Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

DEPARTMENT OF INFORMATION TECHNOLOGY

Academic Year: 2023 - 24

COURSE CODE: DJS22ITL302 **CLASS: S. Y. B. Tech. SemIII (I1-1)**

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BATCH: 1

EXPERIMENT NO. 10

CO/LO:

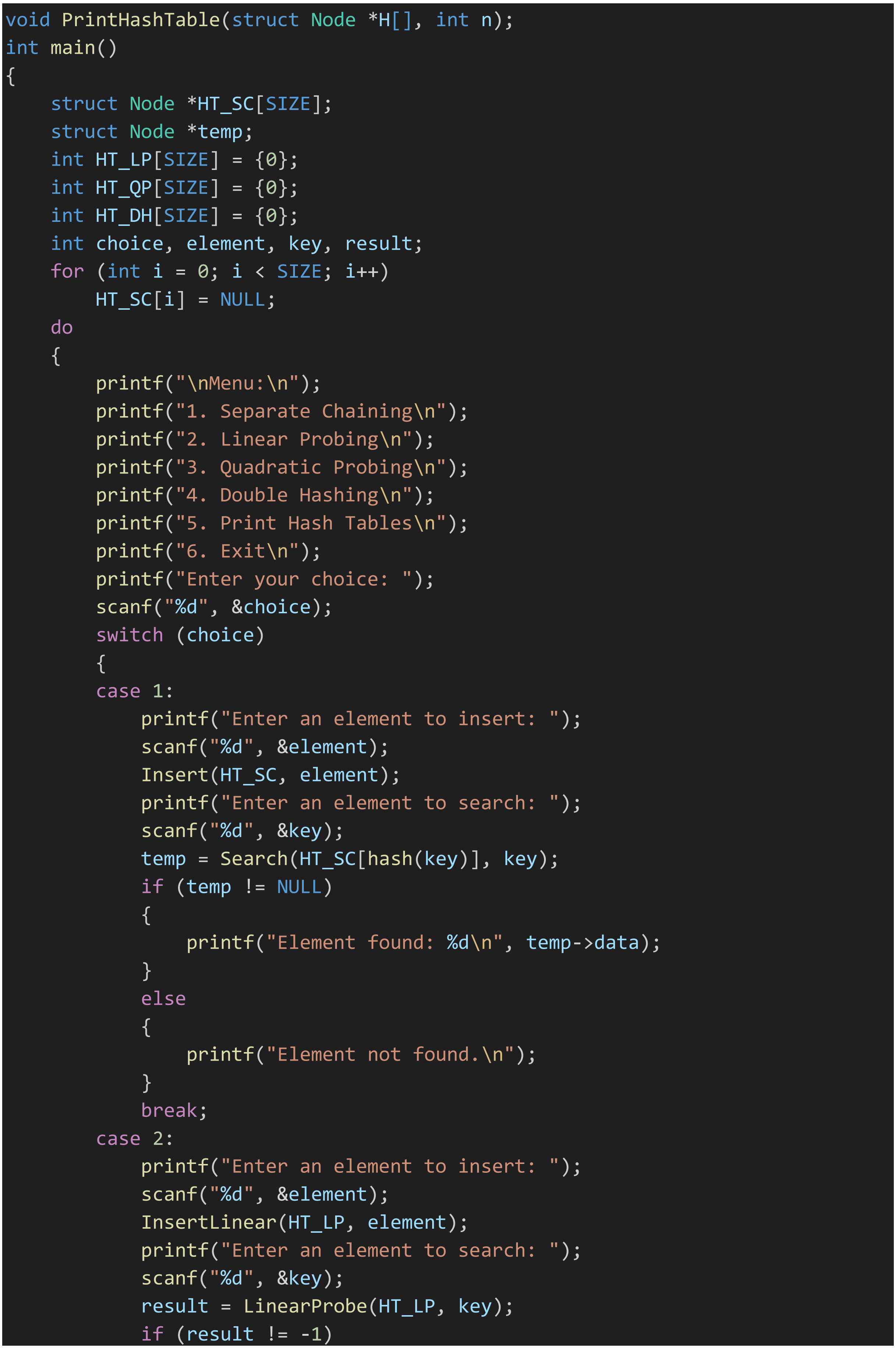
Implement Hashing techniques and collision resolution algorithms.

