

Mandatory Assignment 3, IN3130, 2021

Deadline: WEDNESDAY November 24, at 23:59

Note: Your solution *must* be approved before December 1, as the Faculty needs the final list of students ready for the exam (with all three mandatory assignments approved) two weeks before the exam!

General guidelines for mandatory assignments at the department can be found at:

Norwegian: <http://www.mn.uio.no/ifi/studier/admin/obliger/oblig-retningslinjer.html>

English: <http://www.mn.uio.no/ifi/english/studies/admin/mandatory-assignments/index.html>

Especially for this mandatory assignment

- This assignment consists of two exercises; each student must turn in his/her own, independent solution to both. Both require textual answers, maybe drawings and some discussion.
- The answers can be delivered to Devilry as one pdf-file.
- If additional specification or clarification becomes necessary, it will be posted as a message on the web page for the course. Check regularly.

Exercise 1 (Undecidability)

We say that a Turing machine M is a *composition* of Turing machines M_1 and M_2 , and write:

$$M = M_1 \& M_2$$

if, for every input x , M produces the same result or output as the one that results when M_1 is first run on input x , and then M_2 is run with the output of M_1 as input. Or put more simply, when M always produces the same output as M_1 “followed by” M_2 .

Question a)

Formulate the Turing machine composition problem (the problem of deciding whether, when given three machines as input, the first is a composition of the remaining two) as a formal language.

Question b)

Prove that the Turing machine composition problem is undecidable. Your proof should be complete – *i.e.*, include the proof that the reduction algorithm exists, by describing that algorithm in sufficient detail.

Exercise 2 (NP-completeness)

We know that 3-SATISFIABILITY is NP-complete. But there is of course nothing special about the number 3.

Question a)

Define 10-SATISFIABILITY and prove that it is NP-complete.

Question b)

What is the complexity of 10-SATISFIABILITY when the number of variables is limited to 100?

Prove your answer.

[end of mandatory assignment 3]