Problem 1

Prove whether the following languages are regular or not.

A Strings over the alphabet $\Sigma = \{0, ..., 9, \#\}$ that contain the substring $c\#^c c$ where $c \in \{0, ..., 9\}$.

This language **is** regular - this can be proven by constructing a regular expression that recognizes the language. *(Notation Note: The string $\#^n$ is the string consisting of # repeated n times. Example: $\#^3 = \#\#\#$)*

$$\bigcup_{r \in \{0,...,9\}} \Sigma^*(r\#^r r)\Sigma^*$$

$$= \Sigma^*(00)\Sigma^* + \Sigma^*(1\#1)\Sigma^* + ... + \Sigma^*(9\#^9 9)\Sigma^*$$

B Strings over the alphabet $\Sigma = \{0, ..., 9, \#\}$ of the form $\langle n \rangle \#^n$ where n is a sequence of digits interpreted as a decimal number.

This language **is not** regular - this can be proven using fooling sets.

C Strings over the alphabet $\Sigma = \{0, ..., 9, \#\}$ that have the same 3 characters repeated in two places.

This language **is not** regular - this can be proven using fooling sets.