Compiler Design Lab (CS 306L)
Week 3: Symbol Table Implementation

⇒ **Time Complexity:**
- For Hash Table ⇒ Constant time
- For Linked List ⇒ O(N)

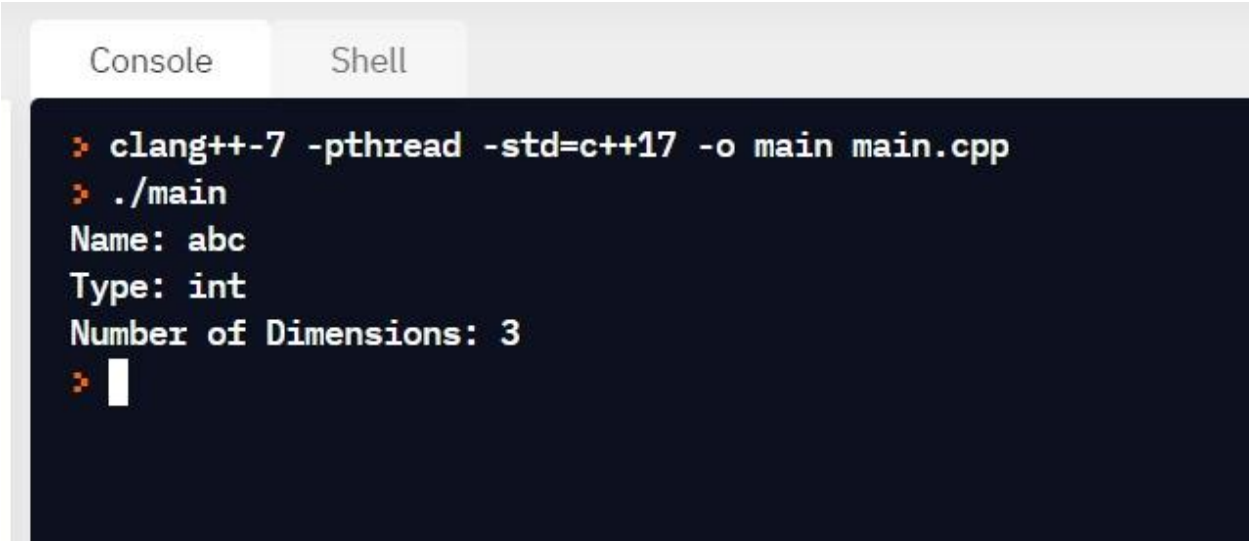
⇒ **Space Complexity:** O(N) for both - Hash Table and Linked List

⇒ **Program for LinkedList:**

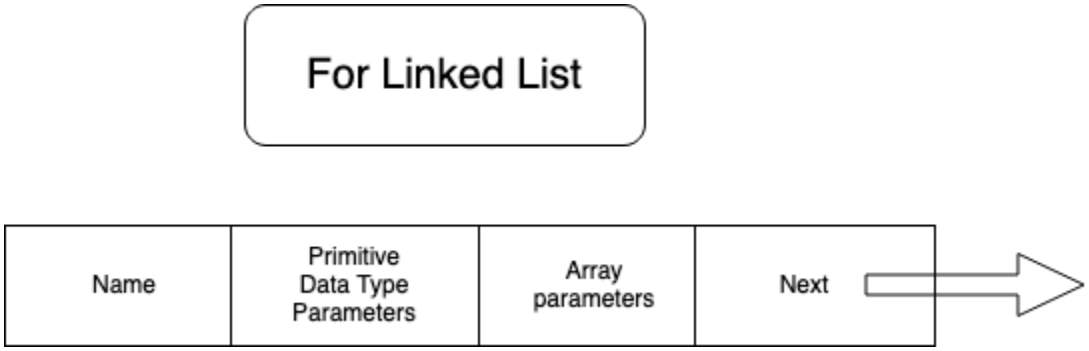
```
 //static program

#include <iostream>

using namespace std;
struct Node{
   string name;
   struct Node* next;
   struct dt *para;
   struct arr *arrayPara;
} *head = NULL;

struct dt{
   string type; //for the datatype of the variable
   string scope; // either global or local
};

struct arr{
   string type; //for the datatype of the variable
   int noOfDimensions; //whether it is a one dimensional array or 2 dimension or n dimensions
                              // => eg. a[3][4] is a 2-D array
   int *dimensions; //and in those the first dimension is 3 and second one is 4
};

int main()
{
   struct Node* temp = ( struct Node* ) malloc(sizeof(struct Node));
   struct arr* arrayPointer = ( struct arr* ) malloc(sizeof(struct arr));
   head = temp;
   temp -> para = NULL;
   head -> arrayPara=arrayPointer;
   head -> name="abc";
   head -> arrayPara->type="int";
   head -> arrayPara->noOfDimensions=3;
   head -> arrayPara->dimensions = (int*)
malloc(sizeof(int)*head->arrayPara->noOfDimensions);
```

```
    cout <<"Name: "<<head->name<<endl;
    cout <<"Type: "<<head->arrayPara->type << endl;
    cout <<"Number of Dimensions: "<<head->arrayPara->noOfDimensions << endl;
    return 0;
}
```

