

NAME: CT-18057 NOOR SHAUKAT & CT-18054 MUHAMMAD ATHAR SAYEED

SUBJECT: COMPILER DESIGN, ASSIGNMENT

DEPARTMENT: COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

BATCH/ YEAR: 2018/ 4<sup>TH</sup> YEAR

DATE: 9<sup>TH</sup>-JULY-2022

## COMPILER DESIGN CLASS PROJECT – OPERATOR PRECEDENCE PARSER

### EXPLANATION

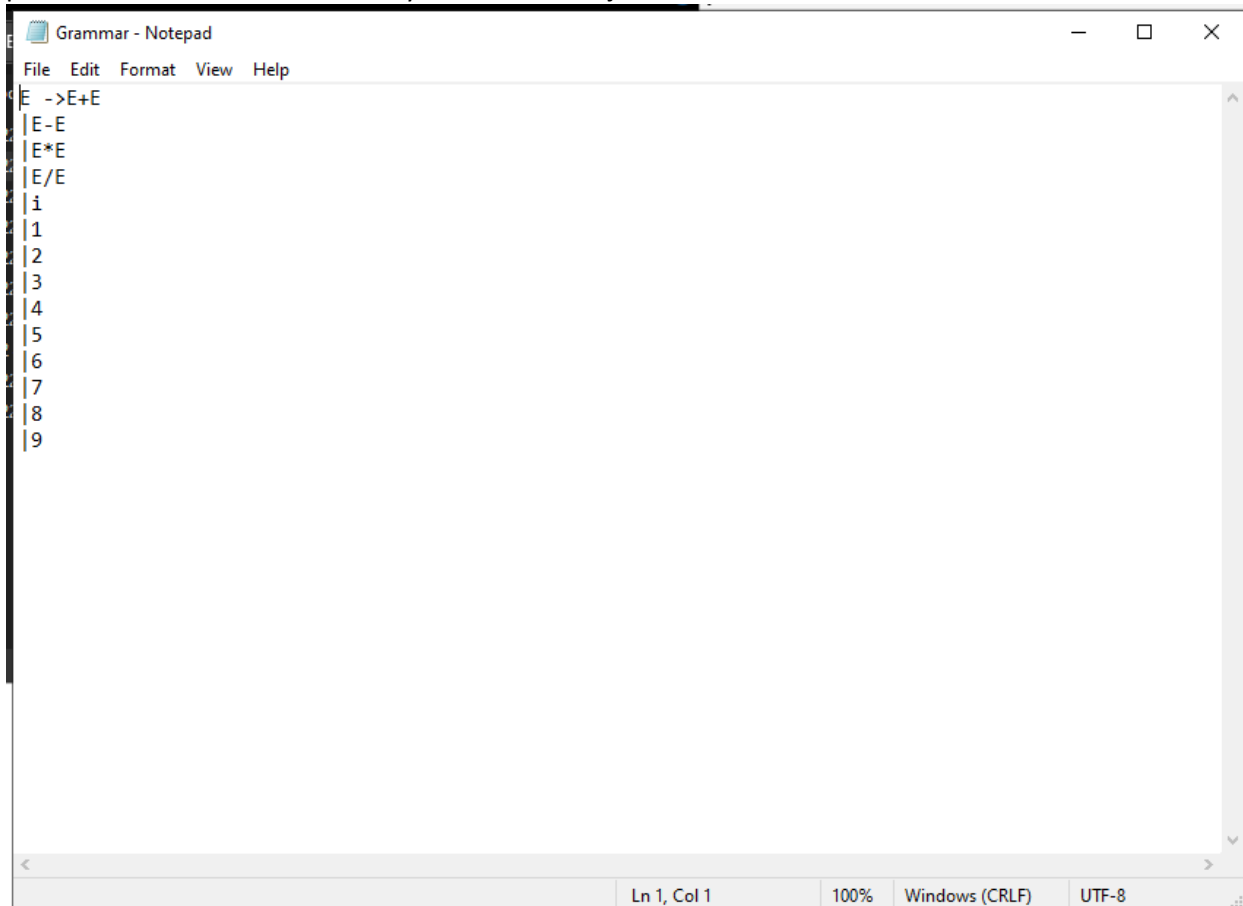
It is a type of shift reduce parser, but in precedence operator, precedence parser, as it's clear by its name it's used for the parsing of the statements having some kind of operators as arithmetic operator.

Grammar is set to be operator precedence if it has following two properties

- No right-hand side of any production has sigma or epsilon
- No two non terminals are adjacent

### GRAMMAR

Following is the grammar where the inputs are from one to nine. Following both of the properties of operator precedence parser that's no sigma or epsilon sign can be seen at the right side of any production rule below additionally there are no adjacent non terminals.



```
Grammar - Notepad
File Edit Format View Help
E ->E+E
E-E
E*E
E/E
i
1
2
3
4
5
6
7
8
9
Ln 1, Col 1 100% Windows (CRLF) UTF-8
```

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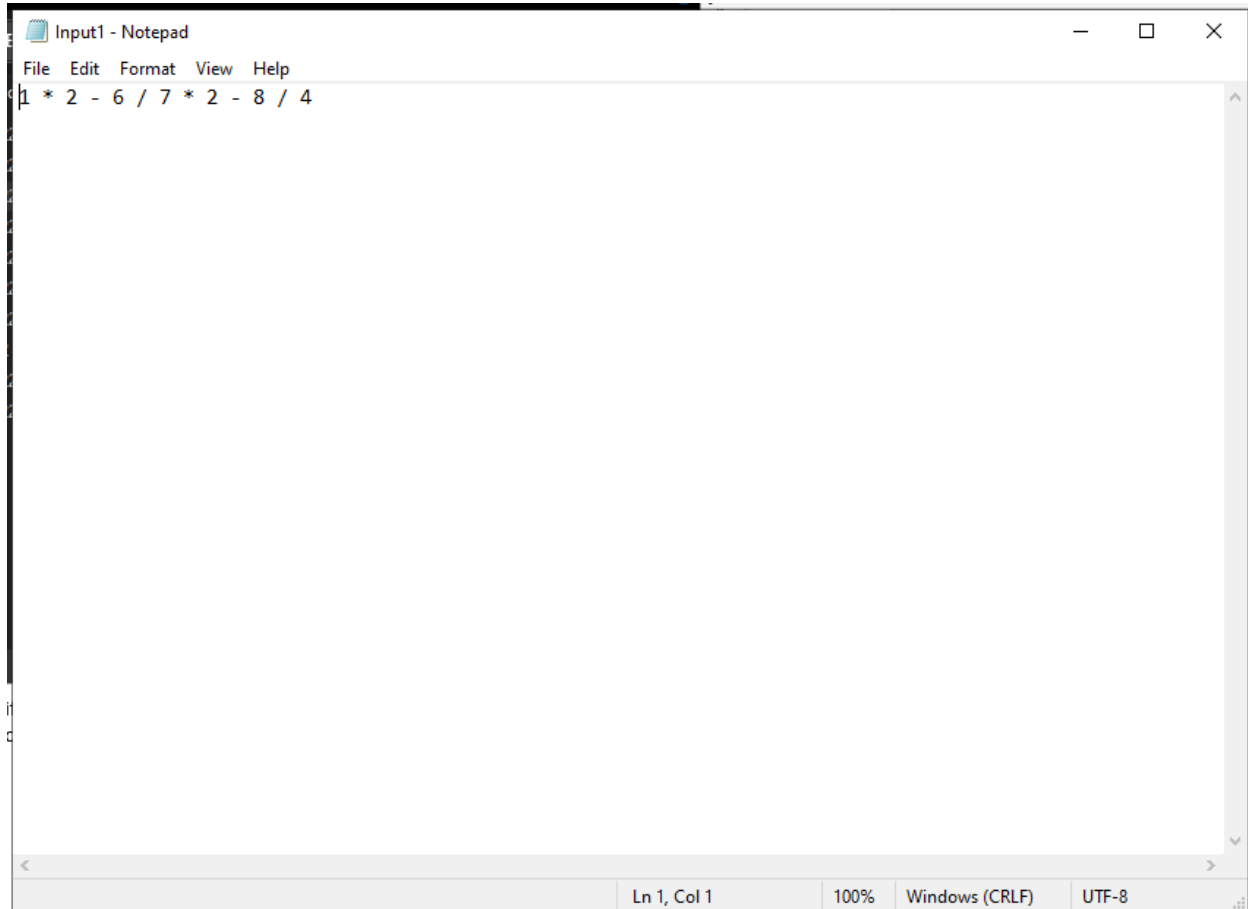
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## INPUT

