**Homework 4 Morally Due Feb 26**

1. (40 points) Recall that a B-NFA is an NFA where we say that an INFINITE string is accepted if there is SOME way to process it where it hits a final state infinitely often. Give an algorithm for the following: given a B-NFA $M$, determine if there exists an infinite string that it accepts.

2. (30 points) The alphabet is $\{a, b\}$. Give a B-NFA for the following languages

   In this problem note that $\{a, b\}^\omega$ means the set of INFINITE strings of $a$'s and $b$'s. The superscript is an $\omega$, not a $w$.

   (a) (15 points)

   $$\{w \in \{a, b\}^\omega \mid w \text{ has an infinite number of } a\text{'s } \}$$

   (b) (15 points)

   $$\{w \in \{a, b\}^\omega \mid w \text{ has a finite number of } a\text{'s } \}$$

   (c) (0 points) Think about: For the above languages ponder if they could be done by a B-DFA which is a DFA where we say an infinite string accepts if it hits some final state infinitely often.

3. (30 points) The alphabet is $\{a, b\}$. Recall that $n_a(w)$ is the number of $a$'s in $w$.

   (a) (10 points) Give a regular expression for

   $$\{w \mid n_a(w) \equiv 0 \pmod 3\}$$

   (b) (10 points) Give a regular expression for

   $$\{w \mid n_a(w) \equiv 1 \pmod 3\}$$

   (c) (10 points) For all $x, y$ with $0 < x < y$, give a regular expression for

   $$\{w \mid n_a(w) \equiv x \pmod y\}$$