# 15B17CI371 – Data Structures Lab
# ODD 2024
# Week 1-LAB A
# Practice Lab

1.

```
#include<iostream>
using namespace std;
struct node{
int data ;
struct  node * next;
};
struct node* insert(struct node* head,int data){
   if(head==NULL){
      struct node* ptr=new struct node;
      ptr->data=data;
      ptr->next=NULL;
      head=ptr;
      return head;
   }
   else{
       struct node* ptr=new struct node;
       ptr->data=data;
       ptr->next=head;
       head=ptr;
       return head;
   }
}
struct node* insertatend(struct node* head, int data){
          struct node*p=new struct node;
   if(head==NULL)
   {
      p->data=data;
      p->next=NULL;
      return p;
   }
   struct node*ptr=head;
   while(ptr->next!=NULL)
   {
      ptr=ptr->next;
   }
   ptr->next=p;
   p->data=data;
   p->next=NULL;
   return head;
}
void print(struct node* head){
```

```
    while(head!=NULL){
        cout<<head->data<<" ";
        head=head->next;
    }
}
int countnodes(struct node*head){
    int count=0,sum=0;
   struct node*ptr= head;
   while(ptr!=NULL){
       sum+=ptr->data;
       count++;
       ptr=ptr->next;

   }
   return count;
}
float average(struct node*head){
    int count=0,sum=0;
   struct node*ptr= head;
   while(ptr!=NULL){
       sum+=ptr->data;
       count++;
       ptr=ptr->next;

   }
   return ((float)sum/count);
}
void printfirst_m(struct node*head,int m){
    struct node*p=head;
    while(m!=0){
        cout<<p->data<<" ";
        p=p->next;
        m--;
    }
    cout<<endl;
}
int printelement(struct node*head, int a){
    struct node*ptr=head;
    while((a-1)!=0){
        ptr=ptr->next;
        a--;
    }
    return ptr->data;
}
void middle(struct node*head){
struct node*ptr=head;
int a=countnodes(head);
if (a%2!=0){
    int b=(a+1)/2;
```

```
    int x=printelement(head,b);
    if(x%2==0){
  cout<<"Middle element : " <<x<<" is even. "<<endl;
    }
    else{
        cout<<"Middle element : " <<x<<" is odd. "<<endl;
    }
}
else{
int c=a/2;
int d= c+1;
int p=printelement(head,c);
int q=printelement(head,d);
if(p%2==0){
cout<<"Middle elements are:\n "<<p<<" (even) & ";
}
else{
cout<<"Middle elements are: "<<p<<" (odd) & ";
}
if(q%2==0){
cout<<q<<" (even).\n ";
}
else{
cout<<q<<" (odd).\n ";
}
}
}
void elementfromend(struct node* head, int a){
    struct node*ptr=head;
    int n= countnodes(head);
    int y=n-a;
    while(y!=0){
ptr=ptr->next;
y--;
    }
    do{
        cout<<ptr->data<<" ";
        ptr=ptr->next;
    }while(ptr!=NULL);
    cout<<endl;
}
struct node* deleteelement(struct node * head, int value){
    struct node *p = head;
    struct node *q = head->next;
    if(p->data==value){
        head=p->next;
        free(p);
        return head;
    }
```

```
    while(q->data!=value && q->next!= NULL)
    {
        p = p->next;
        q = q->next;
    }

    if(q->data == value){
        p->next = q->next;
        free(q);
    }
    return head;
}
struct node* searchdelete(struct node*head, int f){
    struct node*ptr=head;
    while(ptr!=NULL){
    if(ptr->data==f){
        cout<<f<<" exists in the given linked list."<<endl;
        head = deleteelement(head,f);
        cout<<"Updated LL:\n";
        print(head);
        return head;
    }
    else{
        ptr=ptr->next;
    }
    }
    cout<<f<<" doesn't exist in the given LL.\n";
    return head;
}
int checkpair(struct node* head, int a, int b){
struct node*p=head;
struct node*q=head->next;
while(q->data!=b&&q->next!=NULL){
    p=p->next;
    q=q->next;
}
if(q->data==b&&p->data==a){
return 1;}
return 0;
}
struct node* interchangepair(struct node*head,int a, int b, int c, int d)
{
