Exercise 1: Interpret a Turing Machine

(a) Simulate $M$ with inputs $s_1 = abccba$, $s_2 = aacccaa$, $s_3 = abccab$ until it halts.

(b) Give the language $L(M)$ of strings that are accepted by $M$. 
Exercise 2: Construct a Turing Machine

(a) Draw a state diagram of a Turing machine $M$ recognizing the language $L := \{a^n b^n a^n | n \geq 0\}$.

(b) Simulate your Turing machine with the input strings $s_1 = aabbaa$ and $s_2 = abaaa$.

(c) Describe a 3-Tape Turing machine which requires less head movements in total to recognize $L$. 

Exercise 3: Decidable vs Semi-Decidable Languages

(a) What is the difference between a decider and a recognizer?

(b) Show that the following language is semi-decidable

\[ \{ p \in \mathbb{Z}[X] \mid p \text{ is a integer polynomial with an integer root} \} \]

(c) Are there languages that are not even semi-decidable?