

Course Name: Data Structures and Algorithms Lab

Course code : MCSE501P

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Lab Assessment – 2

List of programs:

6. Write a program in C to convert infix form of an algebraic expression into postfix form using stack. Get the input from the keyboard.
7. Write a program in C to implement the following data structures: Singly linked list, doubly linked list, singly linked circular list, doubly linked circular list. Perform insertion and deletion on these data structures.
8. Write a program in C to perform radix sort
9. Write a program in C to perform insertion sort
10. Write a program in C to perform merge sort
11. Write a program in C to perform selection sort

6. Write a program in C to convert infix form of an algebraic expression into postfix form using stack. Get the input from the keyboard.

Program:-

```
#include <limits.h>
#include <stdio.h>
#include <stdlib.h>
#define MAX 20
char stk[20];
int top = -1;
int isEmpty()
{
    return top == -1;
}
int isFull()
{
    return top == MAX - 1;
}
char peek()
{
    return stk[top];
}
char pop()
{
    if(isEmpty())
        return -1;
    char ch = stk[top];
    top--;
    return(ch);
}
void push(char oper)
{
    if(isFull())
        printf("Stack Full!!!!");
    else{
        top++;
        stk[top] = oper;
    }
}
int checkIfOperand(char ch)
{
    return (ch >= 'a' && ch <= 'z') || (ch >= 'A' && ch <= 'Z');
}
int precedence(char ch)
{
    switch (ch)
    {
        case '+':
        case '-':
            return 1;
        case '*':
        case '/':
            return 2;
        case '^':
```

```
        return 3;
    }
    return -1;
}
int covertInfixToPostfix(char* expression)
{
    int i, j;
    for (i = 0, j = -1; expression[i]; ++i)
    {
        if (checkIfOperand(expression[i]))
            expression[++j] = expression[i];
        else if (expression[i] == '(')
            push(expression[i]);
        else if (expression[i] == ')')
        {
            while (!isEmpty() && peek() != '(')
                expression[++j] = pop();
            if (!isEmpty() && peek() != '(')
                return -1;
            else
                pop();
        }
        else
        {
            while (!isEmpty() && precedence(expression[i]) <= precedence(peek()))
                expression[++j] = pop();
            push(expression[i]);
        }
    }
    printf("postfix expression :: \t");
    while (!isEmpty())
        expression[++j] = pop();
    expression[++j] = '\0';
    printf( "%s\n", expression);
}
int main()
{
    char exp[100];
    char *e, x;
    printf("\nEnter the expression : ");
    scanf("%s",exp);
    e = exp;
    covertInfixToPostfix(exp);
    return 0;
}
```

Output:-

```

PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./infix_podtfix1
Enter the expression : a+b
postfix expression :: ab+
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./infix_podtfix1
Enter the expression : (a+b)
postfix expression :: ab+
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./infix_podtfix1
Enter the expression : a+b-c*d/f
postfix expression :: ab+cd*f/-
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./infix_podtfix1
Enter the expression : (a+b)*d/(f^g)
postfix expression :: ab+d*f^g/
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./infix_podtfix1
Enter the expression : (((a+b)*c)/d+((w^f)^T)/g)*r+)
postfix expression :: ab+c*d/wf^T^g/r*++

```

7. Write a program in C to implement the following data structures: Singly linked list, doubly linked list, singly linked circular list, doubly linked circular list. Perform insertion and deletion on these data structures.

7.1. Singly linked list

Program:-

```

#include<stdio.h>
#include<stdlib.h>
struct node
{
    int data;
    struct node *next;
};
struct node *head;

void begininsert ();
void lastinsert ();
void randominsert();
void begin_delete();
void last_delete();
void random_delete();
void display();
void search();
void main ()
{
    int choice =0;
    while(choice != 9)
    {
        printf("\nChoose one option from the following list ...\n");
        printf("\n1.Insert in beginning\n2.Insert at last\n3.Insert at any random location\n4.Delete from Beginning\n5.Delete from last\n6.Delete node after specified location\n7.Show\n8.Exit\n");
        printf("\nEnter your choice?\n");
        scanf("\n%d",&choice);
        switch(choice)
        {
            case 1:
                begininsert();
                break;
            case 2:

```

```
        lastinsert();
        break;
    case 3:
        randominsert();
        break;
    case 4:
        begin_delete();
        break;
    case 5:
        last_delete();
        break;
    case 6:
        random_delete();
        break;
    case 7:
        display();
        break;
    case 8:
        exit(0);
        break;
    default:
        printf("Please enter valid choice..");
    }
}
}
void begininsert()
{
    struct node *ptr;
    int item;
    ptr = (struct node *) malloc(sizeof(struct node *));
    if(ptr == NULL)
    {
        printf("\nOVERFLOW");
    }
    else
    {
        printf("\nEnter value\n");
        scanf("%d",&item);
        ptr->data = item;
        ptr->next = head;
        head = ptr;
        printf("\nNode inserted");
    }
}
void lastinsert()
{
    struct node *ptr,*temp;
    int item;
    ptr = (struct node*)malloc(sizeof(struct node));
    if(ptr == NULL)
    {
        printf("\nOVERFLOW");
    }
}
```

```
else
{
    printf("\nEnter value?\n");
    scanf("%d",&item);
    ptr->data = item;
    if(head == NULL)
    {
        ptr -> next = NULL;
        head = ptr;
        printf("\nNode inserted");
    }
    else
    {
        temp = head;
        while (temp -> next != NULL)
        {
            temp = temp -> next;
        }
        temp->next = ptr;
        ptr->next = NULL;
        printf("\nNode inserted");
    }
}
}
void randominsert()
{
    int i,loc,item;
    struct node *ptr, *temp;
    ptr = (struct node *) malloc (sizeof(struct node));
    if(ptr == NULL)
    {
        printf("\nOVERFLOW");
    }
    else
    {
        printf("\nEnter element value");
        scanf("%d",&item);
        ptr->data = item;
        printf("\nEnter the location after which you want to insert ");
        scanf("\n%d",&loc);
        temp=head;
        for(i=0;i<loc;i++)
        {
            temp = temp->next;
            if(temp == NULL)
            {
                printf("\ncan't insert\n");
                return;
            }
        }
        ptr ->next = temp ->next;
        temp ->next = ptr;
```

```
        printf("\nNode inserted");
    }
}
void begin_delete()
{
    struct node *ptr;
    if(head == NULL)
    {
        printf("\nList is empty\n");
    }
    else
    {
        ptr = head;
        head = ptr->next;
        free(ptr);
        printf("\nNode deleted from the begining ...\n");
    }
}
void last_delete()
{
    struct node *ptr,*ptr1;
    if(head == NULL)
    {
        printf("\nlist is empty");
    }
    else if(head->next == NULL)
    {
        head = NULL;
        free(head);
        printf("\nOnly node of the list deleted ...\n");
    }

    else
    {
        ptr = head;
        while(ptr->next != NULL)
        {
            ptr1 = ptr;
            ptr = ptr->next;
        }
        ptr1->next = NULL;
        free(ptr);
        printf("\nDeleted Node from the last ...\n");
    }
}
void random_delete()
{
    struct node *ptr,*ptr1;
    int loc,i;
    printf("\n Enter the location of the node after which you want to perform deletion \n");
    scanf("%d",&loc);
    ptr=head;
    for(i=0;i<loc;i++)
    {
```

