COMP 314 Homework Assignment J

Note: Solutions will not be provided for this assignment.

Question J1. (120 points) Complete only ONE of the following projects. Solutions will be graded generously. Attempts that show clear evidence of 2–3 hours' solid effort will receive a high score. The emphasis of this question is on doing something interesting and creative with the material we have learned this semester.

- Use JFLAP to create a Turing machine that does something interesting. Submit a diagram of your machine and a description of what it does.

- The `simulateTM.py` program provided with the book materials simulates deterministic Turing machines. Adapt this code so that it correctly simulates *nondeterministic* Turing machines. Submit a printout of your new program, `simulateNTM.py`

- Choose one of the problems we have studied this semester that is believed to require super-polynomial time. (Examples include FACTOR and TSP.) Run some practical experiments showing that a simple program for your chosen problem really does require exponential time. Make some concrete estimates for how long it would take your own computer to solve large instances. (e.g. Approximately how long would it take your program, running on your computer, to find the factors of a 1000-digit number in the worst case? Or, how long would it take to find the shortest Hamiltonian cycle in a 1000-vertex graph?) Submit a 1–2-page description of your experiments.

- Write a Python program that converts an nfa into a dfa. Submit a printout of your program.

- If you have any other idea for a creative project, feel free to suggest it to me. I will probably say yes.

Chapter 15

Question J2. (Ungraded) In your own words, describe the difference between *circular* and *circle-free* machines, as defined by Alan Turing in his 1936 paper.

Chapter 16

Question J3. (Ungraded) In a few sentences of your own words, describe how the undecidability of the halting problem can be used to prove that there exist true but unprovable statements in arithmetic.

Chapter 17

Question J4. (Ungraded) In your own words, describe one of the reductions used by Richard Karp in his 1972 paper.

Total points on this assignment: 120