**LAB-06: Fibonacci Sequence**

**Theory:**

The Fibonacci sequence,also known as Fibonacci numbers, is defined as the sequence of numbers in which each number in the sequence is equal to the sum of two numbers before it.

The Fibonacci sequence is given as:

Fibonacci sequence = 0, 1, 1, 2, 3, 5, 8, 13, 21…

Here, the third term ‘1’ is obtained by adding the first and second term. (i.e., 0+1 = 1)

Similarly,

‘2’ is obtained by adding the second and third term (1+1 = 2)

‘3’ is obtained by adding the third and fourth term (1+2=3) and so on.

For example, the next term after 21 can be found by adding 13 and 21.

The Fibonacci sequence of numbers “Fn” is defined using the recursive relation with the seed values F0=0 and F1=1:

Fn = Fn-1+Fn-2

**Fibonacci sequence using iteration:**

#include <stdio.h>

int main() {

int n, first = 0, second = 1, result, i;

printf("Give an input upto you want to print sequence : \n");

scanf("%d", & n);

printf("Fibonacci Series is:\n");

for (i = 0; i < n; i++) {

if (i <= 1)

result = i;

else {

result = first + second;

first = second;

second = result;

}

printf("%d ", result);

}

return 0;

}

**Fibonacci sequence using recursion:**

#include <stdio.h>

int fibbonacci(int n) {

if (n == 0) {

return 0;

} else if (n == 1) {

return 1;

} else {

return (fibbonacci(n - 1) + fibbonacci(n - 2));

}

}

int main() {

int n;

printf("Please give an input upto you want to print sequence : \n");

scanf("%d", & n);

int i;

printf("Fibbonacci sequence of %d: ", n);

for (i = 0; i < n; i++) {

printf("%d ", fibbonacci(i));

}

return 0;

}

**Fibonacci sequence using tail recursion:**

#include <stdio.h>

int fib(int n, int a, int b) {

if (n == 0)

return a;

else if (n == 1)

return b;

else

return fib(n - 1, b, a + b);

}

int main() {

int n = 9, a = 0, b = 1;

printf("%d ", fib(n, a, b));

return 0;

}

**LAB-07: Greatest Common Divisor (GCD)**

**GCD using iteration:**

include<stdio.h>

#include<conio.h>

int gcd(int, int);

int main() {

int a, b;

int gcd1;

printf("Enter the first number: ");

scanf("%d", & a);

printf("\nEnter second number:");

scanf("%d", & b);

gcd1 = gcd(a, b);

printf("The gcd of two numbers %d and %d is: %d", a, b, gcd1);

}

int gcd(int a, int b) {

int remainder;

if (a == 0) {

return (b);

} else if (b == 0) {

return (a);

} else {

while (b != 0) {

remainder = a % b;

a = b;

b = remainder;

}

return (a);

}

}

**GCD using recursion:**

#include <stdio.h>

int gcd(int x, int y) {

if (y == 0)

return x;

else

gcd(y, x % y);

}#int main()

{

int a, b, g;

printf("Enter a and b:\n");

scanf("%d%d", &a, &b);

g = gcd(a, b);

if(g < 0)

{

g \*= -1;

}

printf("GCD(%d, %d) = %d\n", a, b, g);

return 0;

}



**LAB-08: Tower of Hanoi (TOH)**

**Tower of Hanoi (TOH) using iteration:**

#include <stdio.h>

#include <math.h>

#include <stdlib.h>

#include <limits.h>

struct Stack {

unsigned capacity;

int top;

int \* array;

};

// function to create a stack of given capacity.

struct Stack \* createStack(unsigned capacity) {

struct Stack \* stack =

(struct Stack \* ) malloc(sizeof(struct Stack));

stack -> capacity = capacity;

stack -> top = -1;

stack -> array =

(int \* ) malloc(stack -> capacity \* sizeof(int));

return stack;

}

// Stack is full when top is equal to the last index

int isFull(struct Stack \* stack) {

return (stack -> top == stack -> capacity - 1);

}

// Stack is empty when top is equal to -1

int isEmpty(struct Stack \* stack) {

return (stack -> top == -1);

}

// Function to add an item to stack. It increases

// top by 1

void push(struct Stack \* stack, int item) {

if (isFull(stack))

return;

stack -> array[++stack -> top] = item;

