AP21110011032

## Implementation of Symbol Table :

The symbol table can be implemented in the unordered list if the compiler is used to handle the small amount of data.

A Symbol table can be implemented in one of the following techniques:

• Linear (sorted or unsorted) list

• Binary Search Tree

• Hash table

### 1. Linked List

- This implementation is using a linked list. A link field is added to each record.
- Searching of names is done in order pointed by the link of the link field.
- A pointer "First" is maintained to point to the first record of the symbol table.
- Insertion is fast O(1), but lookup is slow for large tables - O(n) on average

### 2. Hash Table

- A hash table is an array with an index range: 0 to table size - 1. These entries are pointers pointing to the names of the symbol table.
- To search for a name we use a hash function that will result in an integer between 0 to table size - 1.
- Insertion and lookup can be made very fast - O(1).
- The advantage is quick to search is possible and the disadvantage is that hashing is complicated to implement.

### 3. Binary Search Tree

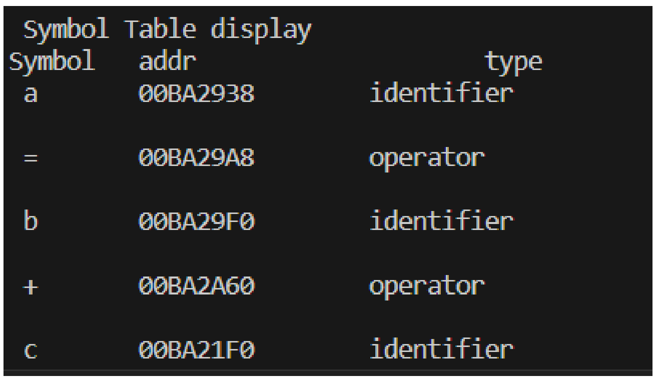
- Another approach to implementing a symbol table is to use a binary search tree i.e. we add two link
- fields i.e. left and right child.
- All names are created as child of the root node that always follows the property of the binary search tree.
- Insertion and lookup are O(log2 n) on average.

## Code

```
#include <stdio.h>
#include <ctype.h>
#include <stdlib.h>
int main()
{
    int x = 0, n, i = 0, j = 0, p = 0;
    void *ptr, *id_address[5];
    char ch, id_Array2[25], id_Array3[25], c;
    printf("Input the expression that ends with ; sign:");
    char s[30];
```

```c
    scanf("%s", s);
    while (s[i] != ';')
    {
        id_Array2[i] = s[i];
        i++;
    }
    n = i - 1;
    printf("\n Symbol Table display\n");
    printf("Symbol \t addr \t\t\t type");
    while (j <= n)
    {
        c = id_Array2[j];
        if (isalpha(c))
        {
            ptr = malloc(c);
            id_address[x] = ptr;
            id_Array3[x] = c;
            printf("\n %c \t %p \t identifier\n", c, ptr);
            x++;
            j++;
        }
        else
        {
            ch = c;
            if (ch == '+' || ch == '-' || ch == '*' || ch == '/' || ch == '%' || ch == '='
|| ch == '<' || ch == '>')
            {
                ptr = malloc(ch);
                id_address[x] = ptr;
                printf("\n %c \t %p \t operator\n", ch, ptr);
                x++;
                j++;
            }
        }
    }
    return 0;
}
```

**OUTPUT**:



```
 Symbol Table display
Symbol   addr                type
 a       00BA2938       identifier

 =       00BA29A8       operator

 b       00BA29F0       identifier

 +       00BA2A60       operator

 c       00BA21F0       identifier
```

## Code Using (Hash Table)

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define HASH_TABLE_SIZE 100
struct SymbolEntry
{
    char *name;
    int value;
    struct SymbolEntry *next;
};
struct SymbolTable
{
    struct SymbolEntry *hash_table[HASH_TABLE_SIZE];
};
unsigned int hash(const char *str)
{
    unsigned int hash = 0;
    while (*str)
    {
        hash = (hash << 5) + *str++;
    }
    return hash %
           HASH_TABLE_SIZE;
}
void insert(struct SymbolTable *table, const char *name, int value)
{
    unsigned int index = hash(name);
    struct SymbolEntry *entry = (struct SymbolEntry *)malloc(sizeof(struct
                                                                    SymbolEntry));
    if (!entry)
    {
        perror("Memory allocation failed");
        exit(EXIT_FAILURE);
    }
    entry->name = strdup(name);
    entry->value = value;
    entry->next = table->hash_table[index];
    table->hash_table[index] = entry;
}
struct SymbolEntry *search(struct SymbolTable *table, const char
                                                          *name)
{
    unsigned int index = hash(name);
    struct SymbolEntry *entry = table->hash_table[index];
    while (entry != NULL)
    {
        if (strcmp(entry->name, name) == 0)
        {
            return entry;
```

```c
        }
        entry = entry->next;
    }
    return NULL;
}
int main()
{
    struct SymbolTable symbol_table;
    for (int i = 0; i < HASH_TABLE_SIZE; i++)
    {
        symbol_table.hash_table[i] = NULL;
    }
    insert(&symbol_table, "x", 59);
    insert(&symbol_table, "y", 27);
    struct SymbolEntry *entry_x = search(&symbol_table, "x");
    if (entry_x)
    {
        printf("Symbol: %s, Value: %d\n", entry_x->name, entry_x->value);
    }
    else
    {
        printf("Symbol not found.\n");
    }
    for (int i = 0; i < HASH_TABLE_SIZE; i++)
    {
        struct SymbolEntry *entry = symbol_table.hash_table[i];
        while (entry)
        {
            struct SymbolEntry *next = entry->next;
            free(entry->name);
            free(entry);
            entry = next;
        }
    }
    return 0;
```

**OUTPUT** :

```
Symbol: x, Value: 59
```