spacemacs

github.com/jeaposthophe/exp/.emacs.el

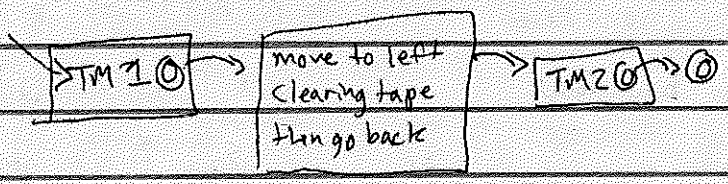
concatenation $\cdot$

Kleene star *

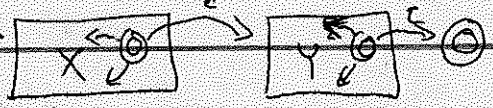
$w \in L(TM_1 \cdot TM_2)$

iff $w = x \cdot y$

$x \in L(TM_1) \wedge y \in L(TM_2)$



NFAs for $X \cdot Y$



$X = 0^*$ $Y = 01^*$

$X \cdot Y = 0^*01^*$

X : state x char ⇒ state x bool

composition $[q_0]w \Rightarrow u[q_a]x$

$f(w) = x$

$g(x) = y$

$\Rightarrow f \circ g(w) = y$

$f(g(w)) = y$

$x(x_{curr}, c) = (x_{next}, acc?)$

if (acc?)

fork use y

end

continue w/ x

$TM_L = ww^R$ $TM_R = 0^n1^n0^n1^n$

$[TM_L, q_0]\ ww^R$ (hidden: $0^n1^n0^n1^n$)

$\Rightarrow^x \ldots [q_a] \ldots$

$[R, q_0]$ hidden

$\Rightarrow^x \ldots [R\ q_a] \ldots$

we need to divide string first!

$TM_L \cdot TM_R(w) :=$

consider all divisions of w into x & y s.t. $w = x \cdot y$

choose I (nondet)

then run $TM_L(x)$

run $TM_R(y)$

if both say yes ⇒ yes

if either say no ⇒ no

$\Sigma_0 \cdot \Sigma_0 \in \Sigma_0$

$\Sigma_0 \cdot \Sigma_1 \in \Sigma_1$

$\Sigma_1 \cdot \Sigma_1 \in \Sigma_1$

$w \in A^*$ iff $w = x_0 \cdot \ldots \cdot x_n$ where $x_i \in A$

Kleene (TM_I) :=
consider all n divisions of w (finite = $|w|$)
consider all ways of divide w into n blocks
test each one on TM_I

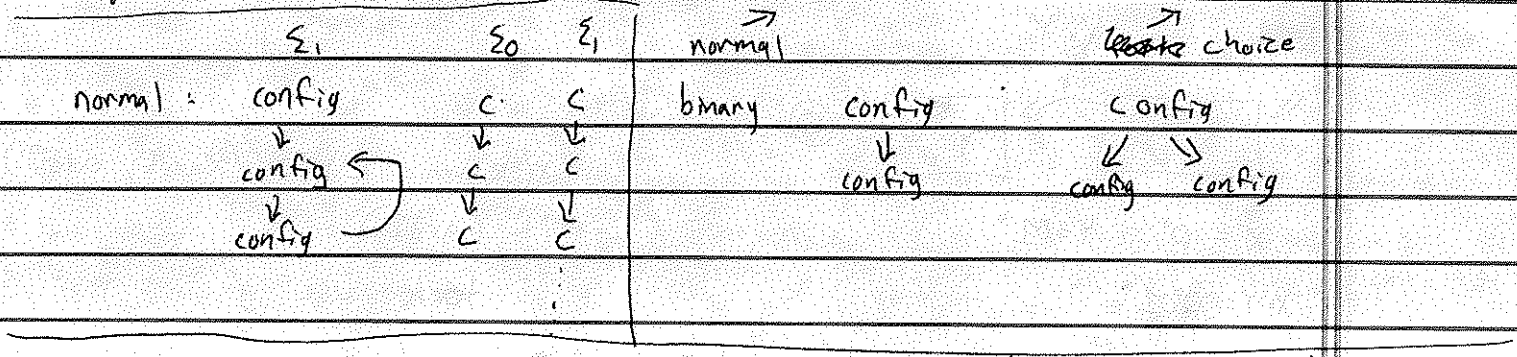
$\Sigma_0^* \in \Sigma_0 \quad \Sigma_1^* \in \Sigma_1$

Want: non-deterministic Turing machines

original : $\delta : Q \times \Gamma \to Q \times \Gamma \times \{L, R\}$

non-det : $\delta : Q \times \Gamma \to P(Q \times \Gamma \times \{L, R\})$

binary choice : $\delta : Q \times \Gamma \to (Q \times \Gamma \times \{L, R\}) + (Q \times Q)$



$\delta(q_i, a) = (q_j, q_k)$

interpretations of non-det:

