UNIVERSITETET I OSLO
Institutt for Informatikk
I. Yu, D. Karabeg

INF2220: algorithms and data structures

Series 9

Toopic: Undecidability and Complexity

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Classroom

The idea is to use these exercises to review the important concepts.

Exercise 1: Assuming the alphabet {0, 1, ',' }, what is the formal language that corresponds to the (lexicographic) sorting problem?

Solution 1: { ϵ, (0), (1), (10), (11), (100), … [all sequences with one input value], (0,0), (0,1),… [all sequences with two numbers, where the first is smaller than or equal to the second]… etc. }

Exercise 2: Correct the following statements and give a short explanation

    a. A formal language is a formal way of speaking a conventional language such as English or Norwegian.
    b. The Turing machine is a hardware computational device built by Alan Turing.
    c. By reducing a problem we make it smaller.
    d. We classify problems into classes based on how important they are.
    e. Church's thesis is Alonso Church's Ph.D. dissertation.

Solution 2: Correct answers are provided in the compendium. These questions are provided to give you a chance to reflect on the meaning of those key concepts, rather than to memorize 'correct answers'.

Exercise 3:
    a. Show that there are more real numbers than natural numbers, by diagonalization.
    b. Show how the same technique may be applied to produce an alternative proof that the Halting problem is unsolvable.

Solution 3:

      a. See the solution to Problem 1. in the compendium.
      b. See Slide 7 and its explanation in Lecture 3 in the compendium.

Exercise 4: Construct a Turing machine that answers 'yes' (halts scanning a 'Y' on its tape) if its input is a string of one or more 0's; and answers 'no' (N) otherwise. Assume that the input alphabet is $\{0,1\}$.

Solution 4: See the solution to Problem 5 in the compendium.