Output Screenshot:



Working structure:



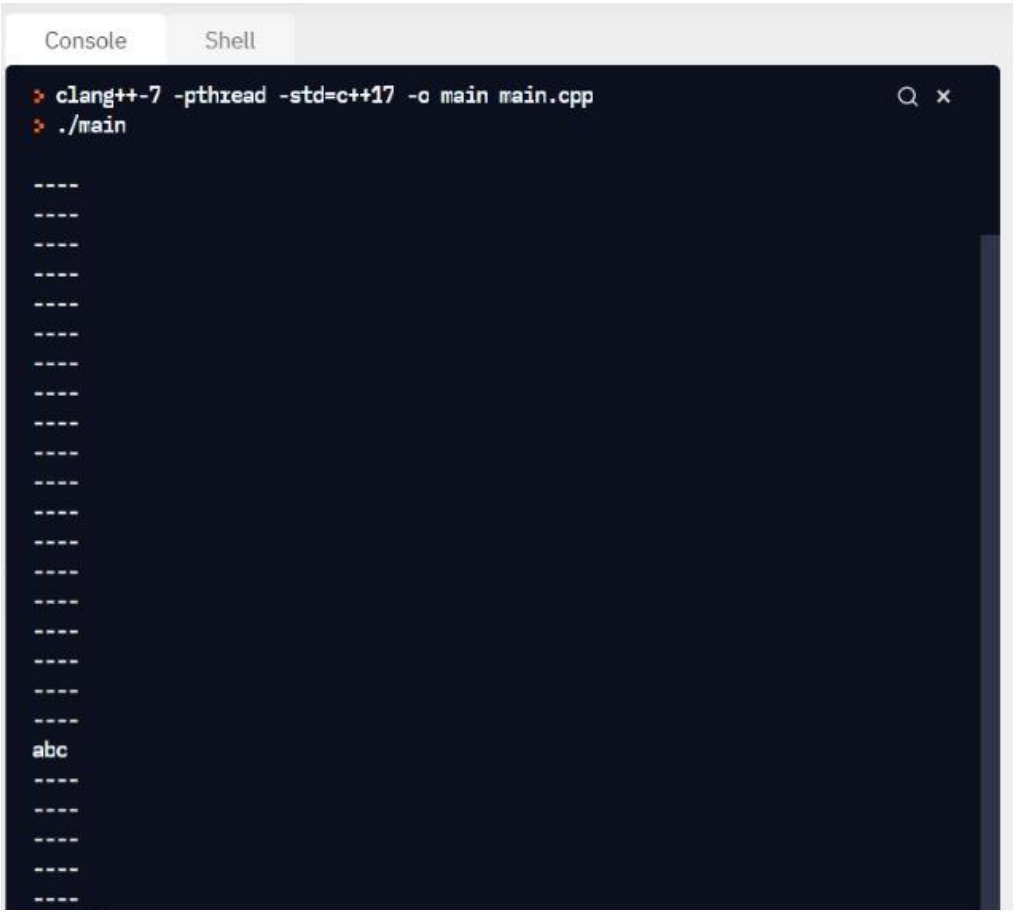
⇒ **Program for HashTable:**

```
//static program
#include <iostream>
#define MAX_NAME 256
#define TABLE_SIZE 25
using namespace std;

struct Node{
	string name;
	struct dt *para;
	struct arr *arrayPara;
}*head=NULL;

struct dt{
	string type;
	string scope;
};

struct arr{
	string type;
	int noOfDimensions;
	int *dimensions;
};

Node* table[TABLE_SIZE];

//the index values for the given keys in the hash table
int HashFunction(string name)
{
	int length = name.length();
	int hash_value = 0;
	for (int i = 0; i < length; i++)
	{
	hash_value += (name[i]);
	}
	hash_value = hash_value % TABLE_SIZE;
	return hash_value;
}

//initialising all the values in the table as null
void IntiTable()
{
	for (int i = 0; i < TABLE_SIZE; i++)
	{
	table[i] = NULL;
	}
}
```

