CS305 Tutorial 9/Assignment 2

1. Design Turing Machines to compute the functions for x & y positive integers represented in unary format.

   1. $f(x,y) = 2x + 3y$

   2. $f(x) = x \bmod 3$

   3. $f(x) = \begin{cases} \frac{x}{2}, & \text{if } x \text{ is even} \\ \frac{x+1}{2}, & \text{if } x \text{ is odd.} \end{cases}$

2. Design a TM to accept the language
   $L = \{ww : w \in \{a,b\}^+\}$.

3. Design a TM that finds the middle of a string of even length. Specifically, if $w = a_1 a_2 \ldots a_n a_{n+1} \ldots a_{2n}$ with $a_i \in \Sigma$, the TM should produce
   $\hat{w} = a_1 a_2 \ldots a_n \, c \, a_{n+1} \ldots a_{2n}$
   where $c \in \Gamma - \Sigma$
   (You no need to assume anything about a_i and cardinality of Σ).

NOTE: Write your logic/ pseudo-code for all the questions.