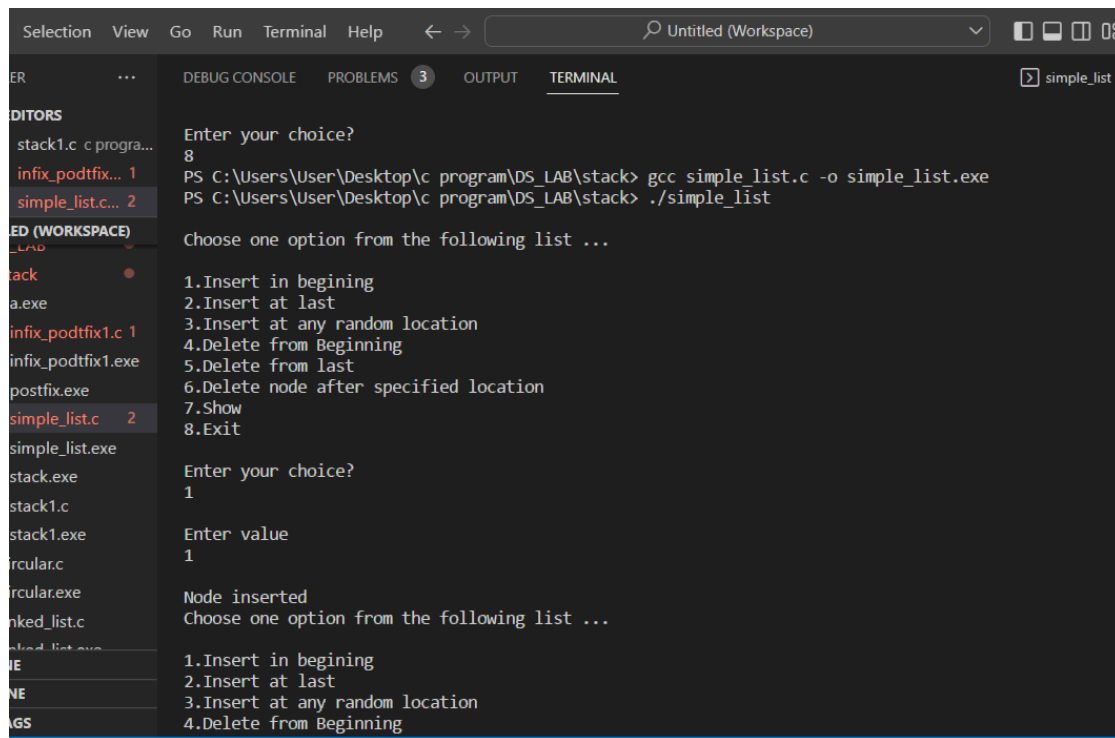
```
    ptr1 = ptr;
    ptr = ptr->next;

    if(ptr == NULL)
    {
        printf("\nCan't delete");
        return;
    }
}
ptr1 ->next = ptr ->next;
free(ptr);
printf("\nDeleted node %d ",loc+1);
}

void display()
{
    struct node *ptr;
    ptr = head;
    if(ptr == NULL)
    {
        printf("Nothing to print");
    }
    else
    {
        printf("\nprinting values . . . . \n");
        while (ptr!=NULL)
        {
            printf("\t%d",ptr->data);
            ptr = ptr -> next;
        }
    }
}
```

