

LR(0) Analysis

Constructing LR(0) tables: Analysis example

- The following is the analysis table obtained for the previous example

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

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LR(0) Analysis

Constructing LR(0) tables: Analysis example

- Check that the table is correct, analysing the following input strings with it:
 - Correct:** $i+(i+i)$
 - Incorrect:** $(i+i$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 4 i 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 7 T 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$**
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$**
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 4 i 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 7 T 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 6 E 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 2 + 6 E 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 4 i 2 + 6 E 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 3 T 2 + 6 E 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 6 E 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 8) 6 E 5 (2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 3 T 2 + 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

i + (i + i) \$

▶ 1 E 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $E \rightarrow T$
- (3) $T \rightarrow i$
- (4) $T \rightarrow (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

(i + i \$

▶ 0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

(| (i + i \$ | | | | | | | |

▶ 5 (0 | | | | | | | |

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) | T
- (3) $T \rightarrow i$
- (4) | (E)

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

(| (i + i \$ | | | | | | | |

▶ 4 i 5 (0 | | | | | | | |

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) | T
- (3) $T \rightarrow i$
- (4) | (E)

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

(| i + i \$

▶ 7 T 5 (0

(0) $E' \rightarrow E\$$

(1) $E \rightarrow E+T$

(2) | T

(3) $T \rightarrow i$

(4) | (E)

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

(| i + i \$

▶ 6 E 5 (0

(0) $E' \rightarrow E\$$

(1) $E \rightarrow E+T$

(2) | T

(3) $T \rightarrow i$

(4) | (E)

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

() i + i \$

▶ 2 + 6 E 5 (0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

() i + i \$

▶ 4 i 2 + 6 E 5 (0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

((i + i \$)))

▶ 3 T 2 + 6 E 5 (0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

((i + i \$)))

▶ 6 E 5 (0

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

((i + i \$)))

▶ 6 E 5 (0)))

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

E	Σ_T					Σ_N	
	i	+	()	s	E	T
0	s4		s5			1	7
1		s2			acc		
2	s4		s5				3
3	r1	r1	r1	r1	r1		
4	r3	r3	r3	r3	r3		
5	s4		s5			6	7
6		s2		s8			
7	r2	r2	r2	r2	r2		
8	r4	r4	r4	r4	r4		
Action						Go-to	

((i + i \$)))

▶ 6 E 5 (0)))

- (0) $E' \rightarrow E\$$
- (1) $E \rightarrow E+T$
- (2) $| T$
- (3) $T \rightarrow i$
- (4) $| (E)$

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LR(0) Analysis

Constructing LR(0) tables: exercise

- Build the LR(0) analysis table associated to the grammar with the following production rules. The axiom of the grammar will be the non-terminal **<Block>**.

```
(1) <Block> → begin <Decs> ; <Ejecs> end
(2) <Decs> → dec
(3)      | <Decs>;dec
(4) <Ejecs> → ejec
(5)      | ejec ; <Ejecs>
```

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LR(0) Analysis

Constructing LR(0) tables: exercise

- Extended grammar:**

```
(0) <Block'> → <Block>$
(1) <Block> → begin <Decs> ; <Ejecs> end
(2) <Decs> → dec
(3)      | <Decs>;dec
(4) <Ejecs> → ejec
(5)      | ejec ; <Ejecs>
```

- We shall use the following abbreviations:

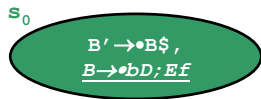
```
<Block'>, B'
<Block>, B
<Decs>, D
<Ejecs>, E
begin, b
dec, d
end, f
ejec, e
```

