CS 445 03/05/19

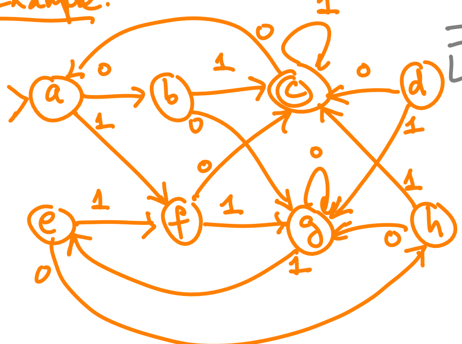
Test 1: Thursday 3/7/19 in class, open book/notes, no TMs

Topics: KMP, Aho-Corasick, RegExp to DFA, DFA minimization

KMP	Aho-Corasick	RegExp to DFA
pattern P	$P_1, P_2, \ldots, P_m$	RE $\xrightarrow{\S 3.9}$ DFA
target T	T	Thompson construction → NFA → subset construction → DFA
p.152	p155	Alg. 3.3 (p122)
Ex. 4.27	Ex. 4.31–4.32	Alg 3.2 (p118)

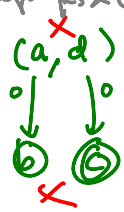
Given a DFA M, decide if M is the smallest DFA that accepts L(M). → #states

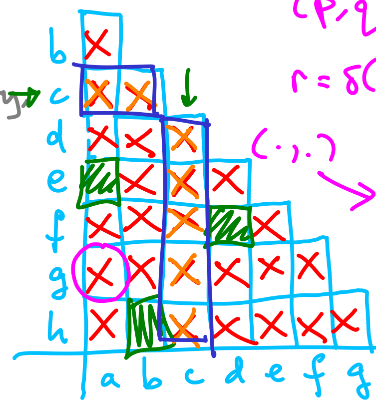
Example: DFA

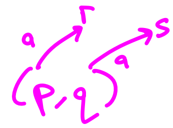


a, b, c (a,b), (a,c), (b,c)

Hopcroft-Ullman
Intro to Automata Theory, Languages & Computation



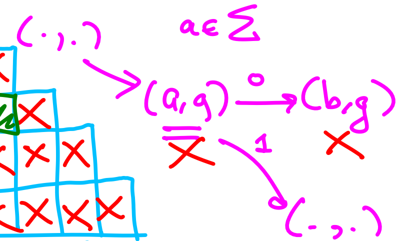


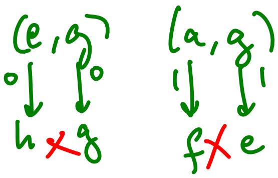


(r,s) ×

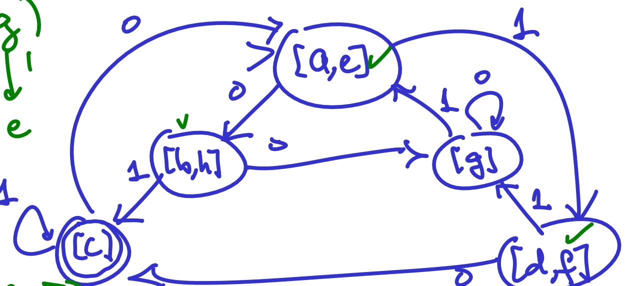
$r = \delta(p,a)$ $s = \delta(q,a)$

$a \in \Sigma$





Algorithm 3.6 (p142) in Dragon 1



Algorithm (Hopcroft-Ullman): $M=(Q,\Sigma,\delta,q_0,F)$

1) for $p \in F$ and $q \in Q \setminus F$: [mark (p,q)]

2) for $(p,q) \in F \times F$ or $(Q\setminus F)\times(Q\setminus F)$: ($p \neq q$)

3) if $\exists a \in \Sigma$ where $(\delta(p,a), \delta(q,a))$ is marked:

4) mark (p,q)

5) recursively mark all unmarked pairs on the list for (p,q) and on the lists of other pairs that are marked at this step

6) else:

7) for all $a \in \Sigma$:

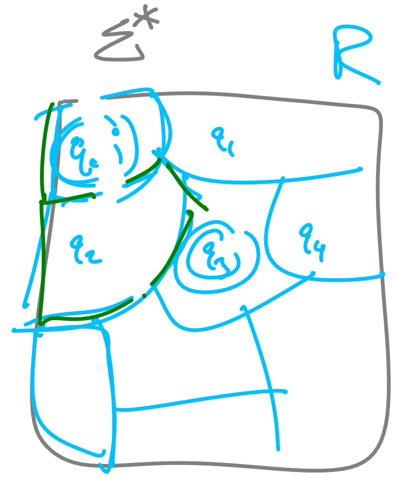
8) put (p,q) on the list for $(\delta(p,a), \delta(q,a))$ unless $\delta(p,a) = \delta(q,a)$

DFA $M = (Q, \Sigma, \delta, q_0, F)$ — Q states, Σ alphabet, δ transition function, q_0 start state, F accept states

$\delta : Q \times \Sigma \to Q$

$q_0 \in Q$

$F \subseteq Q$

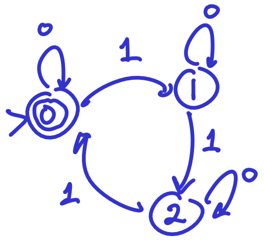


R eqv relation

index = # classes

Relation R_M over Σ^*: $\quad x R_M y$ iff $\delta(q_0, x) = \delta(q_0, y)$

ex:



$[0] = \{0^*, \ldots$

$[1] = \{0^* 1, 0^* 1 0^*, \ldots \}$

$[2] = \{0^* 1 0^* 1, \ldots \}$

A relation R is right-invariant if $xRy \Rightarrow xzRyz \quad \forall z \in \Sigma^*$

Theorem (Myhill-Nerode) The following are equivalent (TFAE):

(1) $L \subseteq \Sigma^*$ is regular ($\exists$ DFA M s.t. $L = L(M)$).

(2) L is the union of some of the equivalence classes of right-invariant equivalence relation of finite index

(3) Define R_L by: $x R_L y$ iff $(xz \in L \Leftrightarrow yz \in L)$

Then R_L is of finite index.