

Welcome to Level-3 :)

A Typical Day in Level-3



Things to Do



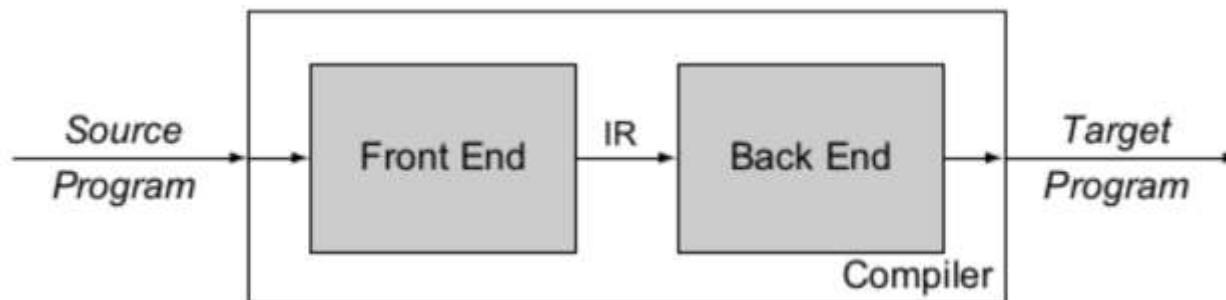
Things NOT to Do



Welcome to CSE 310

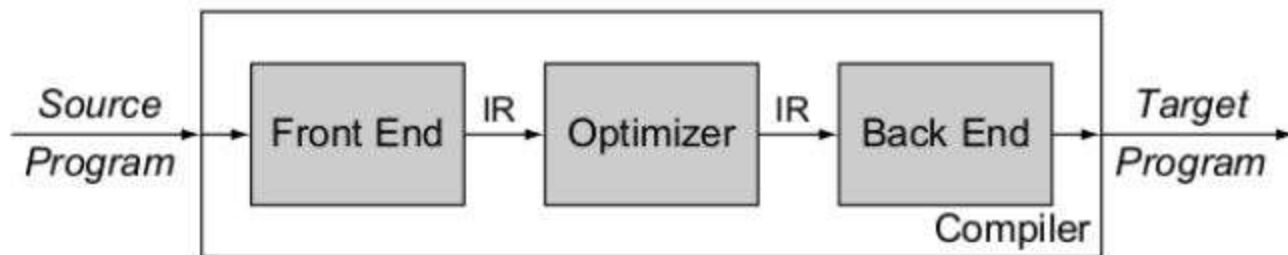
Compiler

- Convert a source program to a target program
- The compilation process usually divided into several phases