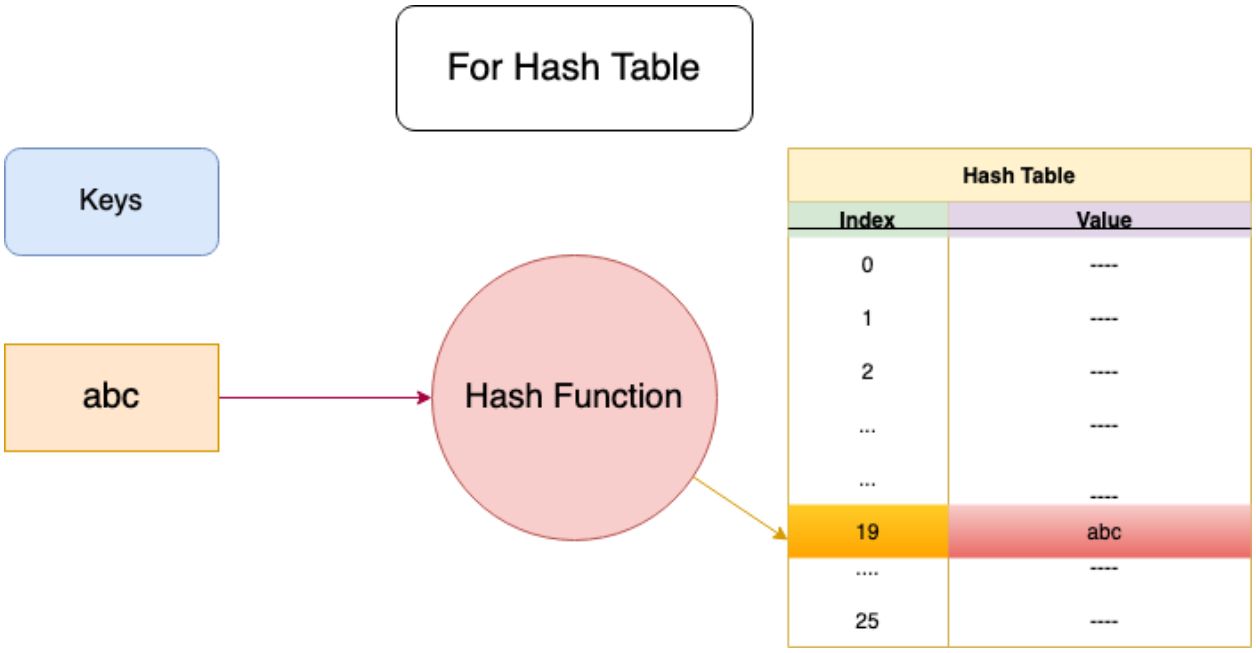
```
//insertion of a new node in the table
bool InsertInTable(Node *p)
{
	if(p == NULL) return false;
	int index = HashFunction(p -> name);
	if(table[index] != NULL)
	{
	return false;
	}
	table[index] = p;
	return true;
}

//printing the values in the table
void PrintTable()
{
	for (int i = 0; i < TABLE_SIZE; i++)
	{
	if (table[i] == NULL)
	{
	cout << "---- \n";
	}
	else
	{
	cout << table[i] -> name << "\n";
	}
	}
}

//finds the address of the given string name
Node* Table_Lookup(string name)
{
  int index = HashFunction(name);
  if(table[index] != NULL && name == (table[index] -> name))
  {
	return table[index];
  }
  else
  {
	return NULL;
  }
}
```

```
int main()
{
        struct Node* temp = ( struct Node* )malloc(sizeof(struct Node));
        struct arr* arrayPointer = ( struct arr* )malloc(sizeof(struct arr));
        head = temp;
        temp -> para=NULL;
        head -> arrayPara=arrayPointer;
        head -> name="abc";
        head -> arrayPara->type="int";
        head -> arrayPara->noOfDimensions=3;
        head -> arrayPara->dimensions = (int*)malloc(sizeof(int)*head -> arrayPara ->
noOfDimensions);
  InsertInTable(head);
  cout << "\n";
  PrintTable();
  cout << Table_Lookup("abc")->name;
        return 0;
}
```

Output Screenshot:



Working structure:



⇒ **Discussion:**

- Out of the two programs, **Hashtable** is **better** as it is faster and helps in reducing the complexity.
- Advantage is that quick search is possible and the disadvantage is that hashing is complicated to implement.
- In case of linkedlist, Insertion is fast O(1), but lookup is slow for large tables – O(n) on average