CS 4410, Fall 2019 – Automata and Formal Languages
Final Exam
Due December 18, 2018 by 10:30 am

- This is a take-home exam. All answers must be your own work. You may:
  - Discuss this exam with me,
  - Use our text book, class notes and handouts,
  - **No other sources are allowed.**
- To receive full credit, **show your work** and **write legibly**.
- If you need clarification about any of the problems, please ask me.

Name: _____

1. Let $L = \left\{ a^n b^j \mid n \geq j \right\}$, prove that L is not regular.

2. Let $L = \{ ww \mid w \in \{a, b\}^* \}$, prove that L is not regular.

3. Consider $L = \{ a^n b^m c^k \mid k = n + m, \; where \; m \geq 0, n \geq 0 \}$.

   a. Find a context-free grammar for L.

   b. Construct an NPDA that accepts L.

4. Construct an NPDA that accepts $L = \{ wcw^R \mid w \in \{a, b\}^* \}$