**1. Source and Header Files**

**Rashmi –**

1. Description:

* Team Leader – Delegated and assigned tasks as needed and kept the team on track.
* Hash Algorithm – Created the hash algorithms as well as the collision resolution method.

1. Individual Source/Header Files:

**Aditi –**

1. Description:

* BST Algorithm – Created a BST that would work with a primary and secondary tree.
* Presentation – Created the presentation outline and presentation.
* Documentation – Created the documentation including the final test plan.

1. Individual Source/Header Files:

**Jennifer –**

1. Description:

* Hash Algorithms: Helped with the overflow aspect of the collsion resolution method
* I/O File: Created the code that would read from an input file and write to an output file
* Screen Output: Created the menu portion of the project and created extra functions to make the main.cpp more organized.

1. Individual Source/Header Files:

**2. Input Data File**

Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA

Maps; Maroon 5; Pop; 2014; Interscope

Kashmir; Led Zeppelin; Rock; 1975; Swan Song

Frozen; Madonna; Pop; 1998; Warner Bros

Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records

Take Five; Dave Brubeck; Jazz; 1959; Columbia

So What; Miles Davis; Jazz; 1959; Columbia

Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia

My Favorite Things; John Coltrane; Jazz; 1961; Atlantic

Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings

Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical

Strange Fruit; Billie Holiday; Jazz; 1939; Commodore

Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca

Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone

Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment

Sun; Gen Hoshino; World; 2015; Speedstar Records

Like A Prayer; Madonna; Pop; 1989; Warner Bros

I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia

Vogue; Madonna; Pop; 1990; Warner Bros

The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records

Like A Stone; Audioslave; Rock; 2002; Interscope

Headstrong; Trapt; Rock; 2002; Warner Bros

Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG

Fix You; Coldplay; Pop; 2005; Parlophone

Dios le Pido; Juanes; World; 2002; Surco

Dinah; Louis Armstrong; Jazz; 1925; NA

Under Pressure; David Bowie; Pop; 1982; Elektra

Yellow; Coldplay; Pop; 2000; Parlophone

No More; Billie Holiday; Jazz; 1944; Columbia

Milestones; Miles Davis; Jazz; 1959; Columbia

Sweet Emotion; Aerosmith; Rock; 1975; Columbia

Moon; Yoko Kanno; World; 1999; Victor Entertainment

Dream On; Aerosmith; Rock; 1973; Columbia

Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine

ZoobiDoobi; Sonu Nigam; World; 2009; T-Series

**3. Music Database - Final Test Plan:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test #** | **Menu Options** | **Input (KEY)** | **Output** | **Remarks** |
| 1 | **T – Print Indented Trees**  1. Using Song Name based binary tree | T  1 | 1. Moonlight Sonata  2. Take Five  3. Vogue  4. Yellow  5. ZoobiDoobi  5. Wildest Dreams  4. The Man Who Sold the World  5. Under Pressure  3. So What  4. Symphony No. 5 in C Minor  5. Symphony No. 40 in G Minor  6. Strange Fruit  7. Suite No. 1 in C Major  8. Sun  9. Sweet Emotion  4. My Favorite Things  5. No More  2. Maps  3. Milestones  4. Moon  3. Kashmir  4. Livin La Vida Loca  5. Like A Prayer  6. Like A Stone  4. Frozen  5. Gimme Shelter  6. I Don't Want to Miss a Thing  7. Kal Ho Na Ho  7. Headstrong  5. Adventure of a Lifetime  6. Baby Baby  7. Fix You  8. Dios le Pido  9. Dream On  9. Dinah | List Printed by Height |
| 2 | **T – Print Indented Trees**  2. Using Artist Name based binary tree | T  2 | 1. Ludwig Van Beethoven  2. Maroon 5  3. Rolling Stones  4. Wolfgang Amadeus Mozart  5. Yoko Kanno  5. Trapt  6. Sonu Nigam  7. Taylor Swift  8. Sonu Nigam  4. Miles Davis  5. Ricky Martin  6. Miles Davis  3. Madonna  4. Madonna  5. Madonna  4. Ludwig van Beethoven  2. Led Zeppelin  3. Louis Armstrong  3. Dave Brubeck  4. John Coltrane  5. Juanes  5. Johann Sebastian Bach  6. Girls' Generation  7. Gen Hoshino  8. David Bowie  9. David Bowie  4. Billie Holiday  5. Coldplay  6. Coldplay  7. Coldplay  6. Billie Holiday  5. Aerosmith  6. Audioslave  7. Aerosmith  8. Aerosmith | List Printed by Height |
