Lecture 30: Closure properties of CFL; basics of Turing Machines

$L^* = \{0^n 1^n 2^n \mid n \geq 0\}$ not a CFL

If L is a CFL $\quad k = 2^{\#NT \text{ in CNF } G}$

$w \in L$, $|w| > k$

$w = u.v.x.y.z \quad |vxy| \leq k$

$|x| \geq 1$

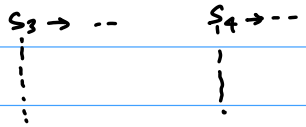
$\forall i \geq 0 \quad uv^i xy^i z \in L$

✓ $L_1 = 0^n 1^n 2^k$, $k, n \geq 0$

✓ $L_2 = 0^k 1^n 2^n$, $k, n \geq 0$

$L_1 \cap L_2 = \{0^n 1^n 2^n \mid n \geq 0\}$

L_3, L_4: CFL



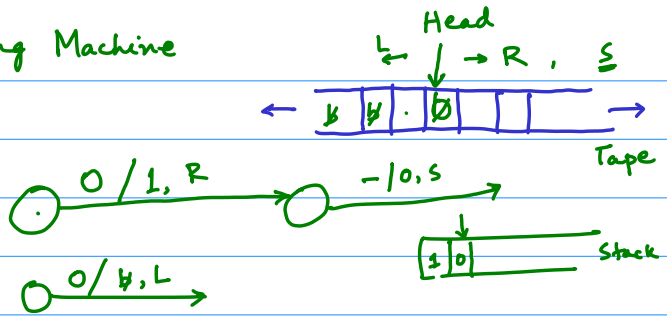
$L_3 \cup L_4$: $\quad S \rightarrow S_3 \mid S_4$

$\overline{L_3}$:

Subst: $\quad 0 \rightarrow L_0$

$1 \rightarrow L_1$

Turing Machine

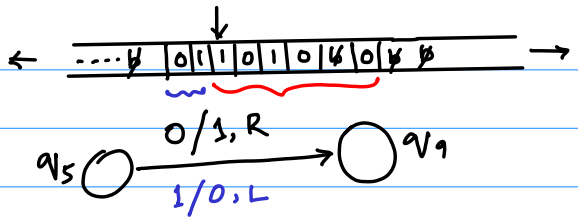


1011 ---.--. → 1100

1011 1101
1011 1100
1011 1111

0001000001 ⟶ 10

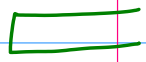
Lecture 31: More on Turing Machines; acceptance by TM; TM configs



Config: $0\ 1\ q_5\ 1\ 0\ 1\ 0\ \not b\ 0$ (α = $0\ 1$, β = $1\ 0\ 1\ 0\ \not b\ 0$)

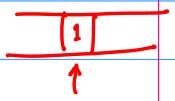
$0\ q_9\ 1\ 0\ 0\ 1\ 0\ \not b\ 0$

$\alpha_0 q_0 \beta_0 \vdash \alpha_1 q_1 \beta_1 \vdash \alpha_2 q_2 \beta_2$

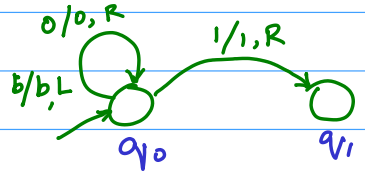


$\alpha_0 q_0 \beta_0 \vdash^* \alpha_i$ done β_i

$\not b\ q_0\ 1$

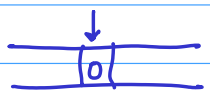


$1\ q_1\ \not b$



$0\ 1\ 0$

$\not b\ q_0\ 0$



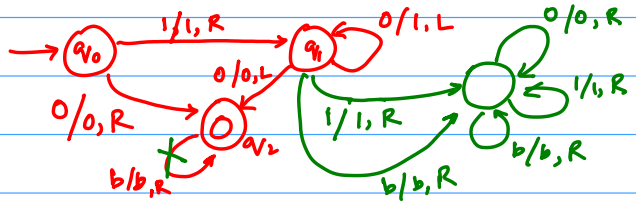
$0\ q_0\ \not b$

$\not b\ q_0\ 0$

$q_0\ 1\ 1$

$\not b\ q_0\ 0$

$0\ q_2\ \not b$

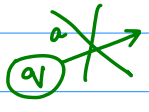


Acc. of strings by final state:

Acc. of " " halting:

M: Turing Machine

$\not b\ q_0\ w \vdash^* \alpha\ q_f\ \beta$ · $w \in L(M)$

$\not b\ q_0\ w \vdash^* \alpha\ q\ \beta$ · s.t. 

$\alpha \cdot \beta$

$w \in H(M)$