CS 381 – HW8 Part II
(Review problems, not to be handed in.)

1. For each of the following languages L over alphabet $\{0, 1\}$, give a DFA that accepts L.
(a) The set of all strings that start and end with a zero.
(b) $L((0+1)^*(000)(0+1))$
(c) The set of all strings such that every block of four consecutive symbols contains at least two 1's.

2.
(i) Miscellaneous Exercise 5 in Kozen (p. 316)
(ii) What is the language accepted by each of the NFA's in part (i)?
(iii) Give an NFA that accepts the following language: the set of strings in $(0+1)^*$ that contain a pair of 0's separated by a string of length divisible by 4.

3.
(i) Describe in English the languages denoted by each of the following regular expressions.
(ii)Construct an NFA or DFA for each of these languages.
(a)$(11+0)^*(00+1)^*$
(b)$(1+01+001)^*(\varepsilon+0+00)$

4. Which of the following languages are regular. Prove your answer.
(a)$\{0^n \mid n\ is\ prime\}$
(b) the set of all strings which do not contain three consecutive 0's.
(c)$\{0^{3^n} \mid n \in \mathbb{N}\}$

5. Describe the equivalence classes under R_L for each of the languages L in problem 4. Prove.

6. Give a context-free grammar generating each of the following sets. Prove.
(a) The set of palindromes (i.e., strings that read the same forward and backward) over alphabet $\{a, b\}$
(b)$\{a^i b^j c^k \mid i \neq j\ or\ j \neq k\}$
(c)The set of all strings over alphabet {a, b} with twice as many a's as b's.
(d) The set of all strings over alphabet {a, b} not of the form ww for some string w.

7. For each language L in problem 6, give a PDA accepting L. Prove.

8. Which of the following are CFL's? Prove.
(a) $\{a^i b^j \mid j = i^2\}$

(b) $\{a^i \mid i\ is\ prime\}$
(c) $\{a^i b^j \mid i \neq j\ and\ i \neq 2j\}$

9. Design Turing machines to accept each of the following languages over alphabet $\{0, 1\}$.
(a) $\{0^n 1^n 0^n \mid n \geq 1\}$
(b) The set of strings with an equal number of 0's and 1's.

9. Is it decidable for TM's M whether $L(M) = rev(L(M))$? $(rev(L) = \{reverse(w) \mid w \in L\}$.) Prove.

These problems taken from *Introduction to Automata Theory, Languages, and Computation* by Hopcroft and Ullman and from the Kozen book.