Vivekanand Education Society's Institute Of Technology
Department Of Information Technology
DSA mini Project
A.Y. 2025-26

Title : BeatLinked-Smart Music Playlist Management System using Data Structures

Sustanibilty Goal: Supports UN SDG 9(Industry, Innovation & Infrastructure) by promoting digital innovation through intelligent, data-driven playlist management.

Domain: **Data Structures & Algorithms**

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6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
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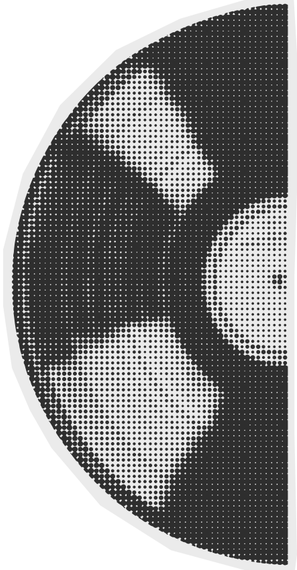
17 PARTNERSHIPS FOR THE GOALS

Content

Introduction to Project

- The **Predictive Song Playlist System** is a console-based Java application that allows users to manage, play, skip, and predict songs in a music playlist.
- The system demonstrates the use of **Data Structures like LinkedList, Queue, and Stack** and simulates **intelligent behavior** by predicting the next song a user may want to play based on their recent activity.
- This project combines **Data Structure implementation** with a simple form of **automation/prediction**



Problem Statement

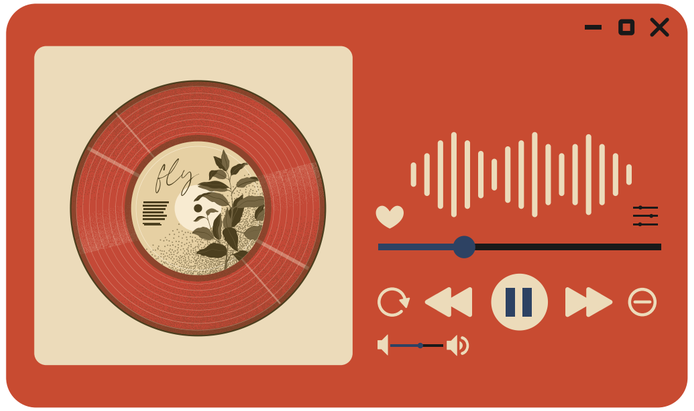
In modern music players, users often want **recommendations or automatic suggestions** for the next song based on their listening history.

Existing systems may require complex AI or database support.

- This project solves the problem by providing a **lightweight predictive playlist system** using only fundamental data structures, making it suitable for learning DSA concepts while offering simple prediction functionality.

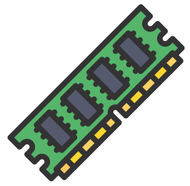
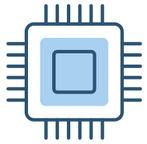
Objectives of the project

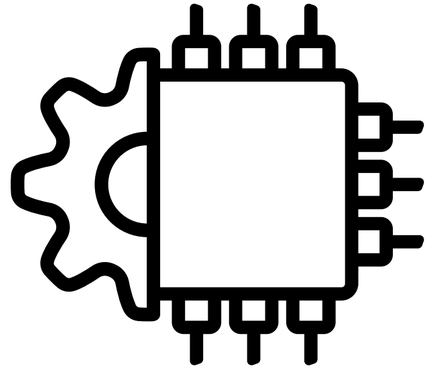
- Implement **play, skip, undo, and prediction features.**
- Demonstrate DSA operations like **insertion, deletion, traversal.**
- Maintain a **recently played list and undo stack.**
- Provide **intelligent next-song suggestions**.



