Instructions for CSC 280/480, Midterm 2

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Please do read all these instructions before starting the test. (The instructions have been made available almost a week ahead of time, online, so that if you read them online as suggested you won’t need to use your test time for reading the instructions.)

1 UR Academic Honesty Pledge

You are bound on this exam by the UR Academic Honesty Pledge: I affirm that I will not give or receive any unauthorized help on this exam, and that all work will be my own. (Due to the restrictions of this being an online exam, the exam can’t make you hand-write the pledge; nonetheless, as per the academic honesty policy of UR, the pledge and its obligations still fully apply even though you are not writing/signing it.)

2 Academic Honesty and Specific Honesty Rules for This Test

The test is open book, open notes, open slides, open videos, open Internet, and open computer. However, it is an academic honesty violation to (in any way—whether phone, text, email, Skype, posting a query on the web, etc., etc.) actively seek help from other humans. To help remove blurry edges regarding what is and is not ok: Between when you start the test and the end of the period when people might be taking the test (please see later in this document regarding when that time period is), you may not make any active outgoing communication/query regarding the content of the test or of this course. But you may, as mentioned above, look, yourself, at books, your notes, anything you want that is on the Web, etc. (So for example asking anyone—even asking the query to some mailing list or on a web forum—“What is undecidability” is cheating, but Googling “undecidability” is allowed. So you may look for example at Stack Exchange, but you may not post queries there.) However, I warn you that searching takes vastly more time, usually, than knowing the answer yourself, so you’re unlikely to finish the exam if you try to do it by searching. Also, all the questions on the exam are living in the world and notation of this course, which in some ways may directly conflicts with the notations and definitions that you may find, under the same names, on the Internet. Thus searching may well cause you to give incorrect answers. On the other hand, if you have the time and need to, you might well choose to draw on the course slides, or our SIP textbook, or your notes. But you won’t have the time to do that too much; you’ll likely mostly need to draw on your understanding of the material.

Finishing the test and then exchanging even the vaguest of information/hints on the test to anyone else before the end of when people might be taking the test—e.g., “It had a lot on XYZ”
or even “It was hard regarding XYZ” or even “It was hard” or “It was easy”—is also academic dishonesty.

3 Instructions

3.1 Time and Timing

This is a 75-minute exam. However, to give you time to jump back in if you get disconnected or your browser hangs (and you may also use that extra time to check your answers), I’ve set Blackboard to only cut each person off after 100 minutes. You thus in the mind of Blackboard have 100 minutes to do this exam. It consists of mostly multiple-choice questions, plus a few true-false questions. Once you start it, even if you stop, the 100 minute counter will keep moving forward in Blackboard’s mind, and when 100 minutes is reached from the moment you started, your exam will be over (and, I believe, will automatically submitted by Blackboard). So if you get disconnected, do jump right back in.

The Blackboard availability window is 930AM Eastern Daylight Time on Monday 4/20 through 930AM Eastern Daylight Time on Tuesday 4/21. You may do it any time you like within that availability window, but do be careful, as of course the Blackboard is a computer and so will be auto-enforcing the availability window strictly. And also do be aware of the warning in the previous paragraph—this is not a 24-hour exam, but rather it is a 75-minute exam (that you will be given by Blackboard just 100 minutes for, clocked from when you start it).

3.2 Scoring and Some Rules and Information

As was also the case on midterm 1, no questions about the midterm’s content will be answered during the test. (Since different people are taking it at different times, this has to be followed for fairness.)

This is a 100-point exam. There are 120 points available, and so it is possible to score over 100 percent, namely, it is possible to score up to 120 percent on this. Due to the quirks of Blackboard, one has to designate which 20 points of questions are the “extra credit” ones, so I have arbitrarily chosen 20 points’ worth of questions and designated them as extra credit. (Note that that means the extra credit questions are not necessarily the hardest questions.)