    struct node*p=head;
    struct node*q=head->next;
    struct node*r=head;
    struct node*s=head->next;
    while(p->data!=a){
        p=p->next;
        q=q->next;
```

```
    }
    while(r->data!=c){
        r=r->next;
        s=s->next;
    }
    int temp1,temp2;
    temp1=p->data;
    p->data=r->data;
    r->data=temp1;
    temp2=q->data;
    q->data=s->data;
    s->data=temp2;
    return head;
}
int checksublist( struct node*h1, struct node*h2){
    int a=printelement(h2,1);
    int i=countnodes(h1);
    int j=countnodes(h2);
    struct node*p=h1;
    struct node*q=h2;
    for(int b=0;b<i;b++){

    if(p->data!=a){
        p=p->next;
        continue;
    }
    else{
      struct node*r=p;
        for(int c=0;c<j;c++){
            if(r->data==q->data)
            {
                r=r->next;
                q=q->next;
                continue;
            }
            else{
                 q=h2;
                 goto pin;
            }
        }
       cout<<"The given sub lists exists in the liinked list at position "<<b+1<<endl;
       return b+1;
    }
    pin:
    p=p->next;
    }
     cout<<"The given sub lists doesnt exists in the linked list . "<<endl;
       return 0;
    }
```

```
    struct node* reverse(struct node*h){
    int arr[countnodes(h)];
    int i=0;
    struct node*p= h;
    while(p!=NULL){
    arr[i]=p->data;
    p=p->next;
    i++;
    }
    p=h;
    int j= countnodes(h)-1;
    while(p!=NULL){
    p->data=arr[j];
    p=p->next;
    j--;
    }
    return h;
    }
    struct node* updatereversedsublist(struct node*h1, struct node*h2, int g){
        int l=countnodes(h2);
        struct node*p=h1;
        struct node*q=h2;
        while((g-1)!=0)
        {
            p=p->next;
            g--;
        }
        while(l!=0){
            p->data=q->data;
            p=p->next;
            q=q->next;
            l--;
        }
        return h1;
    }
int main()
{
    struct node*head;
    head=NULL;
    cout<<"Enter no. of elements to be inserted:\n";
    int a;
    cin>>a;
    int s=a;
    cout<<"Enter elements:\n";
    while(a!=0){
        int k=0;
        cin>>k;
        head=insert(head,k);
        a--;
```

```
 }
 print(head);
 cout<<endl;
cout<<"The number of nodes:"<<countnodes(head)<<endl;
cout<<"Average of nodes:"<<average(head)<<endl;
 cout<<endl;
 cout<<"Enter m for first m elements to be printed:\n";
 int m;
 cin>>m;
 if(m>s){
     cout<<"incorrect value of m\n";
 }
 else{
 printfirst_m(head,m);
 }
 middle(head);
  cout<<"Enter n for last n elements to be printed:\n";
  int c;
  cin>>c;
  elementfromend(head,c);
  cout<<endl<<"Enter a number to search and delete:\n";
  int f;
  cin>>f;
  head=searchdelete(head,f);

 a=s=m=c=0;
 cout<<endl<<"Enter 1st pair:\n";
 cin>>a>>s;
 if(checkpair(head,a,s)){
 cout<<"Enter 2nd pair:\n";
 cin>>m>>c;
 if(checkpair(head,m,c)){
head=interchangepair(head,a,s,m,c);
print(head);
 }
 else{
  cout<<"Pair doesnt exist.\n";

 }
 }
 else{
  cout<<"Pair doesnt exist.\n";
 }
 cout<<"\nEnter No. of elements in sublist:\n";
 cin>>a;
 if(a>countnodes(head)){
  cout<<endl<<"The size of given sublist is more than parent list.\n";
}
else{
```

```
   struct node*h2= NULL;
   cout<<"Enter elements:\n";
   for(int i=0;i<a;i++)
   {
    cin>>s;
    h2=insertatend(h2,s);
   }
   int g=checksublist(head,h2);
   h2=reverse(h2);
   head=updatereversedsublist(head,h2,g);
   print(head);
  }
   return 0;
}
```

```
Enter no. of elements to be inserted:
4
Enter elements:
1
2
3
4
4 3 2 1
The number of nodes:4
Average of nodes:2.5

Enter m for first m elements to be printed:
2
4 3 2
Middle elements are: 3 (odd) & 2 (even).
