System Software Practicals

Assignment 6

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1. Write a program that will take a file as an input which contains a macro definition for adding two numbers 10 times and it will use nested macro calls to increment each number by 1 every time in 10 iterations and generate a macro definition table for the same program.

```
# Required libraries
import argparse


MNT = {}  # Macro Name Table
PNTAB = {}  # Parameter Name Table
KPDTAB = {}  # Keyword Parameter Table
EVNTAB = {}  # Expansion Variable Name Table
SSNTAB = {}  # Sequencing Symbol Name Table
MDT = {}  # Macro Definition Table
APTAB = {}  # Actual Parameter Table

# Indcies of Tables
SSNTAB_IDX  = 1
PNTAB_IDX = 1
EV_IDX = 1
SSTAB_IDX = 4
MDT_IDX = 0
KPDTAB_IDX = 7
APTAB_IDX = 1

mode = "DEFAULT"
parse_macro_declaration = 0
start_inserting_in_mdt = 0

macro = []

if __name__ == "__main__":

   # Parsing FilePath as Arguments
   parser = argparse.ArgumentParser(description="Generates MDT For given Macro Code")
   parser.add_argument("file_path", metavar="filePath", help="File Path to Macro
Code")
   args = parser.parse_args()
```

```python
    file_path = args.file_path

    # Parsing the File
    with open(file_path, "r") as f:
        lines = f.readlines()  # lines = List of lines in file f
        line_count = 0
        for line in lines:
            line_count = line_count + 1

            decoded_line = line.replace('\n','').replace(' ','').split("-")
            label = decoded_line[0]
            operator = decoded_line[1]
            operands = decoded_line[2]
            if parse_macro_declaration:

                macro_name = operator
                parameters = operands.replace(' ','').replace(",", "").split("&")
                pp = 0
                kp = 0
                mdtp = MDT_IDX
                kpdtp = KPDTAB_IDX
                sstp = SSTAB_IDX

                for parameter in parameters:
                    if len(parameter)==0:
                        continue
                    if "=" in parameter:
                        kp = kp + 1
                        p_specs = parameter.split("=")
                        PNTAB[p_specs[0]] = {"IDX": PNTAB_IDX}
                        PNTAB_IDX = PNTAB_IDX + 1
                        KPDTAB[p_specs[0]] = {
                            "IDX": KPDTAB_IDX,
                            "DEFAULT_VAL": p_specs[1],
                        }
                        KPDTAB_IDX = KPDTAB_IDX + 1
                    else:
                        pp = pp + 1
                        PNTAB[parameter] = {"IDX": PNTAB_IDX}
                        PNTAB_IDX = PNTAB_IDX + 1

                MNT[macro_name] = {
                    "#PP": pp,
                    "#KP": kp,
                    "#EV": 0,
                    "MDTP": mdtp,
                    "KPDTP": kpdtp,
                    "SSTP": sstp,
                }
                macro = macro_name


                start_inserting_in_mdt = 1
                parse_macro_declaration = 0
                continue

            if operator == "MACRO":
                if mode == "MACRO_DETECTED":
                    raise Exception(
                        "Invalid Operator MACRO detected while parsing Macro
 definition"
                    )
                elif mode == "DEFAULT":
                    mode = "MACRO_DETECTED"
                    parse_macro_declaration = 1
            elif operator=="LCL":
                if start_inserting_in_mdt==0:
                    raise Exception('Invalid Operator LCL found')

                evs = operands.replace(' ','').replace(',','').split('&')
                cnt = 0
                for ev in evs:
                    if len(ev)==0:
                        continue
                    cnt = cnt + 1
                    EVNTAB[ev] = {"IDX":EV_IDX,"VALUE":-1}
                    EV_IDX = EV_IDX + 1
                MNT[macro]["#EV"] = MNT[macro]["#EV"] + cnt
            elif operator=="SET":
                if start_inserting_in_mdt==0:
                    raise Exception('Invalid Operator SET found')

                key = label.replace('&','').replace(' ','')
                if EVNTAB.get(key,-1)==-1:
                    raise Exception('Expansion Variable not found!')