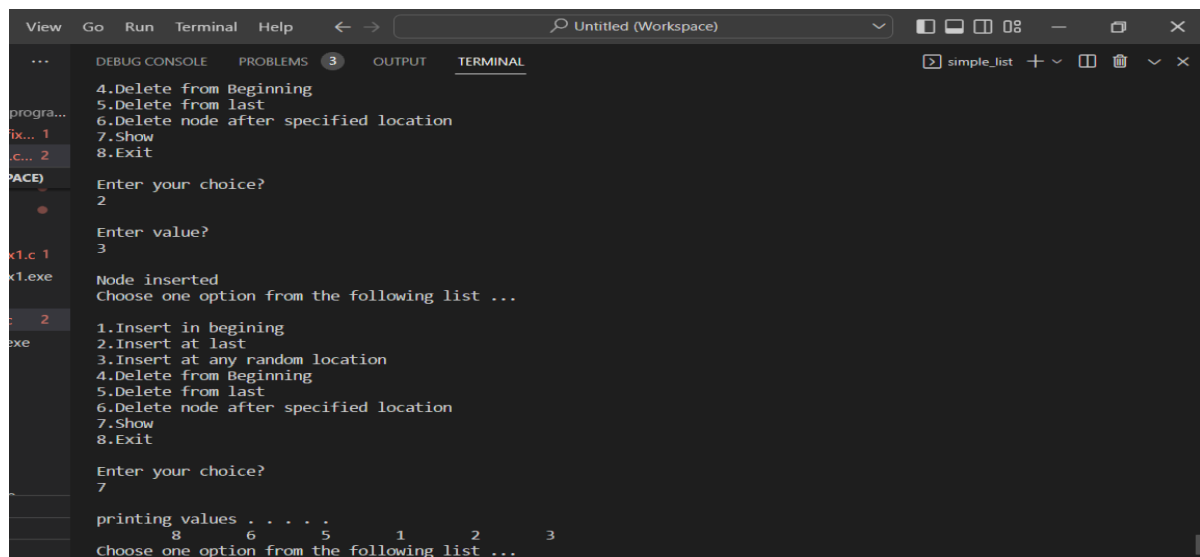
Output:-

Insertion at beginning:-



```
Selection View Go Run Terminal Help ← → Untitled (Workspace)
DEBUG CONSOLE PROBLEMS 3 OUTPUT TERMINAL simple_list
EDITORS
stack1.c c progra...
infix_podtfix... 1
simple_list.c... 2
EDITED (WORKSPACE)
stack1.c
stack1.exe
infix_podtfix1.c 1
infix_podtfix1.exe
postfix.exe
simple_list.c 2
simple_list.exe
stack.exe
stack1.c
stack1.exe
circular.c
circular.exe
linked_list.c
linked_list.exe
LINKER
NONE
TAGS
Enter your choice?
8
PS C:\Users\User\Desktop\c program\DS_LAB\stack> gcc simple_list.c -o simple_list.exe
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./simple_list
Choose one option from the following list ...
1.Insert in begining
2.Insert at last
3.Insert at any random location
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit
Enter your choice?
1
Enter value
1
Node inserted
Choose one option from the following list ...
1.Insert in begining
2.Insert at last
3.Insert at any random location
4.Delete from Beginning
```

Insertion at last:



```
View Go Run Terminal Help ← → Untitled (Workspace)
DEBUG CONSOLE PROBLEMS 3 OUTPUT TERMINAL simple_list + ~ [] X
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit
Enter your choice?
2
Enter value?
3
Node inserted
Choose one option from the following list ...
1.Insert in begining
2.Insert at last
3.Insert at any random location
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit
Enter your choice?
7
printing values . . . . .
8 6 5 1 2 3
Choose one option from the following list ...
```

Insertion at any location:-

```
DEBUG CONSOLE  PROBLEMS 3  OUTPUT  TERMINAL
Enter your choice?
3
Enter element value3
Enter the location after which you want to insert 1
Node inserted
Choose one option from the following list ...

1.Insert in begining
2.Insert at last
3.Insert at any random location
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit

Enter your choice?
7

printing values . . . . .
      1      2      3
Choose one option from the following list ...

1.Insert in begining
```

Deletion:-

List before deletion:-

```
Enter your choice?
7

printing values . . . . .
      4      8      6      5      3      1      2      3
Choose one option from the following list ...
```

Deletion at beginning:

```
6.Delete node after specified location
7.Show
8.Exit

Enter your choice?
4

Node deleted from the begining ...

Choose one option from the following list ...

1.Insert in begining
2.Insert at last
3.Insert at any random location
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit

Enter your choice?
7

printing values . . . . .
      8      6      5      3      1      2      3
Choose one option from the following list ...

1.Insert in begining
2.Insert at last
```

Deletion at last

```
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit

Enter your choice?
5

Deleted Node from the last ...

Choose one option from the following list ...

1.Insert in begining
2.Insert at last
3.Insert at any random location
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit

Enter your choice?
7

printing values . . . . .
      8      6      5      3      1      2
Choose one option from the following list ...

1.Insert in beginning
```

Deletion at given location:-

```
Go Run Terminal Help ← → Untitled (Workspace)
DEBUG CONSOLE PROBLEMS 3 OUTPUT TERMINAL
7.Show
8.Exit

Enter your choice?
6

Enter the location of the node after which you want to perform deletion
3

Deleted node 4
Choose one option from the following list ...

1.Insert in beginning
2.Insert at last
3.Insert at any random location
4.Delete from Beginning
5.Delete from last
6.Delete node after specified location
7.Show
8.Exit

Enter your choice?
7

printing values . . . . .
      8      6      5      1      2
Choose one option from the following list ...

1.Insert in beginning
2.Insert at last
```