Objective:

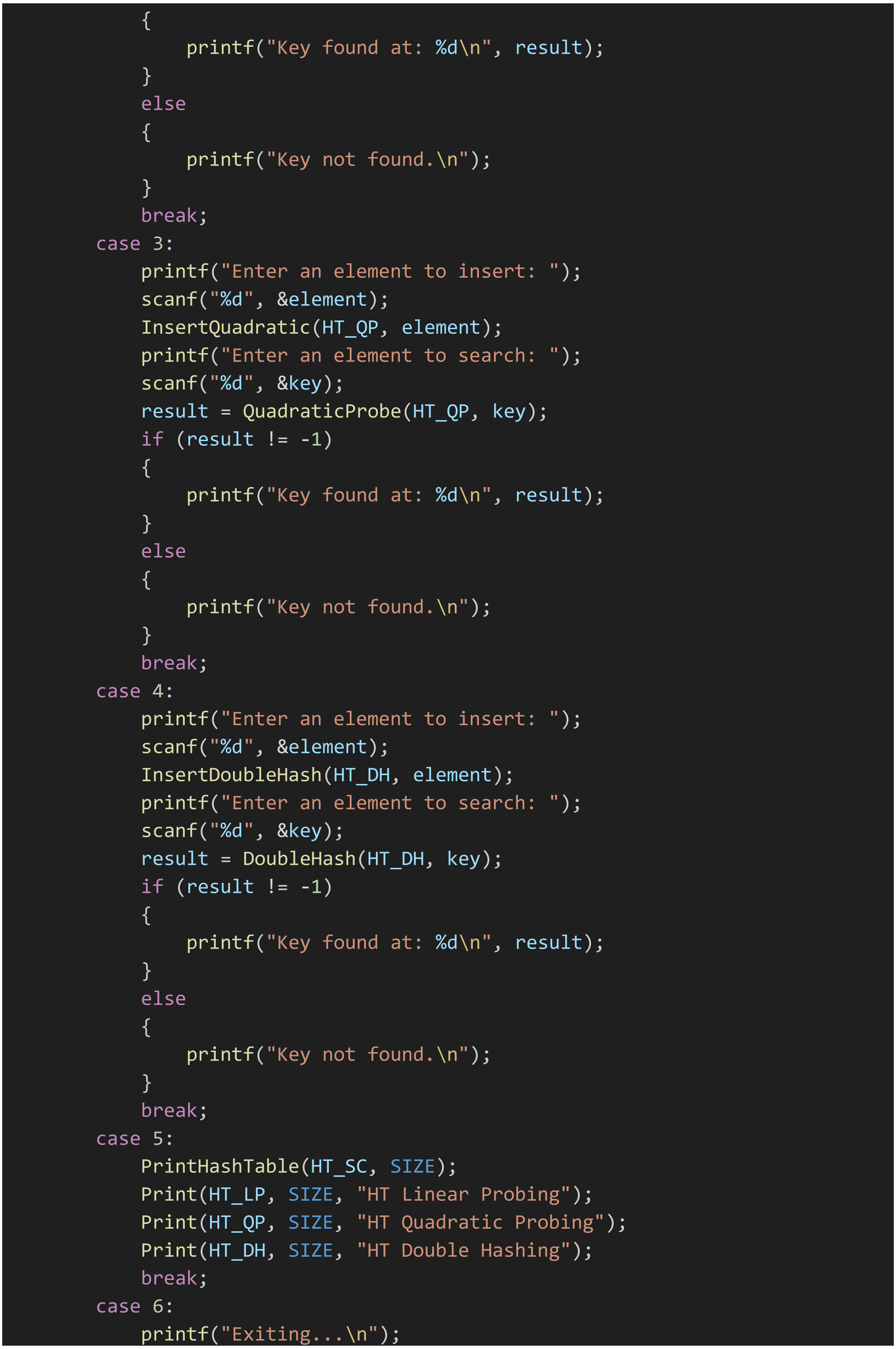
Write a program to Implementation of various hashing techniques with different collision resolution algorithms

Code :

