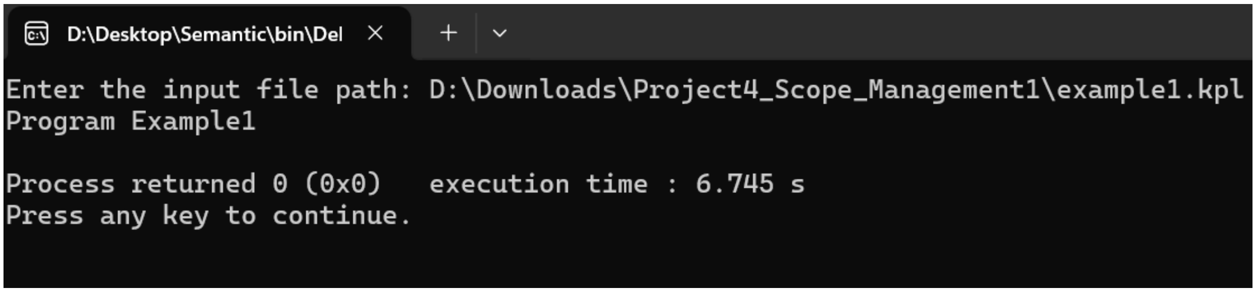
Name: Nguyễn Hữu Hoàng Hải Anh
Student ID: 20226010

LAB 4. SCOPE MANAGEMENT

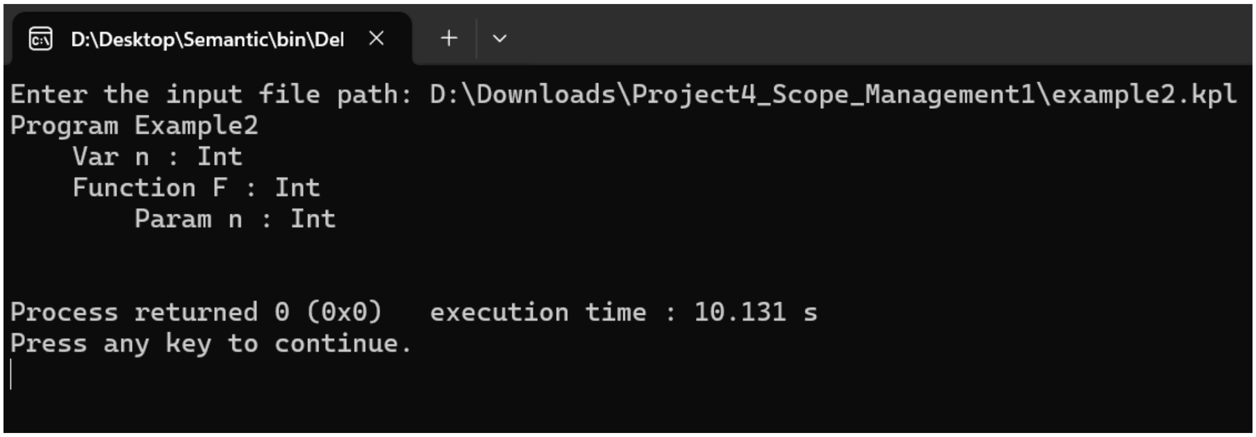
A. The result of executing the program with a KPL file without errors

1. *example1.kpl*



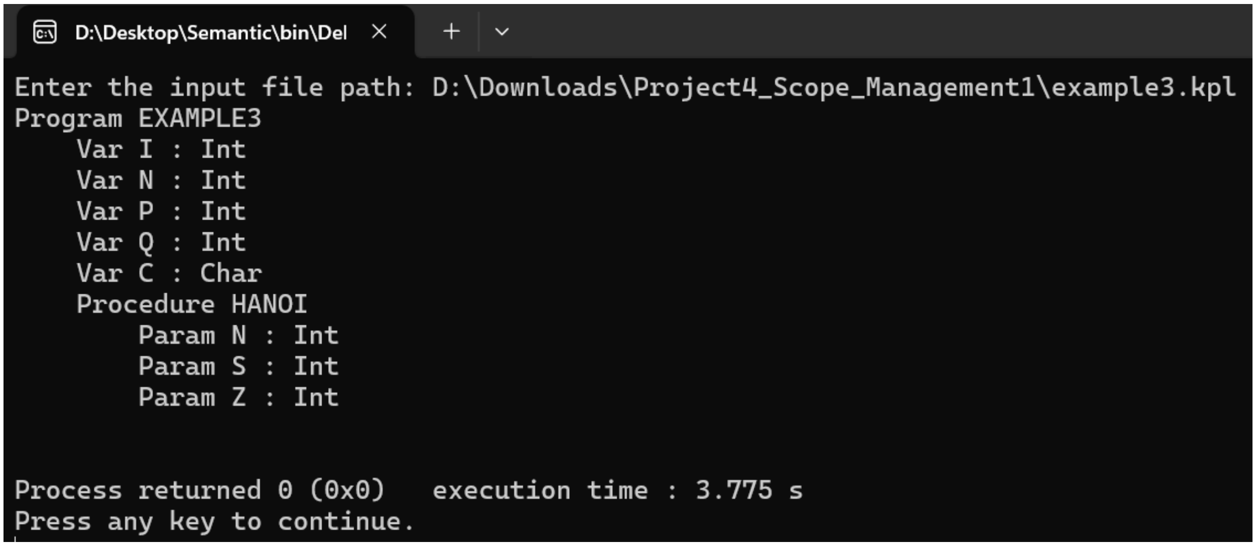
```
Enter the input file path: D:\Downloads\Project4_Scope_Management1\example1.kpl
Program Example1

Process returned 0 (0x0)   execution time : 6.745 s
Press any key to continue.
```

2. *example2.kpl*



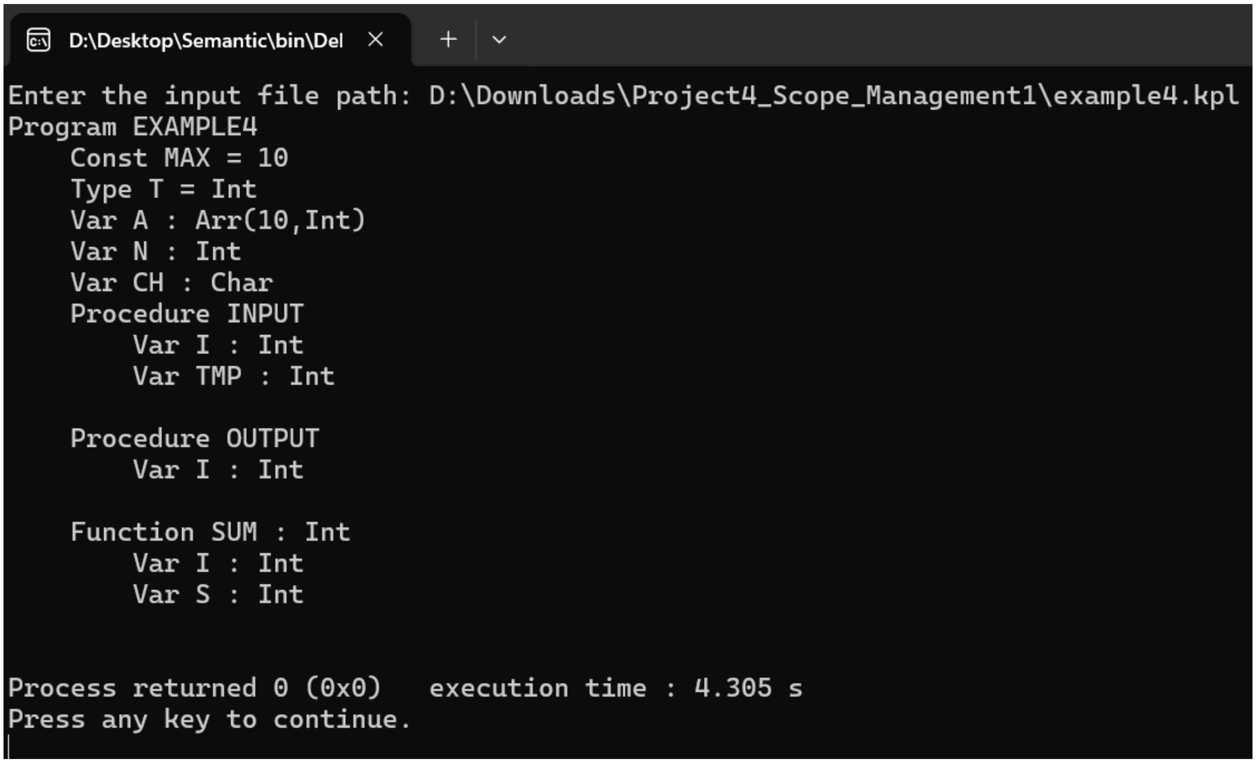
```
Enter the input file path: D:\Downloads\Project4_Scope_Management1\example2.kpl
Program Example2
    Var n : Int
    Function F : Int
        Param n : Int


Process returned 0 (0x0)   execution time : 10.131 s
Press any key to continue.
```

3. *example3.kpl*



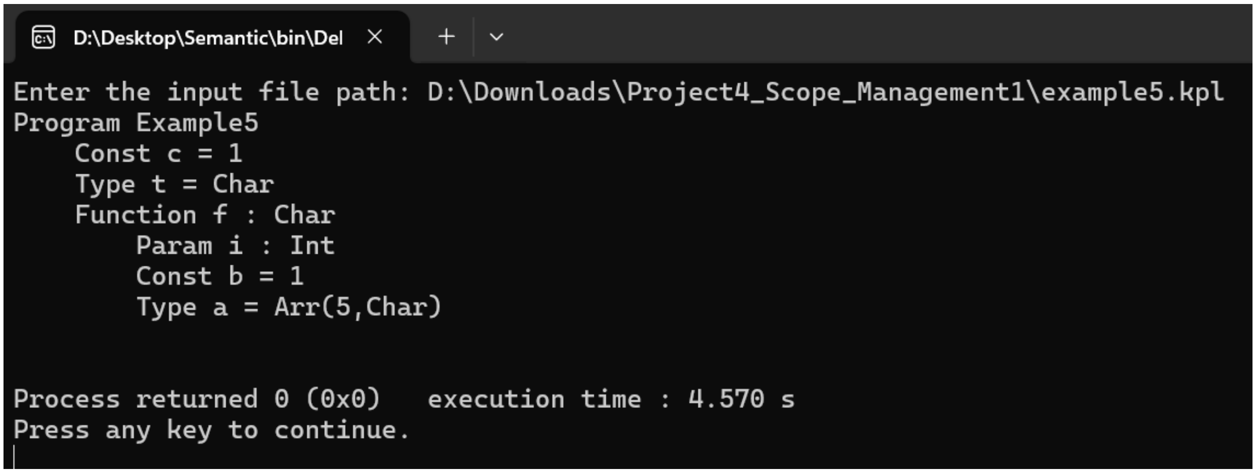
```
Enter the input file path: D:\Downloads\Project4_Scope_Management1\example3.kpl
Program EXAMPLE3
    Var I : Int
    Var N : Int
    Var P : Int
    Var Q : Int
    Var C : Char
    Procedure HANOI
        Param N : Int
        Param S : Int
        Param Z : Int


Process returned 0 (0x0)   execution time : 3.775 s
Press any key to continue.
```

4. *example4.kpl*



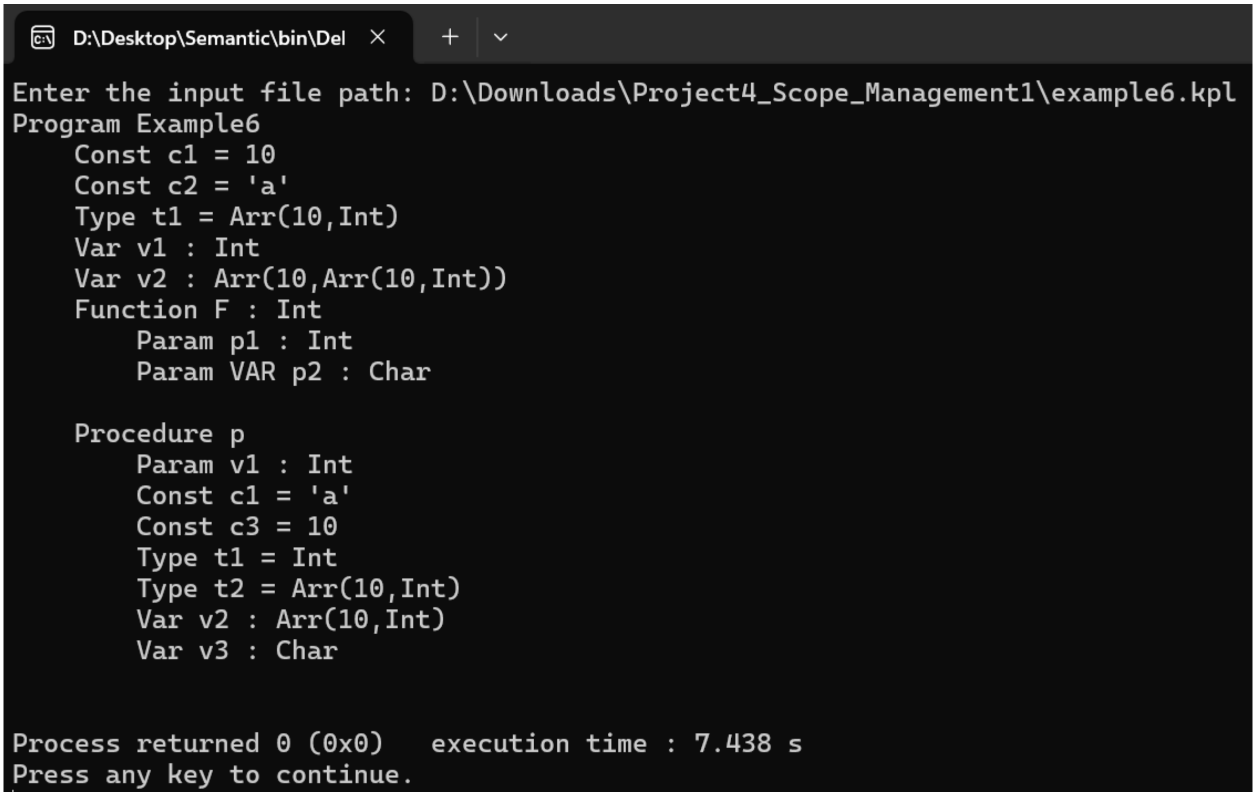
```
Enter the input file path: D:\Downloads\Project4_Scope_Management1\example4.kpl
Program EXAMPLE4
    Const MAX = 10
    Type T = Int
    Var A : Arr(10,Int)
    Var N : Int
    Var CH : Char
    Procedure INPUT
        Var I : Int
        Var TMP : Int

    Procedure OUTPUT
        Var I : Int

    Function SUM : Int
        Var I : Int
        Var S : Int


Process returned 0 (0x0)   execution time : 4.305 s
Press any key to continue.
```

5. *example5.kpl*



```
Enter the input file path: D:\Downloads\Project4_Scope_Management1\example5.kpl
Program Example5
    Const c = 1
    Type t = Char
    Function f : Char
        Param i : Int
        Const b = 1
        Type a = Arr(5,Char)


Process returned 0 (0x0)   execution time : 4.570 s
Press any key to continue.
```

6. *example6.kpl*

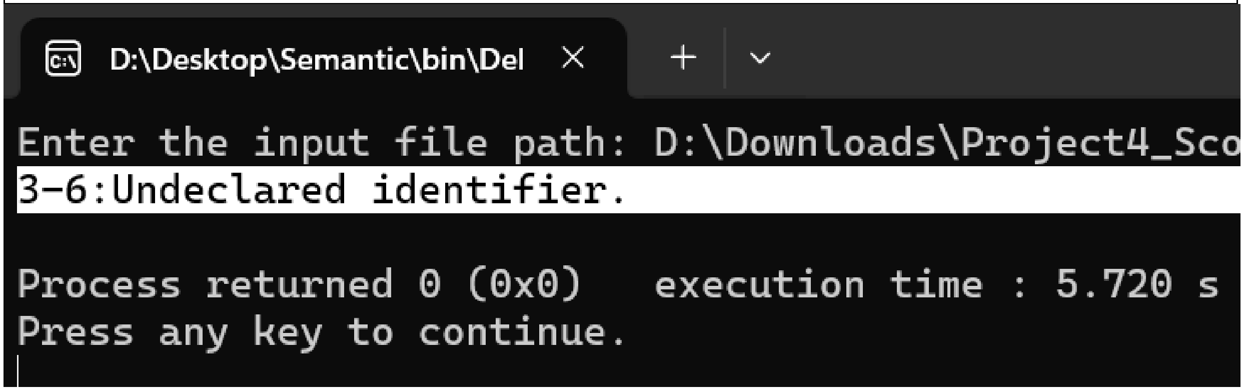


```
Enter the input file path: D:\Downloads\Project4_Scope_Management1\example6.kpl
Program Example6
    Const c1 = 10
    Const c2 = 'a'
    Type t1 = Arr(10,Int)
    Var v1 : Int
    Var v2 : Arr(10,Arr(10,Int))
    Function F : Int
        Param p1 : Int
        Param VAR p2 : Char

    Procedure p
        Param v1 : Int
        Const c1 = 'a'
        Const c3 = 10
        Type t1 = Int
        Type t2 = Arr(10,Int)
        Var v2 : Arr(10,Int)
        Var v3 : Char


Process returned 0 (0x0)   execution time : 7.438 s
Press any key to continue.
```

B. The result of executing the program with errors

1. ERR_UNDECLARED_IDENT, "Undeclared identifier."

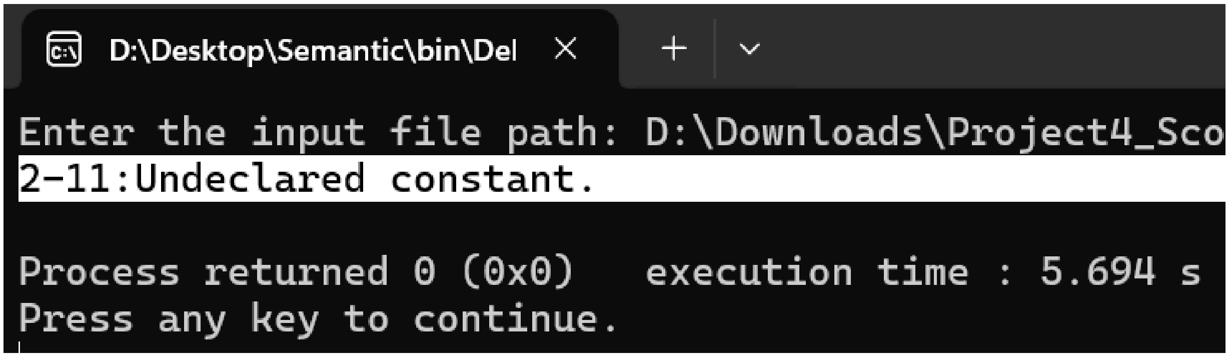
```
Program Error1; (* ERR_UNDECLARED_IDENT *)
Begin
      b = 1;
End.
```



```
Enter the input file path: D:\Downloads\Project4_Sco
3-6:Undeclared identifier.

Process returned 0 (0x0)   execution time : 5.720 s
Press any key to continue.
```

2. ERR_UNDECLARED_CONSTANT, "Undeclared constant."

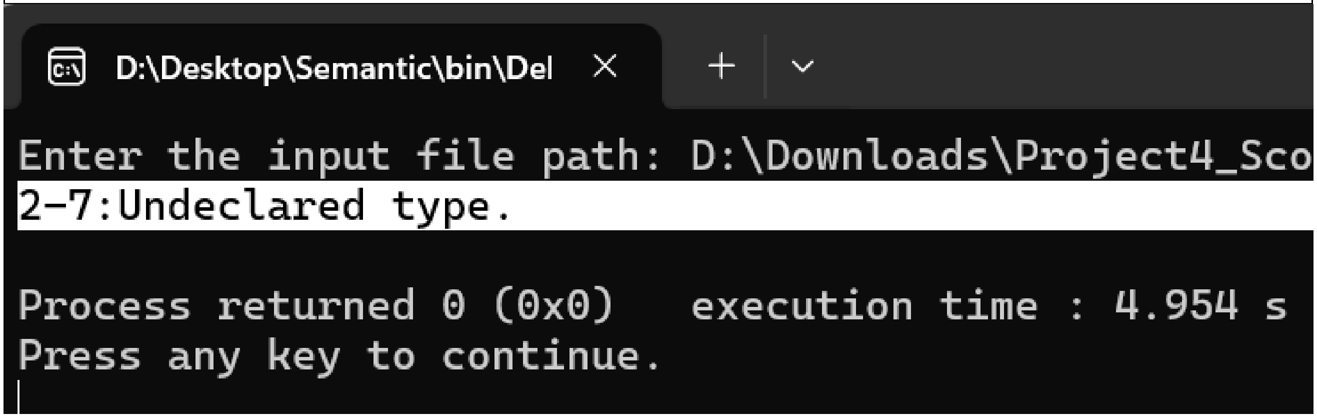
```
Program Error2; (* ERR_UNDECLARED_CONSTANT *)
const b = a;
Begin
End.
```



```
Enter the input file path: D:\Downloads\Project4_Sco
2-11:Undeclared constant.

Process returned 0 (0x0)   execution time : 5.694 s
Press any key to continue.
```

3. **ERR_UNDECLARED_TYPE, "Undeclared type."**

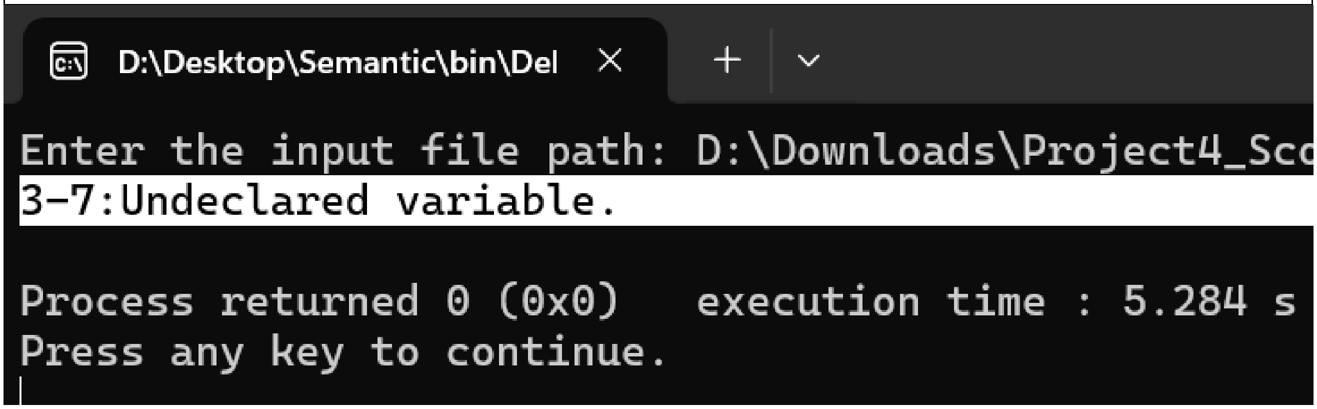
```
Program Error3; (* ERR_UNDECLARED_TYPE *)
var b:a;
Begin
End.
```



```
Enter the input file path: D:\Downloads\Project4_Sco
2-7:Undeclared type.

Process returned 0 (0x0)   execution time : 4.954 s
Press any key to continue.
```

4. **ERR_UNDECLARED_VARIABLE, "Undeclared variable."**

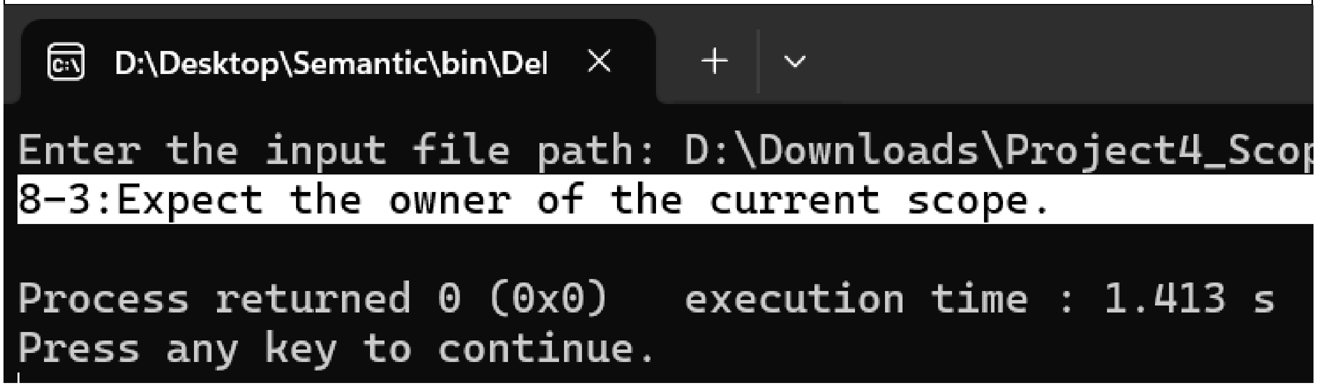
```
Program Error4; (* ERR_UNDECLARED_VARIABLE *)
Begin
  For n := 1 To 7 Do
    Begin
      Call WRITELN;
    End;
End.
```



```
Enter the input file path: D:\Downloads\Project4_Sco
3-7:Undeclared variable.

Process returned 0 (0x0)   execution time : 5.284 s
Press any key to continue.
```

5. **ERR_INVALID_RETURN, "Expect the owner of the current scope."**

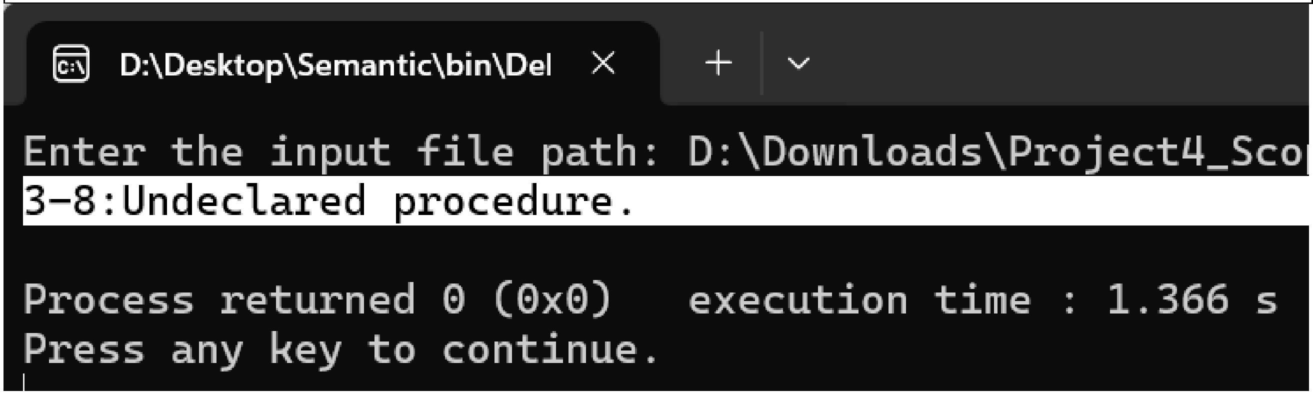
```
Program Error5; (* ERR_INVALID_RETURN *)
FUNCTION F(n : Integer): INTEGER;
BEGIN
  F := n/2;
END;
FUNCTION G(n : Integer): INTEGER;
BEGIN
  F := 2;
  G := 3;
END;
Begin
End.
```



```
Enter the input file path: D:\Downloads\Project4_Scop
8-3:Expect the owner of the current scope.

Process returned 0 (0x0)   execution time : 1.413 s
Press any key to continue.
```

6. **ERR_UNDECLARED_PROCEDURE, "Undeclared procedure."**

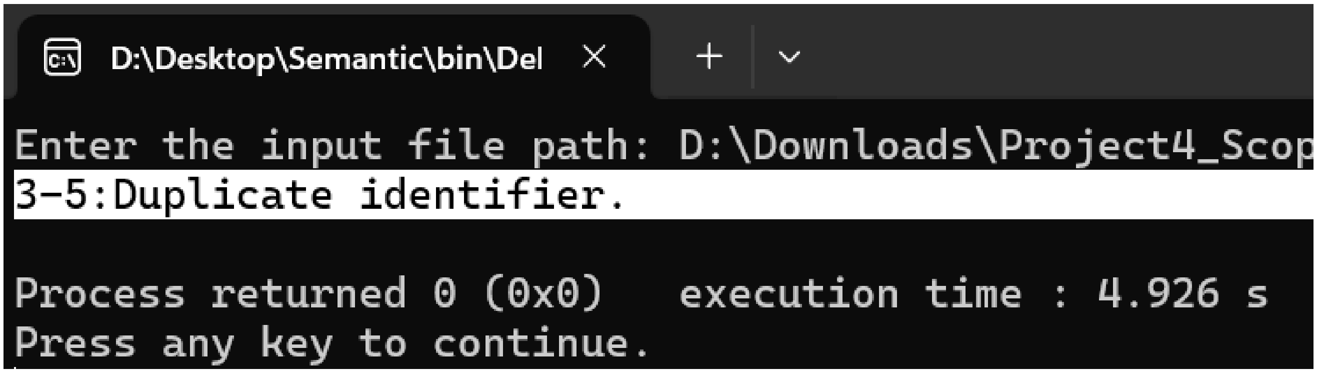
```
Program Error6; (* ERR_UNDECLARED_PROCEDURE *)
Begin
  Call WRITESCREEN;
End.
```



```
Enter the input file path: D:\Downloads\Project4_Sco
3-8:Undeclared procedure.

Process returned 0 (0x0)   execution time : 1.366 s
Press any key to continue.
```

7. **ERR_DUPLICATE_IDENT, "Duplicate identifier."**

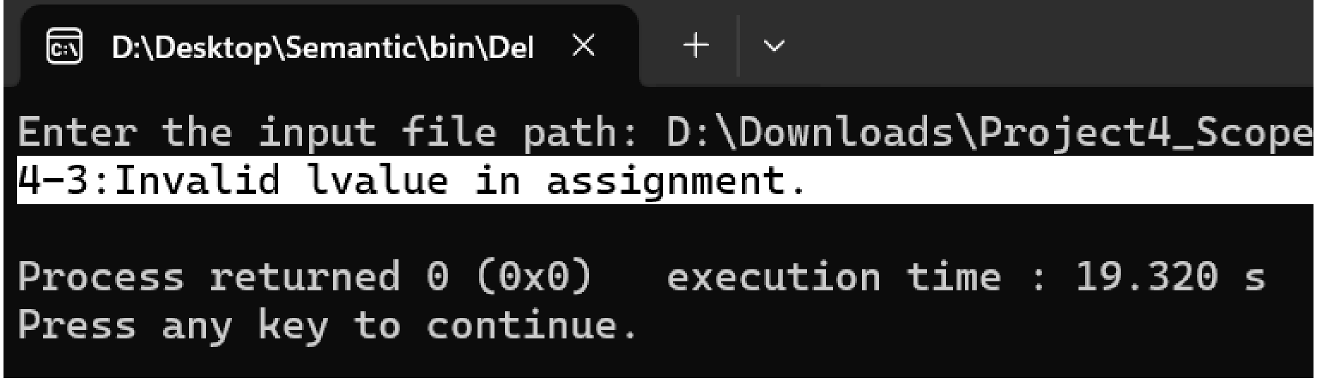
```
Program Error7; (* ERR_DUPLICATE_IDENT *)
VAR A : INTEGER;
    A : INTEGER;
Begin
End.
```



```
Enter the input file path: D:\Downloads\Project4_Scop
3-5:Duplicate identifier.

Process returned 0 (0x0)   execution time : 4.926 s
Press any key to continue.
```

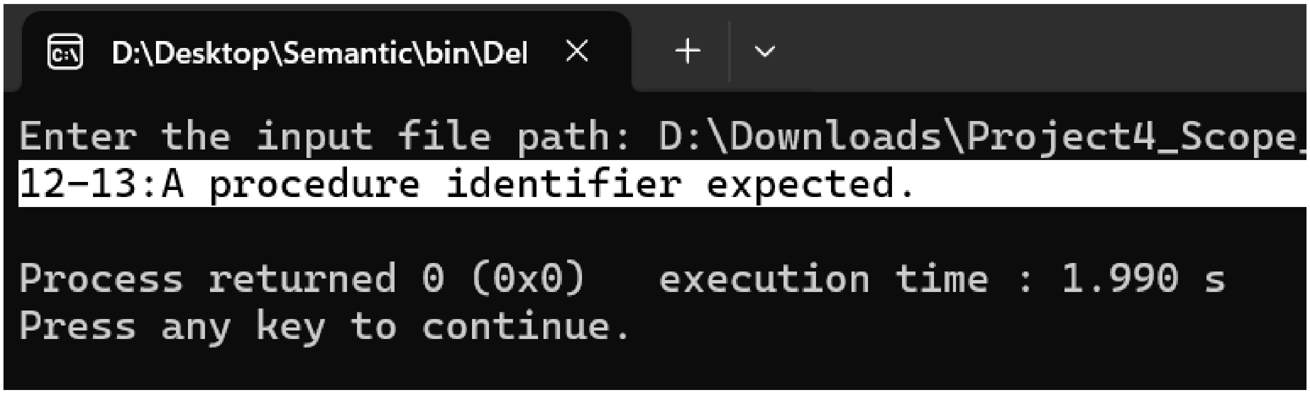
8. ERR_INVALID_LVALUE, "Invalid lvalue in assignment."

```
PROGRAM error8;
CONST a = 5;
BEGIN
  a := 3;
END.
```



```
Enter the input file path: D:\Downloads\Project4_Scope
4-3:Invalid lvalue in assignment.

Process returned 0 (0x0)   execution time : 19.320 s
Press any key to continue.
```

C. With the file example3.kpl, rename a parameter of the procedure HANOI to HANOI and execute. Analyze the reason for the error.



```
Enter the input file path: D:\Downloads\Project4_Scope_
12-13:A procedure identifier expected.

Process returned 0 (0x0)   execution time : 1.990 s
Press any key to continue.
```

- Error: **ERR_INVALID_PROCEDURE**
- The parameter of the procedure HANOI is renamed to HANOI, causing a name conflict between the procedure and the parameter in the same scope.

- When recursively calling CALL HANOI(...), the compiler looks for HANOI in the current scope (procedure scope) and finds the parameter HANOI (of type OBJ_PARAMETER), not the procedure (OBJ_PROCEDURE).