Homework 11 Morally Due May 4 11:00AM
WARNING: THIS HW IS TWO PAGES LONG!!!!!!!!!!!!!!!!!!!!!!

1. (0 points)
   When is the TAKEHOME part of the final due?
   When is the TIMED part taking place?
   (HINT: The TAKEHOME part:
due 11:00AM on May 11.
The TIMED part:
starts at 8:00PM on May 13 and is due at 10:15PM on May 13.
)

2. (40 points)
   (a) (20 points) Using the WS1S convention give a DFA for
       \[ \{(x, y) : x \equiv y \pmod{2}\}. \]
       How many states does it have?
       (All states are labelled A for accept or R for reject or S for stupid.)
   (b) (20 points) Using the WS1S convention give a DFA for
       \[ \{(x, y) : x \equiv y \pmod{3}\}. \]
       How many states does it have?
       (All states are labelled A for accept or R for reject or S for stupid.)

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3. (30 points) Write down the following sets in terms of quantifiers and say what level of the Arithmetic Hierarchy you got them into (it is okay if your level is not optimal).

You are allowed to write things like \((\exists x < y)[BLAH(x, y)]\)

Let

\[ M_0, M_1, \ldots \]

be a standard list of Turing Machines.

(a) (15 points)

\[ \text{EXACT}100 = \{e : M_e \text{ halts on exactly 100 inputs}\}. \]

(b) (15 points)

\[ \text{INFPRIMES} = \{e : M_e \text{ halts on an infinite number of primes}\}. \]

4. (30 points) Show that the following problem is DECIDABLE:

Given a polynomial

\[ a_n x^n + \cdots + a_1 x + a_0 \]

where \(a_0, \ldots, a_n\) are integers, does there exist an integer \(r\) such that

\[ a_n r^n + \cdots + a_1 r + a_0 = 0 \]

(Hint rewrite the last line as

\[ a_n r^n + \cdots + a_1 r = -a_0. \]

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