

St. Francis Xavier University
Department of Computer Science
CSCI 356: Theory of Computing
Assignment 4
Due December 5, 2022 at 1:15pm

Assignment Regulations.

- This assignment must be completed individually.
 - Please include your full name and email address on your submission.
 - You may either handwrite or typeset your submission. If your submission is handwritten, please ensure that the handwriting is neat and legible.
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[7 marks] 1. Consider the following decision problem:

$SUB_{DFA} = \{\langle \mathcal{B}, w \rangle \mid \mathcal{B} \text{ is a deterministic finite automaton and some word in } L(\mathcal{B}) \text{ contains } w \text{ as a subword}\}.$

Prove that SUB_{DFA} is decidable by giving a decision algorithm.

Hint. You may find the fact that the class DFA is closed under the operation of intersection to be useful.

[7 marks] 2. Consider the following decision problem:

$POW_{TM} = \{\langle \mathcal{M}, w \rangle \mid \mathcal{M} \text{ is a Turing machine, } w \text{ is a word, and } \mathcal{M} \text{ accepts } w^p \text{ for some positive integer } p\}.$

Show that the problem POW_{TM} is undecidable.

Hint. Reduce from another undecidable problem for Turing machines.

[6 marks] 3. Let B be a language over the alphabet $\Sigma = \{0, 1\}$. Determine whether each of the following statements is true or false, and give a brief (1–2 sentence) justification for each answer.

(a) If $B \leq_m A_{TM}$, then B is decidable.

(b) If $B \leq_m \{0^n 1^n \mid n \geq 0\}$, then B is decidable.

[5 marks] 4. Choose your favourite topic from the course, and write a multiple-choice style question with one correct answer and 3–4 plausible-but-incorrect answers that tests a concept or notion related to that topic.

For inspiration, consider the multiple-choice style questions you saw on the midterm and practice midterm exams.