# CA1: Dataframe Manipulation with Spotify Data

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## Introduction

Pandas is an extremely powerful tool to handle large amounts of tabular data. In this compulsory assignment, you will use Pandas to explore one of the TA's personal spotify data in depth.   Additional information:

- Feel free to create additional code cells if you feel that one cell per subtask is not sufficient.
- Remember, Pandas uses very efficient code to handle large amounts of data. For-loops are not efficient. If you ever have to use a for-loop to loop over the rows in the DataFrame, you have *probably* done something wrong.
- Label all graphs and charts if applicable.

## Task

I typically enjoy indie and rock music. I am a big fan of everything from old-fashioned rock and roll like Led Zeppelin and Jimi Hendrix, to newer indie artists like Joji and Lana Del Rey. This is why my spotify wrapped for 2023 came as quite a surprise:

Now, I'm no hater of pop music, but this was unexpected. For this assignment, you will investigate my listening habits, including a deep dive into my Ariana Grande listening habits, and try to find an answer to why she was my top artist; was there a fault in the spotify algorithm? Am I actually secretly an *Arianator*? (yes, I did have to look that up). Or am I just lying to myself about how often I listen to guilty pleasure music?

## Part 1: Initial loading and exploration

### 1.0 Import necessary libraries:

pandas, numpy, matplotlib.pyplot (other libraries such as seaborn or plotly are also allowed if you want prettier plots). It might also be a good idea to use **os** for task 2.0

```python
import matplotlib.pyplot as plt
# ---- Insert other imports ----
import pandas as pd
import numpy as np
import seaborn as sns
```

### 1.1 Loading the data

Load the dataset in the file `streaming_history_0.csv` into a Pandas DataFrame called `df_spotify_0`.

```
# Loading the dataset

df_spotify_0 =
pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghisto
ry0.csv')
```

### 1.2 Help function

Use the Python command `help` to help you understand how to use the `pd.DataFrame.head` and `pd.DataFrame.tail` methods.

```
# Using help command
help(pd.DataFrame.head)

Help on function head in module pandas.core.generic:

head(self, n: 'int' = 5) -> 'Self'
    Return the first `n` rows.

    This function returns the first `n` rows for the object based
    on position. It is useful for quickly testing if your object
    has the right type of data in it.

    For negative values of `n`, this function returns all rows except
    the last `|n|` rows, equivalent to ``df[:n]``.

    If n is larger than the number of rows, this function returns all
rows.

    Parameters
    ----------
    n : int, default 5
        Number of rows to select.

    Returns
    -------
    same type as caller
        The first `n` rows of the caller object.

    See Also
    --------
    DataFrame.tail: Returns the last `n` rows.

    Examples
    --------
    >>> df = pd.DataFrame({'animal': ['alligator', 'bee', 'falcon',
'lion',
    ...                    'monkey', 'parrot', 'shark', 'whale',
'zebra']})
    >>> df
          animal
    0  alligator
    1        bee
    2     falcon
    3       lion
    4     monkey
    5     parrot
    6      shark
    7      whale
    8      zebra

    Viewing the first 5 lines

    >>> df.head()
          animal
    0  alligator
    1        bee
    2     falcon
    3       lion
    4     monkey

    Viewing the first `n` lines (three in this case)

    >>> df.head(3)
          animal
    0  alligator
    1        bee
    2     falcon

    For negative values of `n`

    >>> df.head(-3)
          animal
    0  alligator
    1        bee
    2     falcon
    3       lion
    4     monkey
    5     parrot


# Using help command
help(pd.DataFrame.tail)
```

```
Help on function tail in module pandas.core.generic:

tail(self, n: 'int' = 5) -> 'Self'
    Return the last `n` rows.

    This function returns last `n` rows from the object based on
    position. It is useful for quickly verifying data, for example,
    after sorting or appending rows.

    For negative values of `n`, this function returns all rows except
    the first `|n|` rows, equivalent to ``df[|n|:]``.

    If n is larger than the number of rows, this function returns all
rows.

    Parameters
    ----------
    n : int, default 5
        Number of rows to select.

    Returns
    -------
    type of caller
        The last `n` rows of the caller object.

    See Also
    --------
    DataFrame.head : The first `n` rows of the caller object.

    Examples
    --------
    >>> df = pd.DataFrame({'animal': ['alligator', 'bee', 'falcon',
'lion',
    ...                    'monkey', 'parrot', 'shark', 'whale',
'zebra']})
    >>> df
          animal
    0  alligator
    1        bee
    2     falcon
    3       lion
    4     monkey
    5     parrot
    6      shark
    7      whale
    8      zebra

    Viewing the last 5 lines
    >>> df.tail()
       animal
    4  monkey
    5  parrot
    6   shark
    7   whale
    8   zebra

    Viewing the last `n` lines (three in this case)

    >>> df.tail(3)
      animal
    6  shark
    7  whale
    8  zebra

    For negative values of `n`

    >>> df.tail(-3)
       animal
    3    lion
    4  monkey
    5  parrot
    6   shark
    7   whale
    8   zebra
```