 Enter n for last n elements to be printed:
2
2 1

Enter a number to search and delete:
1
1 exists in the given linked list.
Updated LL:
4 3 2
Enter 1st pair:
4
3
Enter 2nd pair:
2
1
Pair doesnt exist.

Enter No. of elements in sublist:
2
Enter elements:
4
3
The given sub lists exists in the liinked list at position 1
3 4 2 %
```

2.

```
#include<iostream>
#include<string.h>
using namespace std;
struct node
{
   string data;
   struct node *next;
```

```
};
void traversal(struct node *ptr)
{
   while(ptr!=NULL)
   {
      cout<<ptr->data<<" ";
      ptr = ptr->next;
   }
}
struct node* insert(struct node* head,string data){
   if(head==NULL){
      struct node* ptr=new struct node;
      ptr->data=data;
      ptr->next=NULL;
      head=ptr;
      return head;
   }
   else{
       struct node* ptr=new struct node;
       ptr->data=data;
       ptr->next=head;
       head=ptr;
       return head;
   }
}
void alphabet(struct node *ptr, char data)
{

   while(ptr!=NULL)
   {
     if(ptr->data[0]==data)
      {
      cout<<ptr->data<<" ";
      }
      ptr = ptr->next;
   }
}
int exist(struct node *ptr, string data)
{

   while(ptr!=NULL)
   {
     if(ptr->data==data)
      {
      return 1;
      }
      ptr = ptr->next;
   }
      return 0;
```

```
}
void max(struct node *ptr)
{ int max;
string data=ptr->data;
  max=ptr->data.length();

    while(ptr!=NULL)
    {
       if(ptr->data.length()>max)
        {
        max=ptr->data.length();
        data=ptr->data;

        }
        ptr=ptr->next;

    }
    cout<<"The max length element is  "<<data;
}
int main()
{
struct node* head;
head=NULL;
cout<<"Enter no. of elements to be inserted:\n";
int a;
cin>>a;
int k=a;
cout<<"Enter elements:\n";
while(a!=0){
    string s;
    cin>>s;
    head=insert(head,s);
    a--;
    }
traversal(head);
char s;
cout<<endl<<"enter alphabet  ";
cin>>s;
alphabet(head,s);
string m;
cout<<endl;
cout<<"Enter string you want to find:  ";
cin>>m;
if(exist(head,m))
{
cout<<"It exists"<<endl;
}
else{
    cout<<"It doesnot exist"<<endl;
```

```
}
max(head);
}
```

```
Enter no. of elements to be inserted:
5
Enter elements:
sam
kav
sim
kim
harchit
harchit kim sim kav sam
enter alphabet  s
sim sam
Enter string you want to find:  sam
It exists
The max length element is  harchit%
```

3.