Requirements of the system (Hardware, software)

Hardware:

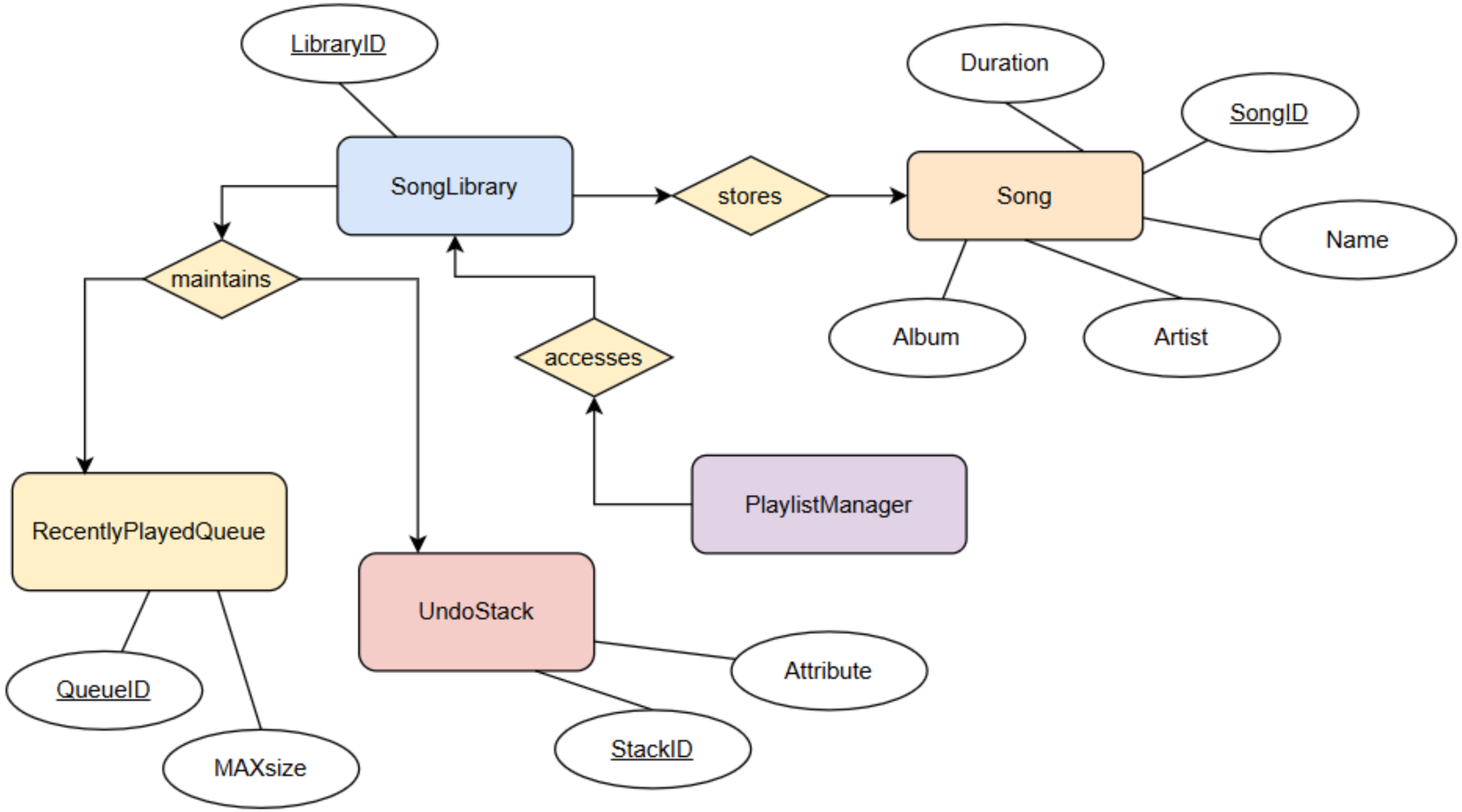
- 4GB RAM minimum 
- 500MB free storage
- Any standard processor 