### 1.3 Getting an overview

Print the first `five` and last `ten` rows of the dataframe. Have a quick look at which columns are in the dataset.

```
print(df_spotify_0.head())
print(df_spotify_0.tail(10))

            endTime            artistName
trackName  \
0  2022-12-03 02:02  Cigarettes After Sex
Truly
1  2022-12-03 02:02         Leonard Cohen  Take This Waltz - Paris
Version
2  2022-12-06 21:05          Vlad Holiday                 So Damn Into
You
3  2022-12-06 21:05                 Lorde
Team
4  2022-12-06 21:05         Ariana Grande                         Into
You
```

```
   msPlayed
0   30000.0
1    8210.0
2   37895.0
3    8984.0
4    1221.0
                endTime         artistName
trackName  \
11949  2023-01-02 20:58      Ariana Grande                    six
thirty
11950  2023-01-02 20:58      Leonard Cohen          Thanks for the
Dance
11951  2023-01-02 20:59           Des Rocs          Used to the
Darkness
11952  2023-01-02 20:59  Caroline Polachek         Hit Me Where It
Hurts
11953  2023-01-02 20:59  Caroline Polachek         Hit Me Where It
Hurts
11954  2023-01-02 20:59  Kaizers Orchestra
Resistansen
11955  2023-01-02 20:59           Mr.Kitty                    After
Dark
11956  2023-01-02 20:59       daddy's girl  after dark x sweater
weather
11957  2023-01-02 20:59       daddy's girl  after dark x sweater
weather
11958  2023-01-02 20:59       daddy's girl  after dark x sweater
weather

       msPlayed
11949    1699.0
11950   19483.0
11951     185.0
11952     603.0
11953     208.0
11954     208.0
11955  101447.0
11956     301.0
11957     208.0
11958     789.0
```

## 1.4 Formatting correctly

When working with Pandas, it's very useful to have columns which contains dates in a specific format called *datetime*. This allows for efficient manipulation and analysis of time-series data, such as sorting, filtering by date or time, and resampling for different time periods. Figure out which column(s) would be appropriate to convert to datetime, if any, and if so, perform the conversion to the correct format.

```
# Formatting the endtime column to datatame dtype of pandas
df_spotify_0['endTime'] = pd.to_datetime(df_spotify_0['endTime'])

df_spotify_0.head()

              endTime            artistName 
trackName  \
0 2022-12-03 02:02:00  Cigarettes After Sex 
Truly
1 2022-12-03 02:02:00         Leonard Cohen  Take This Waltz - Paris 
Version
2 2022-12-06 21:05:00          Vlad Holiday                 So Damn 
Into You
3 2022-12-06 21:05:00                 Lorde 
Team
4 2022-12-06 21:05:00         Ariana Grande 
Into You

   msPlayed
0   30000.0
1    8210.0
2   37895.0
3    8984.0
4    1221.0
```

### 1.5 Unique artists

Find how many unique artists are in the dataset.

```
# Finding and showing the unique artists number
artist_name = df_spotify_0['artistName'].unique()
artist_name
print(f'Total No. Unique Artist: {len(artist_name)}')

Total No. Unique Artist: 495
```

### 1.6 Unique songs

Find how many unique songs are in the dataset.

```
# Funding and showing the unique artists number
songs_name = df_spotify_0['trackName'].unique()
songs_name
print(f'Total No. Unique Songs: {len(songs_name)}')
len(songs_name)

Total No. Unique Songs: 1308

1308
```