7.2. doubly linked list

Code:-

```
#include<stdio.h>
#include<stdlib.h>
struct node
{
    struct node* prev;
    int data;
    struct node* next;
};
struct node* head = NULL;
void insert_at_beginning(int);
void insert_at_end(int);
void insert_at_position(int, int);
void delete_from_beginning();
void delete_from_position(int);
void delete_from_end();
```

```
void print_from_beginning();
void print_from_end(struct node*);
void search_data(int);
void update_node_data(int, int);
void list_sort();
struct node* create_node(int);
int size_of_list();
int getData();
int getPosition();
void empty_list_message();
void memory_error_message();
void invalid_position_message();
int main()
{
    // char user_active = 'Y';
    int user_choice;
    int data, position;
    while (1)
    {
        printf("-----Nidhi singh 22MAI0015-----");
        printf("\n\n----- Doubly Linked List -----");
        printf("\n1. Insert a node at the beginning");
        printf("\n2. Insert a node at the end");
        printf("\n3. Insert a node at the given position");
        printf("\n4. Delete a node from the beginning");
        printf("\n5. Delete a node from the end");
        printf("\n6. Delete a node from the given position");
        printf("\n7. Print list from the beginning");
        printf("\n8. Search a node data");
        printf("\n9. Exit");
        printf("\n\n-----");
        printf("\nEnter your choice: ");
        scanf("%d", &user_choice);
        printf("\n-----");
        switch(user_choice)
        {
            case 1:
                printf("\nInserting a node at beginning");
                data = getData();
                insert_at_beginning(data);
                break;
            case 2:
                printf("\nInserting a node at end");
                data = getData();
                insert_at_end(data);
                break;
            case 3:
                printf("\nInserting a node at the given position");
                data = getData();
                position = getPosition();
                insert_at_position(data, position);
                break;
            case 4:
                printf("\nDeleting a node from beginning\n");
```

```
delete_from_beginning();
break;
case 5:
printf("\nDeleting a node from end\n");
delete_from_end();
break;
case 6:
printf("\nDelete a node from given position\n");
position = getPosition();
delete_from_position(position);
break;
case 7:
printf("\nPrinting the list from beginning\n\n");
print_from_beginning();
break;
case 8:
printf("\nSearching the node data");
data = getData();
search_data(data);
break;
case 9:
printf("\nProgram was terminated\n\n");
return 0;
default:
printf("\n\tInvalid Choice\n");
}
printf("\n.....\n");
// printf("\nDo you want to continue? (Y/N) : ");
// fflush(stdin);
// scanf("%c", &user_active);
}
return 0;
}
void memory_error_message()
{
printf("\nMemory was not allocated!\n");
}
void invalid_position_message()
{
printf("\nInvalid position!\n");
}
void empty_list_message()
{
printf("\nList is Empty!\n");
}
struct node* create_node(int data)
{
struct node* new_node = (struct node*) malloc(sizeof(struct
node));
if (new_node == NULL)
{
return NULL;
}
else
```

```
{
new_node->prev = NULL;
new_node->data = data;
new_node->next = NULL;
}
}
void insert_at_beginning(int data)
{
struct node* new_node = create_node(data);
if (new_node == NULL)
{
memory_error_message();
return;
}
else if(head == NULL)
{
head = new_node;
}
else
{
new_node->next = head;
head->prev = new_node;
head = new_node;
}
printf("\n* Node with data %d was inserted \n", data);
}
void insert_at_end(int data)
{
struct node* new_node = create_node(data);
if (new_node == NULL)
{
memory_error_message();
return;
}
else if (head == NULL)
{
head = new_node;
}
else
{
struct node* temp = head;
while (temp->next != NULL)
{
temp = temp->next;
}
temp->next = new_node;
new_node->prev = temp;
}
printf("\n* Node with data %d was inserted \n", data);
}
void insert_at_position(int data, int pos)
{
struct node* new_node = create_node(data);
int size = size_of_list();
```

```
if (new_node == NULL)
{
memory_error_message();
return;
}
else if (head != NULL && (pos < 1 || pos > size))
{
invalid_position_message();
return;
}
else if (head == NULL && pos == 1)
{
head = new_node;
}
else if (head != NULL && pos == 1)
{
new_node->next = head;
head->prev = new_node;
head = new_node;
}
else
{
struct node* temp = head;
int count = 1;
while (++count < pos)
{
temp = temp->next;
}
temp->next->prev = new_node;
new_node->next = temp->next;
temp->next = new_node;
new_node->prev = temp;
}
printf("\n* Node with data %d was inserted \n", data);
}
void delete_from_beginning()
{
if (head == NULL)
{
empty_list_message();
return;
}
struct node* temp = head;
head = head->next;
int data = temp->data;
free(temp);
printf("\n* Node with data %d was deleted \n", data);
}
void delete_from_end()
{
if (head == NULL)
{
empty_list_message();
return;
}
```

```
}
struct node* temp = head;
int data = 0;
while (temp->next != NULL)
{
temp = temp->next;
}
if (temp->prev == NULL)
{
head = NULL;
}
else
{
temp->prev->next = temp->next;
}
data = temp->data;
free(temp);
printf("\n* Node with data %d was deleted \n", data);
}

void delete_from_position(int pos)
{
if (head == NULL)
{
empty_list_message();
return;
}
int size = size_of_list();
struct node* temp = head;
int data = 0;
if (pos < 1 || pos > size)
{
invalid_position_message();
return;
}
else if (pos == 1)
{
head = head->next;
data = head->data;
free(temp);
printf("\n* Node with data %d was deleted \n", data);
}
else
{
int count = 0;
while (++count < pos)
{
temp = temp->next;
}
temp->prev->next = temp->next;
if (pos != size)
{
temp->next->prev = temp->prev;
}
data = temp->data;
}
```

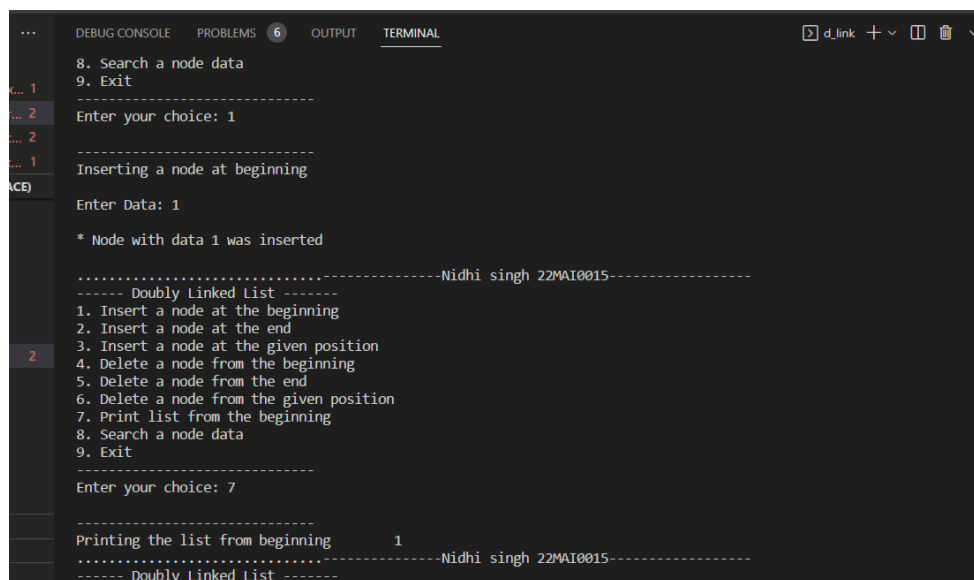


```
free(temp);
printf("\n* Node with data %d was deleted \n", data);
}
}
void print_from_beginning()
{
    struct node* temp = head;
    while (temp != NULL)
    {
        printf("%d ", temp->data);
        temp = temp->next;
    }
}
void search_data(int data)
{
    struct node* temp = head;
    int position = 0;
    int flag = 0;
    while (temp != NULL)
    {
        position += 1;
        if (temp->data == data)
        {
            flag = 1;
            break;
        }
        temp = temp->next;
    }
    if (flag == 0)
    {
        printf("\nNode with data %d was not found\n", data);
    }
    else
    {
        printf("\nNode found at %d position\n", position);
    }
}
int getData()
{
    int data;
    printf("\n\nEnter Data: ");
    scanf("%d", &data);
    return data;
}
int getPosition()
{
    int position;
    printf("\n\nEnter Position: ");
    scanf("%d", &position);
    return position;
}
int size_of_list()
{
    struct node* temp = head;
```

```
int count = 0;
while (temp != NULL)
{
    count += 1;
    temp = temp->next;
}
return count;
}
```