Following are the different inputs that got tested in this project, two inputs are correct whereas the rest of the three are incorrect.

### INPUT 1 - CORRECT



```
Input1 - Notepad
File Edit Format View Help
1 * 2 - 6 / 7 * 2 - 8 / 4
Ln 1, Col 1 100% Windows (CRLF) UTF-8
```

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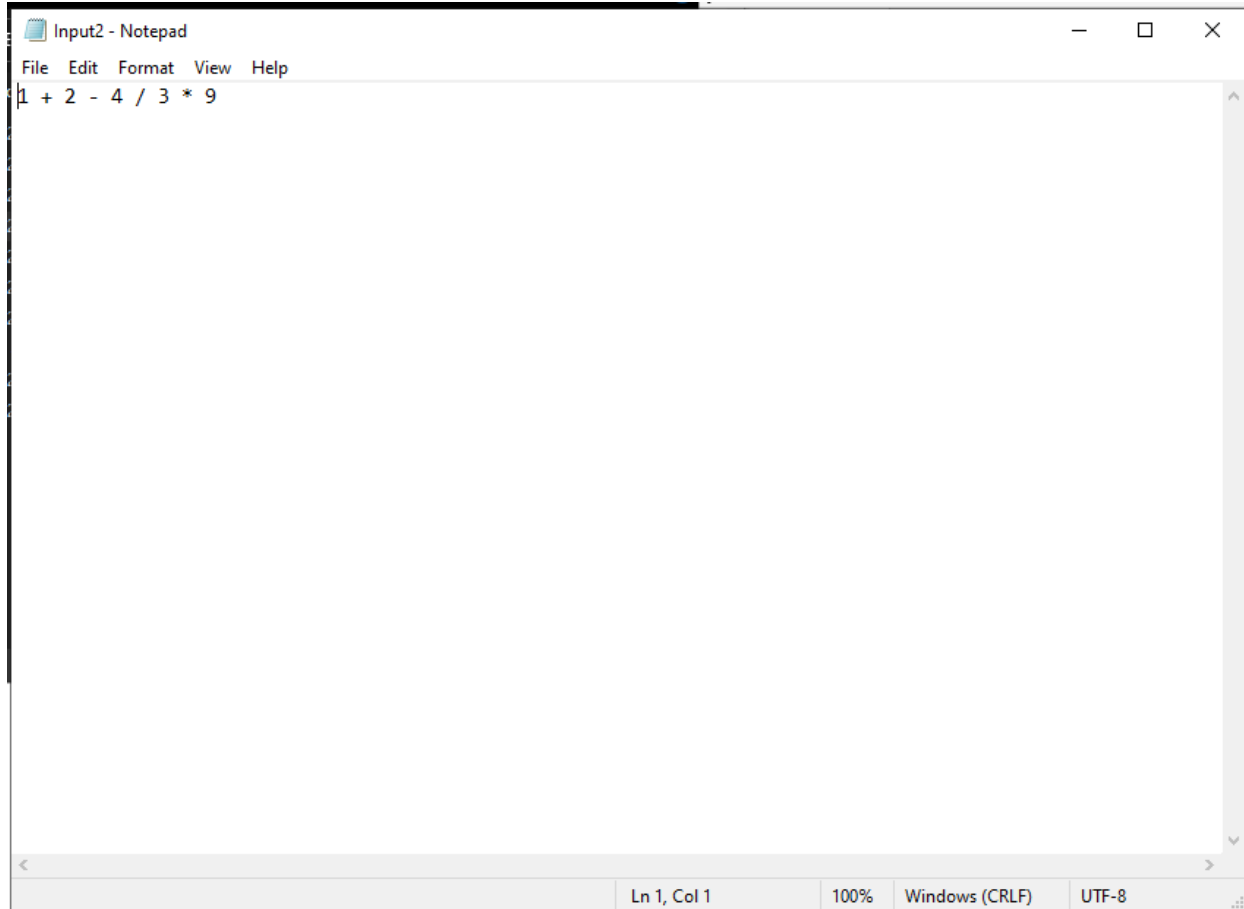
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**INPUT 2 - CORRECT**