}

// Function to remove an item from stack. It

// decreases top by 1

int pop(struct Stack \* stack) {

if (isEmpty(stack))

return INT\_MIN;

return stack -> array[stack -> top--];

}

//Function to show the movement of disks

void moveDisk(char fromPeg, char toPeg, int disk) {

printf("Move the disk %d from \'%c\' to \'%c\'\n", disk, fromPeg, toPeg);

}

// Function to implement legal movement between

// two poles

void moveDisksBetweenTwoPoles(struct Stack \* src, struct Stack \* dest, char s, char d) {

int pole1TopDisk = pop(src);

int pole2TopDisk = pop(dest);

// When pole 1 is empty

if (pole1TopDisk == INT\_MIN) {

push(src, pole2TopDisk);

moveDisk(d, s, pole2TopDisk);

}

// When pole2 pole is empty

else if (pole2TopDisk == INT\_MIN) {

push(dest, pole1TopDisk);

moveDisk(s, d, pole1TopDisk);

}

// When top disk of pole1 > top disk of pole2

else if (pole1TopDisk > pole2TopDisk) {

push(src, pole1TopDisk);

push(src, pole2TopDisk);

moveDisk(d, s, pole2TopDisk);

}

// When top disk of pole1 < top disk of pole2

else {

push(dest, pole2TopDisk);

push(dest, pole1TopDisk);

moveDisk(s, d, pole1TopDisk);

}

}

//Function to implement TOH puzzle

void tohIterative(int num\_of\_disks, struct Stack \* src, struct Stack \* aux, struct Stack \* dest) {

int i, total\_num\_of\_moves;

char s = 'J', d = 'K', a = 'L';

//If number of disks is even, then interchange

//destination pole and auxiliary pole

if (num\_of\_disks % 2 == 0) {

char temp = d;

d = a;

a = temp;

}

total\_num\_of\_moves = pow(2, num\_of\_disks) - 1;

//Larger disks will be pushed first

for (i = num\_of\_disks; i >= 1; i--)

push(src, i);

for (i = 1; i <= total\_num\_of\_moves; i++) {

if (i % 3 == 1)

moveDisksBetweenTwoPoles(src, dest, s, d);

else if (i % 3 == 2)

moveDisksBetweenTwoPoles(src, aux, s, a);

else if (i % 3 == 0)

moveDisksBetweenTwoPoles(aux, dest, a, d);

}

}

// Driver Program

int main() {

// Input: number of disks

unsigned num\_of\_disks;

printf("Enter number of disks:");

scanf("%d", & num\_of\_disks);

struct Stack \* src, \* dest, \* aux;

// Create three stacks of size 'num\_of\_disks'

// to hold the disks

src = createStack(num\_of\_disks);

aux = createStack(num\_of\_disks);

dest = createStack(num\_of\_disks);

tohIterative(num\_of\_disks, src, aux, dest);

return 0;

}

**Tower of Hanoi (TOH) using recursion:**

#include <stdio.h>

int counter = 1;

void hanoi(int n,char source,char dest,char aux){

if (n == 0){

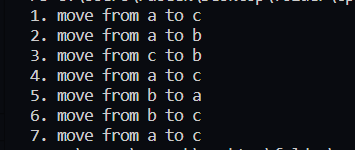
return;

}

hanoi(n-1,source,aux,dest);

printf("%d. move from %c to %c\n",counter++,source,dest);

hanoi(n-1,aux,dest,source);

****

}

int main(){

hanoi(3,'a','c','b');

}

**LAB-09: Linked List**

**Theory:**

A linked list is a linear grouping of data pieces in computer science whose order is not determined by their actual location in memory. Instead, every part relates to the one before it. It is a data structure made up of a number of nodes that collectively stand for a sequence

**Singly Linked List:**

**Algorithm:**

**1. Insert at the End**

1. Allocate memory for new node
2. Store data
3. Traverse to last node
4. Change next of last node to recently created node

**2. Insert at the beginning**

1. Allocate memory for new node
2. Store data
3. Change next of new node to point to head
4. Change head to point to recently created node

**3. Insert at the Middle**

1. Allocate memory and store data for new node
2. Traverse to node just before the required position of new node
3. Change next pointers to include new node in between

**4. Delete from beginning**

1. Point head to the second node
2. Free the first node

**5. Delete from end**

1. Traverse to second last element
2. Change its next pointer to null and free the last node

**6. Delete from middle**

1. Traverse to element before the element to be deleted
2. Change next pointers to exclude the node from the chain and free the deleted node