## Part 1: Questions

Q1: Which columns are in the dataset?  A1: There are 4 coulms in the dataset.  a. endTime  b. artistName  c. trackName  d. msPlayed  Q2: What timeframe does the dataset span?  A2: 2022-12-03 02:02 to 2023-01-02 20:59.  Q3: How many unique artists are in the dataset?  A3: 495  Q4: How many unique songs are in the dataset?  A4: 1308

# Part 2: Working with all the data

### 2.0 Importing all the dataframes

In Task 1, you only worked with about a month worth of data. Now, you will work with over a year worth.

In the *spotify_data* folder, there is more than just one listening record. Load each of the 14 listening records into a dataframe (1 dataframe per listening record), and concatenate them together into one large dataframe named `df`.

```
# Loading rest of the dataset
df_spotify_1 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory1.csv')
df_spotify_2 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory2.csv')
df_spotify_3 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory3.csv')
df_spotify_4 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory4.csv')
df_spotify_5 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory5.csv')
df_spotify_6 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory6.csv')
df_spotify_7 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory7.csv')
df_spotify_8 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory8.csv')
df_spotify_9 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory9.csv')
df_spotify_10 = pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghistory10.csv')
```

```
df_spotify_11 =
pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghisto
ry11.csv')
df_spotify_12 =
pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghisto
ry12.csv')
df_spotify_13 =
pd.read_csv('/Users/jony/DAT200/assignment/spotify_data/streaminghisto
ry13.csv')

# Formatting the endTime dtype to datetime
df_spotify_1['endTime'] = pd.to_datetime(df_spotify_1['endTime'])
df_spotify_2['endTime'] = pd.to_datetime(df_spotify_2['endTime'])
df_spotify_3['endTime'] = pd.to_datetime(df_spotify_3['endTime'])
df_spotify_4['endTime'] = pd.to_datetime(df_spotify_4['endTime'])
df_spotify_5['endTime'] = pd.to_datetime(df_spotify_5['endTime'])
df_spotify_6['endTime'] = pd.to_datetime(df_spotify_6['endTime'])
df_spotify_7['endTime'] = pd.to_datetime(df_spotify_7['endTime'])
df_spotify_8['endTime'] = pd.to_datetime(df_spotify_8['endTime'])
df_spotify_9['endTime'] = pd.to_datetime(df_spotify_9['endTime'])
df_spotify_10['endTime'] = pd.to_datetime(df_spotify_10['endTime'])
df_spotify_11['endTime'] = pd.to_datetime(df_spotify_11['endTime'])
df_spotify_12['endTime'] = pd.to_datetime(df_spotify_12['endTime'])
df_spotify_13['endTime'] = pd.to_datetime(df_spotify_13['endTime'])

# Making the list of the whole dataframe
dataframes = [df_spotify_0, df_spotify_1, df_spotify_2, df_spotify_3,
df_spotify_4, df_spotify_5,
              df_spotify_6, df_spotify_7, df_spotify_8, df_spotify_9,
df_spotify_10,
              df_spotify_11, df_spotify_12, df_spotify_13]

# Concatenating the all dataframe in df
df = pd.concat(dataframes, ignore_index=True)

df.head(20)
```

```
               endTime           artistName  \
0  2022-12-03 02:02:00  Cigarettes After Sex
1  2022-12-03 02:02:00         Leonard Cohen
2  2022-12-06 21:05:00          Vlad Holiday
3  2022-12-06 21:05:00                 Lorde
4  2022-12-06 21:05:00         Ariana Grande
5  2022-12-07 00:21:00     Caroline Polachek
6  2022-12-07 00:21:00     Kaizers Orchestra
7  2022-12-07 00:21:00          Vlad Holiday
8  2022-12-07 00:21:00          Vlad Holiday
9  2022-12-07 00:21:00         Ariana Grande
10 2022-12-07 00:21:00          Pastel Ghost
11 2022-12-07 00:25:00     Caroline Polachek
```

```
12 2022-12-07 00:25:00                 BØRNS
13 2022-12-07 00:25:00          Vlad Holiday
14 2022-12-07 00:25:00     Kaizers Orchestra
15 2022-12-07 00:25:00         Ariana Grande
16 2022-12-07 00:25:00                 BØRNS
17 2022-12-07 00:25:00         Ariana Grande
18 2022-12-07 00:25:00          Royal Deluxe
19 2022-12-07 00:26:00         The Fratellis

                               trackName  msPlayed
0                                  Truly   30000.0
1        Take This Waltz - Paris Version    8210.0
2                       So Damn Into You   37895.0
3                                   Team    8984.0
4                               Into You    1221.0
5                  Hit Me Where It Hurts    1648.0
6                              Prosessen     348.0
7                       So Damn Into You    1555.0
8                       So Damn Into You    1486.0
9                           Best Mistake    8824.0
10                            Dark Beach   23518.0
11                 Hit Me Where It Hurts    1044.0
12                                Clouds    3459.0
13                      So Damn Into You  170086.0
14                             Prosessen    1904.0
15       Just A Little Bit Of Your Heart     557.0
16                          Seeing Stars    6145.0
17      safety net (feat. Ty Dolla $ign)   17838.0
18                      I'm A Wanted Man   16152.0
19  She's Not Gone Yet But She's Leaving   48715.0
```

