York University
CSE 2001 Fall 2017 – Assignment 4 of 4
Instructor: Jeff Edmonds

Sorry. You MUST work in a pair.

Family Name: ______________________ Given Name: ______________________

Student #: ______________________ Email: ______________________

Family Name: ______________________ Given Name: ______________________

Student #: ______________________ Email: ______________________

Section to which to return the test (circle one): A: 9:00, E: 4:00

a	10	
b	15	
c	15	
d	35	
e	10	
f	15	
0) Art	2	
Total	102 marks	

Keep your answers short and clear.

0) (2 marks) Art therapy question: When half done the exam, draw a picture of how you are feeling.

1. Let $P = \{\langle \text{“}M\text{”}, I\rangle \mid M$ is a TM that has a state that it never enters on input I $\}$.

   (a) Suppose I prove $A \leq B$.
   By Dec, I mean Computable/Decidable.
   By Rec, I mean Recognizable but not Co-Recognizable. By Co-Rec, I mean Co-Recognizable but not Recognizable.
   By Neither, I mean neither Recognizable nor Co-Recognizable.
   Circle **ALL** that are possible.

   - If A is decidable then B is: Dec Rec Co-Rec Neither
   - If A is not co-recognizable then B is: Dec Rec Co-Rec Neither
   - If B is recognizable then A is: Dec Rec Co-Rec Neither
   - If B is not decidable then A is: Dec Rec Co-Rec Neither
   - If B is Rec and Co-Rec then B is: Dec Rec Co-Rec Neither

   (b) Is the problem P *recognizable/acceptable*? Either prove it is or argue that it is not.
   Is the problem P *co-recognizable/acceptable*? Either prove it is or argue that it is not.
   (7 sentences.)

   (c) Either prove $Halting \leq_{compute} P$ or argue that it is impossible.
   Hint: In one case, try having a new character c_{loop}
   and the transition function rules $\delta(q_i, c_{loop}) = \langle q_{i+1}, c_{loop}, stay\rangle$.
   Hint: In other case, give the chain of consequences that would follow leading to a contradiction.
   (We only want *No-No, Yes-Yes* reductions.)

   (d) Again either prove $\neg Halting \leq_{compute} P$ or argue impossible.

   (e) State Rice's Theorem. Can you directly use it to prove P or $\neg P$ is undecidable?

   (f) A Yes/No computational problem P (language) can be viewed as the set of *yes* instances. Define what it means for P to be enumerable. Compare and contrast this concept with the “list” definition of P being countable?
   Is the problem P *countable*? Is it*enumerable*? Give a one sentence argue.
   Is the problem $\neg P$ *countable*? Is it*enumerable*?