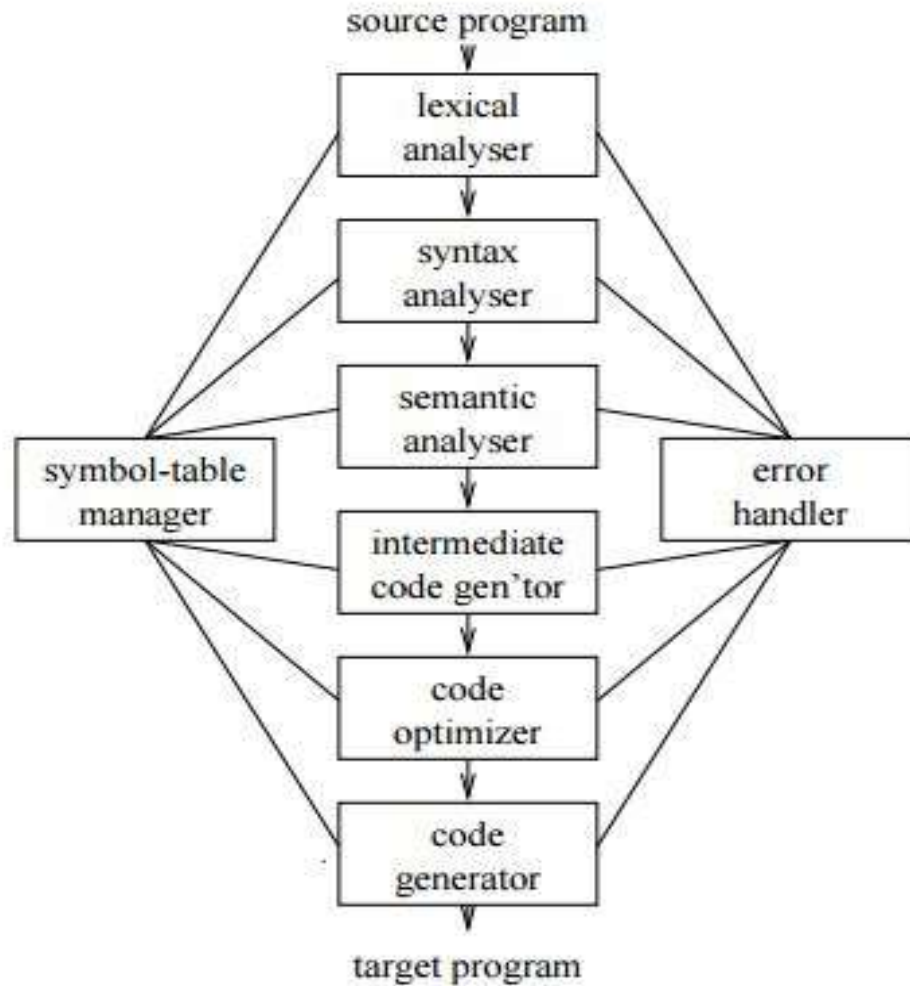


Compiler

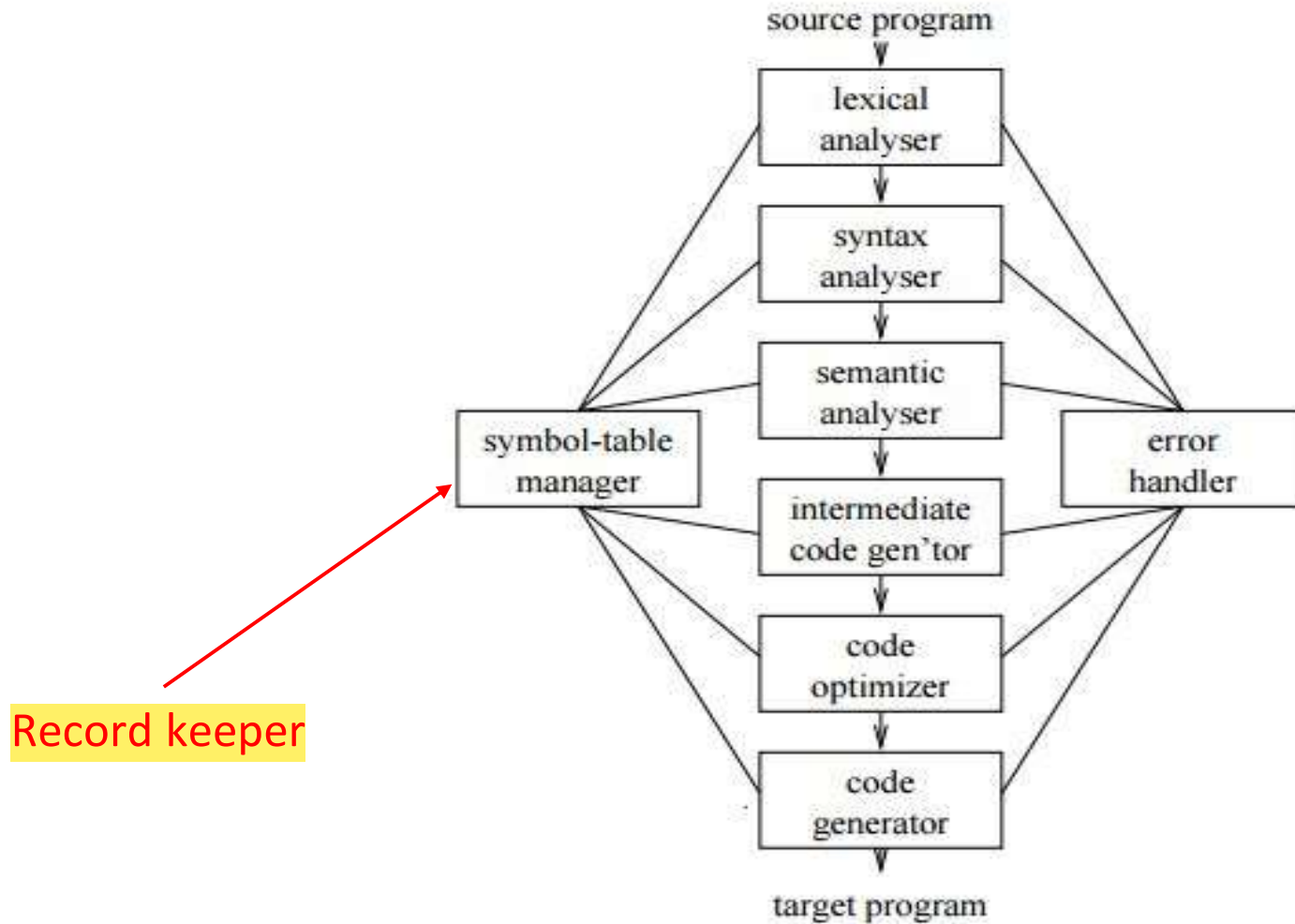
- Convert a source program to a target program
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Compiler

