CS 421 --- LL Parsing Activity

Manager	Keeps team on track	
Recorder	Records decisions / QC	
Reporter	Reports to class	
Reflector	Assesses team performance	

Please write your name/netid legibly in dark ink. Hand in one copy per team. Do not staple or mangle the corners.

Purpose

An LR parser is a more flexible kind of parser than the LL parsers we covered before. In this activity you will learn how to use and generate LR tables.
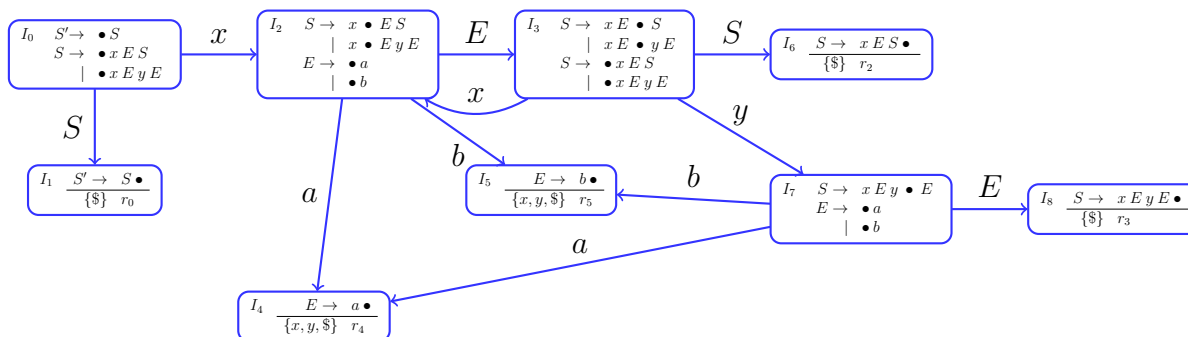
Your objectives:

- Use an LR table to parse a sentence.

- Create a state machine and LR table for a given grammar.

- Detect an ambiguity in a grammar.

Using the State Machine

Consider the following grammar and corresponding state machine.

$$
\begin{aligned}
S' &\to S \\
S &\to x\,E\,S \\
&\mid x\,E\,y\,E \\
E &\to a \\
&\mid b
\end{aligned}
$$

If we try to parse the sentence xaxbya, we get the following behavior. (See next page.)

Step	State	Input	Stack	Action
0	0	xaxbya		Shift x
1	2	axbya	(0,x)	Shift a
2	4	xbya	(0,x), (2,a)	Reduce $E \rightarrow a$
3	2	xbya	(0,x)	Goto 3
4	3	xbya	(0,x),(2,$E \rightarrow a$)	Shift x
5	2	bya	(0,x),(2,$E \rightarrow a$),(3,x)	Shift b
6	5	ya	(0,x),(2,$E \rightarrow a$),(3,x),(2,b)	Reduce $E \rightarrow b$
7	2	ya	(0,x),(2,$E \rightarrow a$),(3,x)	Goto 3
8	3	ya	(0,x),(2,$E \rightarrow a$),(3,x),(2,$E \rightarrow b$)	Shift y
9	7	a	(0,x),(2,$E \rightarrow a$),(3,x),(2,$E \rightarrow b$),(3,y)	Shift a
10	4	a	(0,x),(2,$E \rightarrow a$),(3,x),(2,$E \rightarrow b$),(3,y),(7,a)	Reduce $E \rightarrow a$
11	7		(0,x),(2,$E \rightarrow a$),(3,x),(2,$E \rightarrow b$),(3,y)	Goto 8
12	8		(0,x),(2,$E \rightarrow a$),(3,x),(2,$E \rightarrow b$),(3,y),(7,$E \rightarrow a$)	Reduce $S \rightarrow x\,E\,y\,E$
13	3		(0,x),(2,$E \rightarrow a$)	Goto 6
14	6		(0,x),(2,$E \rightarrow a$),(3,$S \rightarrow ...$)	Reduce $S \rightarrow x\,E\,S$
15	0			Goto 1
16	0		(0,$S \rightarrow ...$)	Accept

Problem 1) Draw the tree that resulted from this parse.

Problem 2) What is the purpose of the shift operation?

Problem 3) What is the purpose of the reduce operation?

Problem 4) In step 12, how does the parser know how many states to pop off the stack when doing the reduce?

Generating State Machines

Example 1)

$$S \rightarrow x\,S\,y$$
$$| \quad \epsilon$$

Action

	x	y	$
0			
1			
2			
3			

Go To

	x	y	$	S
0				
1				
2				
3				

Example 2)

$$S \rightarrow a\,E\,b$$
$$\quad | \quad x$$
$$E \rightarrow E\,x\,E$$
$$\quad | \quad b$$

Action

	a	b	x	$
0				
1				
2				
3				
4				
5				
6				

Go To

	a	b	x	$	S	E
0						
1						
2						
3						
4						
5						
6						

Problem 5)

Is this grammar ambiguous? Prove your answer by generating the LR parsing table.

$$S \rightarrow \ v$$
$$| \ x\,S$$
$$| \ x\,S\,y\,S$$

Action

	v	x	y	$
0				
1				
2				
3				
4				
5				

Go To

	v	x	y	$	S
0					
1					
2					
3					
4					
5					

Problem 6)

You will discover a new kind of conflict in this grammar.

$S \rightarrow a\,b$
$\quad | \quad a\,E$
$\quad | \quad F\,b$
$E \rightarrow b$
$F \rightarrow a$

Action

	a	b	c	$
0				
1				
2				
3				
4				
5				

Go To

	a	b	c	$	S	E	F
0							
1							
2							
3							
4							
5							

LL Parsing Activity--- Reflector's Report

Manager	Keeps team on track	
Recorder	Records decisions	
Reporter	Reports to Class	
Reflector	Assesses team performance	

1. What was a strength of your team's performance for this activity?

2. What could you do next time to increase your team's performance?

3. What insights did you have about the activity or your team's interaction today?

LL Parsing Activity --- Team's Assessment (SII)

Manager or Reflector: Consider the objectives of this activity and your team's experience with it, and then answer the following questions after consulting with your team.

1. What was a **strength** of this activity? List one aspect that helped it achieve its purpose.

2. What is one things we could do to **improve** this activity to make it more effective?

3. What **insights** did you have about the activity, either the content or at the meta level?