CMSC 330 HOMEWORK EXERCISES #1

Problems. In each of the following problems you are given a language and are asked to produce a regular expression and/or finite automaton for the language. In some cases you are asked to give "either" a DFA or regular expression (your choice) and in other cases to give "both" a DFA and regular expression. When writing regular expressions, use the shorthand ϵ to denote the empty string. Write DFA's in the form of a transition diagram. The underlying alphabet is $\Sigma = \{a, b\}$.

The notation $\#a(w)$ appearing below means the number of a's occurring in string w. For example, $\#a(bbaba) = 2$.

1. (Either DFA or Reg. Exp) $\{w|w$ begins with $abab\}$.

2. (Either) $\{w|w$ ends with $abab\}$.

3. (Either) $\{w|w$ begins with ab and ends with $ba\}$.
   (Note: The string aba is in this language!)

4. (Either) $\{w|$ either $\#a(w)$ is divisible by 3 or w begins with $bbb\}$.

5. (Either) $\{w|\#a(w) \equiv 2 \pmod{5}\ \}$.
   (Recall that $i \equiv j \pmod{k}$ if and only if $(i - j)$ is divisible by k.)

6. (Either) $\{w|\#a(w) \equiv 1 \pmod{3}$ and $\#b(w)$ is odd$\}$.

7. (Either) $\{w|\#a(w)$ is even or $|w|$ is even$\}$.

8. (Both DFA and Reg. Exp) $\{w|aaa$ is a substring of $w\}$.

9. (Both) $\{w|aaa$ is **not** a substring of $w\}$.

10. (Either) $\{w|w$ contains exactly one occurrence of the substring $aaa\}$.
    (Note: the string $aaaa$ has two occurrences of aaa!)

11. (DFA only) $\{w|$ neither aa nor bb is a substring of $w\}$.