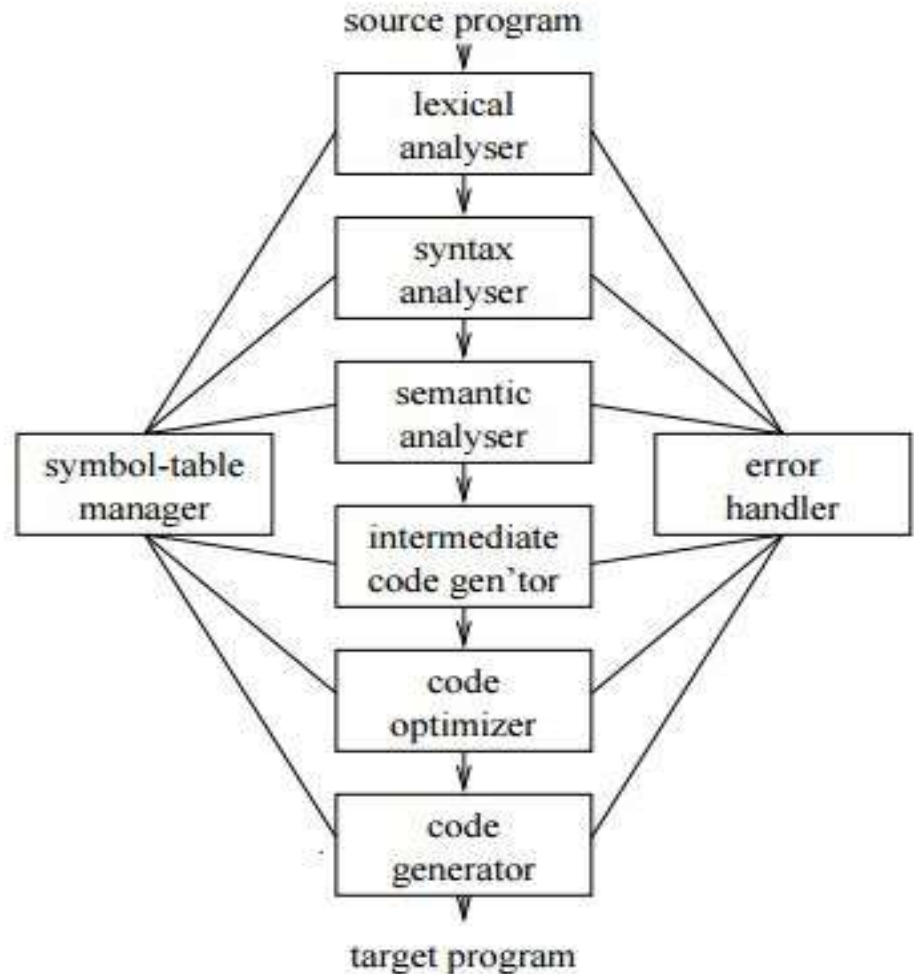


Compiler



Compiler

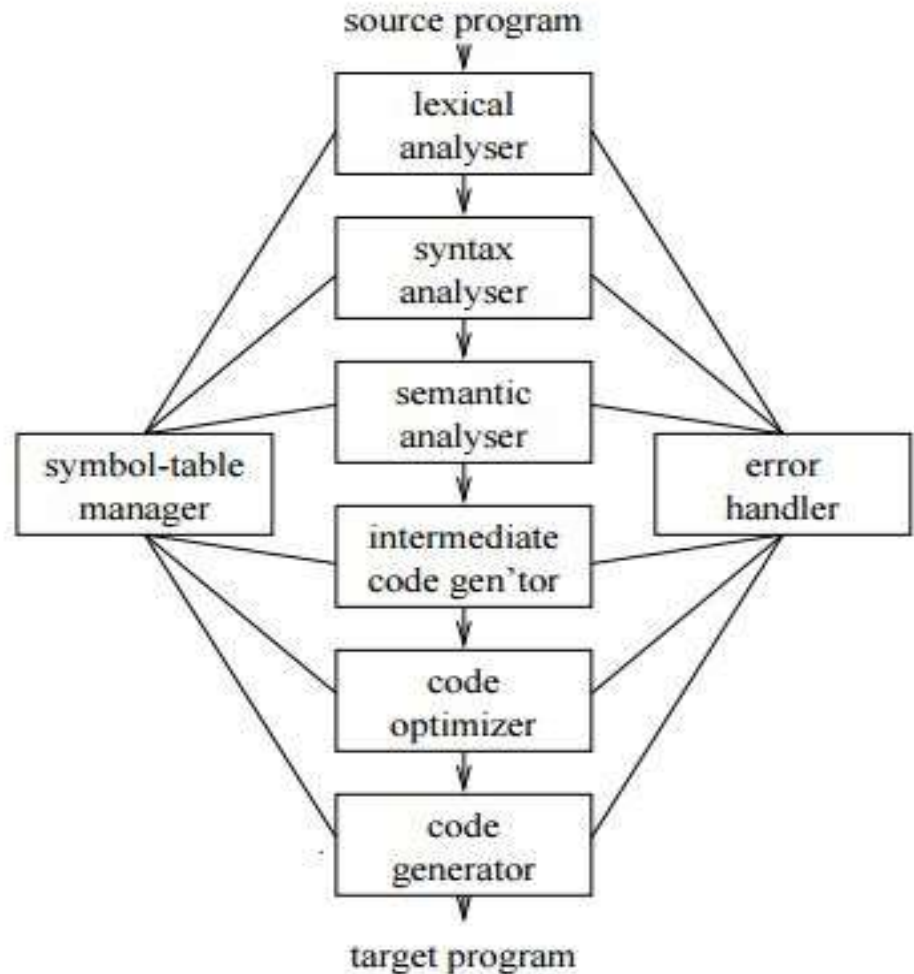
- **Lexical Analyzer** takes the source program as input and converts it into a stream of tokens
- To be used by the syntax analyzer later on
- Also detects some lexical errors
 - Ill formed number
 - Improper variable declaration
 - Unfinished string/comment etc.



