

GROUP HOMEWORK 4, CPSC 421/501, FALL 2025

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Disclaimer: The material may sketchy and/or contain errors, which I will elaborate upon and/or correct in class. For those not in CPSC 421/501: use this material at your own risk...

Please note:

- (1) You must justify all answers; no credit is given for a correct answer without justification.
- (2) Proofs should be written out formally.
- (3) You do not have to use LaTeX for homework, but **homework that is too difficult to read will not be graded.**
- (4) You may work together on homework in groups of up to four, **but you must submit a single homework as a group submission under Gradescope.**

(0) Who are your group members? Please print if writing by hand.

- (1) Let VALID-PYTHON be the set of ASCII strings that are valid Python programs. L be the language

$$L = \{p \in \text{VALID-PYTHON} \mid p \text{ accepts at least one input}\},$$

i.e.,

$$L = \{p \in \text{VALID-PYTHON} \mid \exists i \in \text{ASCII}^* \text{ such that } p \text{ accepts } i\}.$$

- (a) Show that L is recognizable.
- (b) Show that L is undecidable. [Hint: assume that L is decidable. Consider class notes 09_17, pages 8–10.]

- (2) In class we discussed how to run a finite number of Python programs “in parallel.” Say that $p_1, p_2, \dots \in \text{ASCII}^*$ is an infinite sequence of (valid) Python programs. Let

$$(1) \quad L = \{i \in \text{ASCII}^* \mid \exists j \in \mathbb{N} \text{ such that } p_j \text{ accepts } i\}$$

- (a) Show that L is recognizable.
- (b) Show that **there exist programs $p_1, p_2, \dots$ such that L as in (1) is undecidable.** [Hint: Assume that L is decidable; use the decidability of L to decide ACCEPTANCE.]

(3) Exercise 9.3.1 on the handout “Uncomputability in CPSC421/501.”

(4) Exercise 9.3.2(b) on the handout “Uncomputability in CPSC421/501.”

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