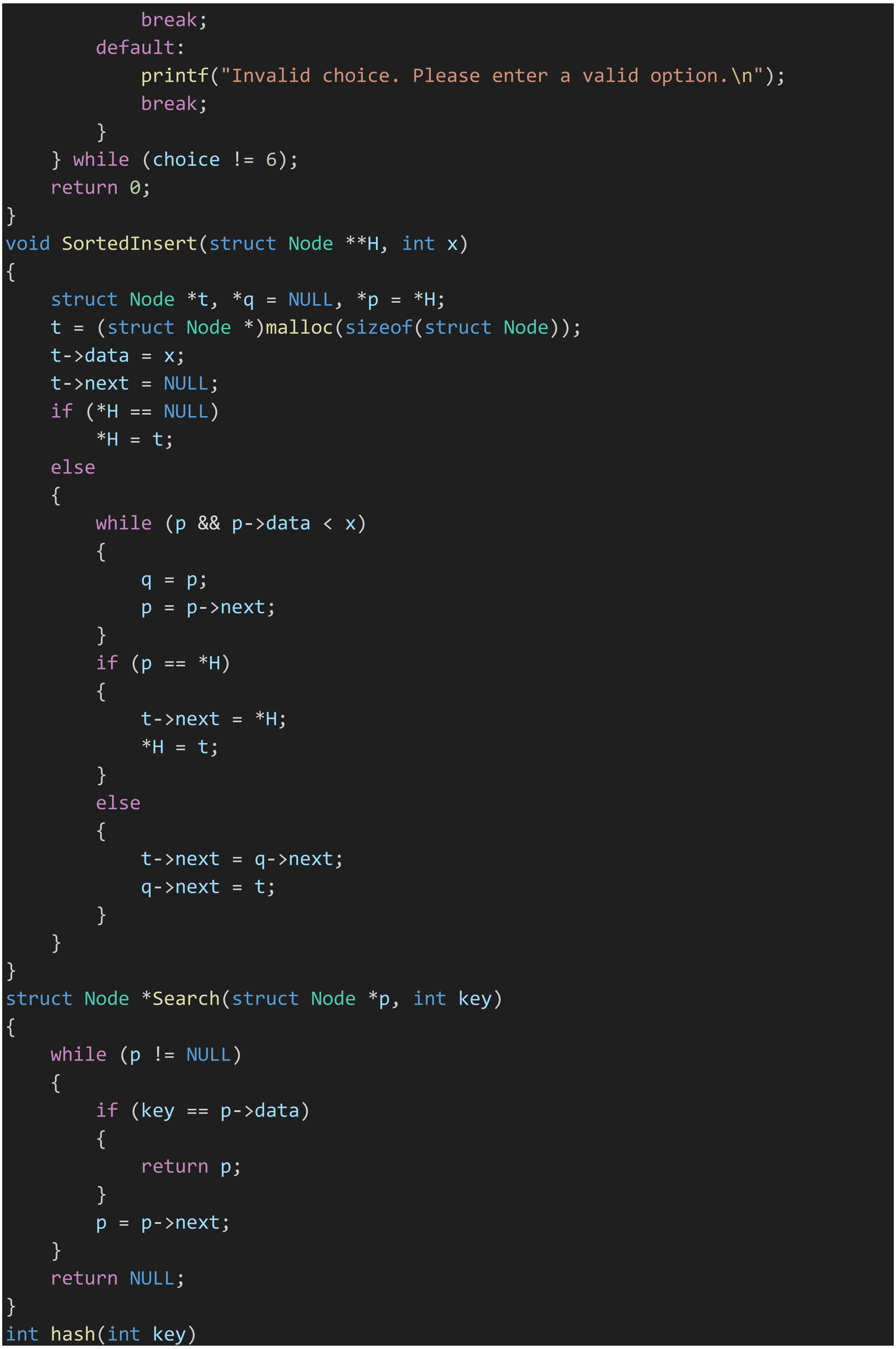
```
#include <stdio.h>
#include <stdlib.h>
#define SIZE 10
#define PRIME 7
#include <stdio.h>
#include <stdlib.h>
#define SIZE 10
#define PRIME 7
struct Node
{
    int data;
    struct Node *next;
};
// Function prototypes
void SortedInsert(struct Node **H, int x);
struct Node *Search(struct Node *p, int key);
int hash(int key);
void Insert(struct Node *H[], int key);
int LinearProbe(int H[], int key);
void InsertLinear(int H[], int key);
int QuadraticProbe(int H[], int key);
void InsertQuadratic(int H[], int key);
int PrimeHash(int key);
int DoubleHash(int H[], int key);
void InsertDoubleHash(int H[], int key);
void Print(int vec[], int n, const char *s);
```



