REPORT ON LINKED LISTS

PROGRAMMING DATA STRUCTURES AND ALGORITHMS

Course-Work 02

National Institute of Business Management
Kurunegala

HDSE 23.2F
26/09/2023

KUHDSE23.2F-001 – E.M.C.S.B. Ekanayaka

KUHDSE23.2F-002 - R.M.C.N. Rathnayaka

KUHDSE23.2F-003 – M.S.F. Shazna

KUHDSE23.2F-004 – N.P.U.L. Nugawela

Contents

INTRODUCTION

Linked lists are fundamental data structures used in computer science and programming.

They provide a flexible way to store and manipulate data, making them essential in various applications and algorithms.

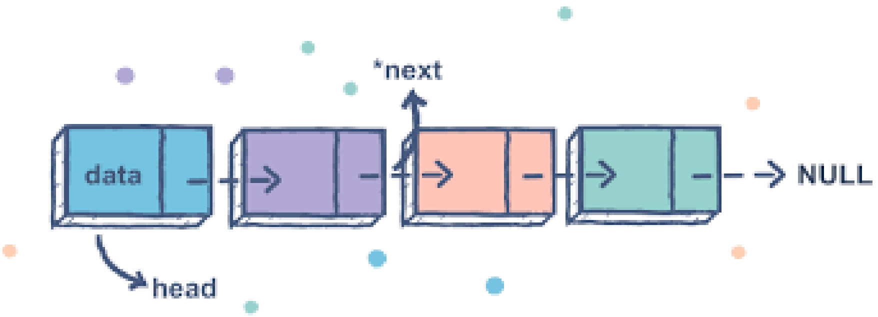
This report aims to provide an overview of linked lists, their types, operations, advantages, disadvantages, and common use cases.

What is a Linked List?

A linked list is a linear data structure consisting of a sequence of elements, each of which is called a node.

Unlike arrays, where elements are stored in contiguous memory locations, linked list elements are connected via pointers, forming a chain-like structure.

Each node contains two parts: the data and a reference (or pointer) to the next node in the sequence.

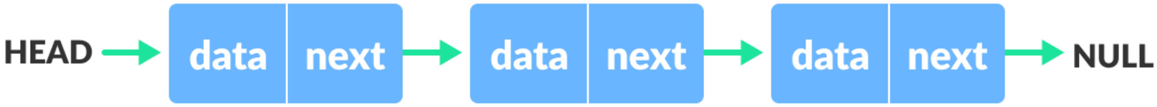


TYPES OF LINKED LISTS

1.Singly Linked List

- This kind of linked list is unidirectional, that means it can only be traversed in one direction from initial node called **Head** to last node called **Tail**.
- A single node contains data and a pointer to the next node which helps in maintaining the structure of the list. Here, each node points to the next node in the sequence, but there is no pointer to the previous node.
- The first node (Head) helps to the access every other element in the list.
- The last node (Tail) points to NULL which determines the end of the list.

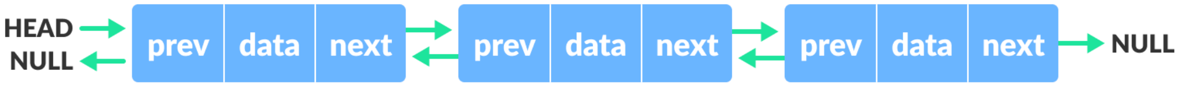
Advantages	Disadvantages
Simple Implementation	Limited Backward Traversal
Memory and Space Efficiency	Extra Memory Overhead
Flexibility in Traversal	Difficulty in finding the last element
Dynamic Size	Costly Deletion Operation



2. Doubly Linked List

- This is kind of a linked list is bidirectional which means navigation allows traversal in both directions.
- Doubly Linked List contains a link element called **First** and **Last**.
- Each link carries a data field and a link field called next.
- Each link is linked with its next link using its next link.
- Each link is linked with its previous link using its previous link.
- A doubly linked list extends the functionality of a singly linked list by including pointers to both the next node called **Next** and previous node called **Prev**.
- The last link carries a link as NJLL to mark the end of the list.

Advantages	Disadvantages
Bidirectional Traversal	Increased Memory Usage
Enhanced flexibility in implementations	Complexity in Implementation
Improved error handling	Slower Traversal
Simplified Reversal of elements	Reduced Space Efficiency

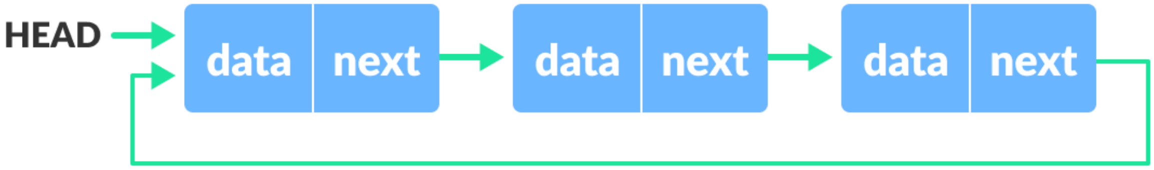


3. Circular Linked List

- The Circular linked list is where all the nodes are connected to form a circle.
- The first node called **Head** and last node called **Tail** are connected to each other forming a loop.
- There is no NULL at the end.
- This can be useful in applications where continuous cyclic access is required, such as scheduling algorithms.
- There are two types of circular linked lists:

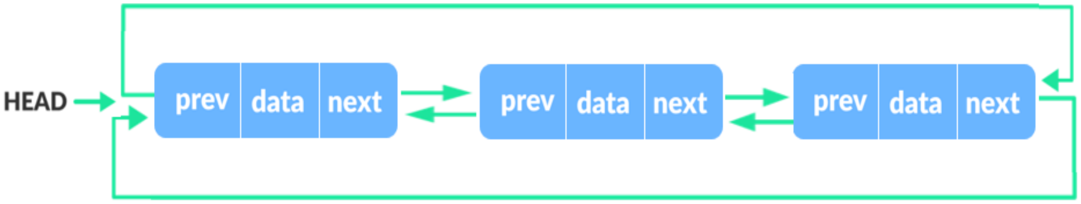
1. Circular Singly linked list

The last node of the list contains a pointer to the first node of the list. We traverse the circular singly linked list until we reach the same node where we started. The circular singly linked list has no beginning or end. No null value is present in the next part of any of the nodes.



2. Circular Doubly linked list

Two consecutive elements are linked by the previous and next pointer and the last node points to the first node by the next pointer and also the first node points to the last node by the previous pointer.



Advantages	Disadvantages
Accessibility of a node	Possibility of an infinite loop
Easy traversal	Complex compared to singly linked lists
Efficient memory usage	Harder to find the end of the list
Implementation of circular buffer	More memory is needed because it happens in run-time

EXAMPLES OF LINKED LISTS

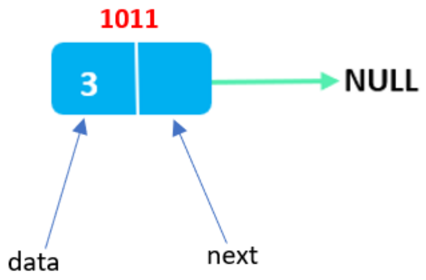
1. Singly Linked List

A singly linked list executed using Python

Here a single node is created since linking several nodes gives us a complete list.

For this, we make a Node class that holds some data and a single pointer next, that will be used to point to the next Node type object in the Linked List.

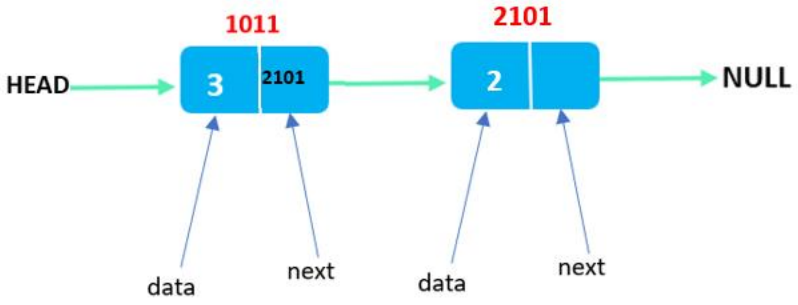
Here the value assigned to the node is 3.



```
class Node:

   # constructor

      def __init__(self, data = None, next=None):

        self.data = data

        self.next = next

# Creating a single node

first = Node(3)

print(first.data)
```

Here a singly linked list is made with two nodes: `node1` containing 3 and `node2` containing 2. `node1` points to `node2`, forming the list with `node1` as the head.

```
class Node:
    def __init__(self, data=None, next_node=None):
        self.data = data
        self.next = next_node
class LinkedList:
    def __init__(self):
        self.head = None
# Creating nodes with values
node2 = Node(2)
node1 = Node(3)
# Linking nodes together
node1.next = node2
# Creating a linked list with the head pointing to the first node
LL = LinkedList()
LL.head = node1
```



The places where singly linked lists are used is:

1. **Implementing stacks and queues:** Singly linked lists can be used to implement stacks and queues. In a stack, elements are added and removed from one end of the list, while in a queue, elements are added at one end and removed from the other end of the list.

2. **Navigation in web browsers:** Singly linked lists can be used to store the browsing history in web browsers. Each URL visited is stored as a node in the list, with the next pointer pointing to the next URL visited.

3. **Navigation of images in social media:** Just like playlist of song, singly linked list is used in image viewer in which each image represents a node and we can view one image after the other.