| 3 | **T – Print Indented Trees**  3. Go To the Main Menu | T  3 | Going to the Main menu..  Please enter a letter to perform one of the Menu operations OR enter 'H' to see the Menu: |  |
| 4 | **B – Print Breadth-First Traversal**  **1. Using Song Name based binary tree** | B  1 | Breadth-First Traversal using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  Maps; Maroon 5; Pop; 2014; Interscope  Take Five; Dave Brubeck; Jazz; 1959; Columbia  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Milestones; Miles Davis; Jazz; 1959; Columbia  So What; Miles Davis; Jazz; 1959; Columbia  Vogue; Madonna; Pop; 1990; Warner Bros  Frozen; Madonna; Pop; 1998; Warner Bros  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Moon; Yoko Kanno; World; 1999; Victor Entertainment  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Yellow; Coldplay; Pop; 2000; Parlophone  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Like A Prayer; Madonna; Pop; 1989; Warner Bros  No More; Billie Holiday; Jazz; 1944; Columbia  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Under Pressure; David Bowie; Pop; 1982; Elektra  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Like A Stone; Audioslave; Rock; 2002; Interscope  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  Fix You; Coldplay; Pop; 2005; Parlophone  Headstrong; Trapt; Rock; 2002; Warner Bros  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Dios le Pido; Juanes; World; 2002; Surco  Sun; Gen Hoshino; World; 2015; Speedstar Records  Dinah; Louis Armstrong; Jazz; 1925; NA  Dream On; Aerosmith; Rock; 1973; Columbia  Sweet Emotion; Aerosmith; Rock; 1975; Columbia | Songs aligned to the left |
| 5 | **B – Print Breadth-First Traversal**  2. Using Artist Name based binary tree | B  2 | Breadth-First Traversal using Artist Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Maps; Maroon 5; Pop; 2014; Interscope  Take Five; Dave Brubeck; Jazz; 1959; Columbia  Dinah; Louis Armstrong; Jazz; 1925; NA  Frozen; Madonna; Pop; 1998; Warner Bros  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Like A Prayer; Madonna; Pop; 1989; Warner Bros  So What; Miles Davis; Jazz; 1959; Columbia  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Dios le Pido; Juanes; World; 2002; Surco  Vogue; Madonna; Pop; 1990; Warner Bros  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Headstrong; Trapt; Rock; 2002; Warner Bros  Moon; Yoko Kanno; World; 1999; Victor Entertainment  Like A Stone; Audioslave; Rock; 2002; Interscope  No More; Billie Holiday; Jazz; 1944; Columbia  Fix You; Coldplay; Pop; 2005; Parlophone  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Milestones; Miles Davis; Jazz; 1959; Columbia  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Yellow; Coldplay; Pop; 2000; Parlophone  Sun; Gen Hoshino; World; 2015; Speedstar Records  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  Dream On; Aerosmith; Rock; 1973; Columbia  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Under Pressure; David Bowie; Pop; 1982; Elektra | Songs aligned to the left |
| 6 | **B – Print Breadth-First Traversal**  3. Go to the Main Menu | B  3 | Going to the Main menu..  Please enter a letter to perform one of the Menu operations OR enter 'H' to see the Menu: |  |
| 7 | **D – Print Depth-First Traversal**  1. In-Order Traversal of Song Name (Primary key) based binary tree | D  1 | In-Order Traversal using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Dinah; Louis Armstrong; Jazz; 1925; NA  Dios le Pido; Juanes; World; 2002; Surco  Dream On; Aerosmith; Rock; 1973; Columbia  Fix You; Coldplay; Pop; 2005; Parlophone  Frozen; Madonna; Pop; 1998; Warner Bros  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Headstrong; Trapt; Rock; 2002; Warner Bros  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Like A Stone; Audioslave; Rock; 2002; Interscope  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Maps; Maroon 5; Pop; 2014; Interscope  Milestones; Miles Davis; Jazz; 1959; Columbia  