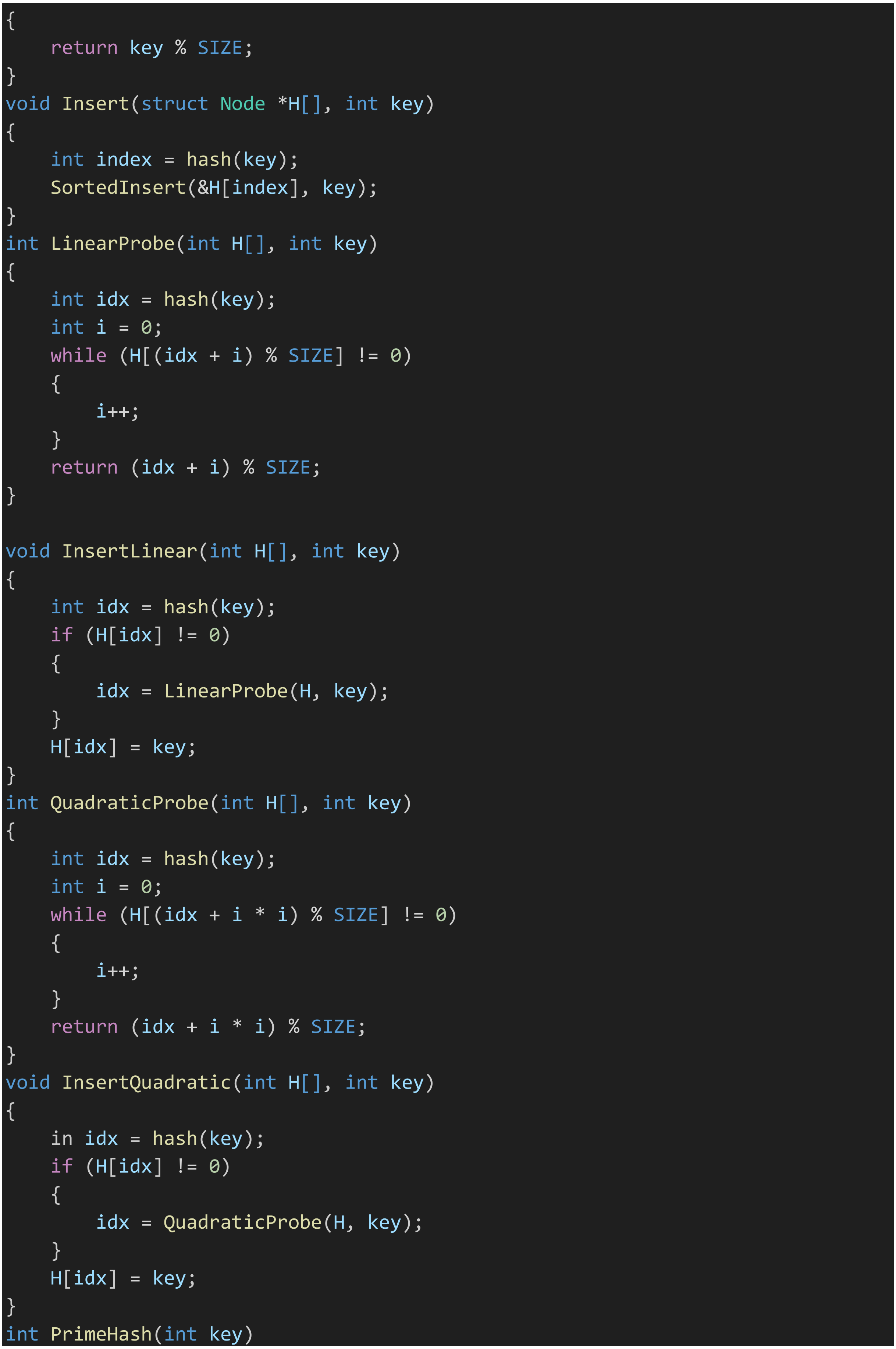
```
void PrintHashTable(struct Node *H[], int n);
int main()
{
    struct Node *HT_SC[SIZE];
    struct Node *temp;
    int HT_LP[SIZE] = {0};
    int HT_QP[SIZE] = {0};
    int HT_DH[SIZE] = {0};
    int choice, element, key, result;
    for (int i = 0; i < SIZE; i++)
        HT_SC[i] = NULL;
    do
    {
        printf("\nMenu:\n");
        printf("1. Separate Chaining\n");
        printf("2. Linear Probing\n");
        printf("3. Quadratic Probing\n");
        printf("4. Double Hashing\n");
        printf("5. Print Hash Tables\n");
        printf("6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch (choice)
        {
        case 1:
            printf("Enter an element to insert: ");
            scanf("%d", &element);
            Insert(HT_SC, element);
            printf("Enter an element to search: ");
            scanf("%d", &key);
            temp = Search(HT_SC[hash(key)], key);
            if (temp != NULL)
            {
                printf("Element found: %d\n", temp->data);
            }
            else
            {
                printf("Element not found.\n");
            }
            break;
        case 2:
            printf("Enter an element to insert: ");
            scanf("%d", &element);
            InsertLinear(HT_LP, element);
            printf("Enter an element to search: ");
            scanf("%d", &key);
            result = LinearProbe(HT_LP, key);
            if (result != -1)
```



```
            {
                printf("Key found at: %d\n", result);
            }
            else
            {
                printf("Key not found.\n");
            }
            break;
        case 3:
            printf("Enter an element to insert: ");
            scanf("%d", &element);
            InsertQuadratic(HT_QP, element);
            printf("Enter an element to search: ");
            scanf("%d", &key);
            result = QuadraticProbe(HT_QP, key);
            if (result != -1)
            {
                printf("Key found at: %d\n", result);
            }
            else
            {
                printf("Key not found.\n");
            }
            break;
        case 4:
            printf("Enter an element to insert: ");
            scanf("%d", &element);
            InsertDoubleHash(HT_DH, element);
            printf("Enter an element to search: ");
            scanf("%d", &key);
            result = DoubleHash(HT_DH, key);
            if (result != -1)
            {
                printf("Key found at: %d\n", result);
            }
            else
            {
                printf("Key not found.\n");
            }
            break;
        case 5:
            PrintHashTable(HT_SC, SIZE);
            Print(HT_LP, SIZE, "HT Linear Probing");
            Print(HT_QP, SIZE, "HT Quadratic Probing");
            Print(HT_DH, SIZE, "HT Double Hashing");
            break;
        case 6:
            printf("Exiting...\n");
```