```
#include <iostream>
#include <cmath>
using namespace std;
struct Node {
    int value;
    Node* next;

    Node(int val) : value(val), next(nullptr) {}
};
void insert(Node*& head, int value);
void printElements(Node* head);
int countElements(Node* head);
bool hasNegative(Node* head);
int countGreaterThan15(Node* head);
void deleteValue(Node*& head, int value);
void updateValue(Node* head, int oldValue, int newValue);
void insertAtPosition(Node*& head, int value, int position);
void deletePrimes(Node*& head);
void deleteFibonacci(Node*& head);
bool isPrime(int n);
```

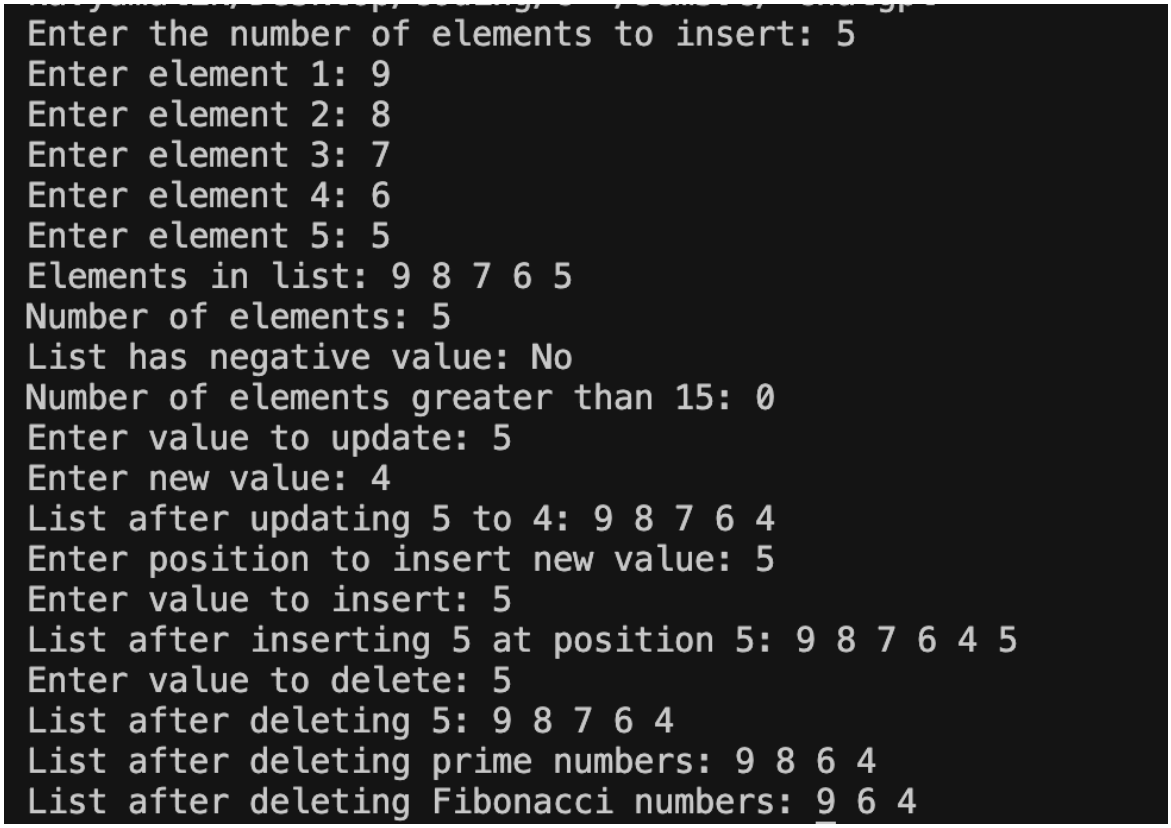
```
bool isFibonacci(int num);
bool isPerfectSquare(int x);
void deleteNode(Node*& head, Node* target, Node* prev);
int main() {
    Node* head = nullptr;
    int n;
    cout << "Enter the number of elements to insert: ";
    cin >> n;
    for (int i = 0; i < n; i++) {
        int value;
        cout << "Enter element " << i + 1 << ": ";
        cin >> value;
        insert(head, value);
    }
    cout << "Elements in list: ";
    printElements(head);
    cout << "Number of elements: " << countElements(head) << endl;

    cout << "List has negative value: " << (hasNegative(head) ? "Yes" : "No") << endl;

    cout << "Number of elements greater than 15: " << countGreaterThan15(head) << endl;

    int oldValue, newValue;
    cout << "Enter value to update: ";
    cin >> oldValue;
    cout << "Enter new value: ";
    cin >> newValue;
    updateValue(head, oldValue, newValue);
    cout << "List after updating " << oldValue << " to " << newValue << ": ";
    printElements(head);

    int position, insertValue;
    cout << "Enter position to insert new value: ";
    cin >> position;
    cout << "Enter value to insert: ";
    cin >> insertValue;
    insertAtPosition(head, insertValue, position);
    cout << "List after inserting " << insertValue << " at position " << position << ": ";
    printElements(head);

    int deleteValueInput;
    cout << "Enter value to delete: ";
    cin >> deleteValueInput;
    deleteValue(head, deleteValueInput);
    cout << "List after deleting " << deleteValueInput << ": ";
    printElements(head);

    deletePrimes(head);
    cout << "List after deleting prime numbers: ";
```

```
    printElements(head);

    deleteFibonacci(head);
    cout << "List after deleting Fibonacci numbers: ";
    printElements(head);

    return 0;
}
void insert(Node*& head, int value) {
    Node* newNode = new Node(value);
    if (!head) {
        head = newNode;
        head->next = head;
    } else {
        Node* temp = head;
        while (temp->next != head) {
            temp = temp->next;
        }
        temp->next = newNode;
        newNode->next = head;
    }
}
void printElements(Node* head) {
    if (!head) {
        cout << "List is empty" << endl;
        return;
    }
    Node* temp = head;
    do {
        cout << temp->value << " ";
        temp = temp->next;
    } while (temp != head);
    cout << endl;
}
int countElements(Node* head) {
    if (!head) return 0;
    int count = 0;
    Node* temp = head;
    do {
        count++;
        temp = temp->next;
    } while (temp != head);
    return count;
}
bool hasNegative(Node* head) {
    if (!head) return false;
    Node* temp = head;
    do {
        if (temp->value < 0) return true;