2. Doubly Linked List

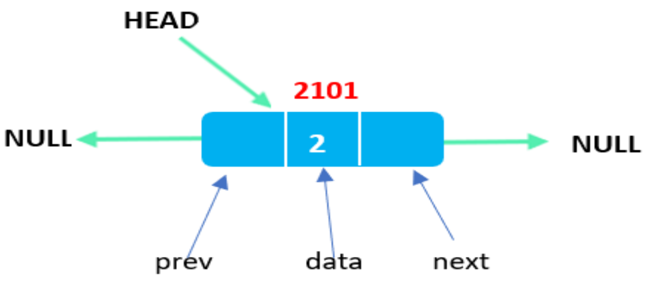
A doubly linked list executed using Python

Here a single node is created since linking several nodes gives us a complete list.

For this, we make a Node class that holds some data and two pointers next and prev, that will be used to point to the next Node and the previous node type object in the Linked List.

Here the value assigned to the node is 3.

```
# Creating a node class

class Node:

  def __init__(self, data):

    self.data = data   #adding an element to the node

    self.next = None   # not linked with any other node

    self.prev = None   # not be linked in either direction


class DoublyLinkedList:

  def __init__(self):

    self.head = None # Initially there are no elements in the list

 # Creating a doubly linked list

doubly_linked_list = DoublyLinkedList()

# Assigning the value 2 to the head

doubly_linked_list.head = Node(2)
```

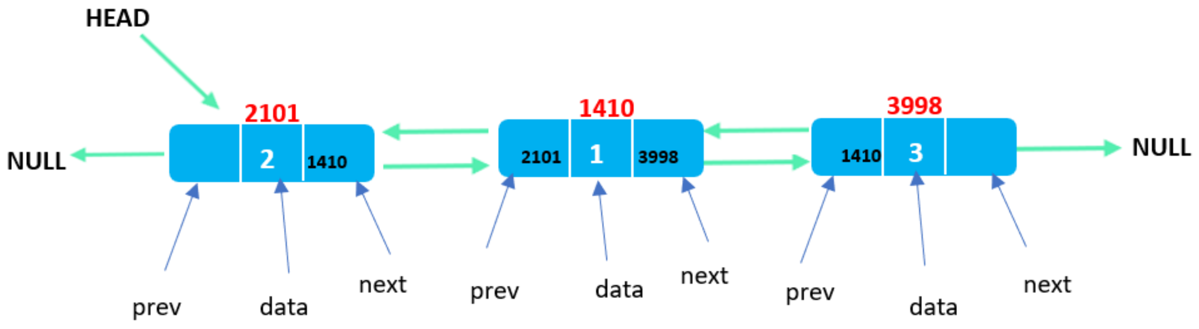


Here define a `Node` class for individual list elements, each equipped with data, a `next` pointer to the next node, and a `prev` pointer to the previous node.

The `DoublyLinkedList` class acts as the container for the linked list, initially with an empty `head`.

Three nodes, `node_1`, `node_2`, and `node_3`, are created, linked sequentially, and `node_1` is designated as the `head`. The code then displays the doubly linked list by traversing it from the `head`.

```
class Node:
   def __init__(self, data):
       self.data = data
       self.next = None
       self.prev = None
class DoublyLinkedList:
   def __init__(self):
       self.head = None
# Creating a doubly linked list
doubly_linked_list = DoublyLinkedList()
# Creating nodes with values
node_1 = Node(2)
node_2 = Node(1)
node_3 = Node(3)
# Linking nodes together
node_1.next = node_2  # Link node_1 to node_2
node_2.prev = node_1
node_2.next = node_3
node_3.prev = node_2
# Setting node_1 as the head of the list
doubly_linked_list.head = node_1
# Displaying the list
current = doubly_linked_list.head
```



The places where doubly linked lists are used is:

1. **Undo/Redo Functionality:** Doubly linked lists are commonly employed to implement undo and redo functionality in various applications. Each state change is stored as a node, enabling users to move both forward and backward through the history of changes.

2. **Text Editors**: Text editors can use doubly linked lists to represent text documents. Each line or paragraph is stored as a node, allowing users to navigate through the document bidirectionally for editing and viewing purposes.

3. **Music Playlist**: Doubly linked lists can be used to create music playlists. Each song represents a node, enabling users to move through the playlist in both directions, facilitating playback and management.

4. **Task Management**: In task management applications, doubly linked lists can be employed to represent tasks. Users can navigate through their task lists in both directions, making it convenient for marking tasks as completed or revisiting previous tasks.