Software:

- Java JDK 11 or higher 
- Any Java IDE (Eclipse, VS Code, IntelliJ) 
- Terminal / Command Prompt 

ER diagram of the proposed system



Front End

```
--- Predictive Song Playlist ---
1. Display All Songs
2. Play a Song
3. Skip a Song
4. Undo Last Action
5. Show Recently Played
6. Predict Next Song
7. Exit
Enter your choice:
```

Implementation

```java
import java.util.LinkedList;
import java.util.Scanner;

// Song class
class Song {
    String name;
    String artist;
    String album;
    int duration; // in seconds

    public Song(String name, String artist, String album, int duration) {
        this.name = name;
        this.artist = artist;
        this.album = album;
        this.duration = duration;
    }

    @Override
    public String toString() {
        return name + " by " + artist + " (" + album + ") [" + duration + "s]";
    }
}

// Song Library using LinkedList
class SongLibrary {
    LinkedList<Song> songs;

    public SongLibrary() {
        songs = new LinkedList<>();
    }

    public void addSong(Song song) {
        songs.add(song);
    }

    public void displayAllSongs() {
```

```java
class SongLibrary {
    public void displayAllSongs() {
            System.out.println("No songs in the library.");
            return;
        }
        System.out.println("Song Library:");
        int i = 1;
        for (Song s : songs) {
            System.out.println(i + ". " + s);
            i++;
        }
    }

    public Song getSong(int index) {
        if (index >= 0 && index < songs.size()) {
            return songs.get(index);
        } else {
            return null;
        }
    }

    public int size() {
        return songs.size();
    }
}

// Playlist Manager with Queue and Stack
class PlaylistManager {
    LinkedList<Song> recentlyPlayed; // Queue
    LinkedList<Song> undoStack;      // Stack
    int maxRecent;

    public PlaylistManager(int maxRecent) {
        recentlyPlayed = new LinkedList<>();
        undoStack = new LinkedList<>();
        this.maxRecent = maxRecent;
    }

    public void playSong(Song song) {
        System.out.println("Playing: " + song);
        // Add to recently played queue
        recentlyPlayed.addLast(song);
        if (recentlyPlayed.size() > maxRecent) {
            recentlyPlayed.removeFirst(); // maintain max size
        }
        // Push to undo stack
        undoStack.push(song);
    }

    public void skipSong(Song song) {
        System.out.println("Skipped: " + song);
        // Push skipped song to undo stack
        undoStack.push(song);
    }

    public void undoLastAction() {
        if (undoStack.isEmpty()) {
            System.out.println("Nothing to undo.");
            return;
        }
        Song last = undoStack.pop();
        System.out.println("Undoing last action. You can replay: " + last);
        playSong(last);
    }

    public void showRecentlyPlayed() {
        if (recentlyPlayed.isEmpty()) {
```

```java
    public void showRecentlyPlayed() {
        if (recentlyPlayed.isEmpty()) {
            System.out.println("No recently played songs.");
            return;
        }
        System.out.println("Recently Played Songs:");
        for (Song s : recentlyPlayed) {
            System.out.println("- " + s);
        }
    }

    // Simple prediction: picks the 1st song in library that is not in recently played
    public void predictNextSong(SongLibrary library) {
        for (Song s : library.songs) {
            if (!recentlyPlayed.contains(s)) {
                System.out.println("Predicted Next Song: " + s);
                return;
            }
        }
        System.out.println("No prediction available (all songs recently played).");
    }
}

// Main Program
public class EchoQueueSystem {
    Run main | Debug main | Run | Debug
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);
        SongLibrary library = new SongLibrary();
        PlaylistManager manager = new PlaylistManager(maxRecent:5); // Keep last 5 songs

        // Sample songs
        library.addSong(new Song(name:"Shape of You", artist:"Ed Sheeran", album:"Divide", duration:240));
        library.addSong(new Song(name:"Blinding Lights", artist:"The Weeknd", album:"After Hours", duration:200));
        library.addSong(new Song(name:"Levitating", artist:"Dua Lipa", album:"Future Nostalgia", duration:203));
        library.addSong(new Song(name:"Believer", artist:"Imagine Dragons", album:"Evolve", duration:210));
        library.addSong(new Song(name:"Perfect", artist:"Ed Sheeran", album:"Divide", duration:265));

        int choice;
        do {
            System.out.println("\n--- Predictive Song Playlist ---");
            System.out.println("1. Display All Songs");
            System.out.println("2. Play a Song");
            System.out.println("3. Skip a Song");
            System.out.println("4. Undo Last Action");
            System.out.println("5. Show Recently Played");
            System.out.println("6. Predict Next Song");
            System.out.println("7. Exit");
            System.out.print("Enter your choice: ");
            choice = sc.nextInt();
            sc.nextLine(); // consume newline

            switch (choice) {
                case 1:
                    library.displayAllSongs();
                    break;
                case 2:
                    library.displayAllSongs();
                    System.out.print("Enter song number to play: ");
                    int playIndex = sc.nextInt() - 1;
                    sc.nextLine();
                    Song playSong = library.getSong(playIndex);
                    if (playSong != null) {
                        manager.playSong(playSong);
                    } else {
                        System.out.println("Invalid song selection.");
                    }
                    break;
                case 3:
                    library.displayAllSongs();
                    System.out.print("Enter song number to skip: ");
                    int skipIndex = sc.nextInt() - 1;
                    sc.nextLine();
                    Song skipSong = library.getSong(skipIndex);
                    if (skipSong != null) {
                        manager.skipSong(skipSong);
                    } else {
                        System.out.println("Invalid song selection.");
                    }
                    break;
                case 4:
                    manager.undoLastAction();
                    break;
                case 5:
                    manager.showRecentlyPlayed();
                    break;
                case 6:
                    manager.predictNextSong(library);
                    break;
                case 7:
                    System.out.println("Exiting... Goodbye!");
                    break;
                default:
                    System.out.println("Invalid choice. Try again.");
            }

        } while (choice != 7);

        sc.close();
    }
}
```