On each question, you will get full credit if you select the best answer, and no credit for selecting any of the other answers. (Note: You will not be assigned negative points for selecting an incorrect answer.) Your only hand-in will be your submission of the test via doing it in Blackboard; even if you make notes on scrap paper during the test, you should not hand those in. Not all students may have the same ordering of the questions or the same ordering of the answers to a given question.

Note that all but one of the questions are worth 5 points each. The exception is the 10-point question regarding proving the undecidability of a particular language (that you perhaps have not seen before). For each question, choose the best answer. (Note: For questions that have “[[BLANK]]” in their text, you are to choose which is the best of the options as to filling in the location where that “[[BLANK]]” is. For example, if the question is, “The lists of odd primes, in order, starts: 3, 5, 7, 11, [[BLANK]], 17,” the answer would be whichever of the multiple-choice options said “13”.)
3.3 Notation

Following SIP Chapter 0, we’ll generally use the term language for a set of strings.

We will generally use the standard conventions of mathematics regarding quantification. So if a True/False question is, “If $A \subseteq \{0, 1\}^*$, then $A = \emptyset$,” the correct answer is False. It is not ok to say “but I wrote True and that is correct because when $A = \emptyset$ the statement evaluates to True,” as that is reading the implicit quantification over $A$ as being existential, when the standard reading of the implicit quantifier in this setting would be that it is universal.

I mention, as a heads up, that due to the way Blackboard handles LATEX mathematical equations (namely, LATEX to MathML to .png), some of the math symbols may be rendered in a way that looks slightly different than you might expect, or are slightly misaligned or slightly too big or too small. Here, via actual LATEX (and so this is not what they will look like in Blackboard) are some of the symbols that to me were a bit “off” when rendered in Blackboard: $\emptyset$ (the 0 part comes out very wide, basically like a circle rather than an oval), $\epsilon$ and $\in$ (be careful to distinguish “epsilon” from “is an element of”), $\leq_p$ (in regular LATEX the $m$ and the $p$ are perfectly aligned above each other, but in Blackboard they sometimes are not), and things like $\langle M \rangle$ and $\langle M, x \rangle$ and so on (sometimes Blackboard puts space after an opening bracket or before a closing bracket).

Regarding polynomial-time many-one reducibility ($\leq_p$), I mention in passing that in the reading you did in Chapter 7.4 of SIP, Sipser uses a different terminology and a different notation. He speaks of this as one language being “polynomial time mapping reducible” to another language, or “polynomial time reducible” for short, and his notation for this is not $\leq_p$, but rather is the $\leq$ sign with an upper-case roman latter P as its subscript. However, the notions of the two notations are the same. (And as a reminder—which might be useful to know on this exam—I here give you a definition, namely, $B_1 \leq_p B_2$ exactly if there exists a polynomial-time computable function $f$ such that, for each string $x$, it holds that: $x \in B_1 \iff f(x) \in B_2$. We in such a case might say that “$B_1 \leq_p B_2$ via the polynomial-time function $f$."

Of course, do not confuse the notations or reductions of the above paragraph with the different notion we used in our unit on decidability and undecidability, which is denoted by “$\leq_m$” (and which itself appears in this exam) and is called a “mapping reduction” and in fact is a close cousin of the above notion, except in its definition the reduction function is not required to be polynomial-time computable, but rather is required to be to be computable.

3.4 Advice

Finally, a few pieces of advice: Keep in mind that if you for each answer that is asserting that something is not decidable, or is not Turing-recognizable, or is not co-Turing-recognizable you try to write down on scrap paper an entire proof, you’ll likely finish almost no problems. Rather, if your goal is just to classify, you’ll likely want to triage: Try the standard ways of trying to quickly see for yourself that a language is decidable, or is Turing-recognizable, or is co-Turing-recognizable, and then, at least during your first pass through the test, you might want to choose your answer based on what that showed you. But, beware, if something is one of those, and you failed to see the argument showing that it is, that might lead you wrong. So think carefully though quickly. Also, some of these are harder than they look, or require you to have some insight into the problem in order to get them right—so, again, think carefully, drawing on what you learned from the lectures/book reading/workshops/slides/tutorials to try to understand and solve the given question.