3.Circular Linked List

Circular Singly Linked List

A Circular Singly linked list executed using Python

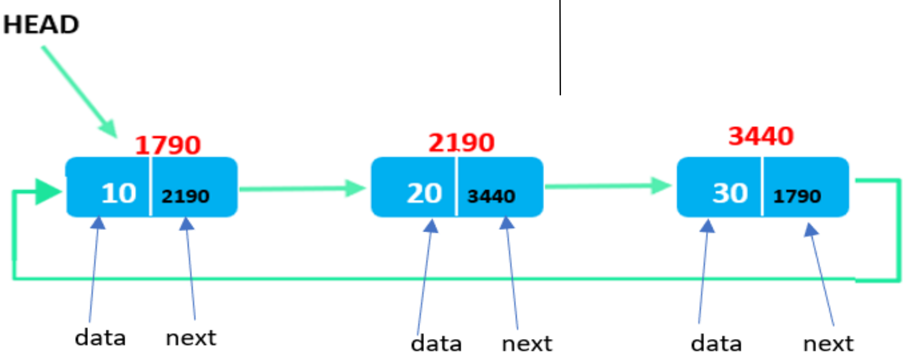
Initially, an empty linked list, `MyList`, is instantiated.

Three nodes, each containing values 10, 20, and 30, are then added.

The `next` pointers of these nodes are intended to create a circular linkage, where the last node points back to the head node, forming a loop.

```
class Node:
  def __init__(self, data):
    self.data = data
    self.next = None
class LinkedList:
  def __init__(self):
    self.head = None
# Create an empty LinkedList
MyList = LinkedList()
```

```
# Add the first node.
first = Node(10)
# Linking with head node
MyList.head = first
# Linking next of the node with head to make it circular
first.next = MyList.head
# Add the second node.
second = Node(20)
# Linking with the first node
second.next = MyList.head
# Update the head to point to the second node
MyList.head = second
# Add the third node.
third = Node(30)
# Linking with the second node
third.next = MyList.head
# Update the next pointer of the last node
first.next = third
```



Circular Doubly Linked List

A Circular doubly linked list executed using Python

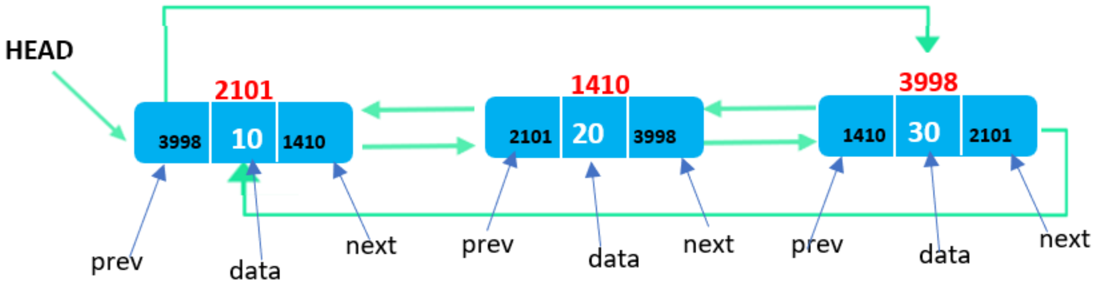
This code constructs a doubly linked circular linked list by defining nodes with values 10, 20, and 30.

It ensures that the "next" and "prev" pointers are correctly updated to establish the circular structure.

This results in a doubly linked list where each node is linked both forward and backward, forming a closed loop.

```
class Node:

    def __init__(self, data):

        self.data = data

        self.next = None

        self.prev = None

class LinkedList:

    # constructor to create an empty LinkedList

    def __init__(self):

        self.head = None

# Create an empty LinkedList

MyList = LinkedList()
```

```
# Add first node.

first = Node(10)

# linking with head node

MyList.head = first

# linking next of the node with head

first.next = MyList.head

# linking prev of the head

MyList.head.prev = first

# Add second node.

second = Node(20)

first.next = second

second.prev = first

second.next = MyList.head

MyList.head.prev = second

# Add third node.

third = Node(30)

second.next = third

third.prev = second

third.next = MyList.head

# linking prev of the head

MyList.head.prev = third
```



The places where circular singly linked lists are used is:

1. **Music and Playlist Management:** Circular singly linked lists can be employed to manage playlists in media players. Songs are represented as nodes, and the "next" pointer links each song to the next one in the playlist. When you reach the end of the playlist, it loops back to the beginning, creating a seamless music playback experience.

2. **File Systems**: In some file systems, circular singly linked lists are used to manage free disk space. Each free block is represented as a node, and when space is allocated, the block is removed from the list. When the space is freed, the block is added back to the list. The circular structure ensures efficient space allocation and reuse.

3. **Game Development**: Circular singly linked lists can be used in game development for managing game elements that need to cycle through a predefined sequence. For example, in a game with power-ups, the power-ups can be organized in a circular list, allowing players to cycle through them.

The places where circular doubly linked lists are used is:

1. **Undo/Redo Functionality**: In software applications, like text editors or graphic design software, where users need to undo or redo actions, doubly circular linked lists can be employed. Each node represents a state or action, and users can navigate backward (undo) or forward (redo) through the list of states.

2. **Cache Management:** Doubly circular linked lists are used in caching mechanisms, such as the LRU (Least Recently Used) cache. In an LRU cache, the most recently used items are moved to the front of the list, while the least recently used items are at the end. When the cache reaches its capacity, items from the end of the list (the least recently used) are removed.

