

Tutorial 5

Exercise 1 (compulsory)

Assume that a language A is reducible to language B . Which of the following claims are true?

1. A decider for language A can be used to decide the language B .
 2. If A is decidable then B is decidable too.
 3. If A is undecidable then B is undecidable too.
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Exercise 2 (compulsory)

1. Give examples of three different languages that are recognizable but not decidable. Argue why the languages are recognizable but not decidable.
 2. Give examples of three different languages that are not recognizable. Argue why they are not recognizable.
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Exercise 3 (compulsory)

Consider the following decision problem:

”Does a given TM M accept a string 0010?”

1. Define this problem as a language L_{0010} .
 2. Prove that L_{0010} is undecidable by reduction from A_{TM} .
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Exercise 4 (compulsory)

Consider the following decision problem:

”Does a given TM M accept all strings?”

1. Define this problem as a language $TOTAL_{TM}$.
 2. Prove that $TOTAL_{TM}$ is undecidable by reduction from A_{TM} .
 3. Prove that EQ_{TM} is undecidable by reduction from $TOTAL_{TM}$.
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Exercise 5 (if you feel you need additional practice on reductions)

Problems 5.26 and 5.27 on page 241 (in international edition), or Problems 5.10 and 5.11 on page 239 (in standard edition).

Exercise 6 (optional and slightly challenging)

Problem 5.29 on page 241 (in international edition) or Problem 5.13 on page 239 (in standard edition).
(Note the analogy between useless states in Turing machines and dead-code in e.g. java programs.)