Input2 - Notepad

File Edit Format View Help

1 + 2 - 4 / 3 \* 9

Ln 1, Col 1 100% Windows (CRLF) UTF-8

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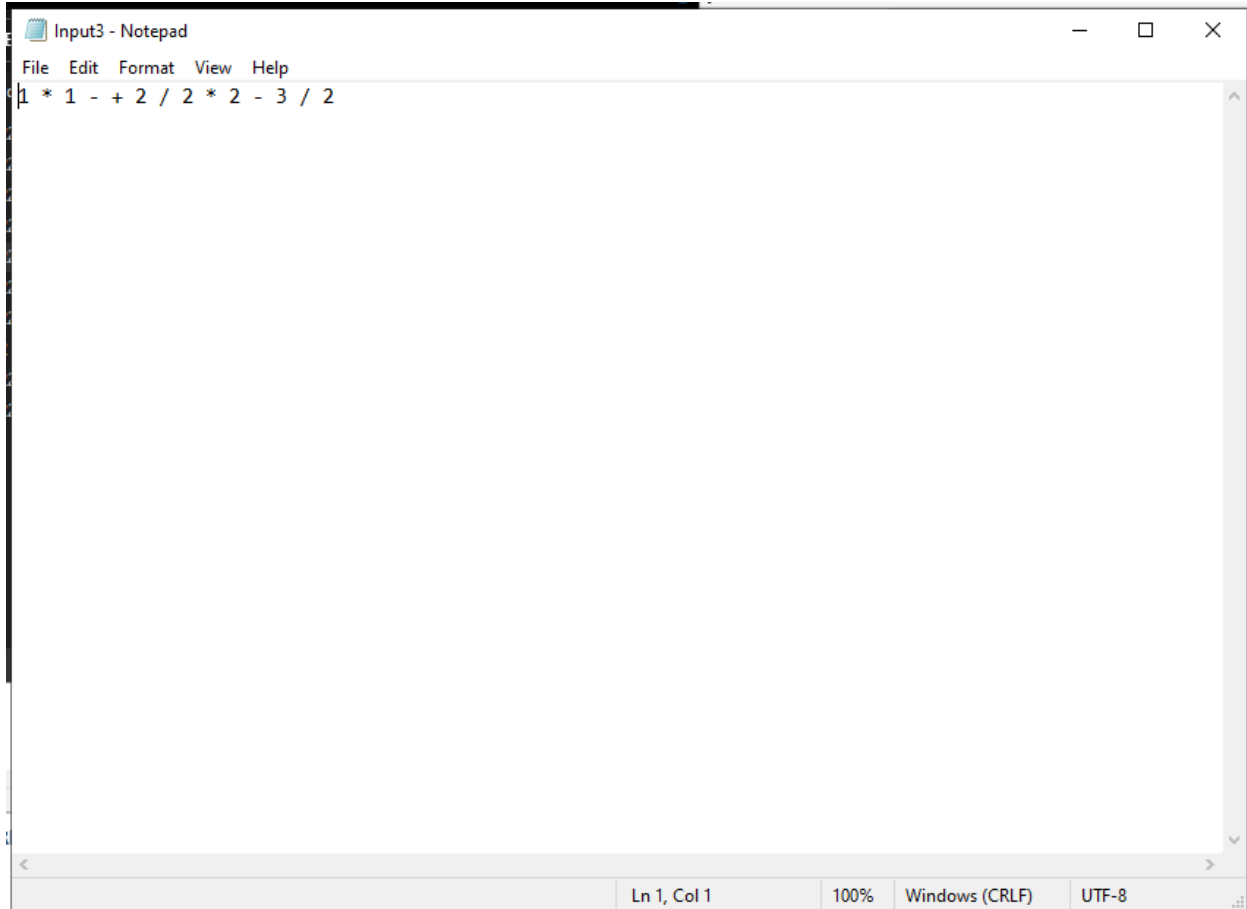
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INPUT 3 – INCORRECT (TWO OPERATORS APPEAR TOGETHER)



```
Input3 - Notepad
File Edit Format View Help
1 * 1 - + 2 / 2 * 2 - 3 / 2
Ln 1, Col 1 100% Windows (CRLF) UTF-8
```

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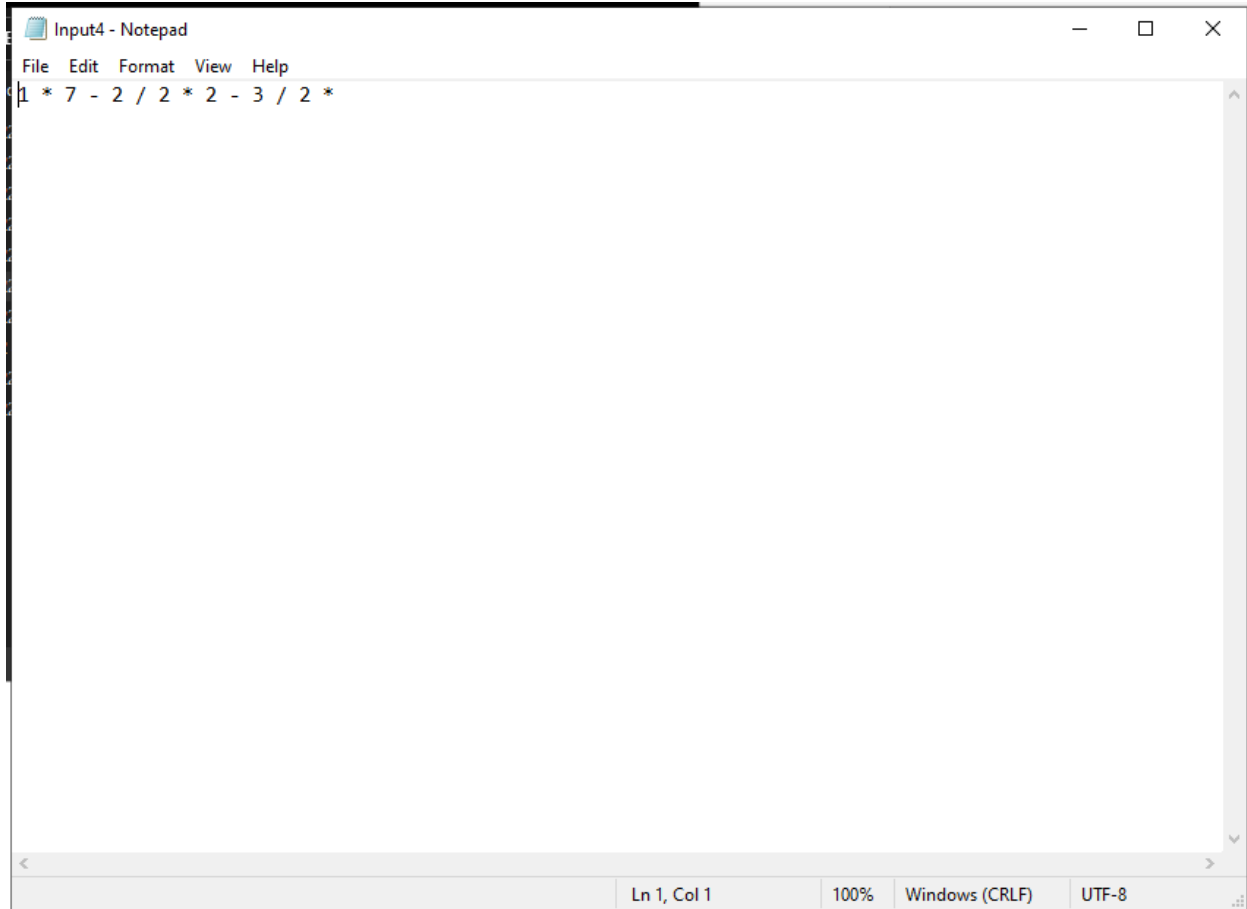
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INPUT 4 – INCORRECT (OPERATOR AT THE VERY END OF A STATEMENT)



```
Input4 - Notepad
File Edit Format View Help
1 * 7 - 2 / 2 * 2 - 3 / 2 *
Ln 1, Col 1 100% Windows (CRLF) UTF-8
```