3. **Navigation in Circular Data Structures**: In data structures like circular queues, where elements are processed in a circular manner, doubly circular linked lists are beneficial. Each node can represent an element in the queue, and forward and backward traversal enables efficient processing.

IMPLEMENTATION

Insert

Singly Linked List

```
class Node:
    def __init__(self,data):
        self.data = data;
        self.next = None;
          class SinglyLinkedList:
    def __init__(self):
        self.head = None;
        self.tail = None;

 #addNode() will add a new node to the list

    def addNode(self, data):
        #Create a new node
        newNode = Node(data);

        #Checks if the list is empty
        if(self.head == None):
            #If list is empty, both head and tail w
ill point to new node
            self.head = newNode;
            self.tail = newNode;
else:
            self.tail.next = newNode;
   #newNode will become new tail of the list

            self.tail = newNode;

#display() will display all the nodes present
 in the list
```

```
       def display(self):
           #Node current will point to head
           current = self.head;

           if(self.head == None):
               print("List is empty");
               return;
           print("Nodes of singly linked list: ");
           while(current != None):
#Prints each node by incrementing pointer
               print(current.data),
               current = current.next;

   sList = SinglyLinkedList();

   #Add nodes to the list
   sList.addNode(1);
   sList.addNode(2);
   sList.addNode(3);
   sList.addNode(4);

   #Displays the nodes present in the list
   sList.display();
```

OUTPUT IS:

```
1 2 3 4
```

Doubly Linked List

```
   class Node:
     def __init__(self,data):
       self.data = data;
       self.previous = None;
       self.next = None;

   class InsertStart:

#Represent the head and tail of the doubly link
ed list
     def __init__(self):
       self.head = None;
       self.tail = None;

#addAtStart() will add a node to the starting of
the list
     def addAtStart(self, data):
       #Create a new node
       newNode = Node(data);

       #If list is empty
       if(self.head == None):

 #Both head and tail will point to newNode
         self.head = self.tail = newNode;
#head's previous will point to None
         self.head.previous = None;

#tail's next will point to None, as it is the last
node of the list
         self.tail.next = None;
```

```
#Add newNode as new head of the list
    else:
 #head's previous node will be newNode

      self.head.previous = newNode;
      #newNode's next node will be head
      newNode.next = self.head;

 #newNode's previous will point to None
      newNode.previous = None;
      #newNode will become new head
      self.head = newNode;

  def display(self):
    #Node current will point to head
    current = self.head;
    if(self.head == None):
      print("List is empty");
      return;
  print("Adding a node to the start of the list: ");

    while(current != None):

      print(current.data),
      current = current.next;

    print();
dList = InsertStart();
#Adding  to the list
dList.addAtStart(1);
dList.display();
dList.addAtStart(2);
dList.display();
dList.addAtStart(3);
dList.display();
dList.addAtStart(4);
dList.display();
dList.addAtStart(5);

dList.display();
```

OUTPUT IS:

```
Adding a node to the start of the list: 5 4 3 2 1
```

Circular Singly Linked List

```
class Node:
 def __init__(self, data):
  self.data = data
  self.next = None
class LinkedList:
 def __init__(self):
  self.head = None

 #Add new element at the start of the list
 def push_front(self, newElement):
  newNode = Node(newElement)
  if(self.head == None):
   self.head = newNode
   newNode.next = self.head
   return
  else:
   temp = self.head
   while(temp.next != self.head):
    temp = temp.next
   temp.next = newNode
   newNode.next = self.head
   self.head = newNode
```

```
#display the content of the list
 def PrintList(self):
  temp = self.head
  if(temp != None):
   print("The list contains:", end=" ")
   while (True):
    print(temp.data, end=" ")
    temp = temp.next
    if(temp == self.head):
     break
   print()
  else:
   print("The list is empty.")

# test the code
MyList = LinkedList()

#Add three elements at the start of the list.
MyList.push_front(10)
MyList.push_front(20)
MyList.push_front(30)
MyList.PrintList()
```

OUTPUT IS:

```
30  20  10
```

Circular Doubly Linked List

```
class Node:
 def __init__(self, data):
  self.data = data
  self.next = None
  self.prev = None
class LinkedList:
 def __init__(self):
  self.head = None
 #Add new element at the start of the list
 def push_front(self, newElement):
  newNode = Node(newElement)
  if(self.head == None):
   self.head = newNode
   newNode.next = self.head
   newNode.prev = self.head
   return
  else:
   temp = self.head
   while(temp.next != self.head):
    temp = temp.next
   temp.next = newNode
   NewNode.prev = temp
   newNode.next = self.head
   self.head.prev = newNode
   self.head = newNode
```

```
#display the content of the list
 def PrintList(self):
  temp = self.head
  if(temp != None):
   print("The list contains:", end=" ")
   while (True):
    print(temp.data, end=" ")
    temp = temp.next
    if(temp == self.head):
     break
   print()
  else:
   print("The list is empty.")

# test the code
MyList = LinkedList()

#Add three elements at the start of the list.
MyList.push_front(10)
MyList.push_front(20)
MyList.push_front(30)
MyList.PrintList()
```