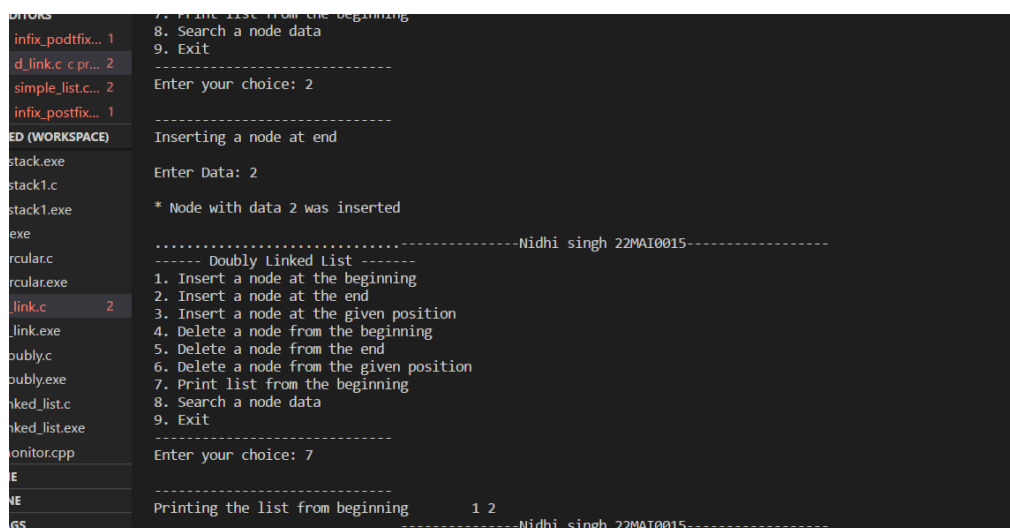
Output:-

Insertion at beginning:-



```
DEBUG CONSOLE  PROBLEMS 6  OUTPUT  TERMINAL
8. Search a node data
9. Exit
-----
Enter your choice: 1
-----
Inserting a node at beginning
Enter Data: 1
* Node with data 1 was inserted
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning
2. Insert a node at the end
3. Insert a node at the given position
4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 7
-----
Printing the list from beginning      1
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
```

Insertion at last:-



```
infix_postfix... 1
d_link.c c pr... 2
simple_list.c... 2
infix_postfix... 1
ED (WORKSPACE)
stack.exe
stack1.c
stack1.exe
exe
rcular.c
rcular.exe
link.c 2
link.exe
publy.c
publy.exe
nked_list.c
nked_list.exe
onitor.cpp
E
NE
GS
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 2
-----
Inserting a node at end
Enter Data: 2
* Node with data 2 was inserted
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning
2. Insert a node at the end
3. Insert a node at the given position
4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 7
-----
Printing the list from beginning      1 2
-----Nidhi singh 22MAI0015-----
```

Insertion at given location:-

```

Enter your choice: 3
-----
Inserting a node at the given position
Enter Data: 3
Enter Position: 1
* Node with data 3 was inserted
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning
2. Insert a node at the end
3. Insert a node at the given position
4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 7
-----
Printing the list from beginning      3 1 2
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning

```

Deletion at beginning

```

6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 4
-----
Deleting a node from beginning
* Node with data 3 was deleted
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning
2. Insert a node at the end
3. Insert a node at the given position
4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 7
-----
Printing the list from beginning      1 2
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning

```

Deletion at last

```

4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 5
-----
Deleting a node from end
* Node with data 2 was deleted
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning
2. Insert a node at the end
3. Insert a node at the given position
4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 7
-----
Printing the list from beginning      1
-----Nidhi singh 22MAI0015-----

```

Deletion at given location

```

1. Insert a node at the beginning
2. Insert a node at the end
3. Insert a node at the given position
4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: 6

-----
Delete a node from given position
Enter Position: 2

Invalid position!
-----Nidhi singh 22MAI0015-----
----- Doubly Linked List -----
1. Insert a node at the beginning
2. Insert a node at the end
3. Insert a node at the given position
4. Delete a node from the beginning
5. Delete a node from the end
6. Delete a node from the given position
7. Print list from the beginning
8. Search a node data
9. Exit
-----
Enter your choice: █

```

7.3. singly linked circular list

```

#include<stdio.h>
#include<stdlib.h>
struct node
{
int data;
struct node *next;
};
struct node *head;
void beginsert ();
void lastinsert ();
void randominsert();
void begin_delete();
void last_delete();
void random_delete();
void display();
void search();
void main ()
{
int choice =0;
while(choice != 7)
{
printf("\n***** Main Menu*****\n");
printf("\nChoose one option from the following list ...\n");
printf("\n===== \n");
printf("\n1.Insert in begining\n2.Insert at last\n3.Delete from Beginning\n");
printf("\n4.Delete from last\n5.Search for an element\n6.Show\n7.Exit\n");
printf("\nEnter your choice?\n");
scanf("\n%d",&choice);
switch(choice)
{
case 1:
beginsert();
break;
case 2:

```

```
lastinsert();
break;
case 3:
begin_delete();
break;
case 4:
last_delete();
break;
case 5:
search();
break;
case 6:
display();
break;
case 7:
exit(0);
break;
default:
printf("Please enter valid choice..");
}
}
}
void beginsert()
{
struct node *ptr,*temp;
int item;
ptr = (struct node *)malloc(sizeof(struct node));
if(ptr == NULL)
{
printf("\nOVERFLOW");
}
else
{
printf("\nEnter the node data?");
scanf("%d",&item);
ptr->data = item;
if(head == NULL)
{
head = ptr;
ptr->next = head;
}
else
{
temp = head;
while(temp->next != head)
temp = temp->next;
ptr->next = head;
temp->next = ptr;
head = ptr;
}
printf("\nnode inserted\n");
}
}
void lastinsert()
```

```
{
struct node *ptr,*temp;
int item;
ptr = (struct node *)malloc(sizeof(struct node));
if(ptr == NULL)
{
printf("\nOVERFLOW\n");
}
else
{
printf("\nEnter Data?");
scanf("%d",&item);
ptr->data = item;
if(head == NULL)
{
head = ptr;
ptr->next = head;
}
else
{
temp = head;
while(temp->next != head)
{
temp = temp->next;
}
temp->next = ptr;
ptr->next = head;
}
printf("\nnode inserted\n");
}
}

void begin_delete()
{
struct node *ptr;
if(head == NULL)
{
printf("\nUNDERFLOW");
}
else if(head->next == head)
{
head = NULL;
free(head);
printf("\nnode deleted\n");
}
else
{
ptr = head;
while(ptr->next != head)
ptr = ptr->next;
ptr->next = head->next;
free(head);
head = ptr->next;
printf("\nnode deleted\n");
}
}
```

```
void last_delete()
{
    struct node *ptr, *preptr;
    if(head==NULL)
    {
        printf("\nUNDERFLOW");
    }
    else if (head ->next == head)
    {
        head = NULL;
        free(head);
        printf("\nnode deleted\n");
    }
    else
    {
        ptr = head;
        while(ptr ->next != head)
        {
            preptr=ptr;
            ptr = ptr->next;
        }
        preptr->next = ptr -> next;
        free(ptr);
        printf("\nnode deleted\n");
    }
}

void search()
{
    struct node *ptr;
    int item,i=0,flag=1;
    ptr = head;
    if(ptr == NULL)
    {
        printf("\nEmpty List\n");
    }
    else
    {
        printf("\nEnter item which you want to search?\n");
        scanf("%d",&item);
        if(head ->data == item)
        {
            printf("item found at location %d",i+1);
            flag=0;
        }
        else
        {
            while (ptr->next != head)
            {
                if(ptr->data == item)
                {
                    printf("item found at location %d ",i+1);
                    flag=0;
                    break;
                }
            }
        }
    }
}
```

```
else
{
flag=1;
}
i++;
ptr = ptr -> next;
}
}
if(flag != 0)
{
printf("Item not found\n");
}
}
}
void display()
{
struct node *ptr;
ptr=head;
if(head == NULL)
{
printf("\nnothing to print");
}
else
{
printf("\n printing values ... \n");
while(ptr -> next != head)
{
printf("%d\n", ptr -> data);
ptr = ptr -> next;
}
printf("%d\n", ptr -> data);
}
}
```

Output:-

Insertion at beginning:-


```
... DEBUG CONSOLE PROBLEMS 8 OUTPUT TERMINAL
5.Search for an element
6.Show
7.Exit
1
2
2 Enter your choice?
2 1
1 Enter the node data?1
2 node inserted
2 *****Main Menu*****
Choose one option from the following list ...
=====
2 1.Insert in begining
2 2.Insert at last
2 3.Delete from Beginning
2 4.Delete from last
2 5.Search for an element
2 6.Show
2 7.Exit
2 Enter your choice?
6
printing values ...
1
```

Insertion at last:-

```
RS 7.Exit
k_podtfix... 1 Enter your choice?
nk.c c pr... 2 2
c.c.c c pr... 2 Enter Data?2
ple_list.c... 2 node inserted
k_podtfix... 1 *****Main Menu*****
WORKSPACE) Choose one option from the following list ...
c =====
.exe 1.Insert in begining
y.c 2.Insert at last
y.exe 3.Delete from Beginning
_list.c 4.Delete from last
_list.exe 5.Search for an element
c 6.Show
c 7.Exit
.exe Enter your choice?
or.cpp 6
k.c printing values ...
k.exe 1
am_1.c 2
```

Deletion at beginning

```
EDITORS
infix_podtfix... 1 1.Insert in begining
d_link.c c pr... 2 2.Insert at last
list_circ.c pr... 2 3.Delete from Beginning
simple_list.c... 2 4.Delete from last
infix_podtfix... 1 5.Search for an element
6.Show
7.Exit
LED (WORKSPACE) Enter your choice?
link.c 3
link.exe node deleted
oubly.c
oubly.exe
```

Deletion at last

```

EDITORS
infix_postfix... 1
d_link.c pr... 2
list_circ.c pr... 2
simple_list.c... 2
infix_postfix... 1
ED (WORKSPACE)
link.c 2
link.exe
publy.c
publy.exe
linked_list.c
linked_list.exe
st_circ 2
st_circ.exe
monitor.cpp
postfix.c
postfix.exe
rogram_1.c
-----
E
NE
6
6.Show
7.Exit
Enter your choice?
4
node deleted
*****Main Menu*****
Choose one option from the following list ...
=====
1.Insert in begining
2.Insert at last
3.Delete from Beginning
4.Delete from last
5.Search for an element
6.Show
7.Exit
Enter your choice?
6
printing values ...
4
3
2

```

Search

```

1.Insert in begining
2.Insert at last
3.Delete from Beginning
4.Delete from last
5.Search for an element
6.Show
7.Exit
Enter your choice?
5
Enter item which you want to search?
3
item found at location 2
*****Main Menu*****

```

7.4.doubly linked circular list

Insertion at beginning:-

```

4.Delete from last
5.Search
6.Show
7.Exit
1
2
2
Enter your choice?
1
Enter Item value1
Node inserted
*****Main Menu*****
2
Choose one option from the following list ...
=====
1.Insert in Beginning
2.Insert at last
3.Delete fromBeginning
4.Delete from last
5.Search
6.Show
7.Exit
Enter your choice?
6
printing values ...

```

Insertion at last:-

```

Enter your choice?
2

Enter value3

node inserted

*****Main Menu*****

Choose one option from the following list ...

=====

1.Insert in Beginning
2.Insert at last
3.Delete fromBeginning
4.Delete from last
5.Search
6.Show
7.Exit

Enter your choice?
6

printing values ...
1
3

```

Deletion at beginning

```

2.Insert at last
3.Delete fromBeginning
4.Delete from last
5.Search
6.Show
7.Exit

Enter your choice?
3

*****Main Menu*****

Choose one option from the following list ...

=====

1.Insert in Beginning
2.Insert at last
3.Delete fromBeginning
4.Delete from last
5.Search
6.Show
7.Exit

Enter your choice?
6

printing values ...
3

