CSCE-433 Formal Languages & Automata
CSCE-627 Theory of Computability

Spring 2022

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Assignment # 5
(Due April 8, 2022)

Instructions.

- Your assignment must be typed using your favorite word processor. You may draw diagrams by hand, but only if you are very neat and the diagram is legible.
- Turn in a PDF file of your homework on Canvas.
- Homework is always due at the **beginning** of the class on the due day.

Questions.

1. (20 points) Give implementation-level descriptions of Turing machines that decide the following languages over the alphabet $\{0, 1\}$.
   (a) (CSCE 433 students only) $L_{433} = \{w \mid w$ contains twice as many 0's as 1's$\}$.
   (b) (CSCE 627 students only) $L_{627} = \{w \mid w$ does not contains twice as many 0's as 1's$\}$.

2. (20 points) Show that the collection of (Turing-)decidable languages is closed under the operations of (a) complementation, and (b) intersection. Use the solution for Problem 3.15(a) in the textbook (page 191) as a guide for the level of details needed in your solutions.

3. (20 points) Show that the collection of Turing-recognizable languages is closed under the operation of intersection. Use the solution for Problem 3.16(a) in the textbook (page 191) as a guide for the level of details needed in your solutions.

4. (20 points) Prove that the following languages are decidable.
   (a) (CSCE 433 students only) $L_{433} = \{\langle A\rangle \mid A$ is a DFA and $L(A) = \Sigma^*\}$.
   (b) (CSCE 627 students only) $L_{627} = \{\langle G\rangle \mid G$ is a CFG that generates $\epsilon\}$.

5. (20 points) Prove: let L be a language such that both L and the complement $\overline{L}$ of L are Turing-regconizable, then L is decidable. The level of details of your proof should be similar to that for Questions 2-3 above.