Describing Regular Expressions

a) \(0(0|1)^*0\)  
   - All strings beginning and ending in 0
b) \(((0|1)^*)^*\)  
   - All strings
c) \((0|1)^*(0|1)(0|1)\)  
   - All strings with 0 as third digit from right

Creating Regular Expressions

For all strings of 0’s and 1’s that…

a) Begin in 1
   - \(1(0|1)^*\)
b) End in 1
   - \((0|1)^*1\)
c) Contains 00
   - \((0|1)^*00(0|1)^*\)
d) Do not contain 00
   - \((0|1)^*(c|0)\)

Creating NFA

For all strings of 0’s and 1’s that…

a) Begin in 1
b) End in 1
c) Contains 00
d) Do not contain 00

Based on regular expression

Creating DFA

For all strings of 0’s and 1’s that…

a) Begin in 1
b) End in 1
a) Construct NFA
b) Accept ababbab
   7,5,1,2,6,8,7,5,3,4,8,7,5,1,2,6,8,7,5,3,4,6,8,7,5,1,2,6,8,7,5,3,4,6,8 accept
c) Reduce NFA to DFA

- Start = $\varepsilon$-closure(7) = {7, 5, 1, 3, 8}  
  // mark DFA state
- $r \in R = (\{7, 5, 1, 3, 8\})$
- move $(\{7, 5, 1, 3, 8\}, a) = \{2\}$  
  • $e = \varepsilon$-closure({2}) = {2, 6, 8, 7, 5, 1, 3}  
    // new DFA state
  • $R = R \cup (2, 6, 8, 7, 5, 1, 3)$  
    // add to R
- $\delta = \delta \cup (7, 5, 1, 3, 8, a, 2, 6, 8, 7, 5, 1, 3)$
- move $(\{7, 5, 1, 3, 8\}, b) = \{4\}$
  • $e = \varepsilon$-closure({4}) = {4, 6, 8, 7, 5, 1, 3}  
    // new DFA state
  • $R = R \cup (4, 6, 8, 7, 5, 1, 3)$  
    // add to R
- $\delta = \delta \cup (7, 5, 1, 3, 8, b, 4, 6, 8, 7, 5, 1, 3)$

R = {{7, 5, 1, 3, 8}, {2, 6, 8, 7, 5, 1, 3}, {4, 6, 8, 7, 5, 1, 3}}

- $r_0 \in R = \{2, 6, 8, 7, 5, 1, 3\}$  
  // mark DFA state
- move $((2, 6, 8, 7, 5, 1, 3), a) = \{2\}$  
  • $e = \varepsilon$-closure({2}) = {2, 6, 8, 7, 5, 1, 3}  
    // existing DFA state
  • $\delta = \delta \cup (2, 6, 8, 7, 5, 1, 3, a, 2, 6, 8, 7, 5, 1, 3)$
- move $((2, 6, 8, 7, 5, 1, 3), b) = \{4\}$
  • $e = \varepsilon$-closure({4}) = {4, 6, 8, 7, 5, 1, 3}  
    // existing DFA state
  • $\delta = \delta \cup (2, 6, 8, 7, 5, 1, 3, b, 4, 6, 8, 7, 5, 1, 3)$

- R = {{7, 5, 1, 3, 8}, {2, 6, 8, 7, 5, 1, 3}, {4, 6, 8, 7, 5, 1, 3}}
- No more unmarked states to process
- $F_d = {{7, 5, 1, 3, 8}, {2, 6, 8, 7, 5, 1, 3}, {4, 6, 8, 7, 5, 1, 3}}$
- Since 8 $\in F_d$

For RE $(a | b)^*$

- Initial partitions
  • Accept $\to \{1, 2, 3\} \to P_1$
  • Reject $\to \emptyset$
- Split partition?
  • move(1, a) $\to P_1$
  • move(2, a) $\to P_1$
  • move(3, a) $\to P_1$
  • move(1, b) $\to P_1$
  • move(2, b) $\to P_1$
  • move(3, b) $\to P_1$
- Not required, minimization done

Root state P1

After cleanup

After cleanup

DFA Reduction Pictorial
For RE \((a^* \mid b^*)^*\)

a) Construct NFA

![NFA Diagram]

b) Accept ababbab

11,9,3,1,2,4,10,12,11,9,7,5,6,8,10,12,11,9,3,1,2,4,10,12...

For RE \((a^* \mid b^*)^*\)

c) Reduce NFA to DFA

- Start = \(e\)-closure(1)
  \[= \{11,9,3,1,4,7,5,8,10,12\}\]
- \(R = \{(11,9...12)\}\)
- \(r \in R = \{11,9...12\}\)
- move ((11,9...12), a) = 2
  \[= e\)-closure(2) = \{2,11,9...12\}\]
- move ((11,9...12), b) = 6
  \[= e\)-closure(6) = \{6,11,9...12\}\]
- ...
- NFA to DFA reduction pictorial

For RE \((a^* \mid b^*)^*\)

d) Minimize DFA

- Initial partitions
  - Accept = \{1,2,3\} \(\rightarrow\) P1
  - Reject = \Ø
- Split partition?
  - move(1, a) \(\rightarrow\) P1
  - ...
  - Not required, minimization done

e) Compare 2 minimized DFAs

- Identical up to state names!