```

Deletion at last

```

OPEN EDITORS
  C infix_podtfix... 1
  C d_link.c c pr... 2
  C list_cir.c c pr... 2
  X C dou_cir_list... 2
  C simple_list.c... 2
  C infix_podtfix... 1
  C d_link.c c pr... 2
  C dou_cir_list.c 2
  C doubly.c
  C doubly.exe
  C linked_list.c
  C linked_list.exe
  C list_cir.c 2
  C list_cir.exe
  C monitor.cpp
  C podtfix...

UNTITLED (WORKSPACE)
  d_link.exe
  C dou_cir_list.c 2
  dou_cir_list.exe
  doubly.c
  doubly.exe
  linked_list.c
  linked_list.exe
  list_cir.c 2
  list_cir.exe
  monitor.cpp
  podtfix...

OUTLINE
TIMELINE
CPU TAGS

6.Show
7.Exit

Enter your choice?
4

node deleted

*****Main Menu*****

Choose one option from the following list ...

=====

1.Insert in Beginning
2.Insert at last
3.Delete fromBeginning
4.Delete from last
5.Search
6.Show
7.Exit

Enter your choice?
6

nothing to print

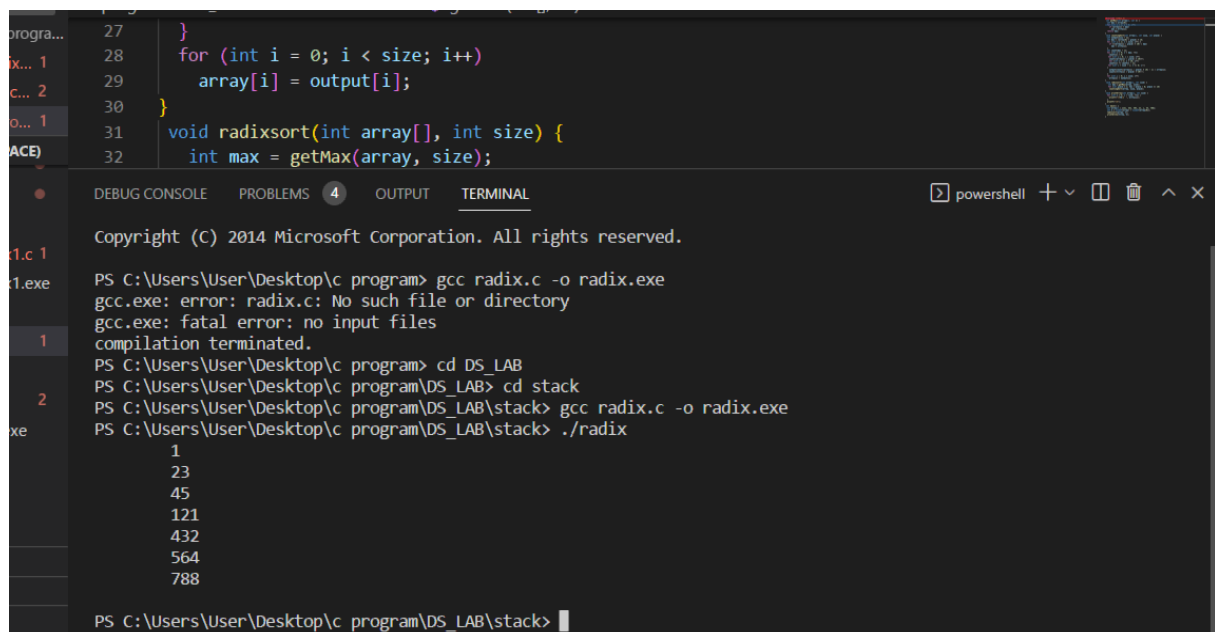
*****Main Menu*****

Choose one option from the following list ...

```

8. Write a program in C to perform radix sort**Program:-**

```
#include <stdio.h>
int getMax(int array[], int n) {
    int max = array[0];
    for (int i = 1; i < n; i++)
        if (array[i] > max)
            max = array[i];
    return max;
}
void countingSort(int array[], int size, int place) {
    int output[size + 1];
    int max = (array[0] / place) % 10;
    for (int i = 1; i < size; i++) {
        if (((array[i] / place) % 10) > max)
            max = array[i];
    }
    int count[max + 1];
    for (int i = 0; i < max; ++i)
        count[i] = 0;
    for (int i = 0; i < size; i++)
        count[(array[i] / place) % 10]++;
    for (int i = 1; i < 10; i++)
        count[i] += count[i - 1];
    for (int i = size - 1; i >= 0; i--)
    {
        output[count[(array[i] / place) % 10] - 1] = array[i];
        count[(array[i] / place) % 10]--;
    }
    for (int i = 0; i < size; i++)
        array[i] = output[i];
}
void radixsort(int array[], int size) {
    int max = getMax(array, size);
    for (int place = 1; max / place > 0; place *= 10)
        countingSort(array, size, place);
}
void printArray(int array[], int size) {
    for (int i = 0; i < size; ++i) {
        printf("\t%d\n ", array[i]);
    }
    printf("\n");
}
int main() {
    int array[] = { 121, 432, 564, 23, 1, 45, 788 };
    int n = sizeof(array) / sizeof(array[0]);
    radixsort(array, n);
    printArray(array, n);
}
```

Output:-

```
Copyright (C) 2014 Microsoft Corporation. All rights reserved.

PS C:\Users\User\Desktop\c program> gcc radix.c -o radix.exe
gcc.exe: error: radix.c: No such file or directory
gcc.exe: fatal error: no input files
compilation terminated.
PS C:\Users\User\Desktop\c program> cd DS_LAB
PS C:\Users\User\Desktop\c program\DS_LAB> cd stack
PS C:\Users\User\Desktop\c program\DS_LAB\stack> gcc radix.c -o radix.exe
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./radix
1
23
45
121
432
564
788

PS C:\Users\User\Desktop\c program\DS_LAB\stack>
```

9. Write a program in C to perform insertion sort

```
#include <stdio.h>
void printArray(int array[], int size) {
    for (int i = 0; i < size; i++) {
        printf("\n\t%d ", array[i]);
    }
    printf("\n");
}

void insertionSort(int array[], int size) {
    for (int step = 1; step < size; step++) {
        int key = array[step];
        int j = step - 1;
        while (key < array[j] && j >= 0) {
            array[j + 1] = array[j];
            --j;
        }
        array[j + 1] = key;
    }
}

int main() {
    int data[] = {9, 5, 1, 4, 3, 6, 45, 13, 98, 8, 4, 2};
    int size = sizeof(data) / sizeof(data[0]);
    for (int i = 0; i < size; i++) {
        printf("\n\t%d ", data[i]);
    }
    insertionSort(data, size);
    printf("Sorted array in ascending order:\n");
    printArray(data, size);
}
```