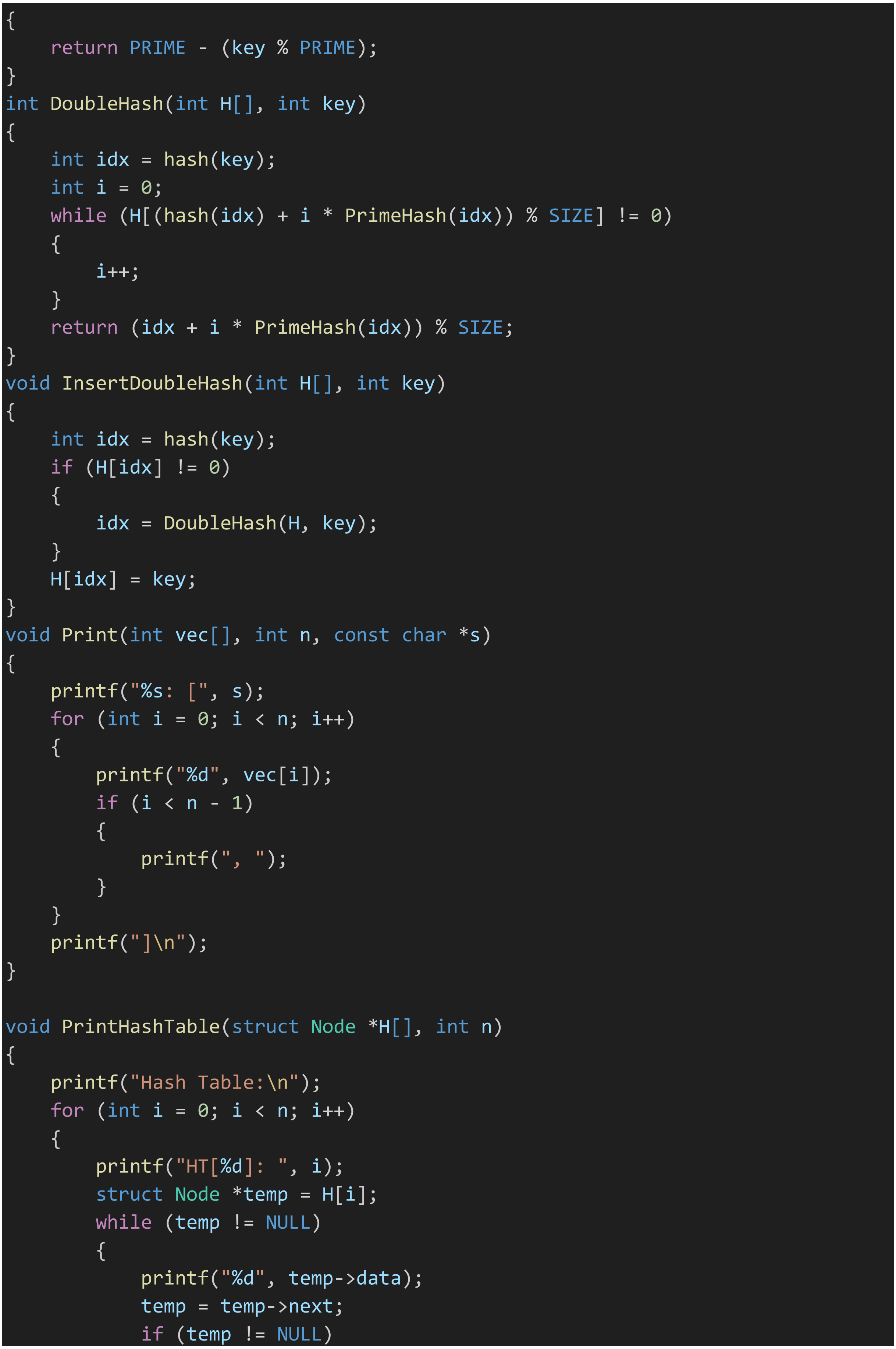


```
            break;
        default:
            printf("Invalid choice. Please enter a valid option.\n");
            break;
        }
    } while (choice != 6);
    return 0;
}
void SortedInsert(struct Node **H, int x)
{
    struct Node *t, *q = NULL, *p = *H;
    t = (struct Node *)malloc(sizeof(struct Node));
    t->data = x;
    t->next = NULL;
    if (*H == NULL)
        *H = t;
    else
    {
        while (p && p->data < x)
        {
            q = p;
            p = p->next;
        }
        if (p == *H)
        {
            t->next = *H;
            *H = t;
        }
        else
        {
            t->next = q->next;
            q->next = t;
        }
    }
}
struct Node *Search(struct Node *p, int key)
{
    while (p != NULL)
    {
        if (key == p->data)
        {
            return p;
        }
        p = p->next;
    }
    return NULL;
}
int hash(int key)
```



