Choose any 2 of the 3 problems. If all three are answered, only questions 1 and 2 will be graded.

1. Consider language $L_1 = \{ w \mid w$ does not contain the substring “00” $\}$ over $\Sigma = \{0, 1\}$:
   (a). (5 pts) Write one difference between NFA and DFA in general and explain clearly.
   (b). (10 pts) Draw a state diagram of an NFA for this language $L_1$.
   (c). (5 pts) Draw a state diagram of a DFA for this language $L_1$.

2. Consider language $L_2 = \{ w \mid w$ begins and ends with the same symbol $\}$ over $\Sigma = \{0, 1\}$, for example, string 101 is in $L_2$, but string 100 is not in $L_2$.
   (a). (5 pts) Write one difference between Turing machines and Pushdown Automata in general and explain clearly.
   (b). (10 pts) Draw a Turing machine of any type to accept this language $L_2$. You can use the following notation to label the transitions:
   (c). (5 pts) Explain clearly how your Turing machine works to accept a valid string. You may use any string from $L_2$ as an example.

3. Consider $\Sigma = \{0, 1\}$:
   (a). (5 pts) Give the Pumping Lemma for regular languages. State clearly and completely.
   (b). (15 pts) Prove whether or not the following language $L_3$ is a regular language. If it is regular, give a regular expression for $L_3$. If not, apply the pumping lemma to prove it.
   $$L_3 = \{ 0^m 1^n \mid m < n \}.$$