Compiler

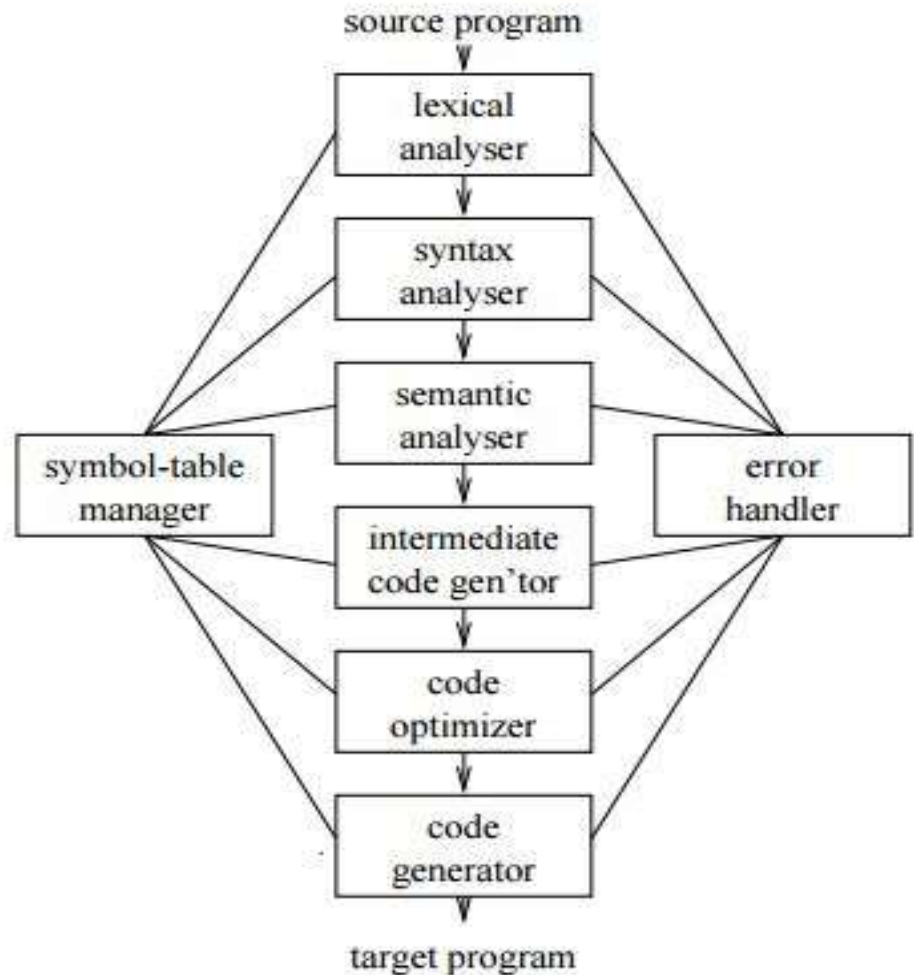
- **Syntax analyzer** uses the tokens produced by the lexical analyzer to depict the grammatical structure of the token stream
- Builds implicit syntax tree
- Detects syntax errors

CFG



Compiler

- **Semantic analyzer** uses the **syntax tree** and the **information in the symbol table** to check the source program for semantic consistency with the language definition
- **Check semantic errors**
 - Type checking
 - Variable declared as void
 - Undeclared variable
 - Error in no./type of function argument during call



What will we do in this course?

- Construct and manage **symbol table**
- Perform **lexical analysis** using **flex**
- Perform **syntax analysis**, **semantic analysis**, and **intermediate code generation**
- Some code **optimization** too
- So... We are going to build a **COMPILER!**

