Assignment 2

1. Consider the alphabet $\Sigma = \{0, 1\}$. Give regular expressions generating the following languages.

   (a) $\{w \in \Sigma^* \mid w$ begins with a 0 and ends with a 1$\}$
   (b) $\{w \in \Sigma^* \mid w$ contains at least four 0s$\}$
   (c) $\{w \in \Sigma^* \mid w$ contains the substring 1101$\}$
   (d) $\{w \in \Sigma^* \mid w$ has length at least 4 and its third symbol is a 0$\}$
   (e) $\{w \in \Sigma^* \mid w$ begins with a 0 and has even length, or begins with a 1 and has odd length$\}$
   (f) $\{\epsilon, 0\}$
   (g) The empty set
   (h) All strings over Σ
   (i) All strings over Σ except the empty string

2. Consider the alphabet $\Sigma = \{a, b\}$. For each of the following languages, give two strings that are members and two strings that are *not* members.

   (a) b^*a^*
   (b) $a(ab)^*b$
   (c) $a^+ \cup b^+$
   (d) $(aba)^*$
   (e) $\Sigma a \Sigma^* b \Sigma^* a \Sigma$
   (f) $aba \cup bab$
   (g) $b(\epsilon \cup a)b$
   (h) $\Sigma^*(a \cup ba \cup bb)\Sigma^*$

3. Consider the alphabet is $\Sigma = \{a, b, c\}$. For each of the following languages, specify if the language is regular or non-regular. You must support your answer: if the language is non-regular, explain why; if the language is regular design a finite automaton that accepts the language.

   (a) $\{a^{2i}b^j \mid i, j \geq 1\}$
   (b) $\{a^n b^m c^k \mid n, m, k \geq 1\}$
   (c) $\{a^n b^{n+m} c^m \mid n, m \geq 1\}$