- oracle : know the correct path
- fork : parallelism w/ concurrent machines

$u[q_i]av \Rightarrow u[q_j]av$ or $u[q_i]av \Rightarrow v[q_k]qv$

$w \in L(PTM)$ iff $\{[q_0]w\} \Rightarrow^* \{u[q_a]v\} \cup X$

$\delta(q_i, a) = (q_j, b, R)$

$\{u[q_i]av\} \cup X \Rightarrow^* \{ub[q_j]v\} \cup X$

$\delta(q_i, a) = (q_j, q_k)$

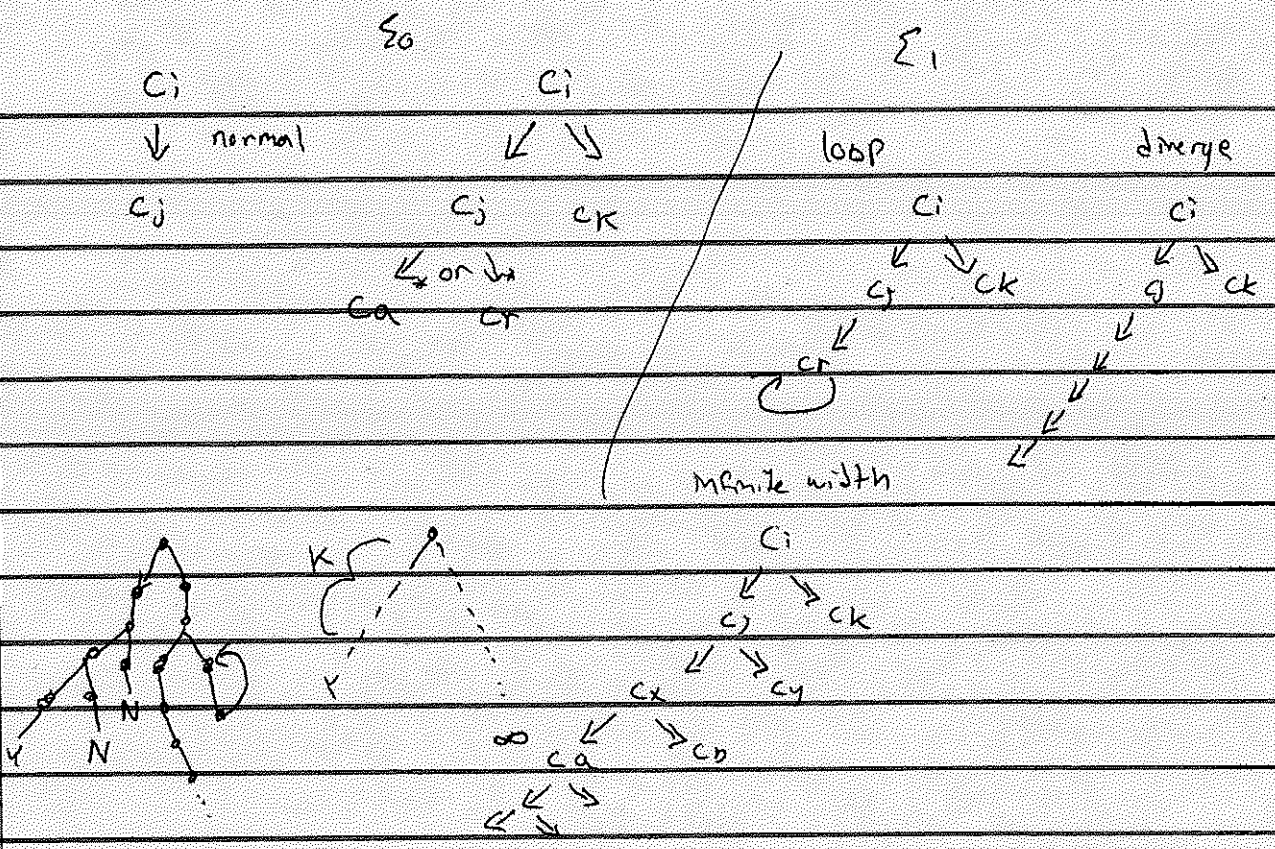
$\{u[q_i]av\} \cup X \Rightarrow^* \{u[q_j]av, u[q_k]av\} \cup X$ ②

$\{u_0[q_{i0}]v_0, \ldots, u_n[q_{in}]v_n\} \Rightarrow$

$\#u_0 q_{i0} v_0 \# \ldots \# u_n q_{in} v_n \#$

$\#u_0 q_j v_0 \# u_0 q_k v_0 \# \ldots \# u_n q_{in} v_n \#$ ← ②

back-tracking : try 1 thing, then try something else



find Y = accept

know no Ys = reject

Σ_0 can't Σ_1

abstract "turn of length k" attempt n

$\Rightarrow$ tape 1: w (original input)

tape 2: current simulation

tape 3: path from $\{L, S, R\}^*$