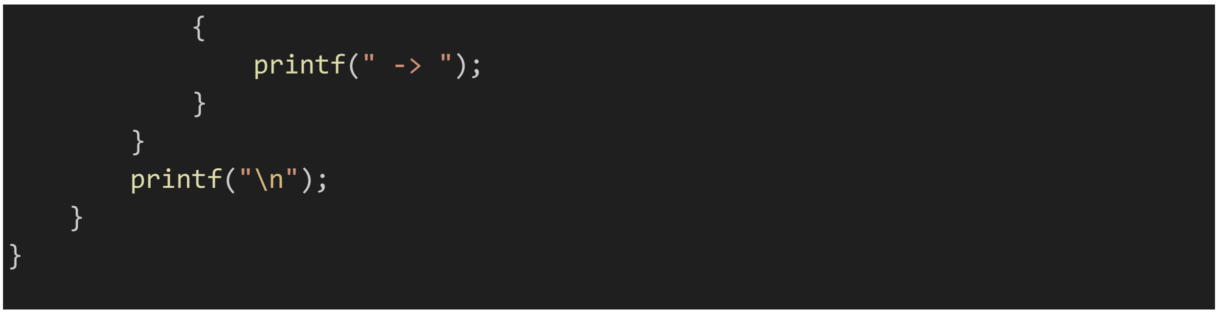
```
{
    return key % SIZE;
}
void Insert(struct Node *H[], int key)
{
    int index = hash(key);
    SortedInsert(&H[index], key);
}
int LinearProbe(int H[], int key)
{
    int idx = hash(key);
    int i = 0;
    while (H[(idx + i) % SIZE] != 0)
    {
        i++;
    }
    return (idx + i) % SIZE;
}

void InsertLinear(int H[], int key)
{
    int idx = hash(key);
    if (H[idx] != 0)
    {
        idx = LinearProbe(H, key);
    }
    H[idx] = key;
}
int QuadraticProbe(int H[], int key)
{
    int idx = hash(key);
    int i = 0;
    while (H[(idx + i * i) % SIZE] != 0)
    {
        i++;
    }
    return (idx + i * i) % SIZE;
}
void InsertQuadratic(int H[], int key)
{
    in idx = hash(key);
    if (H[idx] != 0)
    {
        idx = QuadraticProbe(H, key);
    }
    H[idx] = key;
}
int PrimeHash(int key)
```



