1. Draw the state diagram of a PDA for the following CFL:

A. $L(M) \rightarrow \{0^n 1^m \mid n, m \geq 0 \text{ and } 2n = 3m\}, \text{ where } \Sigma = \{0, 1\}$

B. $L(M) \rightarrow \{0^n 1^m 2^m 3^n \mid n, m > 0\}, \text{ where } \Sigma = \{0, 1, 2, 3\}$

C. $L(M) \rightarrow \{w = 0^i 1^j 2^k \mid i, j, k \geq 0 \text{ and } j < i + k\}, \text{ where } \Sigma = \{0, 1, 2\}$

D. $L(M) \rightarrow \{w_1 \# w_2 \mid \text{ the number of } 00 \text{ in } w_1 \text{ is equal to the number of } 11 \text{ in } w_2\}, \text{ where } \Sigma = \{0, 1\}$

E. $L(M) \rightarrow \{w \# x \mid w^R \text{ is a substring of } x\}, \text{ where } \Sigma = \{0, 1\}$

2. Draw the state diagram of a TM that decides the following languages:

A. $L(M) \rightarrow \{w \in \Sigma^* \mid w \text{ contains equal numbers of } 0s \text{ and } 1s\}, \text{ where } \Sigma = \{0, 1\}$

B. $L(M) \rightarrow \{0^n 1^n 2^n \mid n, m \geq 0\}, \text{ where } \Sigma = \{0, 1, 2\}$

C. $L(M) \rightarrow \{0^i 1^j 2^k \mid i, j, k > 0 \text{ and } k = i * j\}, \text{ where } \Sigma = \{0, 1, 2\}$

D. $L(M) \rightarrow \{0^{2^n} \mid n \geq 0\}, \text{ where } \Sigma = \{0\}$

E. $L(M) \rightarrow \{w \in \Sigma^* \mid w \text{ is a palindrome}\}, \text{ where } \Sigma = \{0, 1\}$

3. Prove that the following languages are decidable.

A. L = {⟨M, w⟩ | The Turing machine M halts on input w within N steps}

B. L = {⟨G⟩ | G is a connected undirected graph}

4. Show that the following statements are true:

A. The collection of decidable languages is closed under Union.

B. The collection of decidable languages is closed under Complement.