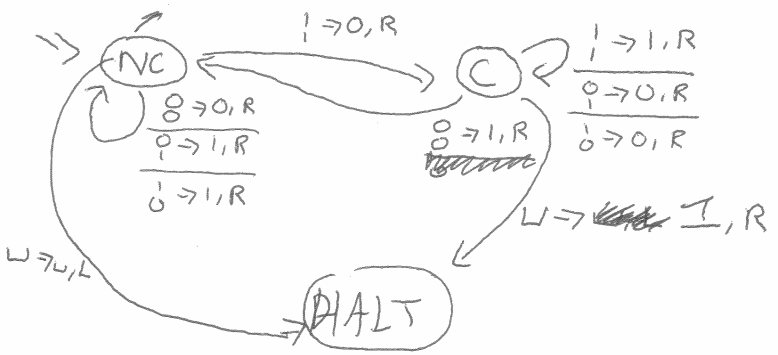
20-1 $\Sigma = \{ \binom{0}{0}, \binom{0}{1}, \binom{1}{0}, \binom{1}{1} \}$ $\Gamma = \{0, 1, \sqcup\} \cup \Sigma$



DFA ⟺ REX TM ⟺ Enumerator

PDA ⟺ CFG DFA ⟺ NFA

(simple machine) (complex)

Basic PL ⟺ Complicate PL

Stay Put TM $\delta: Q \times \Gamma \to Q \times \Gamma \times \{L, R\}$

intuition + new → $\delta': Q \times \Gamma \to Q \times \Gamma \times \{L, R, S\}$

+

new semantics

$$\frac{\delta(q_i, a) = (q_j, b, S)}{u\,[q_i]\,a\,v \Rightarrow u\,[q_j]\,b\,v}$$

Galois

$X =$ $u\,[q_i]\,a\,v$ —trans→ ⌊ ⌋ $= Y$

$f \downarrow$ ⌊ ⌋ $\downarrow g$

$u\,[q_j]\,b\,v$ ←trans⁻¹— ⌊ ⌋

$\downarrow$

$u\,d\,[q_x]\,v$

$\text{trans} = \text{trans}^{-1} = id$

$$\frac{\delta(q_i, a) = (q_k, b, R) \quad / \quad \delta(q_k, c) = (q_j, c, L)}{u\,[q_i]\,a\,c\,v \Rightarrow u\,b\,[q_k]\,c\,v \Rightarrow u\,[q_j]\,b\,c\,v}$$

Translating from Stay to Normal: 1 state per S

1 extra step per S

20-2

2-TM $= (Q, \Sigma, \Gamma, q_0, \delta, q_a, q_r)$

$\delta : \quad Q \times \Gamma \Rightarrow Q \times \Gamma \times \{L, R\}$

$\delta' : \quad Q \times \Gamma^2 = Q \times \Gamma \times \Gamma$

$\rightarrow Q \times (\Gamma \times \{L, R\})^2$

$= Q \times (\Gamma \times \{L, R\}) \times (\Gamma \times \{L, R\})$

2-config $= {}^{u}_{x}[q_i]^{v}_{y}$ $\qquad C_0 = {}^{\varepsilon}_{\varepsilon}[q_0]^{w}_{\varepsilon}$

$\Rightarrow_2$ $\qquad \Rightarrow_1$

$$\frac{\delta(q_i, b, \beta) = (q_j, (c, R), (r, L))}{{}^{ua}_{x\alpha}[q_i]^{bv}_{\beta y} \Rightarrow_2 {}^{uac}_{x}[q_j]^{v}_{\alpha r y}}$$

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

${}^{u}_{x}[q_i]^{v}_{y} \Rightarrow_2 {}^{u'}_{x'}[q_j]^{v'}_{y'}$ iff $u[q_i]v \Rightarrow_1 u'[q_j]v'$ and $x[q_i]y \Rightarrow_1 x'[q_j]y'$

2-config c_i —trans→ 1-config (TM = ?)

$\Downarrow_2$ $\qquad \Downarrow_\alpha$

2-config c_{i+1} ←trans⁻¹— 1-config

${}^{ua}_{x\alpha}[q_i]^{bv}_{\beta y}$ —trans→ $ua[\ ]bv \ x\alpha \bullet \beta y$

$\rightarrow [q_i]\, ua\, \dot{b}\, v \,\#\, x\alpha\, \dot{\beta}\, y$

$\Downarrow_*] \rightarrow ???$

${}^{uac}_{x}[q_j]^{v}_{\alpha r y} \leftarrow [q_j]\, uac\, \dot{v}_0 v \,\#\, x\, \dot{\alpha}\, r\, y$

$q_i \Rightarrow^{\wedge} q_i/b \Rightarrow^{\wedge} q_i/b/\beta \rightarrow^{*} q_j/cR/rL$

$\Downarrow_\alpha$

$q_j \overset{*}{\leftarrow} q_j/\text{gold} \leftarrow q_j/cR$