**Singly Linked List**

#include <stdio.h>

#include <stdlib.h>

struct Node{

int data;

struct Node \*next;

};

typedef struct Node NodeType;

NodeType \*head = NULL;

NodeType \*getnode(){

NodeType \*p;

p=(NodeType\*)malloc(sizeof(NodeType));

return(p);

}

void display(){

// printf("linked list elements:\n");

if (head == NULL){

printf("Linked list is empty\n");

}

else{

NodeType \*ptr;

ptr = head;

printf("[ ");

while (ptr != NULL){

if (ptr->next == NULL){

printf("%d",ptr->data);

}else{

printf("%d -> ",ptr->data);

}

ptr = ptr->next;

}

printf(" ]\n");

}

}

void insertEnd(int x){

NodeType \*p;

p = (NodeType\*)malloc(sizeof(NodeType));

p->data = x;

p->next = NULL;

if (head == NULL){

head = p;

}else{

NodeType \*ptr = head;

while (ptr->next!=NULL){

ptr = ptr->next;

}

ptr->next = p;

}

}

void insertBeg(int x){

NodeType \*ptr = getnode();

ptr->data = x;

ptr->next = head;

head = ptr;

}

void insert(int x,int index){

if (head == NULL){

printf("Empty List: index out of range");

return;

}

if (index ==0){

insertBeg(x);

return;

}

NodeType \*prev = getnode();

NodeType \*ptr = head;

// ptr = head;

for (int i=0;i<index;i++){

prev = ptr;

ptr = ptr->next;

}

NodeType \*p =getnode();

p->data = x;

p->next = ptr;

prev->next = p;

}

void deleteEnd(){

if (head==NULL){

printf("Cannot delete. List is already empty\n");

return;

}

NodeType \*prev = getnode();

NodeType \*ptr = head;

while (ptr->next!=NULL){

prev = ptr;

ptr = ptr->next;

}

prev->next = NULL;

free(ptr);

}

void deleteBeg(){

if (head==NULL){

printf("Cannot delete. List is already empty\n");

return;

}

NodeType \*ptr = head;

head = ptr->next;

free(ptr);

}

void del(int index){

if (head==NULL){

printf("Cannot delete. List is already empty\n");

return;

}

if (index == 0){

deleteBeg;

return;

}

NodeType \*ptr = head;

NodeType \*prev;

for (int i=0;i<index;i++){

prev = ptr;

ptr = ptr->next;

}

prev->next = ptr->next;

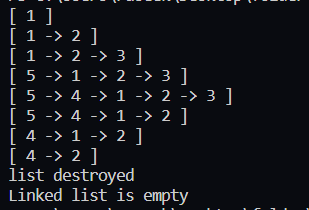
free(ptr);

}

void destroy(){

while (head!=NULL){

NodeType \*toDel = head;

**** head = head->next;

free(toDel);

}

printf("list destroyed\n");

}

int main(){

insertEnd(1); // add 1

display();

insertEnd(2); // add 2

display();

insertEnd(3); // add 3

display();

insertBeg(5); // add 5 at beginning

display();

insert(4,1); // add 4 at 1st index

display();

deleteEnd(); // delete end elemnt

display();

deleteBeg(); // delete 1st element

display();

del(1); //delete elem at index 1

display();

destroy();

display();

}

**LAB-10: Sorting Algorithm**

**Theory:**

A sorting algorithm is a technique for arranging a lot of things in a particular order, like alphabetically, from highest to lowest value, or from shortest to longest distance. Input lists of items are used as the basis for sorting algorithms, which then apply certain operations to those lists to produce sorted arrays as output.

**Bubble Sort**

Step 1: Start

Step 2: Read the array of given items from the user.

Step 3: Take the first element(index = 0), compare the current element with the next element.

Step 4: If the current element is greater than the next element, swap them.

Step 5: Else, If the current element is less than the next element, then move to the next element.

Step 6: Repeat Step 3 to Step 5 until all elements are sorted.