Moon; Yoko Kanno; World; 1999; Victor Entertainment  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  No More; Billie Holiday; Jazz; 1944; Columbia  So What; Miles Davis; Jazz; 1959; Columbia  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Sun; Gen Hoshino; World; 2015; Speedstar Records  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Take Five; Dave Brubeck; Jazz; 1959; Columbia  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Under Pressure; David Bowie; Pop; 1982; Elektra  Vogue; Madonna; Pop; 1990; Warner Bros  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  Yellow; Coldplay; Pop; 2000; Parlophone  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series |  |
| 8 | **D – Print Depth-First Traversal**  2. Pre-OrderTraversal of Song Name (Primary key) based binary tree | D  2 | Pre-Order Traversal using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  Maps; Maroon 5; Pop; 2014; Interscope  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Frozen; Madonna; Pop; 1998; Warner Bros  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Fix You; Coldplay; Pop; 2005; Parlophone  Dios le Pido; Juanes; World; 2002; Surco  Dinah; Louis Armstrong; Jazz; 1925; NA  Dream On; Aerosmith; Rock; 1973; Columbia  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Headstrong; Trapt; Rock; 2002; Warner Bros  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Like A Stone; Audioslave; Rock; 2002; Interscope  Milestones; Miles Davis; Jazz; 1959; Columbia  Moon; Yoko Kanno; World; 1999; Victor Entertainment  Take Five; Dave Brubeck; Jazz; 1959; Columbia  So What; Miles Davis; Jazz; 1959; Columbia  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  No More; Billie Holiday; Jazz; 1944; Columbia  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Sun; Gen Hoshino; World; 2015; Speedstar Records  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Vogue; Madonna; Pop; 1990; Warner Bros  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Under Pressure; David Bowie; Pop; 1982; Elektra  Yellow; Coldplay; Pop; 2000; Parlophone  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series |  |
| 9 | **D – Print Depth-First Traversal**  3. Post-Order Traversal of Song Name (Primary key) based binary tree | D  3 | Post-Order Traversal using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Dinah; Louis Armstrong; Jazz; 1925; NA  Dream On; Aerosmith; Rock; 1973; Columbia  Dios le Pido; Juanes; World; 2002; Surco  Fix You; Coldplay; Pop; 2005; Parlophone  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Headstrong; Trapt; Rock; 2002; Warner Bros  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Frozen; Madonna; Pop; 1998; Warner Bros  Like A Stone; Audioslave; Rock; 2002; Interscope  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Moon; Yoko Kanno; World; 1999; Victor Entertainment  Milestones; Miles Davis; Jazz; 1959; Columbia  Maps; Maroon 5; Pop; 2014; Interscope  No More; Billie Holiday; Jazz; 1944; Columbia  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Sun; Gen Hoshino; World; 2015; Speedstar Records  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  So What; Miles Davis; Jazz; 1959; Columbia  Under Pressure; David Bowie; Pop; 1982; Elektra  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Yellow; Coldplay; Pop; 2000; Parlophone  Vogue; Madonna; Pop; 1990; Warner Bros  Take Five; Dave Brubeck; Jazz; 1959; Columbia  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA |  |
| 10 | **D – Print Depth-First Traversal**  4. In-Order Traversal of Artist Name (Secondary key) based binary tree | D  4 | In-Order Traversal using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Dream On; Aerosmith; Rock; 1973; Columbia  Like A Stone; Audioslave; Rock; 2002; Interscope  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  No More; Billie Holiday; Jazz; 1944; Columbia  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Fix You; Coldplay; Pop; 2005; Parlophone  Yellow; Coldplay; Pop; 2000; Parlophone  Take Five; Dave Brubeck; Jazz; 1959; Columbia  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Under Pressure; David