Some Info

- Linux Platform
- No Plagiarism

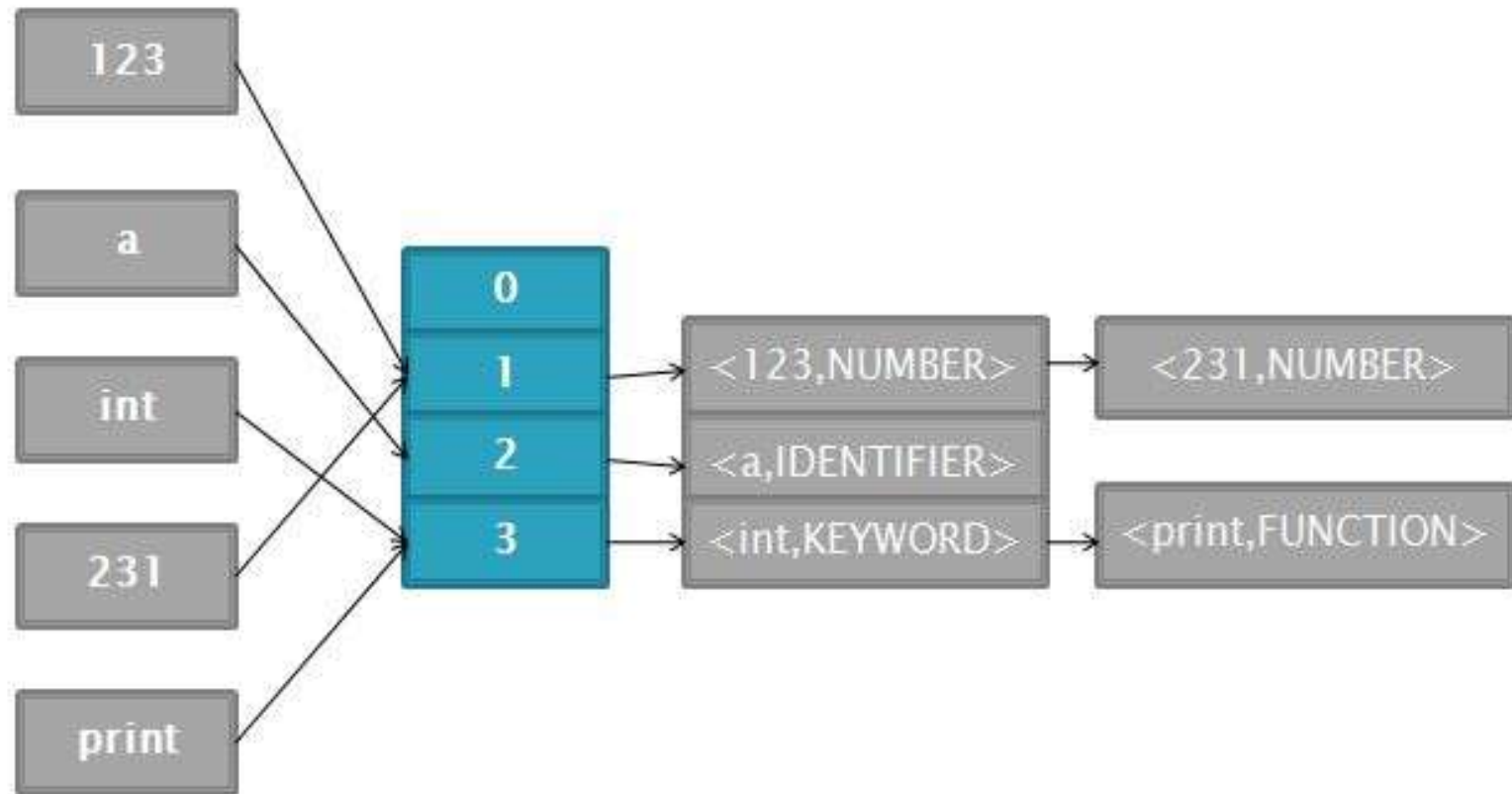
Symbol Table

- A table storing information of occurrence of various entities in the source program
- Function names, return type, no. parameters; variable name, type etc.
- Information are:
 - Symbol Name
 - Type
 - Scope
- Used in almost all phases of a compilation