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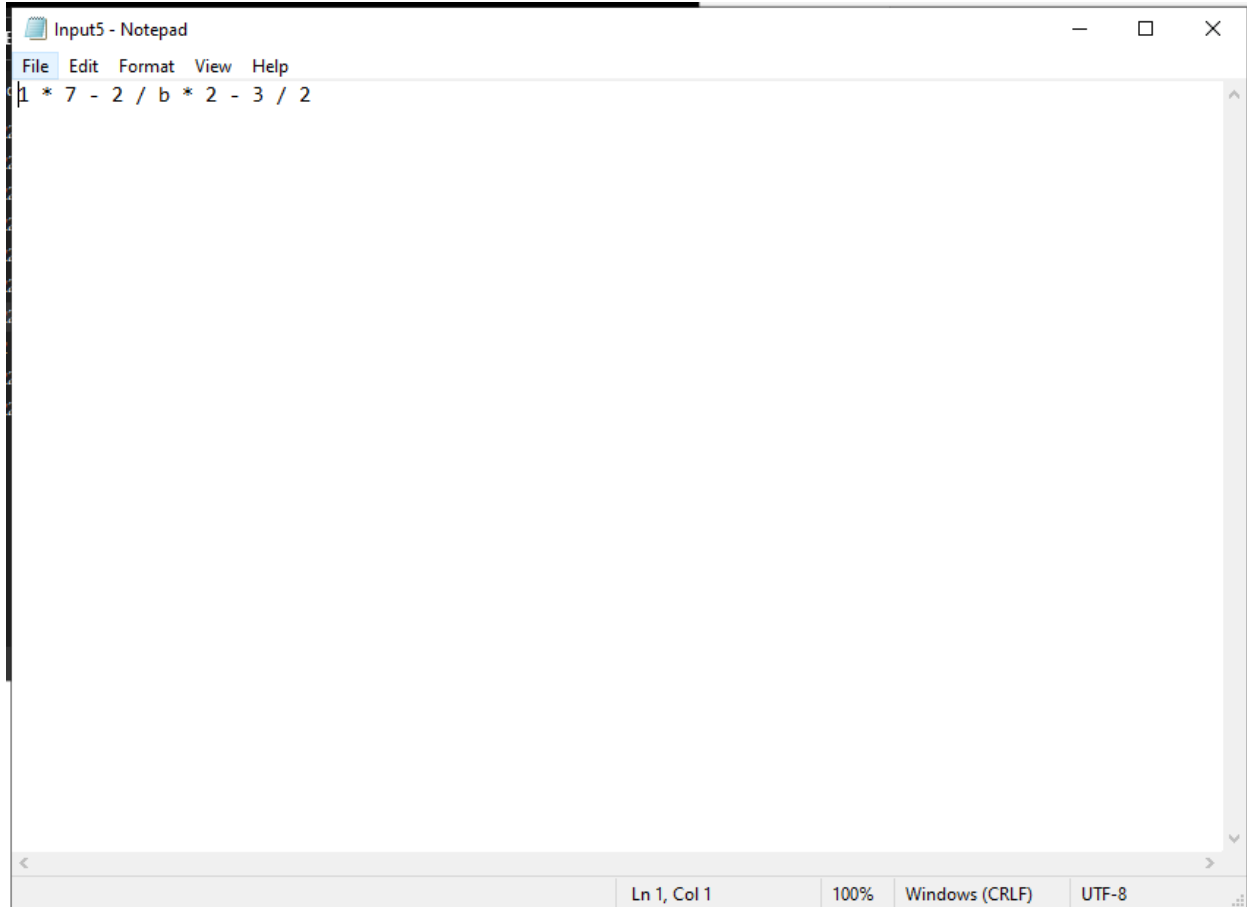
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INPUT 5 – INCORRECT (UNDEFINED CHARACTER)



Input5 - Notepad

File Edit Format View Help

1 \* 7 - 2 / b \* 2 - 3 / 2

Ln 1, Col 1 100% Windows (CRLF) UTF-8

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**PARSING TABLE**

All the written rules of the grammar will be followed by this parsing table.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1																								
2	+	>	>	<	/	<	<	1	2	<	<	<	<	<	<	<	<							
3	.	>	>	<	<	<	<	<	<	<	<	<	<	<	<	<	<							
4	*	>	>	>	>	<	<	<	<	<	<	<	<	<	<	<	<							
5	/	>	>	>	>	<	<	<	<	<	<	<	<	<	<	<	<							
6	i	>	>	>	>																			
7	1	>	>	>	>																			
8	2	>	>	>	>																			
9	3	>	>	>	>																			
10	4	>	>	>	>																			
11	5	>	>	>	>																			
12	6	>	>	>	>																			
13	7	>	>	>	>																			
14	8	>	>	>	>																			
15	9	>	>	>	>																			
16	\$	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<							
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## CODE DEMOSTRATION

```
OperatorPrecedenceParser_CompilerDesignProject.py - Visual Studio Code
D:\> Noor Shaukat > 8TH-SEMESTER, BCIT > CT-465 COMPILER DESIGN > PYTHON FILES > OperatorPrecedenceParser_CompilerDesignProject.py
1 import sys
2 import shlex
3 import csv
4 from wsgiref.util import shift_path_info
5
6 def main():
7     #-----INPUTS FOR TESTING-----
8     input_string=open('Input1.txt','r').readline() #Correct Input
9     input_string=open('Input2.txt','r').readline() #Correct Input
10    input_string=open('Input3.txt','r').readline() #Input Having Two Operators Together
11    input_string=open('Input4.txt','r').readline() #Input Having Operator At The Very End
12    input_string=open('Input5.txt','r').readline() #Input Not Part Of the Grammar
13    print()
14    print("Input: ",input_string)
15
16    #-----TOKENIZATION-----
17    input_ind=list(shlex.shlex(input_string))
18    input_ind.append('$')
19    print()
20    print("Symbol Table For Above Input")
21    symbolTable={}
22
23    #-----Creating Symbol Table-----
24    c=0
25    for i,val in enumerate(input_ind):
26        if val in ['+', '-', '*', '/', '^']:
27            symbolTable[str(val)]="<"+val+">"
28            c=c+1
29        elif val in ['1','2','3','4','5','6','7','8','9']:
30            symbolTable[val]=val
31        elif val not in ['$']:
32            symbolTable[str(val)]="<"+val+">"
33
34    #-----PRINTING SYMBOL TABLE-----
35    print()
36    print("-----Symbol Table-----")
37    print(" ")
38    print('{:12s}'.format(" | Lexem"),{:8s}'.format("Token"),{:8s}'.format(" |"))
39    print(" ")
40    for key,value in symbolTable.items():
```

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```
OperatorPrecedenceParser_CompilerDesignProject.py
33
34 #-----PRINTING SYMBOL TABLE-----
35 print()
36 print("-----Symbol Table-----")
37 print(" ")
38 print('{:12s}'.format(" Lexem"),'{:8s}'.format("Token"),'{:8s}'.format("|"))
39 print(" ")
40 for key,value in symbolTable.items():
41     print('{:10s}'.format(" "+str(key)),'{:10s}'.format(" "+str(value)),'{:10s}'.format("|"))
42 print(" ")
43
44 #-----READING GRAMMAR FROM GRAMMAR.TXT-----
45 master={}
46 master_list=[]
47 new_list=[]
48 non_terminals=[]
49 grammar=open('grammar.txt','r')
50 for row2 in grammar:
51     if '-' in row2:
52         if len(new_list)==0:
53             start_state=row2[0]
54             non_terminals.append(row2[0])
55             new_list=[]
56             new_list.append(row2.rstrip('\n'))
57         else:
58             master_list.append(new_list)
59             del new_list
60             new_list=[]
61             new_list.append(row2.rstrip('\n'))
62             non_terminals.append(row2[0])
63         elif '|' in row2:
64             new_list.append(row2.rstrip('\n'))
65     master_list.append(new_list)
66
67 for x in range(len(master_list)):
68     for y in range(len(master_list[x])):
69         master_list[x][y]=s.replace('|','.') for s in master_list[x][y]
70     master_list[x][y]=''.join(master_list[x][y])
71     master_list[x][y]=non_terminals[x]
```