```

```
        temp = temp->next;
    } while (temp != head);
    return false;
}
int countGreaterThan15(Node* head) {
    if (!head) return 0;
    int count = 0;
    Node* temp = head;
    do {
        if (temp->value > 15) count++;
        temp = temp->next;
    } while (temp != head);
    return count;
}
void deleteValue(Node*& head, int value) {
    if (!head) return;

    Node* temp = head;
    Node* prev = nullptr;

    do {
        if (temp->value == value) {
            deleteNode(head, temp, prev);
            return;
        }
        prev = temp;
        temp = temp->next;
    } while (temp != head);
}
void updateValue(Node* head, int oldValue, int newValue) {
    if (!head) return;

    Node* temp = head;
    do {
        if (temp->value == oldValue) {
            temp->value = newValue;
            return;
        }
        temp = temp->next;
    } while (temp != head);
}
void insertAtPosition(Node*& head, int value, int position) {
    if (position < 0) return;

    Node* newNode = new Node(value);

    if (!head) {
        if (position == 0) {
            head = newNode;
```

```
            head->next = head;
        }
        return;
    }

    if (position == 0) {
        newNode->next = head;
        Node* temp = head;
        while (temp->next != head) {
            temp = temp->next;
        }
        temp->next = newNode;
        head = newNode;
        return;
    }

    Node* temp = head;
    int index = 0;

    while (temp->next != head && index < position - 1) {
        temp = temp->next;
        index++;
    }

    newNode->next = temp->next;
    temp->next = newNode;
}
void deletePrimes(Node*& head) {
    if (!head) return;

    Node* temp = head;
    Node* prev = nullptr;

    do {
        if (isPrime(temp->value)) {
            deleteNode(head, temp, prev);
            temp = prev ? prev->next : head;
        } else {
            prev = temp;
            temp = temp->next;
        }
    } while (temp != head);
}
void deleteFibonacci(Node*& head) {
    if (!head) return;

    Node* temp = head;
    Node* prev = nullptr;
```

```
    do {
        if (isFibonacci(temp->value)) {
            deleteNode(head, temp, prev);
            temp = prev ? prev->next : head;
        } else {
            prev = temp;
            temp = temp->next;
        }
    } while (temp != head);
}
bool isPrime(int n) {
    if (n <= 1) return false;
    if (n <= 3) return true;
    if (n % 2 == 0 || n % 3 == 0) return false;
    for (int i = 5; i * i <= n; i += 6) {
        if (n % i == 0 || n % (i + 2) == 0) return false;
    }
    return true;
}
bool isFibonacci(int num) {
    if (num < 0) return false;
    int x = 5 * num * num;
    return isPerfectSquare(x + 4) || isPerfectSquare(x - 4);
}
bool isPerfectSquare(int x) {
    int s = static_cast<int>(sqrt(x));
    return s * s == x;
}
void deleteNode(Node*& head, Node* target, Node* prev) {
    if (prev) {
        prev->next = target->next;
    } else {
        if (target->next == head) {
            head = nullptr;
        } else {
            Node* last = head;
            while (last->next != head) {
                last = last->next;
            }
            last->next = target->next;
            head = target->next;
        }
    }
    delete target;
}
```




4.

