## **Concept of Shift-reduce Parsing**

- Bottom-up parsing is also known as shift-reduce parsing because its two main actions are shift and reduce.
- Data structures: input-string and stack
- Operations
  - At each **shift action**, the current symbol in the input string is pushed to a stack.
  - At each reduction step, the symbols at the top of the stack (this symbol sequence is the right side of a production) will replaced by the non-terminal at the left side of that production.
  - Accept: Announce successful completion of parsing
  - Error: Discover a syntax error and call error recovery

# Example 01

**Prepared By: Sukarna Sarker** 

#### **Grammar:**

### Perform Shift Reduce Parsing for the string id1 \* id2

	Stack	Input	Action
	\$	id1 * id2 \$	Shift
Grammar:			
E -> E + T   T			
T -> T * F   F			
F -> (E)   id			
String: id1 * id2			
•			
		Pror	oared By: Sukarna Sarke

	Stack	Input	Action
	\$	id1 * id2 \$	Shift
Grammar: E -> E + T   T T -> T * F   F	\$id1	*id2\$	Reduce F->id
F -> (E)   id			
String: id1 * id2			

Prepared By: Sukarna Sarker

	Stack	Input	Action
	\$	id1 * id2 \$	Shift
<b>Grammar:</b> E -> E + T   T	\$id1	*id2\$	Reduce F->id
T -> T * F   F	\$ <b>F</b>	*id2\$	Reduce T->F
F -> (E)   id			
String: id1 * id2			
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Grammar: E -> E + T   T T -> T * F   F F -> (E)   id	
String: id1 * id2	

Stack	Input	Action
\$	id1 * id2 \$	Shift
\$id1	*id2\$	Reduce F->id
\$F	*id2\$	Reduce T->F
\$ <b>T</b>	*id2\$	Shift
	F	repared By: Sukarna Sarker

Grammar: E -> E + T   T T -> T * F   F F -> (E)   id	
String: id1 * id2	

Stack	Input
\$	id1 * id2 \$
\$id1	*id2\$
\$F	*id2\$
\$T	*id2\$
\$T *	id2\$

Reduce T->F Shift **Shift** 

Prepared By: Sukarna Sarker

**Action** 

Shift

Reduce F->id

Grammar: E -> E + T   T T -> T * F   F F -> (E)   id	
String: id1 * id2	

	Stack	Input	Action
	\$	id1 * id2 \$	Shift
	\$id1	*id2\$	Reduce F->id
	\$F	*id2\$	Reduce T->F
	\$T	*id2\$	Shift
	\$T *	id2\$	Shift
	\$T*id	\$	Reduce F->id
		_	
-			wa wa esta di Divi Civilya wa a Ca

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Grammar: E -> E + T   T T -> T * F   F F -> (E)   id	
String: id1 * id2	

Input

id1 \* id2 \$

\*id2\$

\*id2\$

\*id2\$

id2\$

\$

\$

Reduce F->id Reduce T->F Shift Shift Reduce F->id Reduce T->T\*F

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**Action** 

Shift

Grammar: E -> E + T   T T -> T * F   F F -> (E)   id	
String: id1 * id2	

Stack
\$
\$id1
\$F
\$T
\$T *
\$T*id
\$T*F
\$ <b>T</b>

id1 * id2 \$	Shift
*id2\$	Reduce F->id
*id2\$	Reduce T->F
*id2\$	Shift
id2\$	Shift
\$	Reduce F->id
\$	Reduce T->T*F
\$	Reduce E->T
_	
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Input

**Action** 

Grammar: E -> E + T   T T -> T * F   F F -> (E)   id
String: id1 * id2

Stack
\$
\$id1
\$F
\$T
\$T *
\$T*id
\$T*F
\$T
\$E

Input	Action
id1 * id2 \$	Shift
*id2\$	Reduce F->id
*id2\$	Reduce T->F
*id2\$	Shift
id2\$	Shift
\$	Reduce F->id
\$	Reduce T->T*F
\$	Reduce E->T
\$	Accept
Р	repared By: Sukarna Sarker

# Example 02

Prepared By: Sukarna Sarker

#### **Grammar:**

### Perform Shift Reduce Parsing for the string (id)+id

	Stack	Input	Action
	\$	(id)+id	Shift
Grammar:			
E -> E + T   T			
T -> T * F   F			
F -> (E)   id			
String: (id)+id			
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id	Shift
	\$(	id)+id	Shift
Grammar:			
E -> E + T   T			
T -> T * F   F			
F -> (E)   id			
String: (id)+id			
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T			
T -> T * F   F			
F -> (E)   id			
String: (id)+id			
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$( <b>F</b>	)+id\$	Reduce T->F
T -> T * F   F			
F -> (E)   id			
String: (id)+id			
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$( <b>T</b>	)+id\$	Reduce E->T
F -> (E)   id			
String: (id)+id			
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$( <b>E</b>	)+id\$	Shift
String: (id)+id			
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
String: (id)+id			
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id			
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id	\$T	+id\$	Reduce E->T
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id	\$T	+id\$	Reduce E->T
	\$E	+id\$	Shift
		_	
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id	\$T	+id\$	Reduce E->T
	\$E	+id\$	Shift
	\$E+	id\$	Shift
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id	\$T	+id\$	Reduce E->T
	\$E	+id\$	Shift
	\$E+	id\$	Shift
	\$E+id	\$	Reduce F->id
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id	\$T	+id\$	Reduce E->T
	\$E	+id\$	Shift
	\$E+	id\$	Shift
	\$E+id	\$	Reduce F->id
	\$E+ <b>F</b>	\$	Reduce T->F
		Prepared B	y: Sukarna Sarker

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Grammar:	\$(id	)+id\$	Reduce F->id
E -> E + T   T	\$(F	)+id\$	Reduce T->F
T -> T * F   F	\$(T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id	\$T	+id\$	Reduce E->T
	\$E	+id\$	Shift
	\$E+	id\$	Shift
	\$E+id	\$	Reduce F->id
	\$E+F	\$	Reduce T->F
Prepared By: Sukarna Sarker	\$E+T	\$	Reduce E->E+T

	Stack	Input	Action
	\$	(id)+id\$	Shift
	\$(	id)+id\$	Shift
Crommori	\$(id	)+id\$	Reduce F->id
Grammar:	\$(F	)+id\$	Reduce T->F
E -> E + T   T T -> T * F   F	<b>\$</b> (T	)+id\$	Reduce E->T
F -> (E)   id	\$(E	)+id\$	Shift
. (—/   1.5.	\$(E)	+id\$	Reduce F->(E)
	\$F	+id\$	Reduce T->F
String: (id)+id	\$T	+id\$	Reduce E->T
	\$E	+id\$	Shift
	\$E+	id\$	Shift
	\$E+id	\$	Reduce F->id
	\$E+F	\$	Reduce T->F
	\$E+T	\$	Reduce E->E+T
Prepared By: Sukarna Sarker	\$E	\$	Accept