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Fooling sets

1) $L_1 = \{w \mid w \in (a,b)^* \text{ and } n_a(w) = 2n_b(w)\}$

$F_L = (2a^* + b^*)$

$u = a$
$v = ab$
$x = a$
$ux = ab \notin L$ (F_L is distinguishable)
$vx = aba \in L$

Since F_L is distinguishable & the set is infinite L_1 is not regular

2) $L_2 = \{w \mid w \in \{a,b\}^* \text{ and } w \text{ is balanced}\}$
$= L_2 = \{w \mid w \in \{a,b\}^* \text{ and } n_a(w) = n_b(w)\}$
$F_L = (a^* + b^*)$

$u = a$
$v = ab$
$x = a$
$ux = ab \in L$ (F_L is distinguishable)
$vx = aba \notin L$

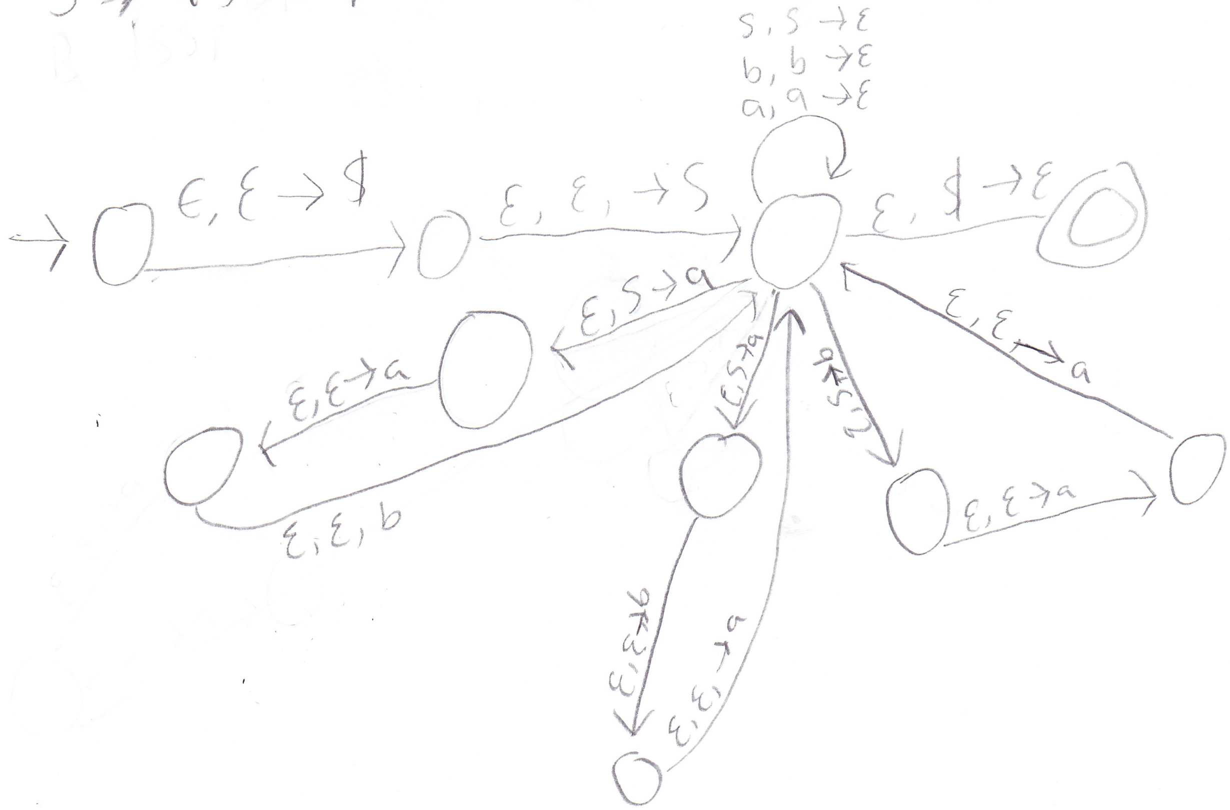
Since F_L is infinite & distinguishable L_2 is not regular

PDAs

$L1 = \{w \mid w \in (a,b)^* \text{ and } n_a(w) = 2n_b(w)\}$

$S \Rightarrow aSaSb \mid aSbSa \mid bSaSa \mid$

1)



2)

CFG is ambiguous

3 $L_2 = \{w \mid w \in \{a, b\}^*$ and w is balanced

1) $S \to aSbS \mid bSaS \mid \varepsilon$

2) CFG is ambiguous

3) $S \to \varepsilon \mid XY \mid YX \mid$

$X \to AS$

$Y \to BS$

$A \to a$

$B \to b$