```
OperatorPrecedenceParser_CompilerDesignProject2.py
72
73 for key,value in master.items():
74     if '-' in key:
75         length=len(key)
76         for i in range(length):
77             if key[i]=='-' and key[i+1]==">":
78                 index=i+2
79                 break
80         var_key=key
81         new_key=key[index:]
82     var=master[var_key]
83     del master[var_key]
84     master[new_key]=var
85
86 #-----READING AND PRINTING PARSING TABLE FROM A FILE-----
87 order_table=[]
88 with open('Order.csv','r') as file2:
89     order= csv.reader(file2)
90     print()
91     print("-----Parsing Table-----")
92     temp=0
93     for i,row in enumerate(order):
94         if(i==0):
95             print(" ",end=" ")
96             for _ in range(len(row)):
97                 print(" ",end=" ")
98             print()
99             temp=len(row)
100         print(" |",end=" ")
101         order_table.append(row)
102         for j,cell in enumerate(row):
103             if i==0 and j==1:
104                 print(" "+cell+" ",end=" ")
105             elif cell==" ":
106                 print(" "+cell+" ",end=" ")
107             else:
108                 print(" "+cell+" ",end=" ")
109         print(" ")
110     print(" ",end=" ")
111     for _ in range(0,temp):
```



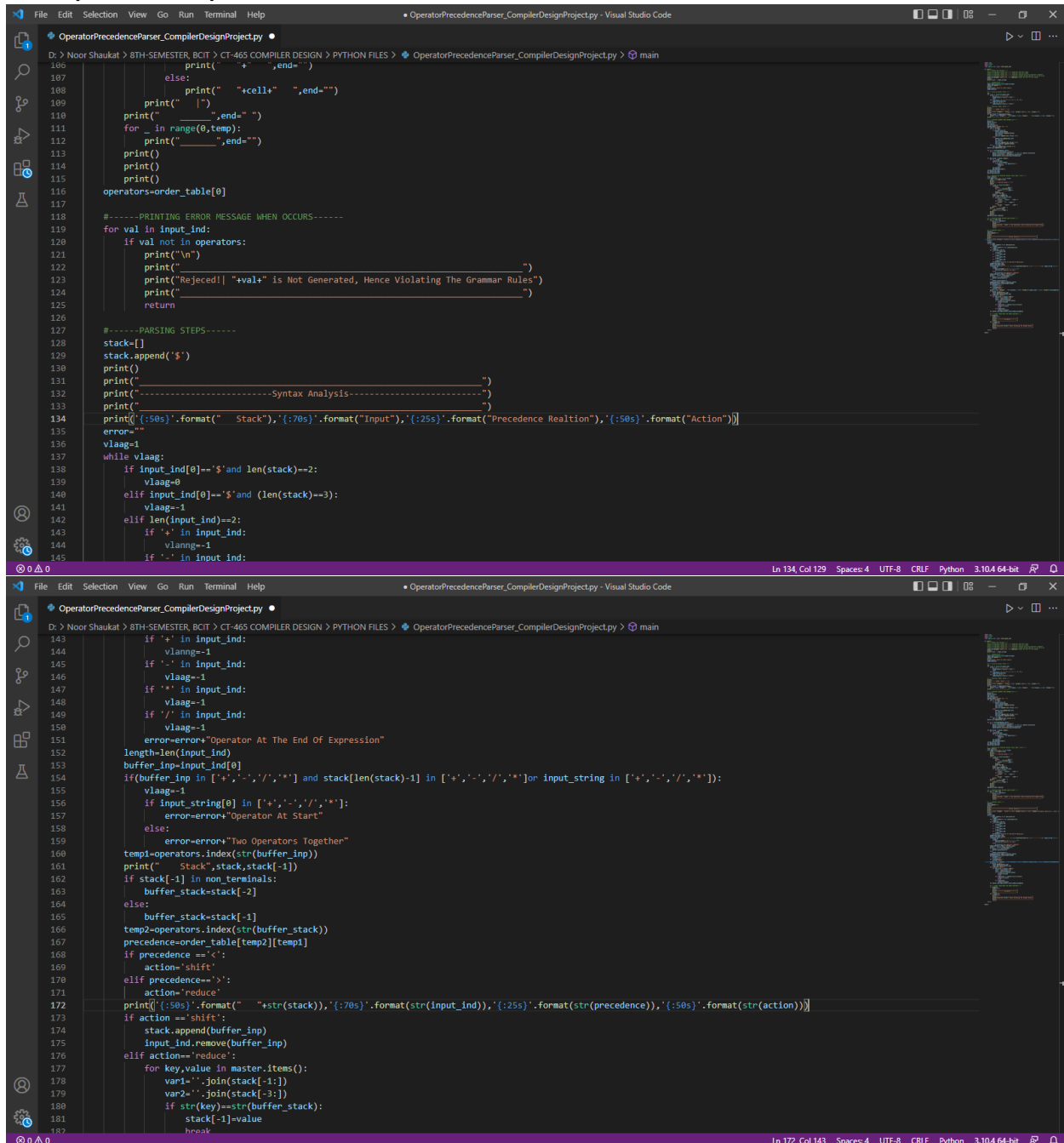
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```
OperatorPrecedenceParser_CompilerDesignProject.py
D:\> Noor Shaukat > 8TH-SEMESTER, BCIT > CT-465 COMPILER DESIGN > PYTHON FILES > OperatorPrecedenceParser_CompilerDesignProject.py > main
106         print(" + ",end="")
107     else:
108         print(" *cell+ " ,end="")
109     print(" )",end=" ")
110     for _ in range(0,temp):
111         print(" ",end="")
112     print()
113     print()
114     print()
115     print()
116     operators_order_table[0]
117
118     #-----PRINTING ERROR MESSAGE WHEN OCCURS-----
119     for val in input_ind:
120         if val not in operators:
121             print("\n")
122             print(" ")
123             print("Rejected! "+val+" is Not Generated, Hence Violating The Grammar Rules")
124             print(" ")
125             return
126
127     #-----PARSING STEPS-----
128     stack=[]
129     stack.append('$')
130     print()
131     print("-----")
132     print("-----Syntax Analysis-----")
133     print("-----")
134     print("{:50s}".format(" Stack"),"{:70s}".format("Input"),"{:25s}".format("Precedence Relation"),"{:50s}".format("Action"))
135     error=""
136     vlaag=1
137     while vlaag:
138         if input_ind[0]=='$' and len(stack)==2:
139             vlaag=0
140         elif input_ind[0]=='$' and (len(stack)==3):
141             vlaag=-1
142         elif len(input_ind)==2:
143             if '+' in input_ind:
144                 vlaag=-1
145             if '*' in input_ind:
146                 vlaag=-1
147             if '/' in input_ind:
148                 vlaag=-1
149             if '%' in input_ind:
150                 vlaag=-1
151             error=error+"Operator At The End Of Expression"
152     length=len(input_ind)
153     buffer_inp=input_ind[0]
154     if(buffer_inp in ['+', '-', '/', '*'] and stack[len(stack)-1] in ['+', '-', '/', '*'] or input_string in ['+', '-', '/', '*']):
155         vlaag=-1
156         if input_string[0] in ['+', '-', '/', '*']:
157             error=error+"Operator At Start"
158         else:
159             error=error+"Two Operators Together"
160     temp1=operators.index(str(buffer_inp))
161     print(" Stack",stack,stack[-1])
162     if stack[-1] in non_terminals:
163         buffer_stack=stack[-2]
164     else:
165         buffer_stack=stack[-1]
166     temp2=operators.index(str(buffer_stack))
167     precedence_order_table[temp2][temp1]
168     if precedence == '<':
169         action='shift'
170     elif precedence == '>':
171         action='reduce'
172     print("{:50s}".format(" "+str(stack)),"{:70s}".format(str(input_ind)),"{:25s}".format(str(precedence)),"{:50s}".format(str(action)))
173     if action == 'shift':
174         stack.append(buffer_inp)
175         input_ind.remove(buffer_inp)
176     elif action == 'reduce':
177         for key,value in master.items():
178             var1=''.join(stack[-1:])
179             var2=''.join(stack[-3:])
180             if str(key)==str(buffer_stack):
181                 stack[-1]=value
182                 break
```