Output:-

```
PS C:\Users\User\Desktop\c program\DS_LAB\stack> gcc insertion.c -o insertion.exe
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./insertion

9
5
1
4
3
6
45
13
98
8
4
2 Sorted array in ascending order:

1
2
3
4
4
5
6
8
9
13
45
98
PS C:\Users\User\Desktop\c program\DS_LAB\stack> █
```

10. Write a program in C to perform merge sort**Program:-**

```
#include <stdio.h>
void printArray(int *A, int n)
{
    for (int i = 0; i < n; i++)
    {
        printf("\n%d ", A[i]);
    }
    printf("\n");
}

void merge(int A[], int mid, int low, int high)
{
    int i, j, k, B[100];
    i = low;
    j = mid + 1;
    k = low;

    while (i <= mid && j <= high)
    {
        if (A[i] < A[j])
        {
            B[k] = A[i];
            i++;
            k++;
        }
        else
        {
            B[k] = A[j];
            j++;
            k++;
        }
    }
}
```

```
        j++;
        k++;
    }
}
while (i <= mid)
{
    B[k] = A[i];
    k++;
    i++;
}
while (j <= high)
{
    B[k] = A[j];
    k++;
    j++;
}
for (int i = low; i <= high; i++)
{
    A[i] = B[i];
}
}

void mergeSort(int A[], int low, int high){
    int mid;
    if(low<high){
        mid = (low + high) /2;
        mergeSort(A, low, mid);
        mergeSort(A, mid+1, high);
        merge(A, mid, low, high);
    }
}

int main()
{
    // int A[] = {9, 14, 4, 8, 7, 5, 6};
    int A[] = {9, 1, 4, 14, 4, 15, 6};
    int n = sizeof(A) / sizeof(A[0]);
    printf("unsorted element list : \n");
    printArray(A, n);
    mergeSort(A, 0, n-1);
    printf("sorted list : \n");
    printArray(A, n);
    return 0;
}
```

```
tack1.c  C infix_podtfix1.c 1  C simple_list.c 2  C radix.c 1  C insertion.c 1  C merge.c 1 x  D  S  T  ...

c program > DS_LAB > stack > C merge.c > printArray(int *, int)
1  #include <stdio.h>
2
3  void printArrav(int *A, int n)

DEBUG CONSOLE  PROBLEMS 6  OUTPUT  TERMINAL
powershell + -  T  X

1 4 4 6 9 14 15
PS C:\Users\User\Desktop\c program\DS_LAB\stack> gcc merge.c -o merge.exe
PS C:\Users\User\Desktop\c program\DS_LAB\stack> ./merge
unsorted element list :

9
1
4
14
4
15
6
sorted list :

1
4
4
6
9
14
15
PS C:\Users\User\Desktop\c program\DS_LAB\stack>
```

11. Write a program in C to perform selection sort

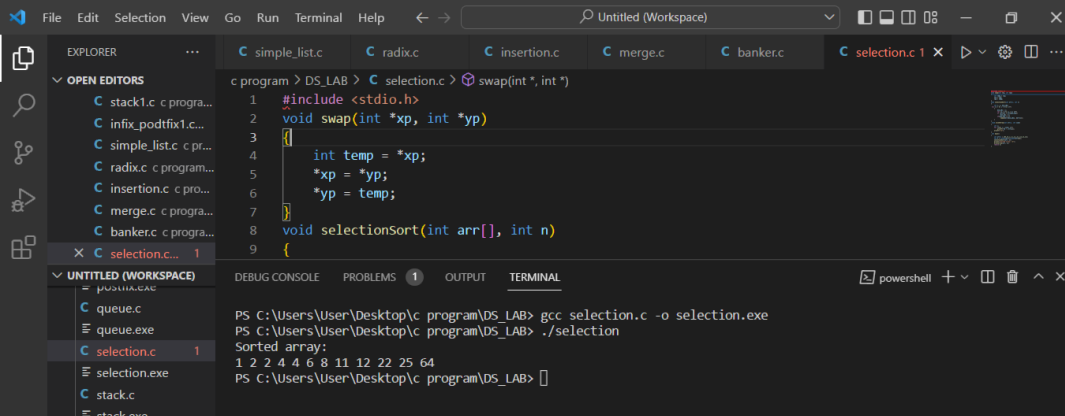
Program:-

```
#include <stdio.h>
void swap(int *xp, int *yp)
{
    int temp = *xp;
    *xp = *yp;
    *yp = temp;
}
void selectionSort(int arr[], int n)
{
    int i, j, min_idx;
    for (i = 0; i < n-1; i++)
    {
        min_idx = i;
        for (j = i+1; j < n; j++)
            if (arr[j] < arr[min_idx])
                min_idx = j;
        if (min_idx != i)
            swap(&arr[min_idx], &arr[i]);
    }
}
void printArray(int arr[], int size)
{
    int i;
    for (i=0; i < size; i++)
        printf("%d ", arr[i]);
    printf("\n");
}
int main()
{
    int arr[] = {64,25,1,4,2,8,2,6,4,12,22,11};
```



```
int n = sizeof(arr)/sizeof(arr[0]);  
selectionSort(arr, n);  
printf("Sorted array: \n");  
printArray(arr, n);  
return 0;  
}
```

Output:-



The screenshot shows the Visual Studio Code interface with a C program for selection sort. The Explorer panel on the left shows the file structure. The main editor displays the code for selection.c, which includes a swap function and a selectionSort function. The terminal at the bottom shows the compilation and execution of the program, resulting in the sorted array: 1 2 2 4 4 6 8 11 12 22 25 64.

```
c program > DS_LAB > selection.c > swap(int *, int *)  
1 #include <stdio.h>  
2 void swap(int *xp, int *yp)  
3 {  
4     int temp = *xp;  
5     *xp = *yp;  
6     *yp = temp;  
7 }  
8 void selectionSort(int arr[], int n)  
9 {  
10  
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