OUTPUT IS:

```
30  20  10
```

Delete

Singly Linked List

```
class Node:
 def __init__(self, data):
  self.data = data
  self.next = None

class LinkedList:
 def __init__(self):
  self.head = None
 #Add new element at the end of the list
 def push_back(self, newElement):
  newNode = Node(newElement)
  if(self.head == None):
   self.head = newNode
   return
  else:
   temp = self.head
   while(temp.next != None):
    temp = temp.next
   temp.next = newNode

 #Delete first node of the list
 def pop_front(self):
  if(self.head != None):
   temp = self.head
   self.head = self.head.next
   temp = None
```

```
#display the content of the list
 def PrintList(self):
  temp = self.head
  if(temp != None):
   print("The list contains:", end=" ")
   while (temp != None):
    print(temp.data, end=" ")
    temp = temp.next
   print()
  else:
   print("The list is empty.")
MyList = LinkedList()

#Add four elements in the list.
MyList.push_back(10)
MyList.push_back(20)
MyList.push_back(30)
MyList.push_back(40)
MyList.PrintList()

#Delete the first node
MyList.pop_front()
MyList.PrintList()
```

OUTPUT IS:

```
List contains:  10  20  30  40
New list contains:  20  30  40
```

Doubly Linked List

```
class Node:
  def __init__(self, data):
    self.data = data
    self.next = None
    self.prev = None
class LinkedList:
  def __init__(self):
    self.head = None

  #Add new element at the end of the list
  def push_back(self, newElement):
    newNode = Node(newElement)
    if(self.head == None):
      self.head = newNode
      return
    else:
      temp = self.head
      while(temp.next != None):
        temp = temp.next
      temp.next = newNode
      newNode.prev = temp

#Delete first node of the list
  def pop_front(self):
    if(self.head != None):
      temp = self.head
      self.head = self.head.next
      temp = None
      if(self.head != None):
        self.head.prev = None

#display the content of the list
  def PrintList(self):
    temp = self.head
    if(temp != None):
      print("The list contains:", end=" ")
      while (temp != None):
        print(temp.data, end=" ")
        temp = temp.next
      print()
    else:
      print("The list is empty.")
# test the code
MyList = LinkedList()

#Add four elements in the list.
MyList.push_back(10)
MyList.push_back(20)
MyList.push_back(30)
MyList.push_back(40)
MyList.PrintList()

#Delete the first node
MyList.pop_front()
MyList.PrintList()
```

OUTPUT IS:

```
List contains:  10  20  30  40
New list contains:  20  30  40
```

Circular Singly Linked List

```
class Node:
  def __init__(self, data):
    self.data = data
    self.next = None
class LinkedList:
  def __init__(self):
    self.head = None

  #Add new element at the end of the list
  def push_back(self, newElement):
    newNode = Node(newElement)
    if(self.head == None):
      self.head = newNode
      newNode.next = self.head
      return
    else:
      temp = self.head
      while(temp.next != self.head):
        temp = temp.next
      temp.next = newNode
      newNode.next = self.head

#Delete first node of the list
  def pop_front(self):
    if(self.head != None):
      if(self.head.next == self.head):
        self.head = None
```

```
      else:
        temp = self.head
        firstNode = self.head
        while(temp.next != self.head):
          temp = temp.next
        self.head = self.head.next
        temp.next = self.head
        firstNode = None

  #display the content of the list
  def PrintList(self):
    temp = self.head
    if(temp != None):
      print("The list contains:", end=" ")
      while (True):
        print(temp.data, end=" ")
        temp = temp.next
        if(temp == self.head):
          break
      print()
    else:
      print("The list is empty.")

MyList = LinkedList()
#Add four elements in the list.
MyList.push_back(10)
MyList.push_back(20)
MyList.push_back(30)
MyList.push_back(40)
MyList.PrintList()
#Delete the first node
MyList.pop_front()
MyList.PrintList()
```

OUTPUT IS:

```
List contains:  10  20  30  40
New list contains:  20  30  40
```