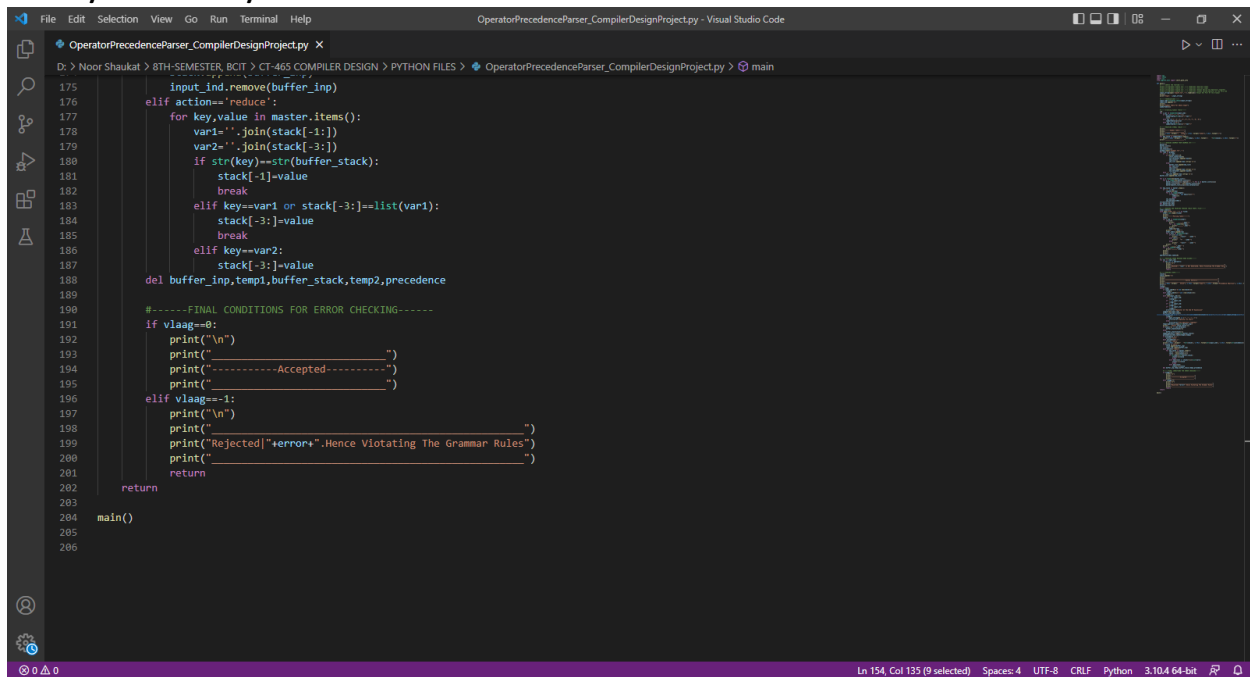
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175     input_ind.remove(buffer_inp)
176     elif action=='reduce':
177         for key,value in master.items():
178             var1=''.join(stack[-1:])
179             var2=''.join(stack[-3:])
180             if str(key)==str(buffer_stack):
181                 stack[-1]=value
182                 break
183             elif key==var1 or stack[-3]==list(var1):
184                 stack[-3]=value
185                 break
186             elif key==var2:
187                 stack[-3]=value
188         del buffer_inp,temp1,buffer_stack,temp2,precedence
189
190     #-----FINAL CONDITIONS FOR ERROR CHECKING-----
191     if vlaag==0:
192         print("\n")
193         print("_____")
194         print("-----Accepted-----")
195         print("_____")
196     elif vlaag==1:
197         print("\n")
198         print("_____")
199         print("Rejected|"+error+"Hence Viotating The Grammar Rules")
200         print("_____")
201         return
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204     return
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```

Firstly, multiple inputs are taken from separate number of files, here the inputs are being checked one at a time having the rest of them being commented.

Then as the code executes the input string gets printed initially, then tokenization is being done, next is the symbol table that gets created and printed, the next portion is to read the grammar of the parser from the grammar.txt file, and it's feed to the a list of new variables in the code, where the grammar rules are marked to be separated by a pipe symbol and at few parts these pipeline symbols are being replaced by arrow symbols written as " $\rightarrow$ ", after this the parsing table is being read from order.csv which also gets printed containing the rules in the following portion by getting it stored in the order variable, coming to the next portion of the code error handing through printing error messages has been done, proceeding part is the syntax analyzer along with the UI or in other words step by step processing of syntax analyzer to show the clear interpretation of the mechanism and some conditions have been applied as if there is a dollar "\$" symbol and the length of the stack is equal to two, that means one is the starting variable and other is the dollar symbol, that states the input is acceptable and make the variable zero, other following conditions are for the error handling where vlaag is converted to minus one "-1". And the next final portion of the code where if vlaag is zero it's accepted, an accepted message is being printed else a rejected message is displayed.