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LR(0) Analysis

Constructing LR(0) tables: exercise

- **Deterministic Finite Automaton showing the transitions:**

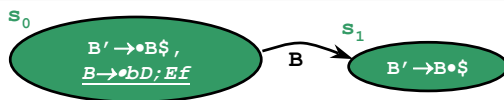


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LR(0) Analysis

Constructing LR(0) tables: exercise

- **Deterministic Finite Automaton showing the transitions:**

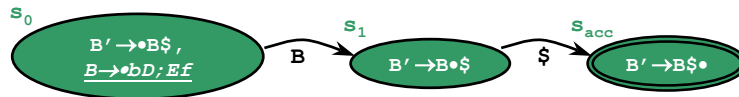


128

LR(0) Analysis

Constructing LR(0) tables: exercise

- **Deterministic Finite Automaton showing the transitions:**

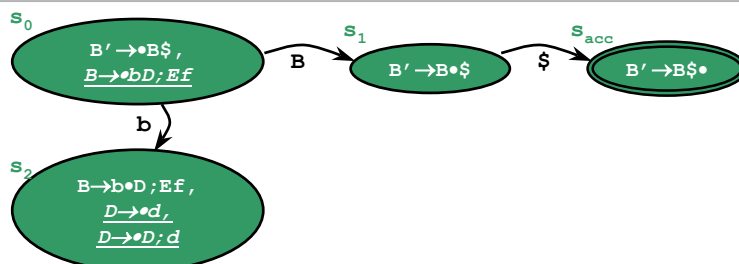


129

LR(0) Analysis

Constructing LR(0) tables: exercise

- **Deterministic Finite Automaton showing the transitions:**

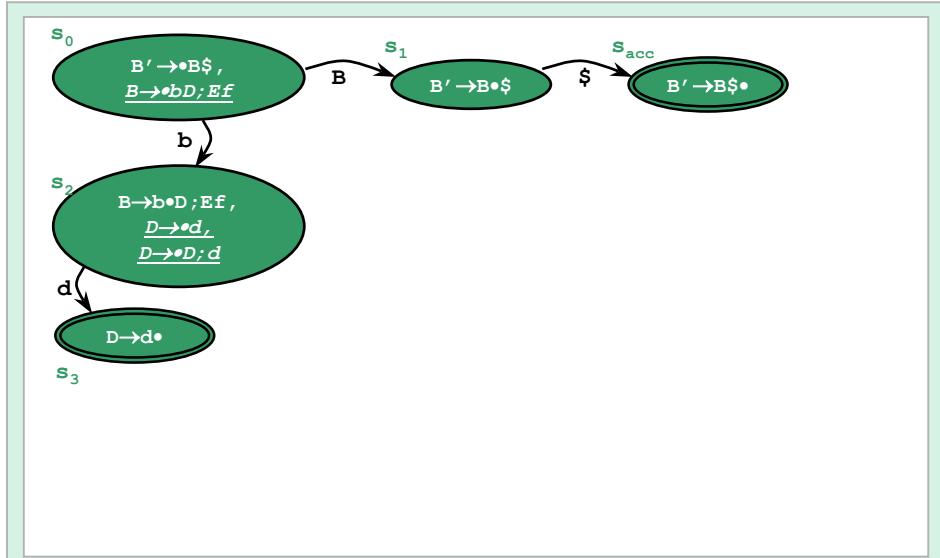


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LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:

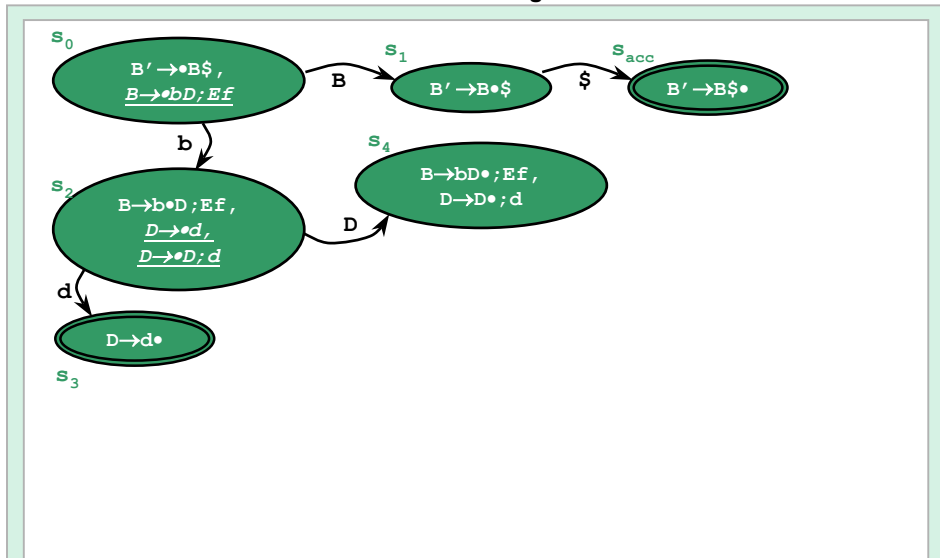


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LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:

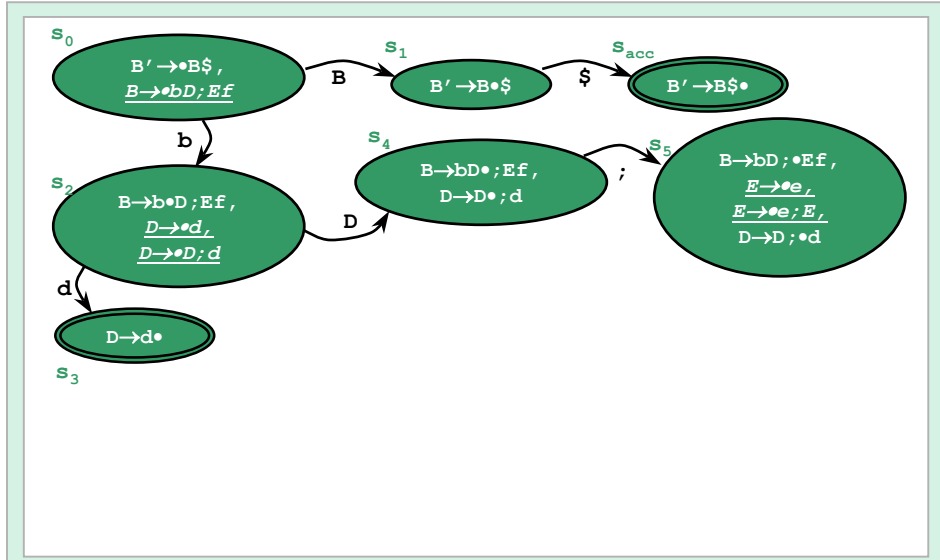


132

LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:

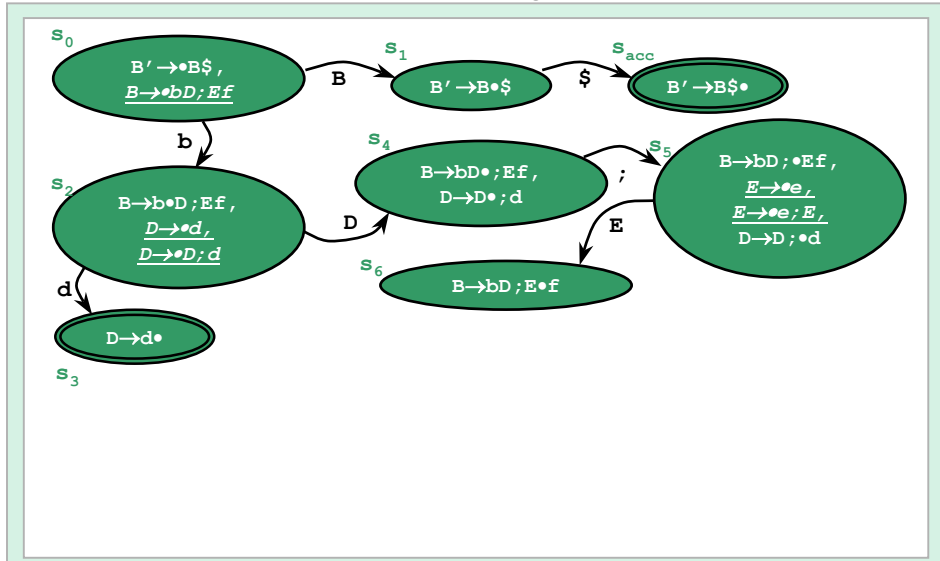


133

LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:

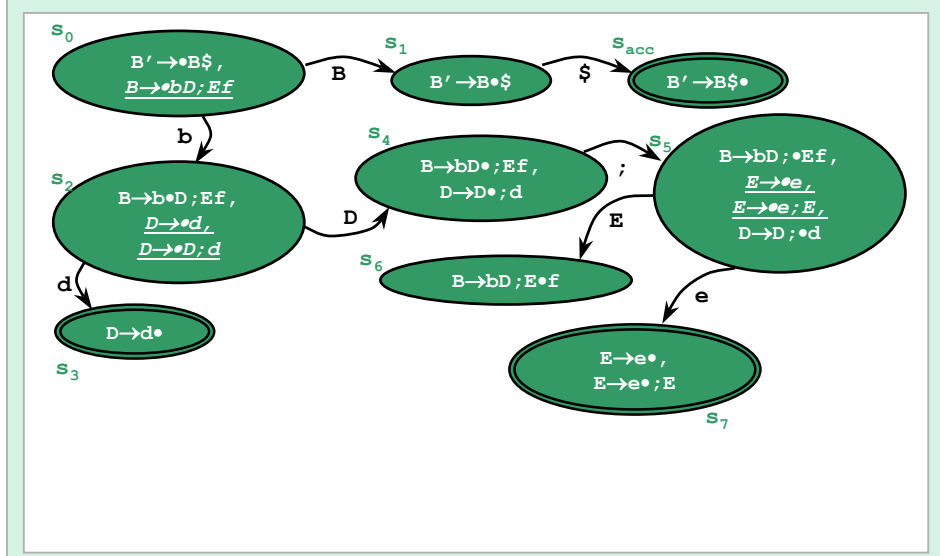


134

LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:

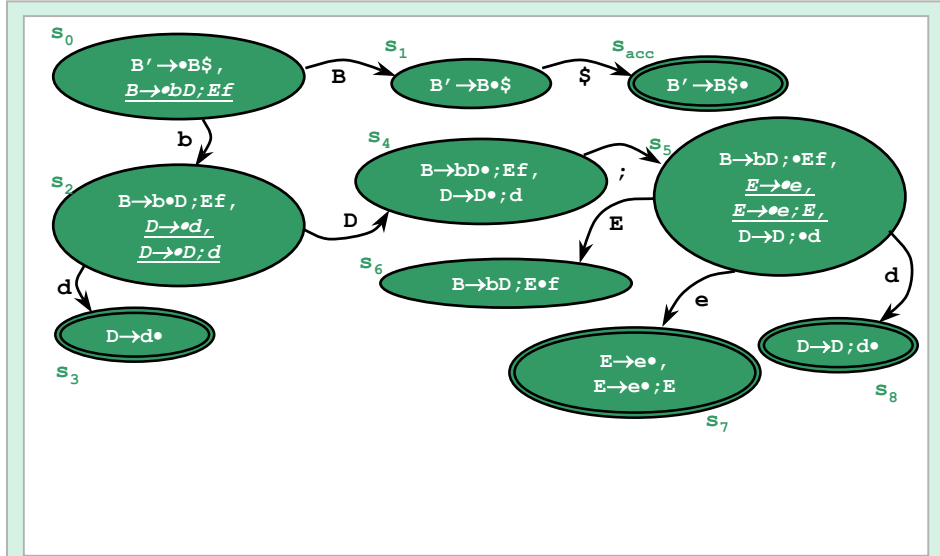


135

LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:

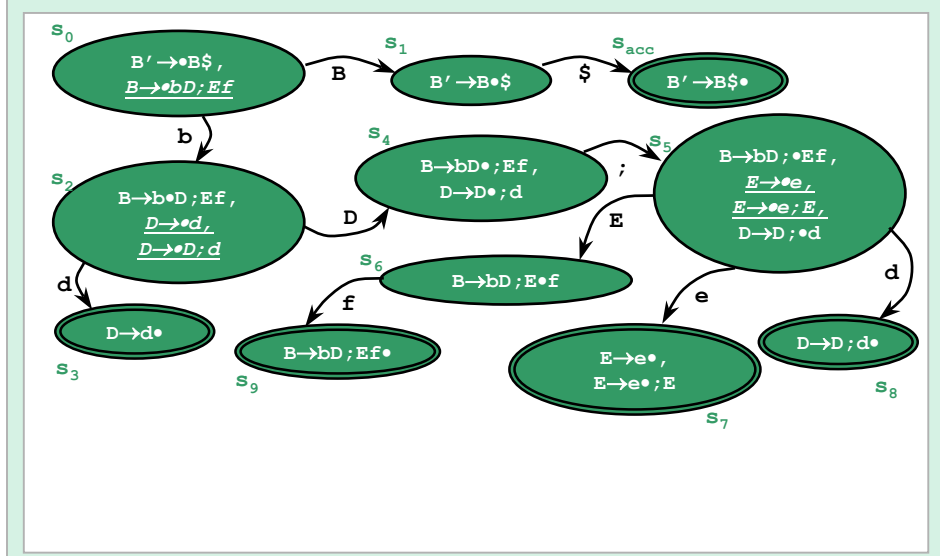


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LR(0) Analysis

Constructing LR(0) tables: exercise

- **Deterministic Finite Automaton showing the transitions:**

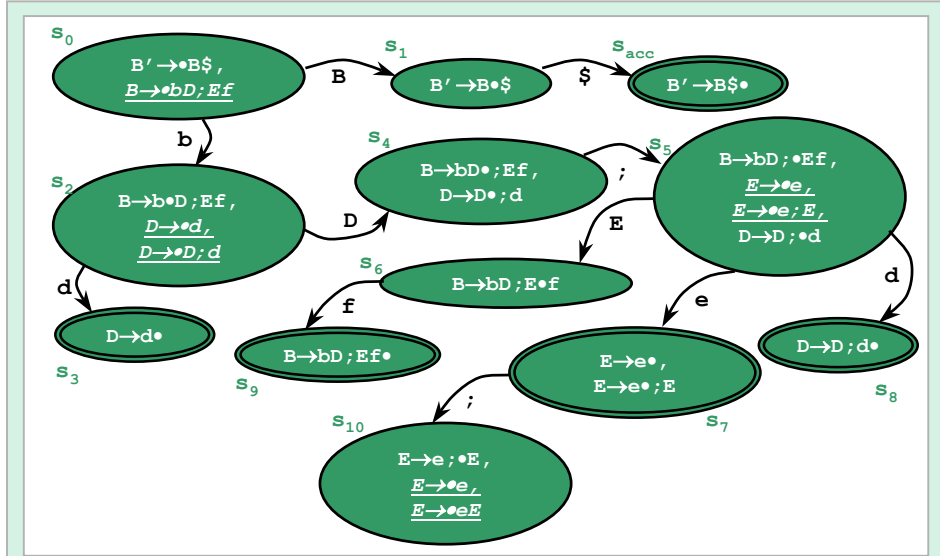


137

LR(0) Analysis

Constructing LR(0) tables: exercise

- **Deterministic Finite Automaton showing the transitions:**

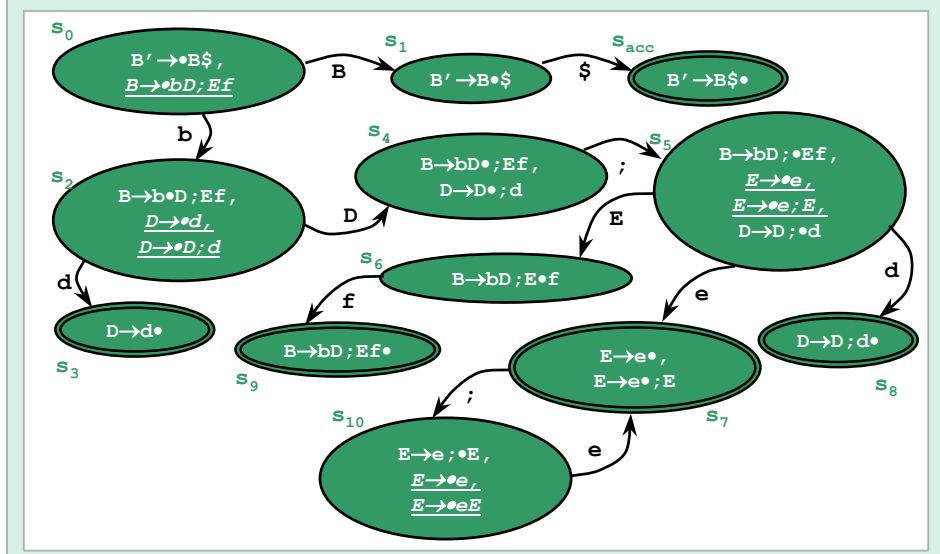


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LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:

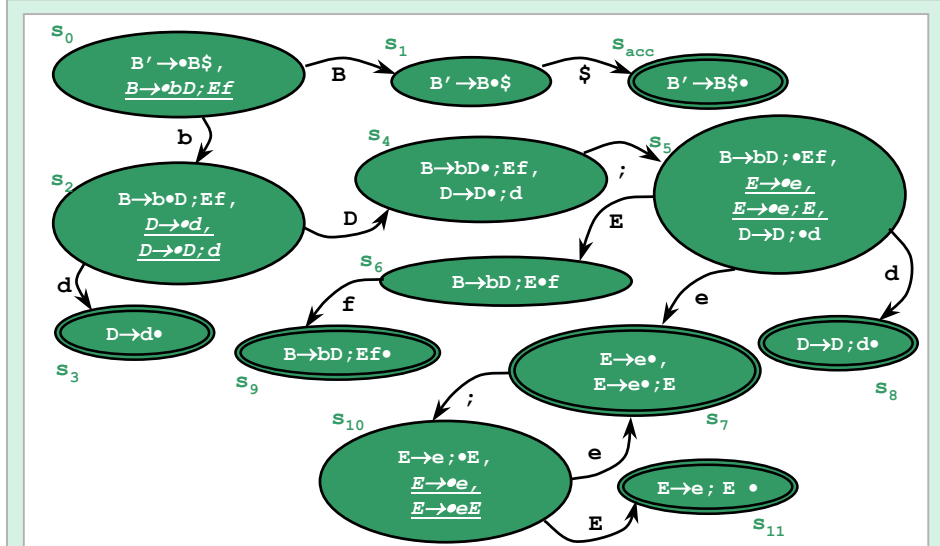


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LR(0) Analysis

Constructing LR(0) tables: exercise

- Deterministic Finite Automaton showing the transitions:



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LR(0) Analysis

Constructing LR(0) tables: exercise

- The following would be the analysis table for the example:

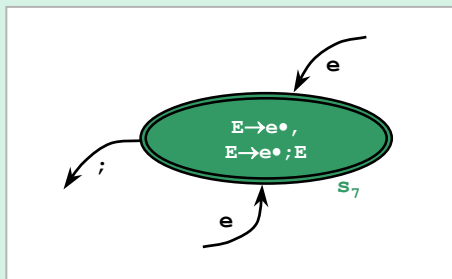
		Σ_T						Σ_N		
E		d	e	b	;	f	\$	B	D	E
0				s2				1		
1							acc			
2		s3							4	
3		r2	r2	r2	r2	r2	r2			
4					s5					
5		s8	s7							6
6						s9				
7		r4	r4	r4	s10/ r4	r4	r4			
8		r3	r3	r3	r3	r3	r3			
9		r1	r1	r1	r1	r1	r1			
10			s7							11
11		r5	r5	r5	r5	r5	r5			
		Action						Go-to		

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LR(0) Analysis

Constructing LR(0) tables: exercise

- There is a reason for the conflict
 - The problem is due to state s_7 :
 - $\langle E j e c s \rangle \rightarrow e j e c \bullet$
 - $\langle E j e c s \rangle \rightarrow e j e c \bullet ; \langle E j e c s \rangle$



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LR(0) Analysis

Constructing LR(0) tables: exercise

- From these two configurations
 $\langle E_j e c s \rangle \rightarrow e j e c \bullet$
 $\langle E_j e c s \rangle \rightarrow e j e c \bullet ; \langle E_j e c s \rangle$
- Given the next terminal symbol “;”, we cannot decide whether we should reduce the first one, or shift the second one.