Circular Doubly Linked List

```
class Node:
 def __init__(self, data):
  self.data = data
  self.next = None
  self.prev = None
class LinkedList:
 def __init__(self):
  self.head = None
#Add new element at the end of the list
 def push_back(self, newElement):
  newNode = Node(newElement)
  if(self.head == None):
   self.head = newNode
   newNode.next = self.head
   newNode.prev = self.head
   return
  else:
   temp = self.head
   while(temp.next != self.head):
    temp = temp.next
   temp.next = newNode
   newNode.next = self.head
   newNode.prev = temp
   self.head.prev = newNode
 #Delete first node of the list
 def pop_front(self):
  if(self.head != None):
   if(self.head.next == self.head):
    self.head = None
```

```
else:
    temp = self.head
    firstNode = self.head
    while(temp.next != self.head):
     temp = temp.next
    self.head = self.head.next
    self.head.prev = temp
    temp.next = self.head
    firstNode = None

 #display the content of the list
 def PrintList(self):
  temp = self.head
  if(temp != None):
   print("The list contains:", end=" ")
   while (True):
    print(temp.data, end=" ")
    temp = temp.next
    if(temp == self.head):
     break
   print()
  else:
   print("The list is empty.")
MyList = LinkedList()
#Add three elements at the end of the list.
MyList.push_back(10)
MyList.push_back(20)
MyList.push_back(30)
MyList.push_back(40)
MyList.PrintList()

#Delete the first node
MyList.pop_front()
MyList.PrintList()
```

OUTPUT IS:

```
List contains:  10  20  30  40
New list contains:  20  30  40
```

In conclusion, linked lists are fundamental data structures that play a crucial role in computer science and programming. They offer flexibility in data storage and manipulation, making them essential for various applications and algorithms. Linked lists come in different forms, including singly linked lists, doubly linked lists, and circular linked lists, each with its own advantages and use cases.

Singly linked lists are simple to implement and memory-efficient, making them suitable for stacks, queues, and navigation in web browsers. Doubly linked lists provide bidirectional traversal, enabling applications like undo/redo functionality and LRU caching. Circular linked lists, whether singly or doubly, allow for seamless looping and are used in scenarios requiring cyclic behavior.

Linked lists are dynamic in size, making them adaptable to changing data needs, but they have trade-offs such as limited random access and memory overhead. Choosing the right type of linked list depends on the specific requirements of a problem.

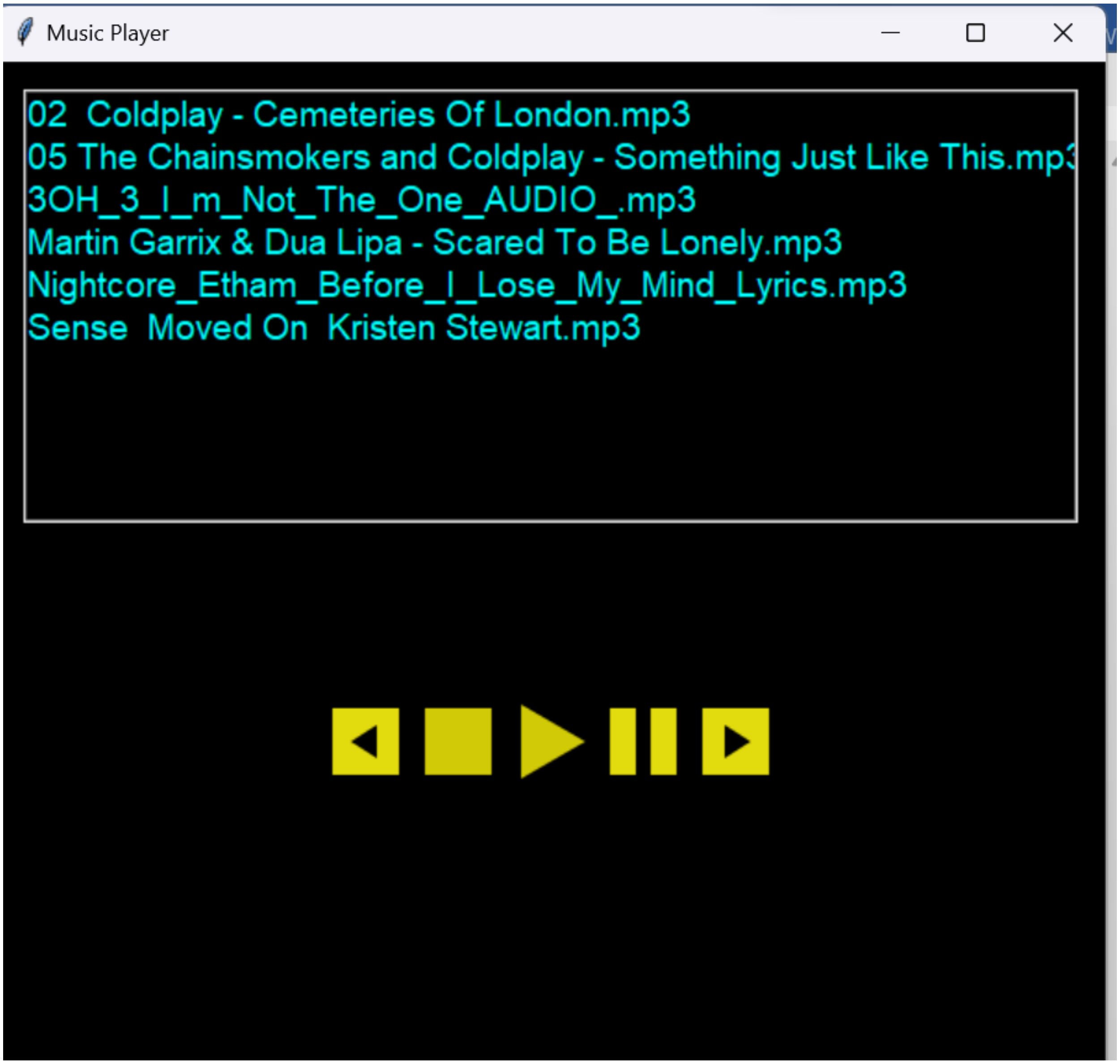
Overall, linked lists are foundational data structures that form the building blocks for more complex data structures and algorithms, and a solid understanding of them is essential for any programmer or computer scientist.