```
#include <iostream>
using namespace std;
struct Node {
    int value;
    Node* next;
    Node* prev;
    Node(int val) : value(val), next(nullptr), prev(nullptr) {}
};
void insert(Node*& head, int value);
void printList(Node* head);
void traverseAndCheckDivisibility(Node* head, int m);
void deleteNodesGreaterThan(Node*& head, int x);
int countElementsBetweenDuplicates(Node* head, int value);
int main() {
    Node* head = nullptr;
    int n;
    cout << "Enter the number of elements to insert: ";
    cin >> n;
    for (int i = 0; i < n; i++) {
        int value;
        cout << "Enter element " << i + 1 << ": ";
```

```
        cin >> value;
        insert(head, value);
    }
    cout << "Doubly Linked List: ";
    printList(head);
    int m;
    cout << "Enter the number to check divisibility: ";
    cin >> m;
    cout << "Nodes divisible by " << m << ": ";
    traverseAndCheckDivisibility(head, m);
    int x;
    cout << "Enter the value to delete nodes greater than: ";
    cin >> x;
    deleteNodesGreaterThan(head, x);
    cout << "List after deleting nodes greater than " << x << ": ";
    printList(head);
    int duplicateValue;
    cout << "Enter the duplicate value to find elements between: ";
    cin >> duplicateValue;
    int count = countElementsBetweenDuplicates(head, duplicateValue);
    cout << "Number of elements between first pair of '" << duplicateValue << "' = " << count << endl;
    return 0;
}
void insert(Node*& head, int value) {
    Node* newNode = new Node(value);
    if (!head) {
        head = newNode;
        return;
    }
    Node* temp = head;
    while (temp->next) {
        temp = temp->next;
    }
    temp->next = newNode;
    newNode->prev = temp;
}
void printList(Node* head) {
    if (!head) {
        cout << "List is empty" << endl;
        return;
    }
    Node* temp = head;
    while (temp) {
        cout << temp->value << " ";
        temp = temp->next;
    }
    cout << endl;
}
void traverseAndCheckDivisibility(Node* head, int m) {
```

```
    if (!head) return;
    Node* temp = head;
    while (temp) {
        if (temp->value % m == 0) {
            cout << temp->value << " ";
        }
        temp = temp->next;
    }
    cout << endl;
}
void deleteNodesGreaterThan(Node*& head, int x) {
    Node* temp = head;
    while (temp) {
        Node* nextNode = temp->next;
        if (temp->value > x) {
            if (temp->prev) {
                temp->prev->next = temp->next;
            } else {
                head = temp->next;
            }
            if (temp->next) {
                temp->next->prev = temp->prev;
            }
            delete temp;
        }
        temp = nextNode;
    }
}
int countElementsBetweenDuplicates(Node* head, int value) {
    if (!head) return 0;
    Node* first = nullptr;
    Node* second = nullptr;
    Node* temp = head;
    while (temp) {
        if (temp->value == value) {
            if (!first) {
                first = temp;
            } else if (!second) {
                second = temp;
                break;
            }
        }
        temp = temp->next;
    }
    if (!first || !second) return 0;
    int count = 0;
    temp = first->next;
    while (temp && temp != second) {
        count++;
```

```
        temp = temp->next;
    }
    return count;
}
```

```
Enter the number of elements to insert: 5
Enter element 1: 1
Enter element 2: 2
Enter element 3: 1
Enter element 4: 2
Enter element 5: 1
Doubly Linked List: 1 2 1 2 1
Enter the number to check divisibility: 2
Nodes divisible by 2: 2 2
Enter the value to delete nodes greater than: 5
List after deleting nodes greater than 5: 1 2 1 2 1
Enter the duplicate value to find elements between: 2
Number of elements between first pair of '2' = 1
```