Step 7: Stop

#include <stdio.h>

void bubbleSort(int \*arr,int size){

int temp;

for (int i=0;i<size-1;i++){

for (int j=0;j<size -1 -i;j++){

if (arr[j] > arr[j+1]){

temp = arr[j+1];

arr[j+1] = arr[j];

arr[j] = temp;

}

}

}

}

void printarr(int \*arr,int size){

for (int i=0;i<size;i++){

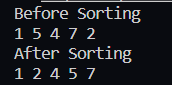
printf("%d ",arr[i]);

}

}

int main(){

int size = 5;

 int arr[size] = {1,5,4,7,2};

printf("Before Sorting\n");

printarr(&arr[0], size);

bubbleSort(&arr[0],size);

printf("\nAfter Sorting\n");

printarr(&arr[0],size);

}

**Selection Sort**

Step 1 : Set MIN to location 0

Step 2 : Search the minimum element in the list

Step 3 : Swap with value at location MIN

Step 4 : Increment MIN to point to next element

Step 5 : Repeat until list is sorted

#include<stdio.h>

void printarr(int \*arr,int size){

for (int i=0;i<size;i++){

printf("%d ",arr[i]);

}

}

int main(){

int size=10,min=0,temp;

int arr[size] = {23,10,20,3,45,76,67,24,2,11};

printf("Bofore sorting:\n");

printarr(&arr[0],size);

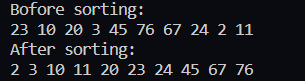
for (int i=0;i<size-1;i++){

min = i;

for (int j=i+1;j<size;j++){

if (arr[j] < arr[min]){

min = j;

 }

}

if (min!=i){

temp = arr[min];

arr[min] = arr[i];

arr[i] = temp;

}

}

printf("\nAfter sorting:\n");

printarr(&arr[0],size);

}

**Insertion Sort**

**Algorithm**

1. Iterate from arr[1] to arr[N] over the array.
2. Compare the current element (key) to its predecessor.
3. If the key element is smaller than its predecessor, compare it to the elements before. Move the greater elements one position up to make space for the swapped element.

#include <stdio.h>

void insertionSort(int arr[], int n){

int i, key, j;

for (i = 1; i < n; i++) {

key = arr[i];

j = i - 1;

while (j >= 0 && arr[j] > key) {

arr[j + 1] = arr[j];

j = j - 1;

}

 arr[j + 1] = key;

}

}

void printArray(int arr[], int n){

int i;

for (i = 0; i < n; i++)

printf("%d ", arr[i]);

printf("\n");

}

int main()

{

int arr[] = { 12, 11, 13, 5, 6 };

int n = sizeof(arr) / sizeof(arr[0]);

insertionSort(arr, n);

printArray(arr, n);

}

**Merge Sort**

**Algorithm**

step 1: start

step 2: declare array and left, right, mid variable

step 3: perform merge function.

mergesort(array,left,right)

mergesort (array, left, right)

if left > right

return

mid= (left+right)/2

mergesort(array, left, mid)

mergesort(array, mid+1, right)

merge(array, left, mid, right)

step 4: Stop

#include <stdio.h>

#include <stdlib.h>

void merge(int arr[], int l, int m, int r){

int i, j, k;

int n1 = m - l + 1;

int n2 = r - m;

int L[n1], R[n2];

for (i = 0; i < n1; i++)

L[i] = arr[l + i];

for (j = 0; j < n2; j++)

R[j] = arr[m + 1 + j];

i = 0; // Initial index of first subarray

j = 0; // Initial index of second subarray

k = l; // Initial index of merged subarray

while (i < n1 && j < n2) {

if (L[i] <= R[j]) {

arr[k] = L[i];

i++;

}

else {

arr[k] = R[j];

j++;

}

k++;

}

while (i < n1) {

arr[k] = L[i];

i++;

k++;

}

while (j < n2) {

arr[k] = R[j];

j++;

k++;

}

}

void mergeSort(int arr[], int l, int r)

{

if (l < r) {

int m = l + (r - l) / 2;

mergeSort(arr, l, m);

mergeSort(arr, m + 1, r);

merge(arr, l, m, r);

}

}

void printArray(int A[], int size)

{

int i;

for (i = 0; i < size; i++)

printf("%d ", A[i]);

printf("\n");

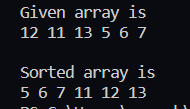
}

int main()

{

int arr[] = { 12, 11, 13, 5, 6, 7 };

int arr\_size = sizeof(arr) / sizeof(arr[0]);

 printf("Given array is \n");

printArray(arr, arr\_size);

mergeSort(arr, 0, arr\_size - 1);

printf("\nSorted array is \n");

printArray(arr, arr\_size);

return 0;

}