Bowie; Pop; 1982; Elektra  Sun; Gen Hoshino; World; 2015; Speedstar Records  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  Dios le Pido; Juanes; World; 2002; Surco  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Dinah; Louis Armstrong; Jazz; 1925; NA  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Frozen; Madonna; Pop; 1998; Warner Bros  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Vogue; Madonna; Pop; 1990; Warner Bros  Maps; Maroon 5; Pop; 2014; Interscope  So What; Miles Davis; Jazz; 1959; Columbia  Milestones; Miles Davis; Jazz; 1959; Columbia  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  Headstrong; Trapt; Rock; 2002; Warner Bros  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Moon; Yoko Kanno; World; 1999; Victor Entertainment |  |
| 11 | **D – Print Depth-First Traversal**  5. Pre-Order Traversal of Artist Name (Secondary key) based binary tree | D  5 | Pre-Order Traversal using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Take Five; Dave Brubeck; Jazz; 1959; Columbia  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Like A Stone; Audioslave; Rock; 2002; Interscope  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Dream On; Aerosmith; Rock; 1973; Columbia  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  No More; Billie Holiday; Jazz; 1944; Columbia  Fix You; Coldplay; Pop; 2005; Parlophone  Yellow; Coldplay; Pop; 2000; Parlophone  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Sun; Gen Hoshino; World; 2015; Speedstar Records  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Under Pressure; David Bowie; Pop; 1982; Elektra  Dios le Pido; Juanes; World; 2002; Surco  Dinah; Louis Armstrong; Jazz; 1925; NA  Maps; Maroon 5; Pop; 2014; Interscope  Frozen; Madonna; Pop; 1998; Warner Bros  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Vogue; Madonna; Pop; 1990; Warner Bros  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  So What; Miles Davis; Jazz; 1959; Columbia  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Milestones; Miles Davis; Jazz; 1959; Columbia  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Headstrong; Trapt; Rock; 2002; Warner Bros  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Moon; Yoko Kanno; World; 1999; Victor Entertainment |  |
| 12 | **D – Print Depth-First Traversal**  6. Post-Order Traversal of Artist Name (Secondary key) based binary tree | D  6 | Post-Order Traversal using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Dream On; Aerosmith; Rock; 1973; Columbia  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Like A Stone; Audioslave; Rock; 2002; Interscope  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  No More; Billie Holiday; Jazz; 1944; Columbia  Yellow; Coldplay; Pop; 2000; Parlophone  Fix You; Coldplay; Pop; 2005; Parlophone  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  Under Pressure; David Bowie; Pop; 1982; Elektra  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Sun; Gen Hoshino; World; 2015; Speedstar Records  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Dios le Pido; Juanes; World; 2002; Surco  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  Take Five; Dave Brubeck; Jazz; 1959; Columbia  Dinah; Louis Armstrong; Jazz; 1925; NA  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Vogue; Madonna; Pop; 1990; Warner Bros  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Frozen; Madonna; Pop; 1998; Warner Bros  Milestones; Miles Davis; Jazz; 1959; Columbia  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  So What; Miles Davis; Jazz; 1959; Columbia  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Headstrong; Trapt; Rock; 2002; Warner Bros  Moon; Yoko Kanno; World; 1999; Victor Entertainment  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Maps; Maroon 5; Pop; 2014; Interscope  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA |  |
| 13 | **D – Print Depth-First Traversal**  7. Go to the previous menu | D  7 | Going to the previous menu..  Please enter a letter to perform one of the Menu operations OR enter 'H' to see the Menu: |  |