                EVNTAB[key]["VALUE"] = operands
            elif operator=="MEND":
                mode = 'DEFAULT'
```

```
                start_inserting_in_mdt = 0
            elif MNT.get(operator,-1)!=-1:
                params = operands.replace(' ','').split(',')
                for param in params:
                    APTAB[param]={"IDX":APTAB_IDX}
                    APTAB_IDX = APTAB_IDX + 1
            elif operator!='MOVER' and operator!='MOVEM' and operator!='AIF' and
operator!='ADD':
                raise Exception('Invalid Operator')


            if start_inserting_in_mdt:
                if label.startswith('.') and SSNTAB.get(label,-1)==-1:
                    SSNTAB[label] = {"IDX":SSNTAB_IDX,"MDT_ENTRY":MDT_IDX}
                    SSNTAB_IDX = SSNTAB_IDX + 1
                for param in PNTAB.keys():
                    replacer = '&'+param
                    operands =
operands.replace(replacer,'(P,'+str(PNTAB[param]["IDX"])+')')
                    label = label.replace(replacer,'(P,'+str(PNTAB[param]["IDX"])+')')
                for param in EVNTAB.keys():
                    replacer = '&'+param
                    operands =
operands.replace(replacer,'(E,'+str(EVNTAB[param]["IDX"])+')')
                    label =
label.replace(replacer,'(E,'+str(EVNTAB[param]["IDX"])+')')
                for param in SSNTAB.keys():
                    operands =
operands.replace(param,'(S,'+str(SSNTAB[param]["IDX"])+')')
                    label = label.replace(param,'(S,'+str(SSNTAB[param]["IDX"])+')')

                MDT[MDT_IDX] = {"LABEL":label,"OPERATOR":operator,"OPERAND":operands}

                MDT_IDX = MDT_IDX + 1



    print('PARAMETER NAME TABLE')
    print('IDX\t\tNAME\t\t')
    for (key,val) in PNTAB.items():
        print(val['IDX'],end='\t\t')
        print(key,end='\n')

    print('')
```

```python
print('')
print('EXPANSION VARIABLE NAME TABLE')
print('IDX\t\tNAME')
for (key,val) in EVNTAB.items():
    print(val['IDX'],end='\t\t')
    print(key,end='\n')

print('')
print('')
print('KEYWORD PARAMETER DEFAULT TABLE')
print('IDX\t\tNAME\t\tDEFAULT_VAL')
for (key,val) in KPDTAB.items():
    print(val['IDX'],end='\t\t')
    print(key,end='\t\t')
    print(val['DEFAULT_VAL'],end='\n')

print('')
print('')
print('SEQUENCING SYMBOL NAME TABLE')
print('IDX\t\tNAME\t\tMDT_ENTRY')
for (key,val) in SSNTAB.items():
    print(val['IDX'],end='\t\t')