**DATE: 9<sup>TH</sup>-JULY-2022**

PROBLEMS OUTPUT DEBUG CONSOLE **TERMINAL**

```
PS D:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES> d:; cd 'd:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES'; & 'c:\python\python310\python.exe' 'c:\Users\WP\.vscode\extensions\ms-python.python-2022.4.1\pythonfiles\lib\python\debugpy\launcher' '51978' '--' 'd:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES\OperatorPrecedenceParser_CompilerDesignProject.py'
```

Input: 1 \* 2 - 6 / 7 \* 2 - 8 / 4

Symbol Table For Above Input

-----Symbol Table-----

Lexem	Token
1	1
*	<*>
2	2
-	<->
6	6
/	</>
7	7
8	8
4	4

-----Parsing Table-----

	+	-	*	/	i	1	2	3	4	5	6	7	8	9	\$
+	>	<	<	<	<	<	<	<	<	<	<	<	<	<	>
-	>	>	<	<	<	<	<	<	<	<	<	<	<	<	>
*	>	>	>	<	<	<	<	<	<	<	<	<	<	<	>
/	>	>	>	>	<	<	<	<	<	<	<	<	<	<	>
i	>	>	>	>											
1	>	>	>	>											
2	>	>	>	>											
3	>	>	>	>											
4	>	>	>	>											
5	>	>	>	>											
6	>	>	>	>											
7	>	>	>	>											
8	>	>	>	>											
9	>	>	>	>											
\$	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<

-----Parsing Table-----

PROBLEMS OUTPUT DEBUG CONSOLE **TERMINAL**

Python Debug Console + - [ ] ^ x

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PROBLEMS	OUTPUT	DEBUG CONSOLE	TERMINAL
Python Debug Console + - [] ☰ ⌵ ×			
-----Syntax Analysis-----			
Stack	Input	Precedence Realtion	Action
Stack ['\$', '\$] ['\$']	['1', '*', '2', '-', '6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', '1'] 1 ['\$', '1']	['*', '2', '-', '6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E'] E ['\$', 'E']	['*', '2', '-', '6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '*'] * ['\$', 'E', '*']	['2', '-', '6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '*', '2'] 2 ['\$', 'E', '*', '2']	['-', '6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E', '*', 'E'] E ['\$', 'E', '*', 'E']	['-', '6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E'] E ['\$', 'E']	['-', '6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-'] - ['\$', 'E', '-']	['6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', '6'] 6 ['\$', 'E', '-', '6']	['/', '7', '*', '2', '-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E', '-', 'E'] E ['\$', 'E', '-', 'E']	['/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', 'E', '/'] / ['\$', 'E', '-', 'E', '/']	['7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Ln 26, Col 36 Spaces: 4 UTF-8 CRLF Python 3.10.4 64-bit 🔍 🔍			
PROBLEMS	OUTPUT	DEBUG CONSOLE	TERMINAL
Python Debug Console + - [] ☰ ⌵ ×			
Stack ['\$', 'E', '-'] - ['\$', 'E', '-']	['6', '/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', '6'] 6 ['\$', 'E', '-', '6']	['/', '7', '*', '2', '-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E', '-', 'E'] E ['\$', 'E', '-', 'E']	['/', '7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', 'E', '/'] / ['\$', 'E', '-', 'E', '/']	['7', '*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', 'E', '/', '7'] 7 ['\$', 'E', '-', 'E', '/', '7']	['*', '2', '-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E', '-', 'E', '/', 'E'] E ['\$', 'E', '-', 'E', '/', 'E']	['*', '2', '-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E', '-', 'E'] E ['\$', 'E', '-', 'E']	['*', '2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', 'E', '*'] * ['\$', 'E', '-', 'E', '*']	['2', '-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', 'E', '*', '2'] 2 ['\$', 'E', '-', 'E', '*', '2']	['-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E', '-', 'E', '*', 'E'] E ['\$', 'E', '-', 'E', '*', 'E']	['-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E', '-', 'E'] E ['\$', 'E', '-', 'E']	['-', '8', '/', '4', '\$'] >		reduce
Stack ['\$', 'E'] E ['\$', 'E']	['-', '8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-'] - ['\$', 'E', '-']	['8', '/', '4', '\$'] <		shift
Stack ['\$', 'E', '-', '8'] 8			
Ln 26, Col 36 Spaces: 4 UTF-8 CRLF Python 3.10.4 64-bit 🔍 🔍			

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```
Python Debug Console
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
Stack ['$', 'E', '-', 'E', '*', 'E'] E
['$', 'E', '-', 'E', '*', 'E']      ['- ', '8', '/', '4', '$']      >      reduce
Stack ['$', 'E', '-', 'E'] E
['$', 'E', '-', 'E']      ['- ', '8', '/', '4', '$']      >      reduce
Stack ['$', 'E'] E
['$', 'E']      ['- ', '8', '/', '4', '$']      <      shift
Stack ['$', 'E', '-'] -
['$', 'E', '-']      ['8', '/', '4', '$']      <      shift
Stack ['$', 'E', '-', '8'] 8
['$', 'E', '-', '8']      ['/', '4', '$']      >      reduce
Stack ['$', 'E', '-', 'E'] E
['$', 'E', '-', 'E']      ['/', '4', '$']      <      shift
Stack ['$', 'E', '-', 'E', '/'] /
['$', 'E', '-', 'E', '/']      ['4', '$']      <      shift
Stack ['$', 'E', '-', 'E', '/', '4'] 4
['$', 'E', '-', 'E', '/', '4']      ['$']      >      reduce
Stack ['$', 'E', '-', 'E', '/', 'E'] E
['$', 'E', '-', 'E', '/', 'E']      ['$']      >      reduce
Stack ['$', 'E', '-', 'E'] E
['$', 'E', '-', 'E']      ['$']      >      reduce
Stack ['$', 'E'] E
['$', 'E']      ['$']      >      reduce

-----Accepted-----
PS D:\Noor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES>
```

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## TESTING OF INPUT 3

Here the input gets rejected as it got two operators beside each other, leading to the violation of the defined grammar rules.

```
PS D:\Noor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES> d:; cd 'd:\Noor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES'; & 'C:\Python\Python310\python.exe' 'c:\Users\VHP\.vscode\extensions\ms-python.python-2022.4.1\pythonFiles\lib\python\debugpy\launcher' '51998' '--' 'd:\Noor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES\OperatorPrecedenceParser_CompilerDesignProject.py'
```

Input: 1 \* 1 - + 2 / 2 \* 2 - 3 / 2

Symbol Table For Above Input

-----Symbol Table-----

Lexem	Token
1	1
*	<*>
-	<->
+	<+>
2	2
/	</>
3	3

-----Parsing Table-----

	+	-	*	/	1	2	3	4	5	6	7	8	9	\$
+	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
-	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
*	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
/	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
1	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
2	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
3	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
4	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
5	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
6	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
7	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
8	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
9	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>
\$	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>	<>

-----Syntax Analysis-----

Stack	Input	Precedence Relation	Action
Stack ['\$'] \$ ['\$']	['1', '*', '1', '-', '+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] <		shift
Stack ['\$', '1'] 1 ['\$', '1']	['*', '1', '-', '+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] >		reduce
Stack ['\$', 'E'] E ['\$', 'E']	['*', '1', '-', '+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] <		shift
Stack ['\$', 'E', '*'] * ['\$', 'E', '*']	['1', '-', '+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] <		shift
Stack ['\$', 'E', '*', '1'] 1 ['\$', 'E', '*', '1']	['-', '+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] >		reduce
Stack ['\$', 'E', '*', 'E'] E ['\$', 'E', '*', 'E']	['-', '+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] >		reduce
Stack ['\$', 'E'] E ['\$', 'E']	['-', '+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] <		shift
Stack ['\$', 'E', '-'] - ['\$', 'E', '-']	['+', '2', '/', '2', '*', '2', '-', '3', '/', '2', '\$'] >		reduce

Rejected|Two Operators Together.Hence Violating The Grammar Rules

```
PS D:\Noor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES>
```

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## TESTING OF INPUT 4

A rejected input as there's an operator at the end of the string.

