Theory of Computation '23
Problem Set 1

1. Give a DFA over the alphabet a, b for each of the following:

   a. Accepts strings which do not contain aaa as a substring.

   b. Accepts all strings which contain aab as a substring but do not contain aaa as a substring. (Hint: First construct two simple DFAs that accept strings satisfying the given conditions and then try to 'compose' them. You should not require more than 9 states for the final DFA)

   c. Accepts all strings that are binary representations of numbers that are 3(mod 5), that is leaves a remainder 3 when divided by 5. (Hint : This one is not easy. Any integer (mod 5) can take 5 possible values. Try creating a state for each of these values that is supposed to 'memorize' the decimal value of the string read so far (mod 5))

2. Give a NFA for the following

$$L = \{wc | w \in \{0,1,2\}^\star, c \in 0,1,2 \text{ and c occurs in w } \}$$

   (Hint : Use closure)

3. Suppose $\Sigma = \{a_1, a_2, \cdots a_k\}$. Given an NFA with $k+1$ states that accept the following language

$$L = \{w | \exists i, 1 \leq i \leq k, w \text{ does not contain } a_i\}$$

   (Hint: Break down in to smaller NFAs)

4. Construct a DFA for

$$L = \{w \in \{a,b\}^\star | w \text{ does not contain exactly two } a\}$$