    print(key,end='\t\t')
    print(val['MDT_ENTRY'],end='\n')

print('')
print('')
print('ACTUAL PARAMETER TABLE')
print('IDX\t\tNAME\t\t')
for (key,val) in APTAB.items():
    print(val['IDX'],end='\t\t')
    print(key,end='\n')

print('')
print('')
print('MACRO NAME TABLE')
print('NAME\t\t#PP\t\t#KP\t\t#EV\t\tMDTP\t\tKPDTP\t\tSSTP')
for (key,val) in MNT.items():
    print(key,end='\t')
    print(val["#PP"],end='\t\t')
    print(val["#KP"],end='\t\t')
    print(val["#EV"],end='\t\t')
    print(val["MDTP"],end='\t\t')
    print(val["KPDTP"],end='\t\t')
```

```
        print(val["SSTP"],end='\n')

    print('')
    print('')
    print('MACRO DEFINITION TABLE')
    print('IDX\t\tLABEL\t\tOPERATOR\t\tOPERANDS')
    for (key,val) in MDT.items():
        print(key,end='\t\t')
        print(val['LABEL'],end='\t\t')
        print(val['OPERATOR'],end='\t\t')
        print(val['OPERAND'],end='\n')
```

Input.txt:

```
-MACRO-
-ADDMACRO1-&X,&Y
-ADD-&X-&Y
-MEND-
-MACRO-
-ADDMACRO2-&P,&Q
-LCL-&R,&S
&R-SET-10
&S-SET-0
.MORE-ADDMACRO1-&P,&Q
&S-SET-&S + 1
-AIF-(&S NE &R) .MORE
-MEND-
-ADDMACRO2-10,20
```

Output.txt:

```
PARAMETER NAME TABLE
IDX         NAME
1           X
2           Y
3           P
4           Q



EXPANSION VARIABLE NAME TABLE
IDX         NAME
1           R
2           S
```

```
KEYWORD PARAMETER DEFAULT TABLE
IDX         NAME       DEFAULT_VAL


SEQUENCING SYMBOL NAME TABLE
IDX         NAME       MDT_ENTRY
1           .MORE      4


ACTUAL PARAMETER TABLE
IDX         NAME
1           &P
2           &Q
3           10
4           20


MACRO NAME TABLE
NAME        #PP        #KP         #EV        #MDTP       KPDTP      SSTP
ADDMACRO1   2          0           0          0           7          4
ADDMACRO2   2          0           2          1           7          4


MACRO DEFINITION TABLE
IDX         LABEL      OPERATOR         OPERANDS
0                      ADD         (P,1)
1                      LCL         (E,1),(E,2)
2           (E,1)      SET         10
3           (E,2)      SET         0
4           (S,1)      ADDMACRO1        (P,3),(P,4)
5           (E,2)      SET         (E,2)+1
6                      AIF         ((E,2)NE(E,1))(S,1)
```

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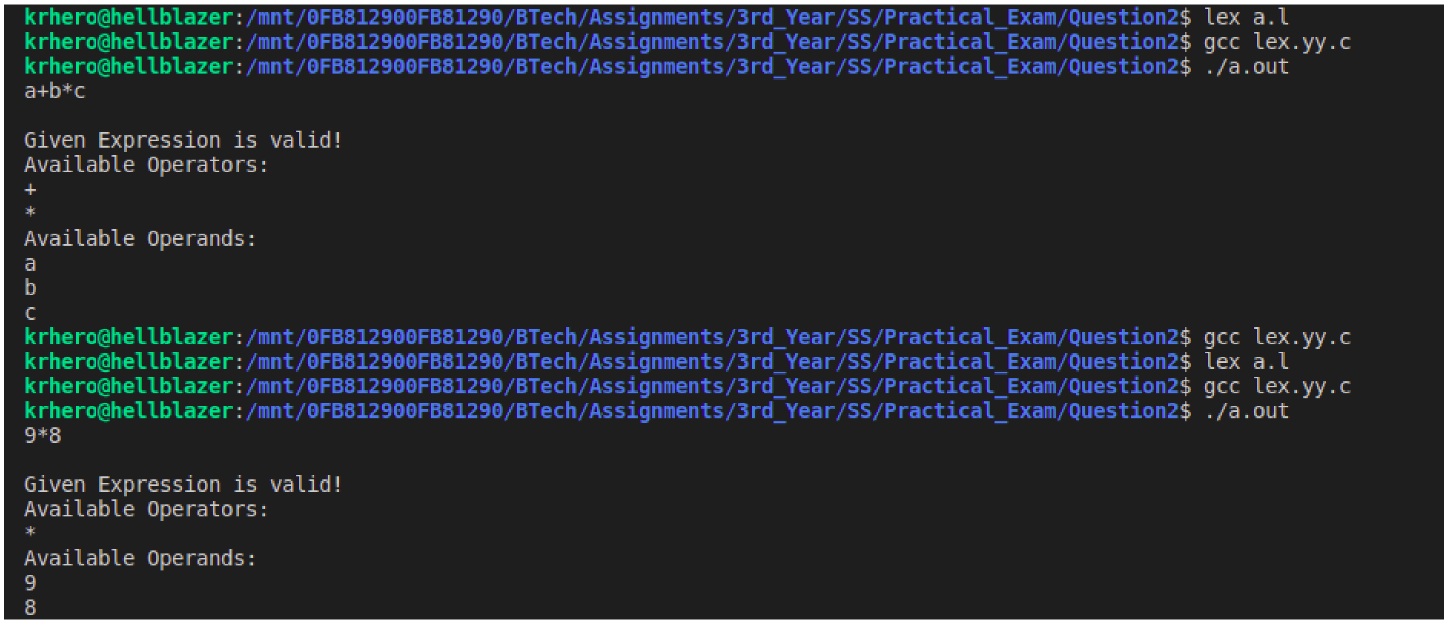
2. Write a LEX program to recognize whether a given arithmetic expression is valid or not, also identify the identifiers and operators.