```
PS D:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES> cd 'd:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES'; & 'C:\Python\Python310\python.exe' 'c:\Users\HP\.vscode\extensions\ms-python.python-2022.4.1\pythonFiles\lib\python\debugpy\launcher' '52827' '--' 'd:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES\OperatorPrecedenceParser_CompileDesignProject.py'
```

Input: 1 \* 7 - 2 / 2 \* 2 - 3 / 2 \*

Symbol Table For Above Input

-----Symbol Table-----

Lexem	Token
1	1
*	<*>
7	7
-	<->
2	2
/	</>
3	3

-----Parsing Table-----

	+	-	*	/	i	1	2	3	4	5	6	7	8	9	\$
+	>	>	<	<	<	<	<	<	<	<	<	<	<	<	>
-	>	>	<	<	<	<	<	<	<	<	<	<	<	<	>
*	>	>	>	<	<	<	<	<	<	<	<	<	<	<	>
/	>	>	>	>	<	<	<	<	<	<	<	<	<	<	>
i	>	>	>	>											
1	>	>	>	>											
2	>	>	>	>											
3	>	>	>	>											
4	>	>	>	>											
5	>	>	>	>											
6	>	>	>	>											
7	>	>	>	>											
8	>	>	>	>											
9	>	>	>	>											
\$	<	<	<	<	<	<	<	<	<	<	<	<	<	<	

-----Syntax Analysis-----

Stack	Input	Precedence Realtion	Action
Stack ['\$', '\$'] ['\$']	['1', '*', '7', '-', '2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] <		shift
Stack ['\$', '1'] ['\$', '1']	['*', '7', '-', '2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] >		reduce
Stack ['\$', 'E'] ['\$', 'E']	['*', '7', '-', '2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] <		shift
Stack ['\$', 'E', '*'] ['\$', 'E', '*']	['7', '-', '2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] <		shift
Stack ['\$', 'E', '*', '7'] ['\$', 'E', '*', '7']	['-', '2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] >		reduce
Stack ['\$', 'E', '*', 'E'] ['\$', 'E', '*', 'E']	['-', '2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] >		reduce
Stack ['\$', 'E'] ['\$', 'E']	['-', '2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] <		shift
Stack ['\$', 'E', '-'] ['\$', 'E', '-']	['2', '/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] <		shift
Stack ['\$', 'E', '-', '2'] ['\$', 'E', '-', '2']	['/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] >		reduce
Stack ['\$', 'E', '-', 'E'] ['\$', 'E', '-', 'E']	['/', '2', '*', '2', '-', '3', '/', '2', '*', '\$'] <		shift

Ln 11, Col 5 Spaces: 4 UTF-8 CRLF Python 3.10.4 64-bit

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```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL Python Debug Console + - [ ] [ ] ^ X

['$', 'E']                                ['- ', '2', '/', '2', '*', '2', '- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- '] -
['$', 'E', '- ']                          ['2', '/', '2', '*', '2', '- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', '2'] 2
['$', 'E', '- ', '2']                      ['/ ', '2', '*', '2', '- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E'] E
['$', 'E', '- ', 'E']                      ['/ ', '2', '*', '2', '- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', 'E', '/'] /
['$', 'E', '- ', 'E', '/']                ['2', '*', '2', '- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', 'E', '/', '2'] 2
['$', 'E', '- ', 'E', '/', '2']            ['*', '2', '- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E', '/', 'E'] E
['$', 'E', '- ', 'E', '/', 'E']            ['*', '2', '- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E'] E
['$', 'E', '- ', 'E']                      ['*', '2', '- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', 'E', '*'] *
['$', 'E', '- ', 'E', '*']                  ['2', '- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', 'E', '*', '2'] 2
['$', 'E', '- ', 'E', '*', '2']              ['- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E', '*', 'E'] E
['$', 'E', '- ', 'E', '*', 'E']              ['- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E'] E
['$', 'E', '- ', 'E']                      ['- ', '3', '/', '2', '*', '$'] > reduce

Ln 11, Col 5 Spaces: 4 UTF-8 CRLF Python 3.10.4 64-bit [ ] [ ] ^ X

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL Python Debug Console + - [ ] [ ] ^ X

['$', 'E', '- ', 'E', '*']                  ['2', '- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', 'E', '*', '2'] 2
['$', 'E', '- ', 'E', '*', '2']              ['- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E', '*', 'E'] E
['$', 'E', '- ', 'E', '*', 'E']              ['- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E'] E
['$', 'E', '- ', 'E']                      ['- ', '3', '/', '2', '*', '$'] > reduce
Stack ['$ ', 'E'] E
['$', 'E']                                  ['- ', '3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- '] -
['$', 'E', '- ']                            ['3', '/', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', '3'] 3
['$', 'E', '- ', '3']                      ['/ ', '2', '*', '$'] > reduce
Stack ['$ ', 'E', '- ', 'E'] E
['$', 'E', '- ', 'E']                      ['/ ', '2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', 'E', '/'] /
['$', 'E', '- ', 'E', '/']                  ['2', '*', '$'] < shift
Stack ['$ ', 'E', '- ', 'E', '/', '2'] 2
['$', 'E', '- ', 'E', '/', '2']              ['*', '$'] > reduce

Rejected|Operator At The End Of Expression.Hence Violating The Grammar Rules
PS D:\Noor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES> [ ]

Ln 11, Col 5 Spaces: 4 UTF-8 CRLF Python 3.10.4 64-bit [ ] [ ] ^ X
```



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## TESTING OF INPUT 5

Rejected as b is an undefined variable to the grammar.

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL Python Debug Console + - [ ] ^ X

PS D:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES> d;; cd 'd:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES'; & 'C:\Python\Python310\python.exe' 'c:\Users\HP\.vscode\extensions\ms-python.python-2022.4.1\pythonFiles\lib\python\debugpy\launcher' '52049' '--' 'd:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES\OperatorPrecedenceParser_CompilerDesignProject.py'

Input: 1 * 7 - 2 / b * 2 - 3 / 2

Symbol Table For Above Input

-----Symbol Table-----
| Lexem | Token |
|-----|-----|
| 1      | 1      |
| *      | <*>   |
| 7      | 7      |
| -      | <->   |
| 2      | 2      |
| /      | </>   |
| b      | <b>    |
| 3      | 3      |
|-----|-----|

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL Python Debug Console + - [ ] ^ X

| 7      | 7      |
| -      | <->   |
| 2      | 2      |
| /      | </>   |
| b      | <b>    |
| 3      | 3      |
|-----|-----|

-----Parsing Table-----

| + | - | * | / | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | $ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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Rejected! b is Not Generated, Hence Violating The Grammar Rules

PS D:\Woor Shaukat\8TH-SEMESTER, BCIT\CT-465 COMPILER DESIGN\PYTHON FILES>
```

**NAME: CT-18057 NOOR SHAUKAT & CT-18054 MUHAMMAD ATHAR SAYEED**

**SUBJECT: COMPILER DESIGN, ASSIGNMENT**

**DEPARTMENT: COMPUTER SCIENCE AND INFORMATION TECHNOLOGY**

**BATCH/ YEAR: 2018/ 4<sup>TH</sup> YEAR**

**DATE: 9<sup>TH</sup>-JULY-2022**