

Sections 4.1–4.2: Decidability

These exercises reflect material from our text, *Introduction to the Theory of Computation*, by Michael Sipser, PWS Publishing Co., 1997.

Definitions

Define each of the following concepts:

- (a) Decidable language
- (b) The halting problem
- (c) The diagonalization method
- (d) The characteristic sequence, χ_A , of a language A
- (e) A co-Turing-recognizable language

Results

The set of all languages over an alphabet Σ is uncountable.

The set of all Turing machines is countable.

There are more languages than Turing machines, so some languages are unrecognizable.

The halting problem is undecidable.

A language is decidable iff it is both Turing-recognizable and co-Turing-recognizable.

Examples

Give a number of examples of decidable regular languages, and present Turing machines which decide them.

Give a number of examples of decidable context-free languages, and present Turing machines which decide them.

Give some examples of non-decidable languages.

An example of a non-recognizable language.

Exercises

We will attempt to solve each of the following exercises as a community project in class today. Finish these solutions as homework exercises, write them up carefully and clearly, and hand them in at the beginning of the next class.

Exercises for Chapter 4, pages 168–169: 1, 2, 3, 4, 5, 6, 7, 8, 9

Problems for Chapter 4, pages 169–170: 10, 11, 16