| 14 | **R : Print Sorted/Unsorted list**  1. Unsorted list using hash table | R  1 | Unsorted list using hash table:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Dream On; Aerosmith; Rock; 1973; Columbia  Moon; Yoko Kanno; World; 1999; Victor Entertainment  Take Five; Dave Brubeck; Jazz; 1959; Columbia  Sun; Gen Hoshino; World; 2015; Speedstar Records  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Vogue; Madonna; Pop; 1990; Warner Bros  No More; Billie Holiday; Jazz; 1944; Columbia  Frozen; Madonna; Pop; 1998; Warner Bros  So What; Miles Davis; Jazz; 1959; Columbia  Like A Stone; Audioslave; Rock; 2002; Interscope  Headstrong; Trapt; Rock; 2002; Warner Bros  Yellow; Coldplay; Pop; 2000; Parlophone  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Fix You; Coldplay; Pop; 2005; Parlophone  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Milestones; Miles Davis; Jazz; 1959; Columbia  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Dios le Pido; Juanes; World; 2002; Surco  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  Dinah; Louis Armstrong; Jazz; 1925; NA  Under Pressure; David Bowie; Pop; 1982; Elektra  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Maps; Maroon 5; Pop; 2014; Interscope  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic |  |
| 15 | **R : Print Sorted/Unsorted list**  2. Sorted list using Song Name (Primary Key) based binary tree | R  2 | Sorted list using Song Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Dinah; Louis Armstrong; Jazz; 1925; NA  Dios le Pido; Juanes; World; 2002; Surco  Dream On; Aerosmith; Rock; 1973; Columbia  Fix You; Coldplay; Pop; 2005; Parlophone  Frozen; Madonna; Pop; 1998; Warner Bros  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Headstrong; Trapt; Rock; 2002; Warner Bros  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Like A Stone; Audioslave; Rock; 2002; Interscope  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Maps; Maroon 5; Pop; 2014; Interscope  Milestones; Miles Davis; Jazz; 1959; Columbia  Moon; Yoko Kanno; World; 1999; Victor Entertainment  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  No More; Billie Holiday; Jazz; 1944; Columbia  So What; Miles Davis; Jazz; 1959; Columbia  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  Sun; Gen Hoshino; World; 2015; Speedstar Records  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Take Five; Dave Brubeck; Jazz; 1959; Columbia  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Under Pressure; David Bowie; Pop; 1982; Elektra  Vogue; Madonna; Pop; 1990; Warner Bros  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  Yellow; Coldplay; Pop; 2000; Parlophone  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series |  |
| 16 | **R : Print Sorted/Unsorted list**  3. Sorted list using Artist Name (Secondary Key) based binary tree | R  3 | Sorted list using Artist Name based binary tree:  ------------------------------------------------------------  SONG NAME; ARTIST NAME; GENRE; YEAR RELEASED; RECORD LABLE  ------------------------------------------------------------  I Don't Want to Miss a Thing; Aerosmith; Rock; 1998; Columbia  Sweet Emotion; Aerosmith; Rock; 1975; Columbia  Dream On; Aerosmith; Rock; 1973; Columbia  Like A Stone; Audioslave; Rock; 2002; Interscope  Strange Fruit; Billie Holiday; Jazz; 1939; Commodore  No More; Billie Holiday; Jazz; 1944; Columbia  Adventure of a Lifetime; Coldplay; Pop; 2015; Parlophone  Fix You; Coldplay; Pop; 2005; Parlophone  Yellow; Coldplay; Pop; 2000; Parlophone  Take Five; Dave Brubeck; Jazz; 1959; Columbia  The Man Who Sold the World; David Bowie; Pop; 1970; Mercury Records  Under Pressure; David Bowie; Pop; 1982; Elektra  Sun; Gen Hoshino; World; 2015; Speedstar Records  Baby Baby; Girls' Generation; World; 2008; S. M. Entertainment  Suite No. 1 in C Major; Johann Sebastian Bach; Classical; 1745; Decca  My Favorite Things; John Coltrane; Jazz; 1961; Atlantic  Dios le Pido; Juanes; World; 2002; Surco  Kashmir; Led Zeppelin; Rock; 1975; Swan Song  Dinah; Louis Armstrong; Jazz; 1925; NA  Moonlight Sonata; Ludwig Van Beethoven; Classical; 1801; NA  Symphony No. 5 in C Minor; Ludwig van