CS 162 — Automata Theory — Winter 2014 — Goodrich — Midterm 2

Name:

ID:

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total:

1. (50 points). General Concepts.

(a) How is a nondeterministic Turing machine's transition function different than that for a deterministic Turing machine?

(b) What is the Church-Turing thesis?

2. (50 points). Undecidability.

(a) Draw a Venn diagram that illustrates the relationships between the following classes of languages: regular languages, context-free languages, decidable languages, Turing-recognizable languages.

(b) Give an example of a language that is undecidable. (You don't need to prove that it is undecidable, however.)

3. (50 points). Countability. Show that the set, $\{3, 6, 9, 12, 15, \ldots\}$, of positive multiples of 3 is countable.

4. (50 points). Context-free Languages. Use the pumping lemma for context-free languages to show that the language $L = \{1^n 2^n 3^n \mid n \geq 1\}$ is not context free.

5. (50 points). Turing Machines. Show that the language $L = \{1^n 2^n 3^n \mid n \geq 1\}$ is decidable by giving a high-level of a description of a Turing Machine that accepts strings in L and rejects strings not in L.

6. (50 points). Universal Turing Machines. Consider the language,

$F_{TM} = \{(M, w, n) \mid M$ is a Turing Machine and M accepts the string w in at most n steps$\}$.

Is F_{TM} decidable? Why or why not? (Prove your answer.)