Outputs

```
--- Predictive Song Playlist ---
1. Display All Songs
2. Play a Song
3. Skip a Song
4. Undo Last Action
5. Show Recently Played
6. Predict Next Song
7. Exit
Enter your choice:
```

```
--- Predictive Song Playlist ---
1. Display All Songs
2. Play a Song
3. Skip a Song
4. Undo Last Action
5. Show Recently Played
6. Predict Next Song
7. Exit
Enter your choice: 6
Predicted Next Song: Shape of You by Ed Sheeran (Divide) [240s]
```

```
--- Predictive Song Playlist ---
1. Display All Songs
2. Play a Song
3. Skip a Song
4. Undo Last Action
5. Show Recently Played
6. Predict Next Song
7. Exit
Enter your choice: 2
Song Library:
1. Shape of You by Ed Sheeran (Divide) [240s]
2. Blinding Lights by The Weeknd (After Hours) [200s]
3. Levitating by Dua Lipa (Future Nostalgia) [203s]
4. Believer by Imagine Dragons (Evolve) [210s]
5. Perfect by Ed Sheeran (Divide) [265s]
Enter song number to play: 4
Playing: Believer by Imagine Dragons (Evolve) [210s]
```

```
--- Predictive Song Playlist ---
1. Display All Songs
2. Play a Song
3. Skip a Song
4. Undo Last Action
5. Show Recently Played
6. Predict Next Song
7. Exit
Enter your choice: 1
Song Library:
1. Shape of You by Ed Sheeran (Divide) [240s]
2. Blinding Lights by The Weeknd (After Hours) [200s]
3. Levitating by Dua Lipa (Future Nostalgia) [203s]
4. Believer by Imagine Dragons (Evolve) [210s]
5. Perfect by Ed Sheeran (Divide) [265s]
```

```
--- Predictive Song Playlist ---
1. Display All Songs
2. Play a Song
3. Skip a Song
4. Undo Last Action
5. Show Recently Played
6. Predict Next Song
7. Exit
Enter your choice: 4
Undoing last action. You can replay: Perfect by Ed Sheeran (Divide) [265s]
Playing: Perfect by Ed Sheeran (Divide) [265s]
```

```
Song Library:
1. Shape of You by Ed Sheeran (Divide) [240s]
2. Blinding Lights by The Weeknd (After Hours) [200s]
3. Levitating by Dua Lipa (Future Nostalgia) [203s]
4. Believer by Imagine Dragons (Evolve) [210s]
5. Perfect by Ed Sheeran (Divide) [265s]
Enter song number to skip: 5
Skipped: Perfect by Ed Sheeran (Divide) [265s]
```

```
--- Predictive Song Playlist ---
1. Display All Songs
2. Play a Song
3. Skip a Song
4. Undo Last Action
5. Show Recently Played
6. Predict Next Song
7. Exit
Enter your choice: 5
Recently Played Songs:
- Blinding Lights by The Weeknd (After Hours) [200s]
- Blinding Lights by The Weeknd (After Hours) [200s]
- Blinding Lights by The Weeknd (After Hours) [200s]
- Believer by Imagine Dragons (Evolve) [210s]
- Shape of You by Ed Sheeran (Divide) [240s]
```