Offline 1: Symbol Table Management

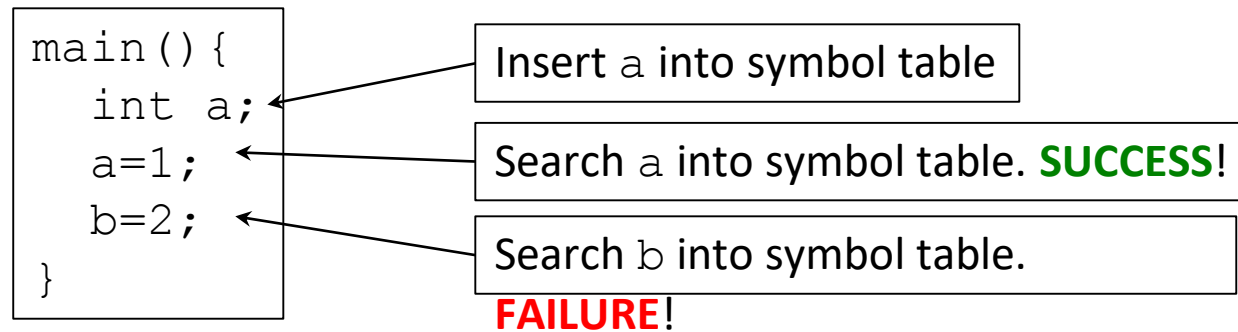
- Implement a simple symbol table
- Hash based (Chaining)
- Each entry is **mainly** a two tuple
<Symbol Name, Symbol Type>
- Use Symbol Name as key of hash table

Offline 1: Symbol Table Management



How Symbol Table Helps?

- How can this type of Symbol Table help?
 - Detect undeclared variable



- Type checking

- Add an extra field for each symbol named **datatype**
- During an assignment operation, check datatype field of RHS and LHS

How Symbol Table Helps?

- How can this type of Symbol Table help?
 - Scope Management

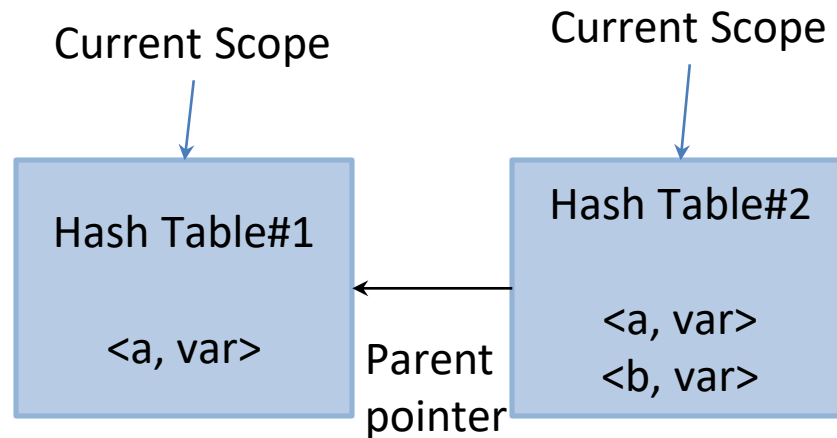
```
main() {  
    int a;  
    {  
        int a,b;  
    }  
    b=2;  
}
```

- Need to allow duplicate entry in symbol table
- Also delete some entries when a block ends
- How to accommodate this??

Symbol Table for Scope Management

- List of Hash Tables

```
main() {  
→  int a;  
→  {  
→    int a,b;  
→  }  
→  b=2;  
→ }
```

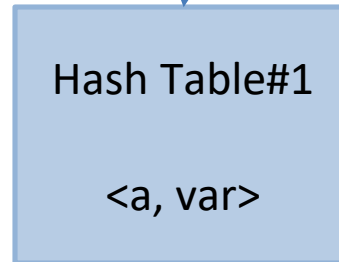


Symbol Table for Scope Management

- List of Hash Tables

```
main() {  
    int a;  
    {  
        int a,b;  
    }  
    b=2;  
}
```