## 2.1 Sorting by time

Datasets often aren't perfect. One example of an issue that could occur is that the time-based data might not be in chronological order. If this were to happen, the rows in your dataframe could be in the wrong order. To ensure this isn't an issue in your dataframe, you should sort the dataframe in chronological order, from oldest to newest.

```python
# Sorting the dataframe based on the endTime column
df = df.sort_values('endTime', ascending=True)
```

## 2.2 Setting a timeframe

For this investigation, we are only interested in investigating listening patterns from **2023**. Remove any data not from **2023** from the DataFrame.

```python
# Taking data of only 2023 to new dataframe
df2 = df[df['endTime'].dt.year == 2023]
```

```
df2.head(20)
```

```
                  endTime         artistName  \
10881 2023-01-01 01:17:00      Ariana Grande
10882 2023-01-01 01:17:00      Ariana Grande
10883 2023-01-01 01:17:00      Ariana Grande
10884 2023-01-01 01:17:00          Peach Pit
10885 2023-01-01 01:17:00     Kelly Clarkson
10886 2023-01-01 01:17:00     Kelly Clarkson
10887 2023-01-01 01:17:00      Ariana Grande
10888 2023-01-01 01:17:00      Ariana Grande
10893 2023-01-01 01:19:00     Regina Spektor
10892 2023-01-01 01:19:00              Lorde
10891 2023-01-01 01:19:00              Lorde
10890 2023-01-01 01:19:00       Fools Garden
10889 2023-01-01 01:19:00  The Neighbourhood
10913 2023-01-01 01:21:00        Marvin Gaye
10912 2023-01-01 01:21:00  Cage The Elephant
10911 2023-01-01 01:21:00  Kaizers Orchestra
10910 2023-01-01 01:21:00            MARBLES
10909 2023-01-01 01:21:00              Lorde
10908 2023-01-01 01:21:00         The Smiths
10907 2023-01-01 01:21:00         The Smiths

                                            trackName  msPlayed
10881                                         7 rings     139.0
10882                                         7 rings     487.0
10883                                       positions     417.0
10884                                 Being so Normal    2205.0
10885                        Santa, Can’t You Hear Me     278.0
10886                        Santa, Can’t You Hear Me     325.0
10887                                      Santa Baby   12293.0
10888                    Right There (feat. Big Sean)   22929.0
10893                              Us - 2005 Remaster   16670.0
10892                                     Solar Power     464.0
10891                                            Team     371.0
10890                                      Lemon Tree     301.0
10889                             A Moment of Silence  118932.0
10913                                        Right On   15904.0
10912                                    That's Right   14745.0
10911                                    Hjerteknuser     534.0
10910                                   I'm Not Ready     441.0
10909                                            Team     905.0
10908  Heaven Knows I'm Miserable Now - 2011 Remaster    1184.0
10907  Heaven Knows I'm Miserable Now - 2011 Remaster     719.0
```

```
df2.tail(20)
```

```
                   endTime        artistName
trackName  \
167419 2023-12-07 20:49:00      Lana Del Rey
Radio
167420 2023-12-07 20:51:00            Mitski            Washing
Machine Heart
167421 2023-12-07 20:51:00      Pastel Ghost
Dark Beach
167422 2023-12-07 20:51:00     Ariana Grande
needy
167423 2023-12-07 21:12:00       Tame Impala
Eventually
167424 2023-12-07 21:12:00                U2              With Or
Without You
167425 2023-12-07 21:12:00          grandson
Darkside
167432 2023-12-07 21:13:00    Arctic Monkeys                   Snap
Out Of It
167431 2023-12-07 21:13:00      Lana Del Rey
Ride
167433 2023-12-07 21:13:00  Childish Gambino
Les
167430 2023-12-07 21:13:00      Lana Del Rey
Ride
167434 2023-12-07 21:13:00      Lana Del Rey
Art Deco
167428 2023-12-07 21:13:00     Ariana Grande                    pete
davidson
167427 2023-12-07 21:13:00          Labrinth
Formula
167426 2023-12-07 21:13:00      Lana Del Rey              Young And
Beautiful
167429 2023-12-07 21:13:00    Arctic Monkeys                   Snap
Out Of It
167435 2023-12-07 21:13:00     Ariana Grande  off the table (with The
Weeknd)
167437 2023-12-07 21:14:00     Leonard Cohen             Thanks for
the Dance
167436 2023-12-07 21:14:00     Ariana Grande
my hair
167438 2023-12-07 21:17:00      The Vaccines   Your Love Is My
Favourite Band

        msPlayed
167419  214573.0
167420  128198.0
167421   19752.0
167422   26220.0
167423  318591.0
167424   13626.0
167425    5404.0
```

```
167432      615.0
167431     1126.0
167433     2484.0
167430      859.0
167434    38298.0
167428      603.0
167427      882.0
167426     3146.0
167429     1497.0
167435    13448.0
167437     9317.0
167436    23757.0
167438    14661.0
```