Gantt Chart

WEEK	TASK
1	**Requirement Analysis & DSA Selection**
2	Design Classes and Data Structures
3	Implement SongLibrary & PlaylistManager
4	Implement Play, Skip, Undo Features
5	Implement Prediction & Recently Played Features
6	Testing, Debugging, and Final Report Preparation

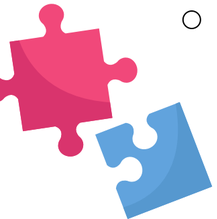
TEST CASE	INPUT	EXPECTED OUTPUT	Result
Play a song	Select song 1	“Playing: Shape of You ...”	**PASS**
Skip a song	Select song 2	“Skipped: Blinding Lights ...”	PASS
Undo last	Last action = play song	Last song plays again	PASS
Predict next	Library contains unplayed songs	First unplayed song is predicted	PASS
Show recently played	Queue not empty	Lists last 5 songs	PASS

Conclusion

The Predictive Song Playlist System successfully demonstrates how fundamental data structures—LinkedList, Queue, and Stack—can be utilized to manage and manipulate a music playlist efficiently. The system allows users to play, skip, undo, and view recently played songs, while also providing a simple prediction of the next song based on listening history.

CHALLENGES AND SOLUTIONS

- **Challenge**: Maintaining prediction without using HashMap
  - **Solution**: Traverse LinkedList of library and compare with recently played queue.
- **Challenge**: Undo feature for both play and skip
  - **Solution**: Use Stack to store last action for LIFO undo



Future Scope

- Add GUI-based interface.
- Include genre and artist-based predictions.
- Integrate real music API for live song data.
- Expand prediction algorithm using simple AI/ML.

References

1. R. Lafore, Data Structures and Algorithms in Java, 2nd ed., Sams Publishing, 2002.
2. Oracle, Java™ Platform Standard Edition Documentation, [Online]. Available: https://docs.oracle.com/javase/8/docs/
3. Y. Daniel Liang, Introduction to Java Programming, 10th ed., Pearson, 2015.
4. GeeksforGeeks, “Java LinkedList, Stack, and Queue”, [Online]. Available: **Implement** play, skip, undo, and prediction features.
5. **Demonstrate DSA operations like** insertion, deletion, traversal.
6. **Maintain a** recently played list and undo stack.
7. **Provide** intelligent next-song suggestions.