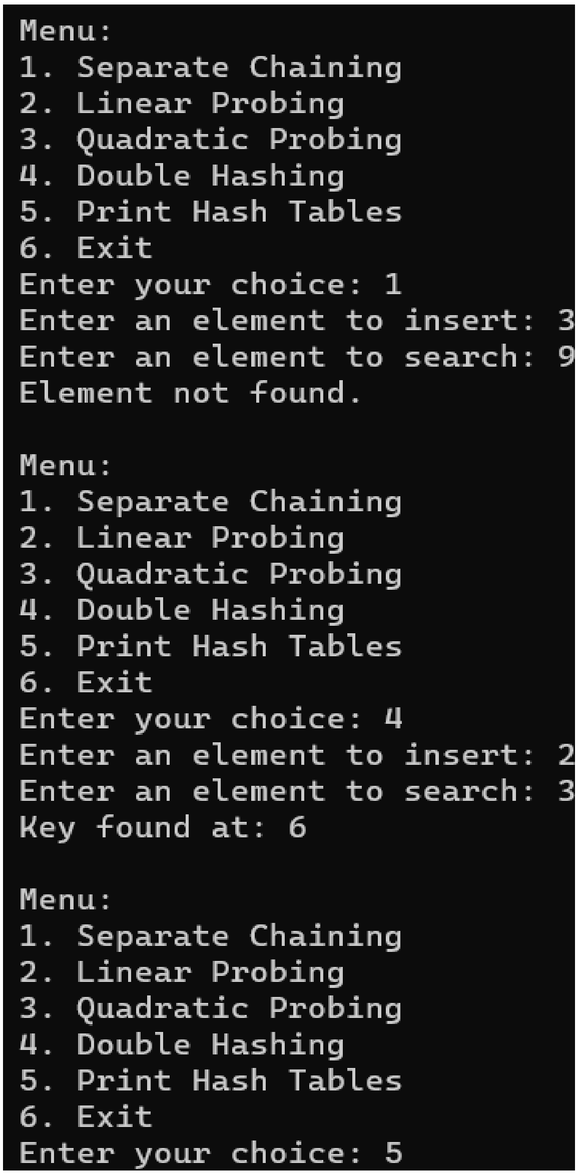
```
{
    return PRIME - (key % PRIME);
}
int DoubleHash(int H[], int key)
{
    int idx = hash(key);
    int i = 0;
    while (H[(hash(idx) + i * PrimeHash(idx)) % SIZE] != 0)
    {
        i++;
    }
    return (idx + i * PrimeHash(idx)) % SIZE;
}
void InsertDoubleHash(int H[], int key)
{
    int idx = hash(key);
    if (H[idx] != 0)
    {
        idx = DoubleHash(H, key);
    }
    H[idx] = key;
}
void Print(int vec[], int n, const char *s)
{
    printf("%s: [", s);
    for (int i = 0; i < n; i++)
    {
        printf("%d", vec[i]);
        if (i < n - 1)
        {
            printf(", ");
        }
    }
    printf("]\n");
}

void PrintHashTable(struct Node *H[], int n)
{
    printf("Hash Table:\n");
    for (int i = 0; i < n; i++)
    {
        printf("HT[%d]: ", i);
        struct Node *temp = H[i];
        while (temp != NULL)
        {
            printf("%d", temp->data);
            temp = temp->next;
            if (temp != NULL)
```



```
            {
                printf(" -> ");
            }
        }
        printf("\n");
    }
}
```

