

University of Toronto  
Scarborough Campus  
February 26, 2022

**CSC C63 Midterm Test**  
**Instructor:** Vassos Hadzilacos

**Aids allowed:** One  $8.5 \times 11$  'cheat sheet' (may be written on both sides)

**Duration:** Two hours

**READ THE INSTRUCTIONS CAREFULLY**

- There should be ?? pages in this exam booklet, including this cover page.
- Answer all questions.
- Put all answers in this booklet, in the spaces provided.
- For rough work, use the backs of the pages; *these will not be graded*.
- The last two pages are blank and can be used for rough work or for overflow. If you use them for overflow, you must *clearly indicate this* on the page(s) containing the question(s) whose answer(s) you are providing in the overflow pages, and you *must not detach them* from the booklet.
- In your answers you may use any result discussed in this course or its prerequisites merely by naming or describing it. In particular, you may use any of the facts regarding undecidable or unrecognizable sets listed on page ??.
- Good luck!

**LIST OF UNDECIDABLE OR UNRECOGNIZABLE SETS:**

- $U = \{\langle M, x \rangle : \text{TM } M \text{ accepts input } x\}$  is undecidable but recognizable; thus  $\overline{U}$  is unrecognizable.
- $H = \{\langle M, x \rangle : \text{TM } M \text{ halts on input } x\}$  is undecidable but recognizable; thus  $\overline{H}$  is unrecognizable.
- $\overline{E} = \{\langle M \rangle : \text{TM } M \text{ accepts some input}\}$  is undecidable but recognizable; thus  $E$  is unrecognizable.
- $FIN = \{\langle M \rangle : \text{TM } M \text{ recognizes a finite language}\}$  and  $\overline{FIN}$  are both unrecognizable.
- $REG = \{\langle M \rangle : \text{TM } M \text{ recognizes a regular language}\}$  and  $\overline{REG}$  are both unrecognizable.