### 2.3 Deleting rows

Often in Data Science, you will encounter when a row entry has the value *NaN*, indicating missing data. These entries can skew your analysis, leading to inaccurate conclusions. For this task, identify and remove any rows in your DataFrame that contain NaN values. Later in the course, you might encounter other techniques of dealing with missing data, typically reffered to as *data imputation*. Here, though, you are just supposed to delete the entire rows with missing data.

```
# Looking is there any null values in the dataframe or not
null_count = df2.isnull().sum().sum()
print('Number of null values:', null_count)

Number of null values: 18

# Removing the row wilth null values and storing in a different
dataframe
df3 = df2.dropna()

# Again checking is there any null values in the dataframe or not
null_count = df3.isnull().sum().sum()
print('Number of null values:', null_count)

Number of null values: 0
```

### 2.4 Convert from milliseconds to seconds

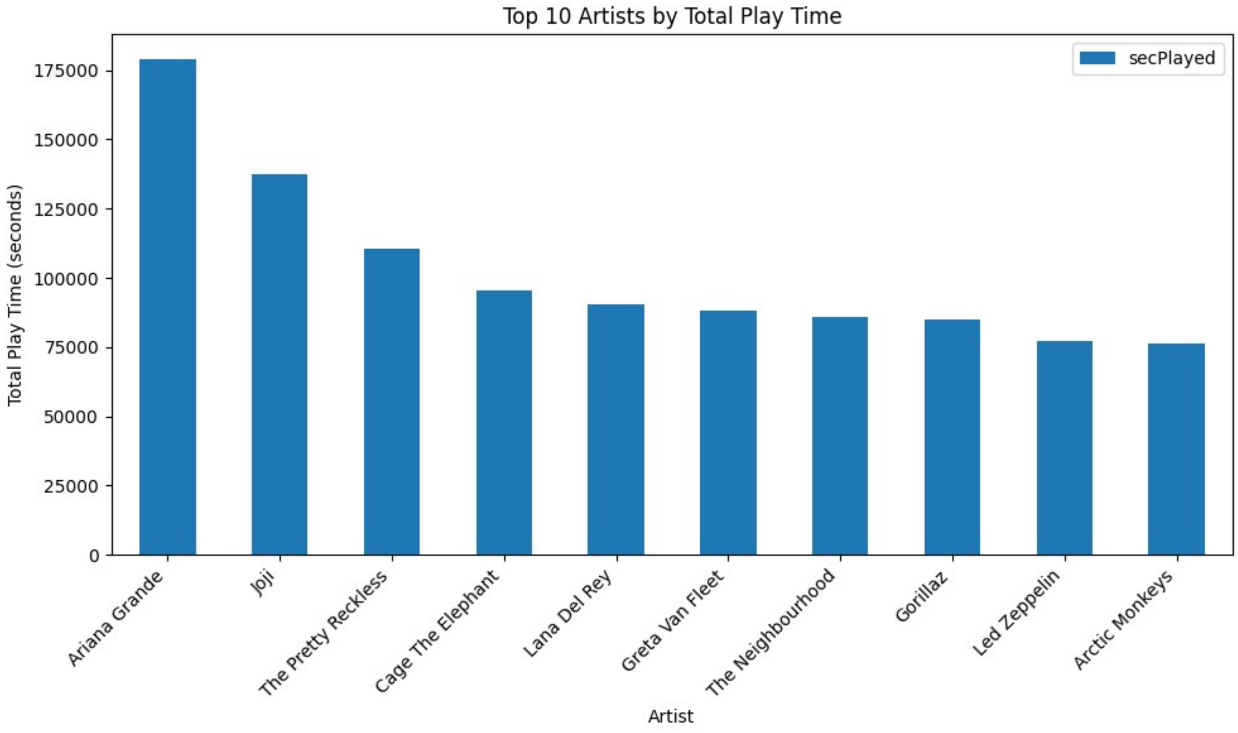
From `msPlayed`, create a new column `secPlayed` with the data converted from milliseconds to seconds. Then delete the column `msPlayed`.

```
# Adding new column named secPlayed which is conversion of miliseconds
to seconds