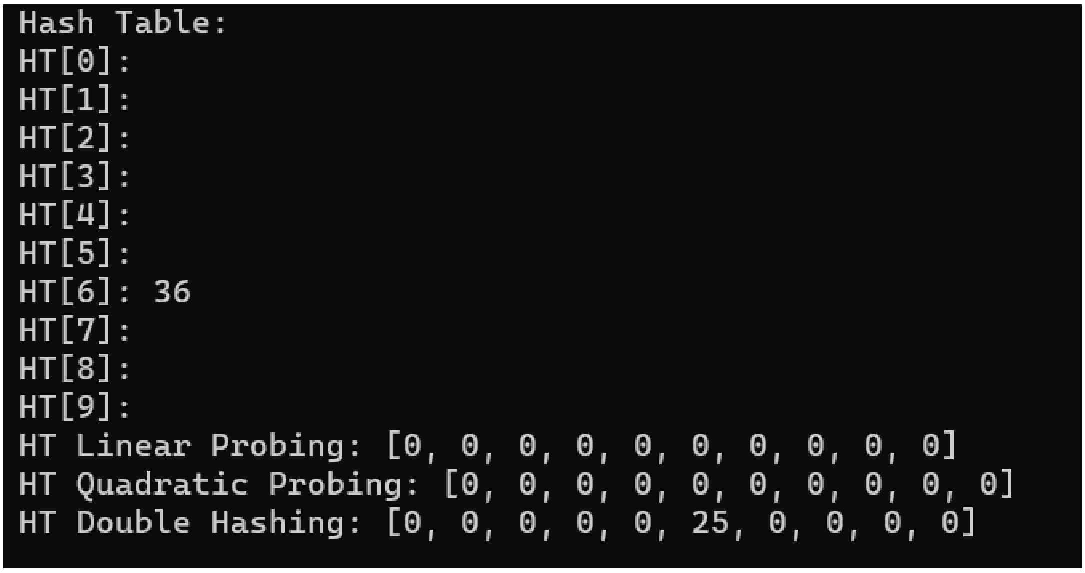
Output :



```
Menu:
1. Separate Chaining
2. Linear Probing
3. Quadratic Probing
4. Double Hashing
5. Print Hash Tables
6. Exit
Enter your choice: 1
Enter an element to insert: 3
Enter an element to search: 9
Element not found.

Menu:
1. Separate Chaining
2. Linear Probing
3. Quadratic Probing
4. Double Hashing
5. Print Hash Tables
6. Exit
Enter your choice: 4
Enter an element to insert: 2
Enter an element to search: 3
Key found at: 6

Menu:
1. Separate Chaining
2. Linear Probing
3. Quadratic Probing
4. Double Hashing
5. Print Hash Tables
6. Exit
Enter your choice: 5
```



```
Hash Table:
HT[0]:
HT[1]:
HT[2]:
HT[3]:
HT[4]:
HT[5]:
HT[6]: 36
HT[7]:
HT[8]:
HT[9]:
HT Linear Probing: [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
HT Quadratic Probing: [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
HT Double Hashing: [0, 0, 0, 0, 0, 25, 0, 0, 0, 0]
```