LEX9: Implementing DFAs

Lexical Analysis

CMPT 379: Compilers

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anoopsarkar.github.io/compilers-class

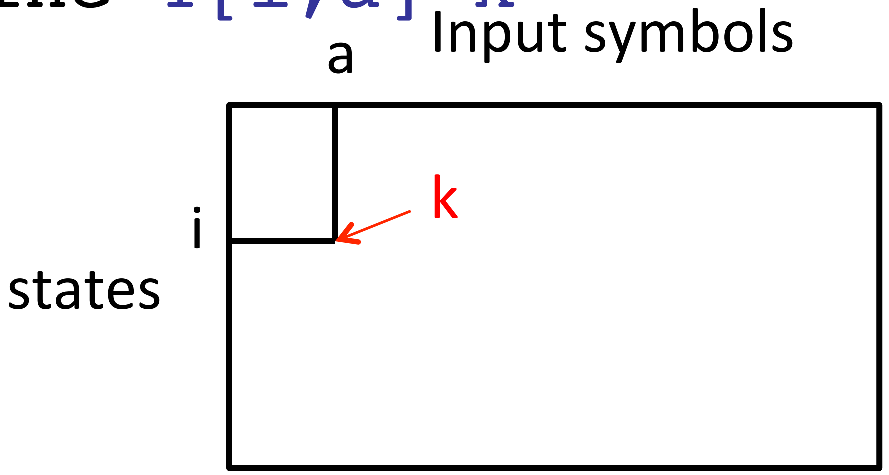
Building a Lexical Analyzer

- Token $\Rightarrow$ Pattern
- Pattern $\Rightarrow$ Regular Expression
- Regular Expression $\Rightarrow$ NFA
- NFA $\Rightarrow$ DFA
- DFA $\Rightarrow$ Table-driven implementation of DFA

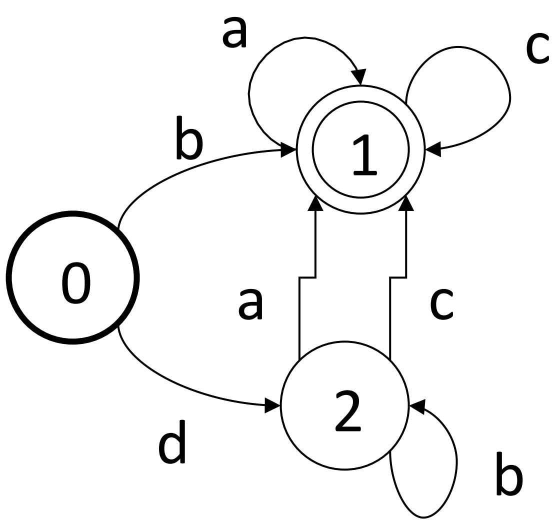
Implement NFAs
Convert regexp to DFA

Implementing DFAs

- 2D array storing the transition table
  - One dimension is states
  - Other dimension is input symbols
  - For every transition S_i S_k define `T[i,a]=k`



Implementing DFAs



	a	b	c	d
0	-	1	-	2
1	1	-	1	-
2	1	2	1	-

```
i = 0
state = 0
while (input[i]) {
    state = nextState(state, input[i])
    i = i + 1
}
```

```
nextState(state, x) {
    return A[state][x]
}
```

Implementing DFAs

- 2D array storing the transition table
  - `Too many states and duplicates`
- Adjacency list
  - more space efficient but slower
- Merge two ideas: array structures used for sparse tables like DFA transition tables

Implementing DFAs

	a	b	c	d
0	-	1	-	2
1	1	-	1	-
2	1	2	1	-

		-	1	-	2			
				1	-	1	-	
1	2	1	-					
1	2	1	1	1	2	1	-	next
0	1	2	3	4	5	6	7	

2	2	2	0	1	0	1	-	check

base

0	2
1	4
2	0

nextState(2,a)= next[0+0]

nextState(1,c)= next[4+2]

nextState(0,c)= next[2+2]

Implementing DFAs

	a	b	c	d
0	-	1	-	2
1	1	-	1	-
2	1	2	1	-

base

0	2
1	4
2	0

		-	1	-	2			
				1	-	1	-	
1	2	1	-					
1	2	1	1	1	2	1	-	next
0	1	2	3	4	5	6	7	

2	2	2	0	1	0	1	-	check

```
nextState(s, x) :
  L := base[s] + x
  return next[L]    if check[L] == s
```

Implementing DFAs

	a	b	c	d
0	-	1	-	2
1	1	-	1	-
2	1	2	1	-

	-	1	-	2			
			1	-	1	-	
-	2	-	-				
-	2	1	1	2	1	-	next
0	1	2	3	4	5	6	

-	2	0	1	0	1	-	check

nextState(2,b)=next[1]

base

0	1
1	3
2	0

-
-
1

default

```
nextState(s, x) :
  L := base[s] + x
  return next[L]    if check[L] == s
  else return nextState(default[s], x)
```

Implementing DFAs

	a	b	c	d
0	-	1	-	2
1	1	-	1	-
2	1	2	1	-

	-	1	-	2			
			1	-	1	-	
-	2	-	-				
-	2	1	1	2	1	-	next
0	1	2	3	4	5	6	

-	2	0	1	0	1	-	check

base

0	1
1	3
2	0

-
-
1

default

```
nextState(s, x) :
  L := base[s] + x
  return next[L]    if check[L] == s
  else return nextState(default[s], x)
```

nextState(2,a)=
nextState(1,a)= next[3]