# Theory of Computation, Fall 2022
# Assignment 11 (Due November 12 Monday 10:00am)

Q1. Prove that the following language is not recursive, but is recursively enumerable.

$$L_1 = \{\text{“}M\text{”} : M \text{ is a Turing machine that halts on at least 2023 strings.}\}$$

Q2. Prove that the following language is not recursively enumerable.

$$L_2 = \{\text{“}M\text{”} : M \text{ is a Turing machine that halts on at most 2022 strings.}\}$$

Q3. Prove that the following language is not recursively enumerable.

$L_3 = \{\text{“}M\text{”} : M$ is a Turing machine such that there are at least 2023 strings on which $M$ does not halt.$\}$

Q4. Prove that the following language is not recursively enumerable.

$L_4 = \{\text{“}M\text{”} : M$ is a Turing machine such that there are at most 2022 strings on which $M$ does not halt.$\}$

Q5. Construct a grammar that generates $\{ww : w \in \{a, b\}^*\}$.