CS 460

Programming Languages

Fall 2023

Dr. Watts

(6 September 2023)

Course Administration

- Exercise 1 Redo
- Exercise 2 Preliminary Exercise
- Project 1 Prelim will be assigned on Wednesday

Regular Expressions

- Alphabet – the symbols that actually appear in the lexeme
- Special symbols to define the regular expression
  - ( ) : grouping
  - * : 0 or more occurrences of a pattern
  - $^+$: 1 or more occurrences of a pattern
  - | : indicates alternatives
  - λ : indicates nothing (lambda)

Regular Expression Examples

- Alphabet = {a,b,c}
- Examples
  - a (b | c) a →
  - a^+ (b | c) a^+ →
  - a (b | c)* a →
  - abc*ba →
  - $(a|b|c|\lambda)((ab^*c)|(cb^*a))^+$ →

Regular Expression for User Defined Names

- Alphabet = {_, a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, A, B, C, D, E, F, G, H ,I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9}
- Regular expression?
  - (_|a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|u|v|w|x|y|z|A|B|C|D|E|F|G|H|I|J|K|L|M|N|O|P|Q|R|S|T|U|V|W|X|Y|Z)(_|a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|u|v|w|x|y|z|A|B|C|D|E|F|G|H|I|J|K|L|M|N|O|P|Q|R|S|T|U|V|W|X|Y|Z|0|1|2|3|4|5|6|7|8|9)*

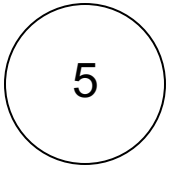
A regular expression for unsigned integer numeric literals

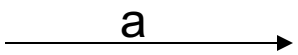
- Alphabet = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}
- Regular expression?
  - $(0|1|2|3|4|5|6|7|8|9)^+$ <= 2^{32} or 2^{64}

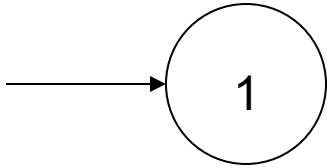
A regular expression for signed integer numeric literals

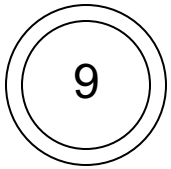
- Alphabet = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, -, +}
- Regular expression?
  - $(+|-|\lambda)\ (0|1|2|3|4|5|6|7|8|9)^{+}$ <= 2^{-32} to $2^{32} - 1$
  - +55 -55 55
  - **What about -000000000?**

Deterministic Finite Automata

- States 

- Transitions 

- Start state 

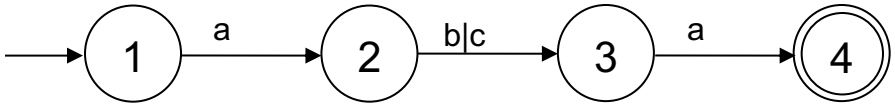
- Final state 

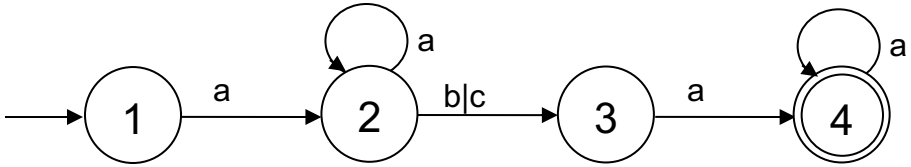
DFAs for Examples

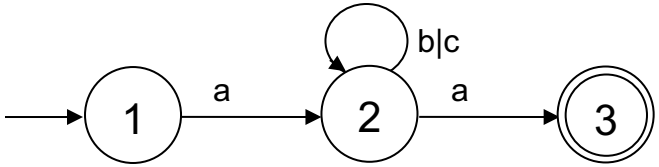
- a (b | c) a
- a^+ (b | c) a^+
- a (b | c)* a
- abc*ba

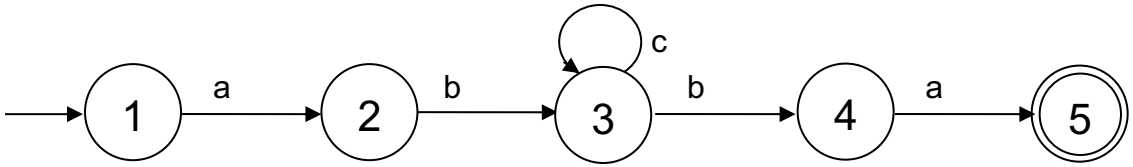
DFAs for Examples

- a (b | c) a
  - aba
  - abc
- a^+ (b | c) a^+
  - aaabaaaaa
  - aaabaacaa
- a (b | c)* a
  - acba
  - aaa
- abc*ba
  - abba
  - acbba









DFAs as scanners (aka tokenizers)

- Alphabet = {a, b, c, x, y, z, ␣}
- Regular expression 1 (RE1)
  - a* (ab | bc) a+
  - DFA
- Regular expression 2 (RE2)
  - x+ (xy | yz | xz) z*
  - DFA

Adding terminating states

- Successful states
- Error states

Programming a DFA

- Table