

## Compilers : Homework 1 Calculator :

### Part1 .

#### LL(1) version :

1.  $\text{exp} \rightarrow \text{term exp2}$
2.  $\text{exp2} \rightarrow +\text{term exp2}$
3.  $\quad \quad \quad | -\text{term exp2}$
4.  $\quad \quad \quad | \epsilon$
5.  $\text{term} \rightarrow \text{factor term2}$
6.  $\text{term2} \rightarrow *\text{factor term2}$
7.  $\quad \quad \quad | /\text{factor term2}$
8.  $\quad \quad \quad | \epsilon$
9.  $\text{factor} \rightarrow \text{num}$
10.  $\quad \quad \quad | (\text{exp})$
11.  $\text{num} \rightarrow 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9$

#### **FIRST :**

$\text{FIRST}(2) = \{ + \}$   
 $\text{FIRST}(3) = \{ - \}$   
 $\text{FIRST}(4) = \{ \epsilon \}$   
 $\text{FIRST}(6) = \{ * \}$   
 $\text{FIRST}(7) = \{ / \}$   
 $\text{FIRST}(8) = \{ \epsilon \}$   
 $\text{FIRST}(9) = \text{FIRST}(11) = \{ 0, \dots, 9 \}$   
 $\text{FIRST}(10) = \{ ( \}$   
 $\text{FIRST}(11) = \{ 0, \dots, 9 \}$   
 $\text{FIRST}(5) = \text{FIRST}(9) \cup \text{FIRST}(10) = \{ 0, \dots, 9, ( \}$   
 $\text{FIRST}(1) = \text{FIRST}(5) = \{ 0, \dots, 9, ( \}$

#### **FOLLOW :**

$\text{FOLLOW}(\text{exp}) = \{ \text{EOF} \}$   
 $\text{FOLLOW}(\text{exp2}) = \text{FOLLOW}(\text{exp}) = \{ \text{EOF} \}$   
 $\text{FOLLOW}(\text{term}) = \text{FIRST}(\text{exp2}) = \text{FIRST}(2) \cup \text{FIRST}(3) \cup \text{FIRST}(4) = \{ +, -, \epsilon \} =$   
 $\quad \quad \quad = \{ +, -, \text{FOLLOW}(\text{exp2}) \} =$   
 $\quad \quad \quad = \{ +, -, \text{FOLLOW}(\text{exp}) \} =$   
 $\quad \quad \quad = \{ +, -, \text{EOF} \}$

$\text{FOLLOW}(\text{term2}) = \text{FOLLOW}(\text{term}) = \{ +, -, \text{EOF} \}$

$$\begin{aligned}\text{FOLLOW}(\text{factor}) &= \text{FIRST}(\text{term2}) = \{*, /, \epsilon\} = \{*, /, \text{FOLLOW}(\text{term2})\} = \\ &= \{*, /, \text{FOLLOW}(\text{term})\} = \\ &= \{*, /, +, -, \text{EOF}\}\end{aligned}$$

$$\text{FOLLOW}(\text{num}) = \text{FOLLOW}(\text{factor}) = \{*, /, +, -, \text{EOF}\}$$

### **FIRST+:**

$$\text{FIRST}+(1) = \{0, \dots, 9, ( \}$$

$$\text{FIRST}+(2) = \{ + \}$$

$$\text{FIRST}+(3) = \{ - \}$$

$$\text{FIRST}+(4) = \text{FIRST}(4) \cup \text{FOLLOW}(4) = \text{FIRST}(4) \cup \text{FOLLOW}(\text{exp2}) = \{ \text{EOF} \}$$

$$\text{FIRST}+(5) = \{0, \dots, 9, ( \}$$

$$\text{FIRST}+(6) = \{ * \}$$

$$\text{FIRST}+(7) = \{ / \}$$

$$\text{FIRST}+(8) = \text{FIRST}(8) \cup \text{FOLLOW}(8) = \text{FIRST}(8) \cup \text{FOLLOW}(\text{term2}) = \{ +, -, \text{EOF} \}$$

$$\text{FIRST}+(9) = \{0, \dots, 9 \}$$

$$\text{FIRST}+(10) = \{ ( \}$$

$$\text{FIRST}+(11) = \{0, \dots, 9 \}$$

### **lookahead table :**

#	0,.....,9	(	+	-	*	/	EOF
<b>exp</b>	term exp2	term exp2	error	error	error	error	error
<b>exp2</b>	error	error	+term exp2	-term exp2	error	error	$\epsilon$
<b>term</b>	factor term2	factor term2	error	error	error	error	error
<b>term2</b>	error	error	$\epsilon$	$\epsilon$	*factor term2	/factor term2	$\epsilon$
<b>factor</b>	num	(exp)	error	error	error	error	error
<b>num</b>	0,.....,9	error	error	error	error	error	error