Homework 6: DFAs, Regular Expressions and Turing machines

Part 1 - DFAs

Draw DFAs for the following language specifications.

1. All strings on $\sum = \{A, B, C\}$ that contain each letter (A, B, and C at least once).
2. All strings on $\sum = \{X, Y, Z\}$ that contain two secutive Xs or three consecutive Zs (or both).
3. All strings on $\sum = \{A, B, C, D\}$ that match the Python regular expression `^(A?(B|CD)*A+D)$`

Part 2 - Regular expressions

For each item, write a single regular expression that matches that item. Note that in **All** cases, the entire string must match without additional characters.

1. A string of digits that contains only digits and contains exactly two fives. Exampels of acceptable strings include: "15445", "55", "05563".
    - The string should be rejected if it contains anything other than a digits
2. A regular expression that matches a time expressed in the form "1:45 PM".
    - The hours part must be a number from 1 to 12, the minutes range from 00 to 59, and the time must indicate either AM or PM (uppercase only and preceded by exactly one space).
3. A regular expression that matches a string representing a comma separated list of variable names such as: `hello`, `get_max`, `sum3`.
    - A variable name consists of letters, digits, and underscores but cannot start with a digit.
    - There is exactly one space after every comma. No other spaces are allowed.
    - Commas and spaces are not allowed before the first name and after the last name.
    - An empty string is considered a match

Part 3 - Turing Machines

Design a Turing Machine on the input alphabet $\{X, Y, Z\}$ that removes all Z characters from the input such there are no gaps. If the input string is $xzzyxzy$, the output should be $xyxy$.

- The final string does not need to reside on the same part of the tape where it started.