CS600 Due Date: 09/29/23

Homework 2

Students are welcome to work together, but *every student must write up their own solutions, independently!* I strongly encourage students to use LaTex for writing up their solutions. Please see the course web-page for a template file.

Question 1: Let $L_{\mathsf{mason}} = \{\langle M \rangle \mid M$ is a TM that decides a language containing the string "Mason"$\}$. Show that L_{mason} is undecidable. (*Hint:* Assume that there is exists such a TM and reach a contradiction.)

Question 2: Let $L = \{\langle M \rangle \mid M$ decides a language containing exactly 4 strings$\}$. Show that L is undecidable.

Question 3: Let $L = \{\langle M \rangle \mid M$ is a TM that accepts w^R whenever it accepts $w\}$. Show that L is undecidable

Question 4: Let $L = \{\langle M_1, M_2, w \rangle \mid$ $M_1(w)$ and $M_2(w)$ both halt, with opposite output$\}$. Show that L is undecidable by giving a *mapping reduction*.

Question 5: Respond with a True or False and provide a one-sentence explanation for each answer:

- $A \leq_m B$ means that "A problems are no harder to solve than B problems"
- $A \leq_m B$ means that "Being able to solve any B problem $\Rightarrow$ Being able to solve any A problem"
- If $A \leq_m B$ and B is decidable, then A is decidable
- To prove that A is undecidable, you can construct a reduction $A \leq_m B$ for some undecidable language B