A MUSIC PLAYER DEVELOPED USING PYTHON

Here a Doubly linked lists is used.

```
import tkinter as tk
import fnmatch
import os
from pygame import mixer

canvas = tk.Tk()
canvas.title("Music Player")
canvas.geometry("600x800")
canvas.config(bg='black')

rootpath = "C:\\Users\\shazna salman\\Desktop\\PDSA\\musicapp\\music"
pattern = "*.mp3"

mixer.init()

prv_img = tk.PhotoImage(file="prv.png")
stop_img = tk.PhotoImage(file="stop.png")
play_img = tk.PhotoImage(file="play.png")
pause_img = tk.PhotoImage(file="pause.png")
next_img = tk.PhotoImage(file="next.png")
def select(event=None):
    if listBox.curselection():
        selected_song = listBox.get(listBox.curselection())
        label.config(text=selected_song)
        mixer.music.load(os.path.join(rootpath, selected_song))
        mixer.music.play()
def stop():
    mixer.music.stop()
    listBox.select_clear(0, 'end')
def pla_next():
    current_selection = listBox.curselection()
    if current_selection:
        next_song_index = current_selection[0] + 1
        if next_song_index < listBox.size():
            next_song_name = listBox.get(next_song_index)
            label.config(text=next_song_name)
            mixer.music.load(os.path.join(rootpath, next_song_name))
            mixer.music.play()
            listBox.select_clear(0, 'end')
            listBox.select_set(next_song_index)
```

```
def pla_prv():
    current_selection = listBox.curselection()
    if current_selection:
        prev_song_index = current_selection[0] - 1
        if prev_song_index >= 0:
            prev_song_name = listBox.get(prev_song_index)
            label.config(text=prev_song_name)
            mixer.music.load(os.path.join(rootpath, prev_song_name))
            mixer.music.play()
            listBox.select_clear(0, 'end')
            listBox.select_set(prev_song_index)
def pause_song():
    if pauseButton["text"] == "Pause":
        mixer.music.pause()
        pauseButton["text"] = "Play"
    else:
        mixer.music.unpause()
        pauseButton["text"] = "Pause"
listBox = tk.Listbox(canvas, fg="cyan", bg="black", width=100, font=('ds-digital', 14))
listBox.pack(padx=15, pady=15)
listBox.bind('<<ListboxSelect>>', select)
label = tk.Label(canvas, text='', bg='black', fg='yellow', font=('ds-digital', 14))
label.pack(pady=15)
top = tk.Frame(canvas, bg="black")
top.pack(padx=10, pady=5, anchor='center')
prevButton = tk.Button(canvas, text="Prev", image=prv_img, bg='black', borderwidth=0,
command=pla_prv)
prevButton.pack(pady=15, in_=top, side='left')
stopButton = tk.Button(canvas, text="Stop", image=stop_img, bg='black', borderwidth=0,
command=stop)
stopButton.pack(pady=15, in_=top, side='left')
playButton = tk.Button(canvas, text="Play", image=play_img, bg='black', borderwidth=0,
command=select)
playButton.pack(pady=15, in_=top, side='left')
pauseButton = tk.Button(canvas, text="Pause", image=pause_img, bg='black',
borderwidth=0, command=pause_song)
pauseButton.pack(pady=15, in_=top, side='left')
nextButton = tk.Button(canvas, text="Next", image=next_img, bg='black',
borderwidth=0, command=pla_next)
nextButton.pack(pady=15, in_=top, side='left')

for root, dirs, files in os.walk(rootpath):
    for filename in fnmatch.filter(files, pattern):
        listBox.insert('end', filename)

canvas.mainloop()
```



```
02  Coldplay - Cemeteries Of London.mp3
05 The Chainsmokers and Coldplay - Something Just Like This.mp3
3OH_3_I_m_Not_The_One_AUDIO_.mp3
Martin Garrix & Dua Lipa - Scared To Be Lonely.mp3
Nightcore_Etham_Before_I_Lose_My_Mind_Lyrics.mp3
Sense  Moved On  Kristen Stewart.mp3
```