22-1/ Σ_0: $\cup$, $\cap$, o

Σ_1: $\cup$, $\cap$

ab $\in$ A o B   iff   a $\in$ A $\wedge$ b $\in$ B

CFG: C.S $\rightarrow$ A.s   B.S

NFA:

DFA: compiling $\nearrow$

nondeterministic TM

22-2/ $f \circ g(x) = y$ iff

$$f(g(x)) = y$$

iff $\quad g(x) = z$

$\quad f(z) = y$

iff $\quad \varepsilon[g, g_0] \; x \Rightarrow \Rightarrow^x \quad w[g, g_a] \; z$

$\quad \varepsilon[f, g_0] \; z \Rightarrow \not\Rightarrow^x \quad w'[f, g_a] \; y$

22-3/ Given a TM M s.t. $L(m) = A$

N s.t. $L(N) = B$

Here concat$(M, N) :=$ Given input x,

tape 0:
input x

split it into $x = uv$
in all possible ways, non-deterministically

tape 1:
ε

run $M(u)$
run $N(v)$

$\Downarrow$

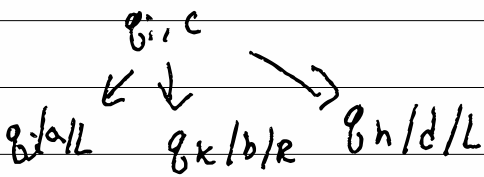return Accept if both Accept

tape 0: v
tape 1: u

return Reject otherwise.

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

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

2-det: $Q \times \Pi \to (Q \times Q) + (Q \times \Pi \times \{L, R\})$

for k

$$\delta(q_i, c) = \{ (q_j, a, L) \qquad (q_k, b, R) \}$$
$$(q_n, d, L)$$

q_i, c

$q_i/a/L \qquad q_k/b/R \qquad q_n/d/L$

$\Rightarrow$

q_i/c

$q_1/c \qquad q_2/c$

$\delta_{nd} = \emptyset \Rightarrow (q_r, q_r)$

$q_i/a/L \qquad q_3/c \qquad q_4/c$
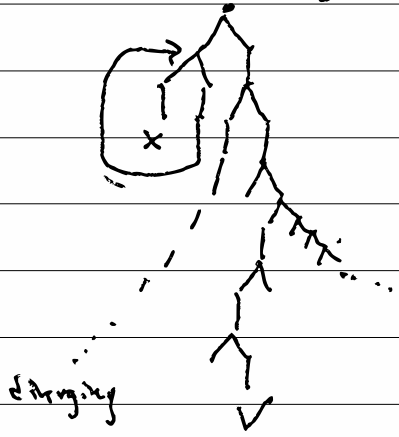
$q_k/b/R \qquad q_n/d/L$
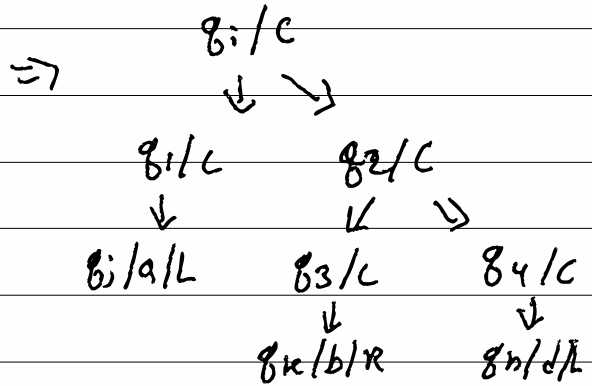
non-deterministic semantics

$$\frac{\delta(q_i, a) = (q_j, b, R)}{x[q_i]ay \Rightarrow xb[q_j]y}$$ L ⌣

$$\frac{\delta(q_i, a) = (q_j, q_k)}{x[q_i]ay \Rightarrow x[q_j]ay}$$ L-forks

$$\frac{\delta(q_i, a) = (q_j, q_k)}{x[q_i]ay \Rightarrow x[q_k]ay}$$ R-forks

deterministic   semantics   for   non-determ's

$\varepsilon[q_0] w$

we say ✓ if there's a ✓
we say X if every path is
a X

dvinging
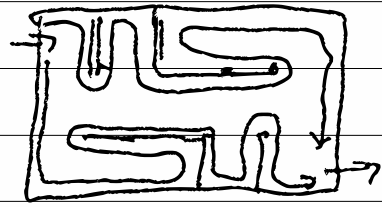
0110011

= depth
— first
search

input:

config $\Rightarrow$ [path, rest of the path, current tape current config)

$w \in L(n\mathcal{L})$

$$c_0 = [w, \varepsilon, \varepsilon, \varepsilon[q_0]w]$$

$$[w, p, \varepsilon, \_] \Rightarrow [w, p+1, p+1, \varepsilon[q_0]w]$$

$$[w, p, Or, x[q_i]y] \Rightarrow [w, p, r, x'[q_j]y']$$

where $x[q_i]y \Rightarrow x'[q_j]y'$

using L, R, N or L-fork

$$[w, p, 1r, x[q_i]y] \Rightarrow$$ using L, R, N, or R-fork

$$[w, p, r, x[q_a]y] \Rightarrow q_a$$

$$[w, p, r, x[q_r]y] \Rightarrow [w, p+1, p+1, \varepsilon[q_0]w]$$

forking   semantics

$$config \quad \models \quad queue \quad of \quad config$$

$$c_0 = [\text{`}\varepsilon[q_0] w\text{`}]$$

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

$$[\text{``}x[q_i]ay\text{''}, c_2, \cdots, c_n]$$
$$\Rightarrow [c_2, \cdots, c_n, \text{``}xb[q_j]y\text{''}]$$

$$\delta(q_i, a) = (q_j, q_k)$$
$$[\text{``}x[q_i]ay\text{''}, c_2, \cdots, c_n]$$
$$\Rightarrow [c_2, \cdots, c_n, \text{``}x[q_j]ay\text{''}, \text{``}x[q_k]ay\text{''}]$$

$$A^{*} = \varepsilon \cup A \circ A^{*}$$