Current Scope



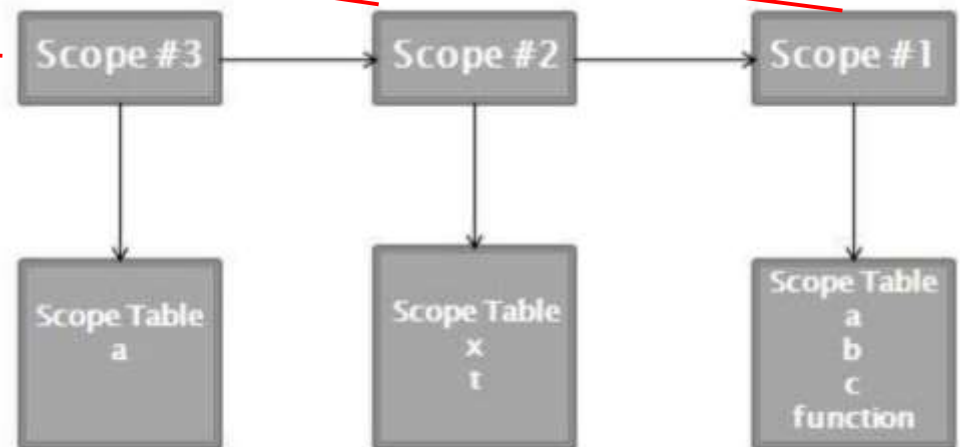
Symbol Table for Scope Management

- **Stack** of Hash Tables
- How does accessing work?
 - Search the topmost scope table
 - If fail, search its parent scope table and so on

Symbol Table for Scope Management

- Stack of Hash Tables

```
1. int a, b, c;
2. int func(int x) {
3.     int t = 0;
4.     if(x == 1) {
5.         int a = 0;
6.         t = 1;
7.     }
8.     return t;
9. }
10. int main() {
11.     int x = 2;
12.     func(x);
13.     return 0;
14. }
```

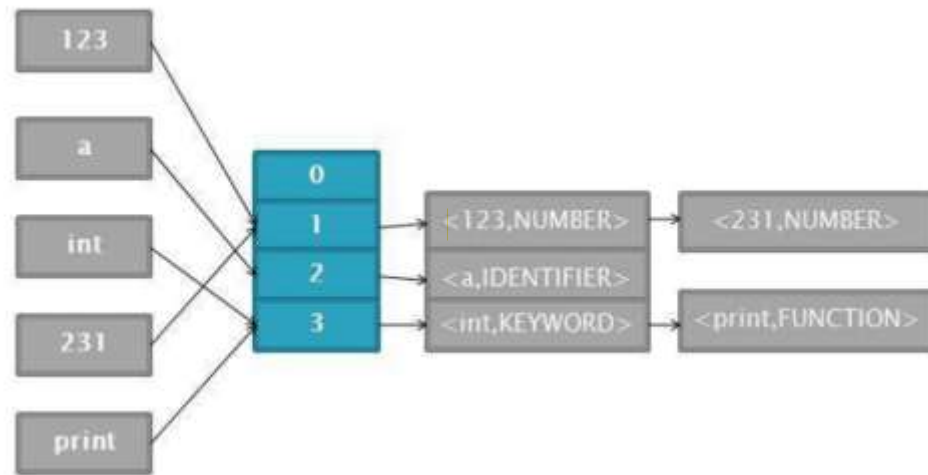


Offline 1: Symbol Table Management

- Three Classes

- 1. SymbolInfo

- Each entry of symbol table is an instance of SymbolInfo (Remember two tuples!!!)
 - Three member vars
 - name, type, pointer to SymbolInfo (separate chaining)



Offline 1: Symbol Table Management

- Three Classes

- 2. ScopeTable

- This class is the implementation of a hash table.
 - Represents each scope
 - Implement four operations
 - » Insert
 - » Lookup
 - » Delete
 - » Print

Offline 1: Symbol Table Management

- Three Classes

3. SymbolTable

- Maintains a list of Scope Tables
- Implement six operations
 - » Enter Scope
 - » Exit Scope
 - » Insert
 - » Delete
 - » Print All Scope Tables
 - » Print Current Scope Table

No Memory Leak

- use `-fsanitize=address` flag

Acknowledgement

- Ajmain Yasar Ahmed Sahil