\[ L = \{ w \mid w \in \{a,b,c\}^* \text{ number of a's} < \# b's \text{ and } \# \text{ of a's} < \# \text{ c's} \} \]

\[ L \text{ is not Context Free.} \]

Suppose \( L \) is context free, \( w \) with pumping length \( p \).

Choose \( s = a^p b^{p+1} c^p \).

By the P.P.L. we can split \( s \) into 5 parts, \( uvxyz \).

\( vxy \) can contain at most 2 distinct Types symbol.

\( |vxy| \leq p \)

contain

\[ \text{Case 1: } v \text{ and } y \text{ are all-}a's \]
so \( v \text{ and } y \) contain no c's
so \( uv^2xy^2z \) has at least
as many a's as c's
so \( uv^2xy^2z \notin L \)

\[ \text{Case 2: } v \text{ and } y \text{ contain no } a's \]
so \( uv^0xy^0z \) contains fewer
of b's or c's (or both)
than a's and so is not in \( L \)

So \( L \) is not a CFL.

\[
\begin{align*}
A & \rightarrow B \\
\_B & \rightarrow \_A \\
\_A & \rightarrow \_B
\end{align*}
\]
Turing Machines

Church-Turing Thesis
Turing Machines can compute any computable function.

finite control read/write head

- read/write from tape
- move r/w head left/right
- accept/reject states (immediate)
- start the r/w head on the left end
- special "blank" symbol $\omega$, $\delta$
- input str starts on left end of the tape
\[ L = \{ w \# w \mid w \in \{0,1\}^* \} \]