CSci 370

Third Hour Exam

Name _____

Friday, November 16
100 points.

I. Some basic definitions

1. (10 points) Give a formal definition of a **Turing Machine**. Be sure to describe the form of the transition function.

2. (5 points) What is a (Turing Machine) **configuration**?

3. (10 points) Say formally what it means for a Turing Machine M with start state q_0 to **accept** a string ω

4. (5 points) What does it mean to say that a language L is **Turing-recognizable**?

5. (5 points) What does it mean to say that a language L is **decidable**?

5. (5 points) A Turing-recognizable language L is sometimes called **recursively enumerable**. What is an **enumerator** in this context?

5. (5 points) Briefly, how do we know that a multi-tape Turing Machine is no more powerful than a single-tape Turing Machine?

II. Turing Machines

1. (15 points) Using the graphical approach used in our textbook (what our author calls a state diagram), describe a Turing Machine which takes strings of zeros and which **accepts** if the length of the string is odd and which **rejects** otherwise.

2. (10 points) Using the machine you defined in the problem above, trace the running of your Turing Machine from the starting configuration $q_{start}000$ using configurations.

III. The pumping lemma for Context Free Languages

1. (10 points) State the pumping lemma for CFL's

2. (5 points) Where does the pumping length come from?

3. Consider the language over $\sum = \{a, b, c\}$ consisting of strings with an equal number of a's, b's, and c's.

   a. (5 points) To show that a language is not a context-free language, we begin by assuming that it is. We then find a string in the language of a suitable length that can not be "pumped", demonstrating that our original assumption that the language is context free is in error. What string in this language might not be capable of being "pumped"?

   b. (10 points) Give an explanation of why this string can not be pumped. Include enough detail that I am convinced that you have considered all possibilities.