COMP-170: Homework #6

Ben Tanen - March 12, 2017

Problem 1

For each of the following sets, give the smallest complexity class in which it is contained. Classes are listed from smallest to largest. Write your choice A through D under each numbered language. Your choices are:

A. DECIDABLE

B. UNDECIDABLE but RECOGNIZABLE

C. UNDECIDABLE and UNRECOGNIZABLE but its compliment is RECOGNIZABLE

D. UNDECIDABLE and both it and its compliment are UNRECOGINZABLE

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I: $\{\langle M, x, y\rangle \mid M \text{ accepts } x \text{ and rejects } y\}$

B

This language is undecidable but recognizable. We can tell when M accepts x and when M rejects y. If M loops on either input, $\langle M, x, y\rangle \notin L$ so it is acceptable to loop.

II: $\{\langle M_1, M_2\rangle \mid M_2 \text{ rejects every input that } M_1 \text{ accepts}\}$

D

L is unrecognizable. $\overline{L} = \{M_2 \text{ accepts or loops on an input that } M_1 \text{ accepts}\}$, and we can't recognize that

III: $\{\langle M_1, M_2\rangle \mid \exists x \exists y\ M_1 \text{ accepts } x \text{ and rejects } y, \text{ but } M_2 \text{ rejects } x \text{ and accepts } y\}$

B

Do $A_{TM} \leq_m L$

IV: $\{\langle M\rangle \mid M \text{ only rejects strings beginning with } 0\}$

C

Run M on strings beginning with 1. As soon as we find one that is rejected, we can recognize.

V: $\{\langle M, w\rangle \mid M \text{ accepts } w \text{ using only } |w|^2 \text{ tape cells}\}$

A

Similar to running for t steps, using thing from class.