```
%{
#include <stdio.h>
#include <string.h>
#define MAX_OPERATORS 100
#define MAX_OPERANDS 100
#define MAX_CHARACTERS 250
   int operators_count = 0, operands_count = 0, valid = 1, top = -1, l = 0, j = 0;
   char operands[MAX_OPERANDS][10], operators[MAX_OPERANDS][10],
stack[MAX_CHARACTERS];
%}
%%
"(" {
   top++;
   stack[top] = '(';
}
"{" {
   top++;
   stack[top] = '{';
}
"[" {
   top++;
   stack[top] = '[';
}
")" {
   if (stack[top] != '(') {
       valid = 0;
   }
   else if(operands_count>0 && (operands_count-operators_count)!=1){
       valid=0;
   }
   else{
       top--;
       operands_count=1;
       operators_count=0;
   }
}
"}" {
   if (stack[top] != '{') {
       valid = 0;
   }
   else if(operands_count>0 && (operands_count-operators_count)!=1){
       valid=0;
   }
   else{
       top--;
       operands_count=1;
       operators_count=0;
   }
}
"]" {
   if (stack[top] != '[') {
       valid = 0;
   }
   else if(operands_count>0 && (operands_count-operators_count)!=1){
       valid=0;
   }
   else{
       top--;
       operands_count=1;
       operators_count=0;
   }

}
"+"|"-"|"*"|"/" {
   operators_count++;
   strcpy(operators[l], yytext);
   l++;
}
[0-9]+|[a-zA-Z][a-zA-Z0-9_]* {
   operands_count++;
   strcpy(operands[j], yytext);
   j++;
}
"\n" {return 0;}
%%

int yywrap()
{
   return 1;
}
int main()
{
   int k;
   yylex();
    if (valid == 1 && top == -1) {
        printf("\nGiven Expression is valid!\n");
        printf("Available Operators:\n");
        for(int i = 0;i<l;i++){
            printf("%s\n",operators[i]);
        }
        printf("Available Operands:\n");
        for(int i = 0;i<j;i++){
            printf("%s\n",operands[i]);
        }
    }
    else
        printf("\nGiven Expression is invalid!\n");
     return 0;
}
```

Output:



```
krhero@hellblazer:/mnt/0FB812900FB81290/BTech/Assignments/3rd_Year/SS/Practical_Exam/Question2$ lex a.l
krhero@hellblazer:/mnt/0FB812900FB81290/BTech/Assignments/3rd_Year/SS/Practical_Exam/Question2$ gcc lex.yy.c
krhero@hellblazer:/mnt/0FB812900FB81290/BTech/Assignments/3rd_Year/SS/Practical_Exam/Question2$ ./a.out
a+b*c

Given Expression is valid!
Available Operators:
+
*
Available Operands:
a
b
c
krhero@hellblazer:/mnt/0FB812900FB81290/BTech/Assignments/3rd_Year/SS/Practical_Exam/Question2$ gcc lex.yy.c
krhero@hellblazer:/mnt/0FB812900FB81290/BTech/Assignments/3rd_Year/SS/Practical_Exam/Question2$ lex a.l
krhero@hellblazer:/mnt/0FB812900FB81290/BTech/Assignments/3rd_Year/SS/Practical_Exam/Question2$ gcc lex.yy.c
krhero@hellblazer:/mnt/0FB812900FB81290/BTech/Assignments/3rd_Year/SS/Practical_Exam/Question2$ ./a.out
9*8

Given Expression is valid!
Available Operators:
*
Available Operands:
9
8
```