secPlayed = []

for i in df3['msPlayed']:
    i = i/1000
    secPlayed.append(i)


df3.insert(4, 'secPlayed', secPlayed)

df3.head()

                  endTime     artistName                 trackName
msPlayed  \
10881 2023-01-01 01:17:00  Ariana Grande                   7 rings
139.0
10882 2023-01-01 01:17:00  Ariana Grande                   7 rings
487.0
10883 2023-01-01 01:17:00  Ariana Grande                 positions
417.0
10884 2023-01-01 01:17:00      Peach Pit           Being so Normal
2205.0
10885 2023-01-01 01:17:00 Kelly Clarkson  Santa, Can’t You Hear Me
278.0

       secPlayed
10881      0.139
10882      0.487
10883      0.417
10884      2.205
10885      0.278

# Dropping the msPlayed column

df3 = df3.drop('msPlayed', axis=1)

df3.head()

                  endTime     artistName                 trackName
secPlayed
10881 2023-01-01 01:17:00  Ariana Grande                   7 rings
0.139
10882 2023-01-01 01:17:00  Ariana Grande                   7 rings
0.487
10883 2023-01-01 01:17:00  Ariana Grande                 positions
0.417
10884 2023-01-01 01:17:00      Peach Pit           Being so Normal
2.205
10885 2023-01-01 01:17:00 Kelly Clarkson  Santa, Can’t You Hear Me
0.278
```

