

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 $O(\log_2 n)$ 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];
```

```

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	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;
        }
    }
}
```

```

        }          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