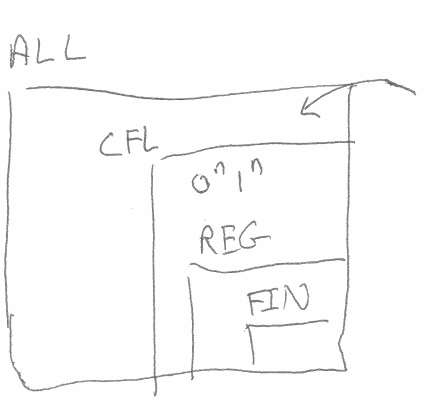
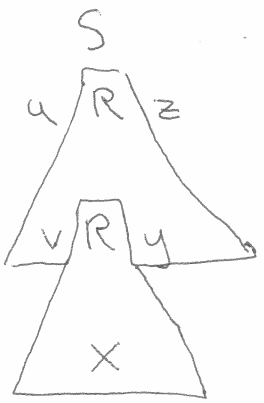
13-1



DFAs repeat states on long (accepted) input

CFGs repeat variables



G'

$S \to uRz$

$R \to vRy$

$R \to x$

$L(G) = A$

$\exists (w \mid |w| > 2^{|V|}).$

$\exists G'. L(G') \subseteq A$

$uv^i xy^i z$ for $i \in N$

CFPP (Context-free pumping property)

$\forall A \in CFL.$

$\exists p \in N.$ // $p = 2^{|V|} + 1$

$\forall (w \in A \mid |w| \geq p).$

$\exists (u, v, x, y, z \in \Sigma^* \mid w = uvxyz$

$\wedge |vy| > 0$

$\wedge |vxy| \leq p)$

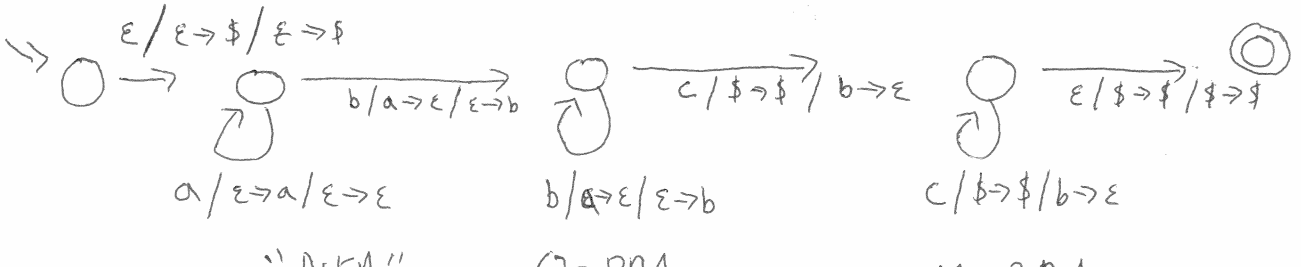
$\forall i \in N.$

$uv^i xy^i z \in A$

$a^n b^n c^n \notin CFL$

one change: arbitrary "recall"

another : 2nd stack



"NFA" = 0-PDA

"PDA" = 1-PDA

2-PDA ⟹ weird middle ground between CFL and TMs

3-PDA ⟹ TM

4-PDA

13-2

$D = \{ ww \mid w \in \{0,1\}^* \}$

$|w| = n$ $\quad \forall k \in \mathbb{N}.\ \exists P.\ |L(P) = ww$ s.t. $|w| \leq k$)

$\exists w.\ w \in D \wedge w \notin L(P).$

$\Rightarrow w = 0^{k+1}0^{k+1}$

ww^R

$S \to \varepsilon$

$\mid 0S0$

$\mid 1S1$

$\forall p \in \mathbb{N}$ (Given p)

$\exists s \in D$ (Choose s) $\quad s = 0^p10^p1$ $\quad s = 0^p0^p$

$s = (01)^p(01)^p$ $\quad s = 0^p1^p0^p1^p$

case 1(a-d) vxy mentions 1 symbol

$\Rightarrow$ clearly Fails

case 2(e-g) vxy mentions 2 symbols

$L01$ and $R01$ $\Rightarrow$ clearly fail

$C10$ $\Rightarrow$ can't affect 1st 0s or 2nd 1s

$E = \{ 0^x \# 0^y \mid x \neq y \}$

$S \to \# \mid 0S0 \Rightarrow 0^n \# 0^n$

$S \to \# \mid XSX$

$X \to XX \mid 0 \mid \varepsilon$

$S \to \# \mid 0XSX \mid XSX0$

$S \to R \mid 0S0$

$R \to X\# \mid \#X$

$X \to 0 \mid 0X$

✓ $F = \{xy \mid x \neq y$ but $|x| = |y| \}$

X $G = \{w\# t \mid t = uwv$ for some u & $v\}$