### 2.5 Finding top 10 favorite artists

Find the top `ten` artists with the highest total play time (in seconds). Plot your findings in a bar graph. (hint: start by creating a new DataFrame with only `artistName` and your time column. To proceed, you will also likely need the `groupby` command from Pandas.)

```
# Creating a new DataFrame with only artistName and secPlayed column
artist_playtime_df = df3[['artistName', 'secPlayed']]

# Grouping by artistName and sum play time
artist_total_playtime = artist_playtime_df.groupby('artistName').sum()

# Sorting artists based on total play time
sorted_artists = artist_total_playtime.sort_values(by='secPlayed',
ascending=False)

# Printing top ten artists
top_ten_artists = sorted_artists.head(10)

top_ten_artists

                      secPlayed
artistName
Ariana Grande        178996.003
Joji                 137229.562
The Pretty Reckless  110293.430
Cage The Elephant     95587.575
Lana Del Rey          90543.113
Greta Van Fleet       88026.405
The Neighbourhood     85673.375
Gorillaz              84858.371
Led Zeppelin          77030.802
Arctic Monkeys        76444.236

# Plotting the Top 10 Songs
top_ten_artists.plot(kind='bar', figsize=(10, 6))
plt.title('Top 10 Artists by Total Play Time')
plt.xlabel('Artist')
plt.ylabel('Total Play Time (seconds)')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



## 2.6 Finding top 10 favorite songs

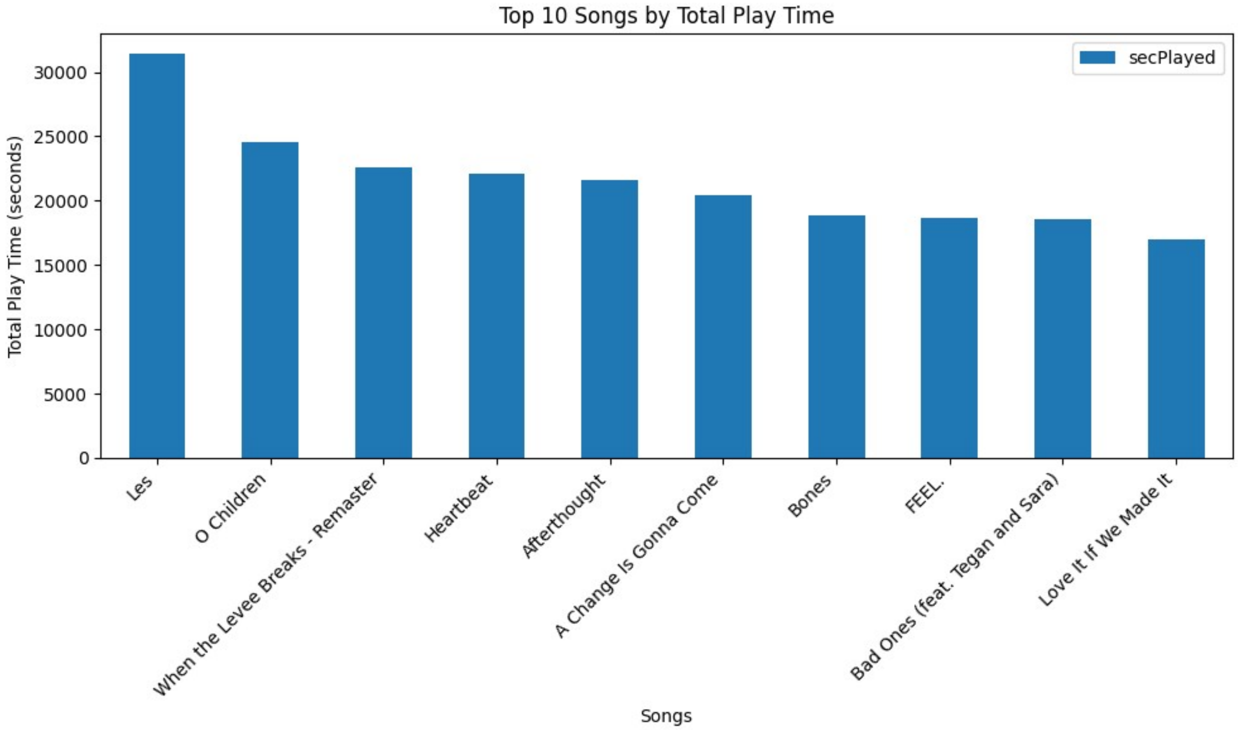
Find the top `ten` songs with the highest play time. Create a graph visualizing the results.

```
# Creating a new DataFrame with only trackName and secPlayed column
track_playtime_df = df3[['trackName', 'secPlayed']]

# Grouping by artistName and sum play time
track_total_playtime = track_playtime_df.groupby('trackName').sum()

# Sorting artists based on total play time
sorted_tracks = track_total_playtime.sort_values(by='secPlayed',
ascending=False)

# Printing top ten artists
top_ten_tracks = sorted_tracks.head(10)

top_ten_tracks
```

```
                                  secPlayed
trackName
Les                               31403.364
O Children                        24558.414
When the Levee Breaks - