```
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// CSci 117 ASsignment 3
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//_____________________________________________________________

//
// Interpreter for language FresnoF17 with +,-,*, /, (), ^ operations, variable declaration, assignment
statement, print statement
// Input is the data file with FresnoF17 program, spaces are allowed.
// There are two program files- Assign1.cpp and Assign2.cpp
// Assign1.cpp has the code to evaluate the expressions as per grammar rules.
// Assign2.cpp contains the code for interpreter for the language FresnoF17 to check the correctness of
the language given in input data file.
// Program- Assign2.cpp uses functions-
// int Exp(),Term(),Exp2(int),Term2(int),Fact(),Num() functions from //ASsign1.cpp
// compile:  $>g++ Assign1.cpp Assign2.cpp
// run with: $>./a.out FresnoF17
//_____________________________________________________________

// CODE

// Assign1.cpp

#include <cstdlib> //for atoi()
#include <stdio.h>
#include <stdlib.h>
#include<math.h> //for mathematical operators (power)
#include <fstream>
using namespace std;

//input file stream defined in file prog3.cpp
extern ifstream fin;

int Exp(),Term(),Exp2(int),Term2(int),Fact(),Num();

//Exp() function calls the Exp2() function for solving addition and subtraction operations
int Exp()
{
   return Exp2(Term());        //Result of Fact() function is passed as parameter to Term2()
}

//Term() function calls the Term2() function for solving multiplication and division operations
int Term()
{
   return Term2(Fact());       //Result of Term() function is passed as parameter to Exp2()
}

//Exp2() recursive function where the parameter passed is the result of multiplication and division
operations
//checks whether it is end of expression
//gets one character from input expression
//skips blank spaces if any
//checks for addition'+' and subtraction'-' operations
//performs operation
```

```
//returns result
int Exp2(int inp)
{

int result=inp;
char a;
if((a=getchar()) != '\n'){
    if(a == '+')
        result = Exp2(result + Term());
    else if(a == '-')
        result = Exp2(result - Term());
}
return result;
}

//Term2() recursive function where the parameter passed is the result of the power operation
//checks whether it is end of expression
//gets one character from input expression
//skips blank spaces if any
//checks for multiplication'*' and division'/' operations
//performs operation
//returns result
int Term2(int inp)
{
int result = inp;
char a;
fin.read(&a,1);
if(a != '\n'){
    if(a == '*')
        result = Term2(result*Fact());
    else if(a == '/')
        result = Term2(result/Fact());
    else if (a == '+' || a == '-' || a == ')')
                fin.unget();
}
if(a == '\n')
        fin.unget();
return result;
}

//Fact() function for performing power operations
//checks whether it is end of expression
//gets one character from input expression
//skips blank spaces if any
//checks for power'^' operations
//performs operation
//returns result
int Fact()
{
int result = Num();
char a;
fin.read(&a,1);
if(a != '\n')
{
    if(a == '^')
```

```
        result = pow((float)result,(float)Fact());
    else
                fin.unget();
}
if(a == '\n')
        fin.unget();
return result;
}

//Num() recursive function
//gets one character from input expression
//skips blank spaces if any
//checks for () operations
//converts each character into numeric number
//returns result
int Num()
{
char a[2];
int result;
int resultExp;
a[0] = getchar();
// ignore blank spaces in input string
while(a[0] == ' '){
    a[0] = getchar();
}
a[1] = '\0';
if ( a[0] == '('){
    resultExp = Exp();
    return resultExp;
}
result = atoi(a);
return result;
}

//_____________________________________________________________________________________

// Assign2.cpp

#include <stdio.h>
#include <stdlib.h>
#include <iostream>
#include <string>
#include <fstream>
#include <vector>
using namespace std;

//Exp function used to evaluate an expression is defined in file prog2.cpp
extern int Exp();

int indexx = 0; //global index for program string
int sym_index = 0; //global for symbol table index

//input file stream handler
ifstream fin;
```

```
//vector to store the list of known keywords in the language defined by the given //grammar
vector<string> keywords(6);

//creates an array of symbol table where each node stores an identifier name, data //type and its value
struct node{
   char id; //single letter var name
   string type;
   double val;
}sym_table[100];   //symbol table with 100 entries
string read_word()
{
      string word;
      if(fin.is_open())   //open data file
      {
            fin >> word;
      }
   return word;
}

void declaration(string type)       //para is type (int or double)
{
      char id;
      bool flag = false;
      while(fin.read(&id,1))
      {
            if(id == ' ' || id == ',')
                  continue;
            else if(id == ';'){
                  flag = true;
                  break;
            }
            else if(id == '\n')
                  break;
            if(isalpha(id)){
                  sym_table[indexx].id =(char)id;
                       sym_table[indexx].type = type;
                  indexx++;
            }else{
                  cout<<"\nSYNTAX ERROR : identifier name not an alphabet for    identifier
"<<id<<"\n";
                  fin.close();
                  exit(1);
            }
      }
      if(!flag){
            cout<<"\nSYNTAX ERROR : Declaration statement not terminated with ;\n";
            fin.close();
            exit(1);
      }
}

void declarations()     //recursively calls declaration()
{
   string word = read_word();
   if(word == "begin"){
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```
        return;
    }
    else if (word == "int" || word =="double")
    {
        declaration(word);      //for one line of declaration until ';'

    }
        declarations();  //recursion for next declaration
}

void print_stmt()
{
        int index = -1;
        bool flag = false;
        char id ;
        char var;
        fin.read(&id,1);
        while(id == ' '){
                fin.read(&id,1);
        }
        if(isalpha(id)){
                var =id;
                fin.read(&id,1);
                if(id != ';'){
                        cout<<"\nSYNTAX ERROR : print statement not terminated with ;\n";
                          fin.close();
                    exit(1);
                }
                for(int i =0;i<indexx;i++){
                        if(var == sym_table[i].id){
                                flag = true;
                                index = i;
                                break;
                        }else{
                                continue;
                        }
                }
                if(!flag){
                        cout<<"\nSEMANTIC ERROR : identifier "<<var<<" in Print Statement not Declared
\n";
                        fin.close();
                        exit(1);
                }else{
                        cout<<endl;
                        cout<<sym_table[index].val;

                }
        }else{
                        fin.unget();
                        cout<<endl;
                        cout<<Exp();
                        cout<<endl;
        }
}
```

```
void assign(string id)
{
	char c;
	fin.read(&c,1);
	int resultExp;
	bool flag = false;
	int index=-1;
	while(c == ' '){
		fin.read(&c,1);
	}
	//look for id in the symbol table if it
	if(!isalpha(id[0])){
		cout<<"\nSYNTAX ERROR : target identifier "<<id[0]<<" not an alphabet in assignment
statement\n";
		fin.close();
		exit(1);
	}
	for(int i =0;i<indexx;i++){
		if(id[0] == sym_table[i].id){
			flag = true;
			index = i;
			break;
		}else{
			continue;
		}
	}
	if(flag != true){
		cout<<"\nSEMANTIC ERROR : identifier "<<id[0]<<" in assignment statement not Declared
\n";
		fin.close();
		exit(1);
		return;
	}
	if (c == '='){
		if( sym_table[index].type != "int"){
			cout<<"\nSEMANTIC ERROR : Type mismatch in assignment statement, identifier
"<<sym_table[index].id<<" of type "<<sym_table[index].type<<" but expecting int type\n";
			exit(1);
			return;
		}
		resultExp = Exp();
		sym_table[index].val = resultExp;
	}
	else{
		cout<<"\nSYNTAX ERROR : in Assignment statement\n";
		return;
	}
}

void statement(string word)
{
   if(word == "print"){
	print_stmt();
   }
else if (word.length()==1 && isalpha(word.at(0))) //a   = c; or a = 2+3*5;
```

```
      {
    assign(word);
    }
}

void statements()
{
    string word = read_word();
    if(word == "end" ){
        return ;
    }
    else
        statement(word);
        statements();
}

void initKeywrdTbl()
{
        keywords[0]="program";
        keywords[1]="begin";
        keywords[2]="end";
        keywords[3]="int";
        keywords[4]="double";
        keywords[5]="print";
}

void parseForLexicalErr()
{
        string word;
        bool found = false;
        bool begFlag = false;
        fin.open("FresnoF17.txt");
        while(fin >> word){
                for(int i=0;i < keywords.size();i++){
                        if(word == keywords[i]){
                                found = true;
                                break;
                        }
                        else
                                found = false;
                }
                if(found == true ||  ((word.size()<3) && isalpha(*(word.begin()))) || word == "=" ||
(*(word.begin())) == '(' || isdigit(*(word.begin())) ){
                        continue;
                }
                else{
                        cout<<endl;
                        cout<<"\nLEXICAL ERROR: Keyword "<<word<<" not valid\n";
                        cout<<endl;
                        fin.close();
                        exit(1);
                }
        }
        fin.close();
        fin.open("FresnoF17.txt");
```

```
	fin.seekg(0,ios_base::beg);
	fin >> word;
	if(word != "program"){
		cout<<"\nSYNTAX ERROR : Keyword PROGRAM not present at begining of the
program\n";
		fin.close();
		exit(1);
	}
	bool endFlag = false;
	while(fin >> word){
		if(word.compare(0,5,"begin") == 0)
			begFlag=true;
		if((word == "int" || word == "double") && begFlag){
			cout<<"\nSYNTAX ERROR : Declarations found even after BEGIN Keyword\n";
			fin.close();
			exit(1);
		}
		if(word.compare(0,3,"end") == 0){
			endFlag = true;
			continue;
		}
		if((word == "print" || word == "=" || isalpha(*(word.begin())) ) && endFlag){
			cout<<"\nSYNTAX ERROR : Statements found even after END Keyword\n";
			fin.close();
			exit(1);
		}
	}
	if(!begFlag){
		cout<<"\nSYNTAX ERROR :BEGIN Keyword not found in the program\n";
		fin.close();
		exit(1);
	}
	if(!endFlag){
		cout<<"\nSYNTAX ERROR :END Keyword not found in the program\n";
		fin.close();
		exit(1);
	}
	fin.close();
}

int main()
{
   string word;
   initKeywrdTbl();
   parseForLexicalErr();
   fin.open("FresnoF17.txt");
   fin.seekg(0,ios_base::beg);
   word = read_word();
   if(word == "program")
   {
      declarations();

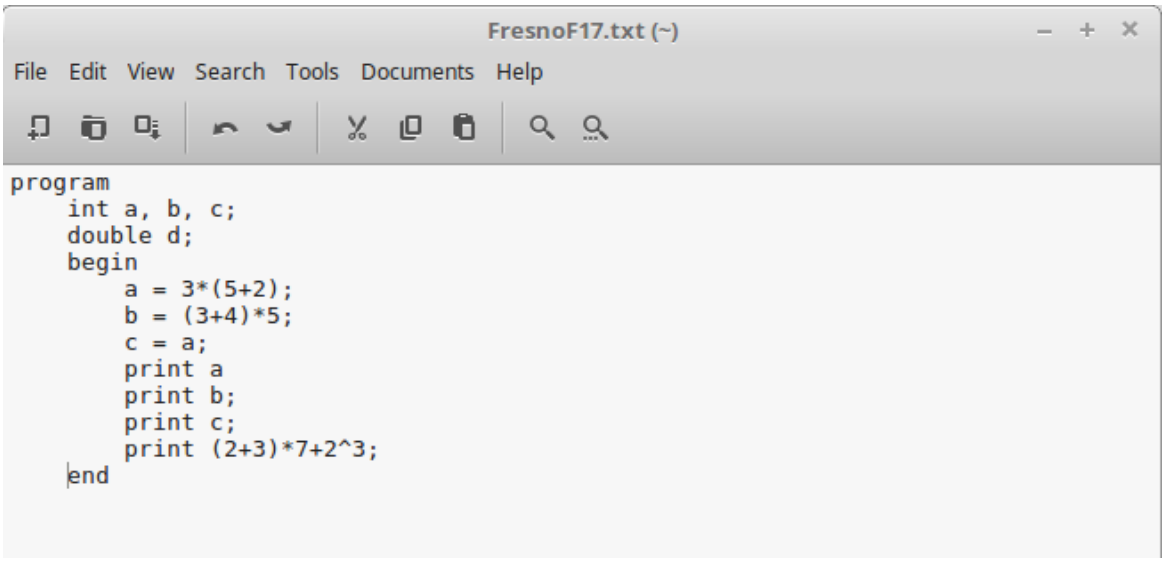
// to display symbol_table entries
//    cout<<"++symbol table++"<<endl;
//    for(int i=0; i<sym_index; i++)
```

```
//    cout<<sym_table[i].id<<"   "<<sym_table[i].type<<"   "<<sym_table[i].value<<endl;

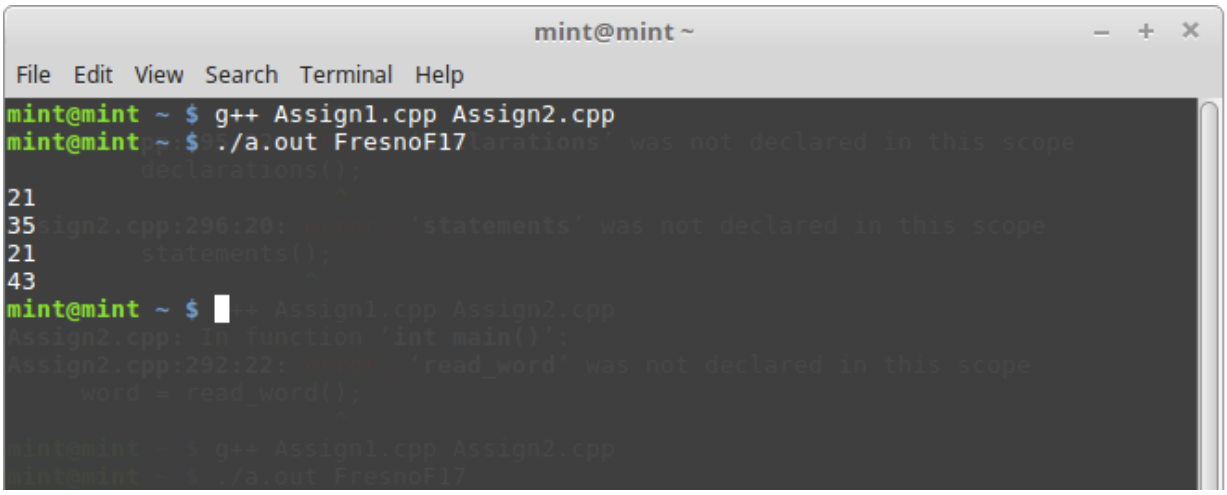
        statements();
    }
    else{
        cout<<"\nSYNTAX ERROR : Keyword PROGRAM not present at begining of the program\n";
    }
}

//_____________________________________________________________________________
```

Input data file which contains the sample FresnoF17 program:



Output



Lexical, Syntax and Semantic Error

Input

*FresnoF17.txt (~)

File Edit View Search Tools Documents Help

```
programst
    int a, b, c;
    double d;
    begin
        a = 3*(5+2);
        b = (3+4)*5;
        c = a;
        print a
        print b;
        print c;
        print (2+3)*7+2^3;
    end
```

Output

mint@mint ~

File Edit View Search Terminal Help

```
mint@mint ~/Desktop $ cd ..
mint@mint ~ $ g++ Assign1.cpp Assign2.cpp
mint@mint ~ $ ./a.out FresnoF17


LEXICAL ERROR: Keyword programst not valid

mint@mint ~ $
```

Input

FresnoF17.txt (~)

File Edit View Search Tools Documents Help

```
program
    int a, b, c;
    sub
    double d;
    begin
        a = 3*(5+2);
        b = (3+4)*5;
        c = a;
        print a
        print b;
        print c;
        print (2+3)*7+2^3;
    end
```

Output

```
mint@mint ~
File  Edit  View  Search  Terminal  Help
mint@mint ~ $ g++ Assign1.cpp Assign2.cpp
mint@mint ~ $ ./a.out FresnoF17


LEXICAL ERROR: Keyword sub not valid

mint@mint ~ $
```

Input

```
FresnoF17.txt (~)
File  Edit  View  Search  Tools  Documents  Help
program
    int a, b, c;
    double d;
    begin
        a = 3*(5+2);
        b = (3+4)*5;
        c = a;
        print a
        print b;
        print c;
        print (2+3)*7+2^3;
```

Output

```
mint@mint ~
File  Edit  View  Search  Terminal  Help
mint@mint ~ $ g++ Assign1.cpp Assign2.cpp
mint@mint ~ $ ./a.out FresnoF17

SYNTAX ERROR :END Keyword not found in the program
mint@mint ~ $
```

Input

FresnoF17.txt (~)

File Edit View Search Tools Documents Help

```
program
    int a, b, c
    double d;
    begin
        a = 3*(5+2);
        b = (3+4)*5;
        c = a;
        print a
        print b;
        print c;
        print (2+3)*7+2^3;
    end
```

Output

mint@mint ~

File Edit View Search Terminal Help

```
mint@mint ~ $ g++ Assign1.cpp Assign2.cpp
mint@mint ~ $ ./a.out FresnoF17

SYNTAX ERROR : Declaration statement not terminated with ;
mint@mint ~ $
```