CSCI 480, Winter 2016
Math Exercises # 4

YOUR NAME HERE

Due date:

- Build deterministic finite automata and/or regular expressions (as requested) for each of the languages in questions 1 to 6. Create simple, meaningful automata and regular expressions (rather than, *e.g.*, using the algorithm to create a regular expression from a DFA) and explain how they work. In all cases the alphabet is $\Sigma = \{0, 1\}$.
- DFAs should be specified with pictures, preferablly typeset with **TikZ**, not tables (as tables are very hard to read). Try to typeset them so that the labels on the arcs are clear, *etc.*
- If you are having a difficult time with **TikZ**, clear, legible hand-drawn figures (or figures created with a drawing program) are acceptable as graphics inclusions into your LaTeX documents.

1. The language $\{100, 10, 011\}$. Regular expression:
2. The language $\{100, 10, 011\}$. DFA:
3. The set of all strings that begin or end with a doubled digit, either 11 or 00. Regular expression:
4. The set of all strings that begin or end with a doubled digit, either 11 or 00. DFA:
5. The set of all strings that have exactly one doubled digit in them. In other words, either 11 or 00 occurs in the string, but not both, and it only occurs once. Regular expression:
6. The set of all strings that have exactly one doubled digit in them. In other words, either 11 or 00 occurs in the string, but not both, and it only occurs once. DFA:
7. Use the pumping lemma to show that the language that consists of all *palindromes* over $\Sigma = \{0, 1\}$ is not regular. A palindrome is a string that reads the same backwards and forwards, for example 11011, 01010, 0, and 0110.
$$L = \{w \in \{0, 1\}^* \mid w = w^R\}$$
8. Use the pumping lemma to show that the following language is not regular. For examples, 00110000, 01110000 and 00 are in the language, but 110 is not.
$$L = \{0^i 1^j 0^{i+j} \mid i, j \in \{0, 1, 2, \ldots\}\}$$
9. Give an example of a regular language R and a nonregular language N such that $R \cup N$ is regular. Describe all three languages in English and either prove they are regular/nonregular, or show that they are instances of languages with known regularity.
10. Give an example of a regular language R and a nonregular language N such that $R \cup N$ is nonregular. Describe all three languages in English and either prove they are regular/nonregular, or show that they are instances of languages with known regularity.