Beethoven; Classical; 1808; Reference Recordings  Frozen; Madonna; Pop; 1998; Warner Bros  Like A Prayer; Madonna; Pop; 1989; Warner Bros  Vogue; Madonna; Pop; 1990; Warner Bros  Maps; Maroon 5; Pop; 2014; Interscope  So What; Miles Davis; Jazz; 1959; Columbia  Milestones; Miles Davis; Jazz; 1959; Columbia  Livin La Vida Loca; Ricky Martin; Pop; 1998; Columbia  Gimme Shelter; Rolling Stones; Rock; 1969; Decca Records  Kal Ho Na Ho; Sonu Nigam; World; 2003; Sony BMG  ZoobiDoobi; Sonu Nigam; World; 2009; T-Series  Wildest Dreams; Taylor Swift; Pop; 2015; Big Machine  Headstrong; Trapt; Rock; 2002; Warner Bros  Symphony No. 40 in G Minor; Wolfgang Amadeus Mozart; Classical; 1789; EMG Classical  Moon; Yoko Kanno; World; 1999; Victor Entertainment |  |
| 17 | **R : Print Sorted/Unsorted list**  4. Go to the Main menu | R  4 | Going to the Main menu..  Please enter a letter to perform one of the Menu operations OR enter 'H' to see the Menu: |  |
| 18 | **P : Search by primary key (Song Name)** | P  Symphony No. 40 in G Minor | This song is available!  Song Name: Symphony No. 40 in G Minor  Artist Name: Wolfgang Amadeus Mozart  Genre: Classical  Year Released: 1789  Record Label: EMG Classical |  |
| 19 | **P : Search by primary key (Song Name)** | P  Sweet Child O' Mine | This song is not available. |  |
| 20 | **S : Search by secondary key (Artist Name)** | S  Audioslave | Song Name: Like A Stone  Artist Name: Audioslave  Genre: Rock  Year Released: 2002  Record Label: Interscope |  |
| 21 | **S : Search by secondary key (Artist Name)** | S  Death Cab for Cutie | Artist Death Cab for Cutie is not available. |  |
| 22 | **A : Add new song to the file** | A  **Song Name:** No One  **Artist Name:** Alicia Keys  **Genre:** Pop  **Year Released:** 2007  **Record Label:** Interscope | Your song has been added to the list. |  |
| 23 | **T – Print Indented Trees**  1. Using Song Name based binary tree | T  1 | Indented Tree using Song Name based binary tree:  1. Moonlight Sonata  2. Take Five  3. Vogue  4. Yellow  5. ZoobiDoobi  5. Wildest Dreams  4. The Man Who Sold the World  5. Under Pressure  3. So What  4. Symphony No. 5 in C Minor  5. Symphony No. 40 in G Minor  6. Strange Fruit  7. Suite No. 1 in C Major  8. Sun  9. Sweet Emotion  4. My Favorite Things  5. No More  **6. No One**  2. Maps  3. Milestones  4. Moon  3. Kashmir  4. Livin La Vida Loca  5. Like A Prayer  6. Like A Stone  4. Frozen  5. Gimme Shelter  6. I Don't Want to Miss a Thing  7. Kal Ho Na Ho  7. Headstrong  5. Adventure of a Lifetime  6. Baby Baby  7. Fix You  8. Dios le Pido  9. Dream On  9. Dinah |  |
| 24 | **E : Erase/Delete a song from the file** | E  **Please enter song name you want to delete:** Headstrong | Your song has been deleted. |  |
| 25 | **E : Erase/Delete a song from the file** | E  **Please enter song name you want to delete:** Hello World | Your song is not in the list. |  |
| 26 | H : Help - to show the menu | H | \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* MENU \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  T : Print Indented Trees  B : Print binary tree Breadth-First Traversals  D : Print binary tree Depth-First Traversals  R : Print Sorted/Unsorted list  P : Search by primary key (Song Name)  S : Search by secondary key (Artist Name)  A : Add new song to the file  E : Erase/Delete a song from the file  H : Help - to show the menu  Q : Quit  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  Please enter a letter to perform one of the Menu operations OR enter 'H' to see the Menu: |  |
| 27 | **V : Save Music to the file** | V | Your file has been saved. |  |
| 28 | **T : Print HashTable Statistics** | T | Load Factor: 26.76%  Longest branch size is: 3  Longest Branch Home Adress: 9  Key: Kashmir  Key: Like A Prayer  Key: Prayer Like A  Longest Branch Home Adress: 45  Key: Like A Stone  Key: Headstrong  Key: Stone Like A  Longest Branch Home Adress: 65  Key: Kal Ho Na Ho  Key: Milestones  Key: Kal Ho Ho Na  Number of full buckets: 3  Number of empty buckets: 42 |  |
| 29 | **Q : Quit** | Q | Exiting now.. Good Bye! |  |

**4. Output (based on the demonstration test plan):**