4, \#, R)$
q_4	–	–	–	–	–

   - Simulate M on input 0011 and 001101.

2. **Decision problems (NIVEAU II)**

   Let w_i be the i-th word in $\{0, 1\}^*$ and M_n the n-th turing machine. Consider:

   - the general halting problem K: "Does Turing machine M_n halt for input w_i?" and
   - the special halting problem K' "Does Turing machine M_n halt for input w_n?"

   (a) Prove that K' is undecidable but semi-decidable.

   (b) Use reduction to prove that K is undecidable.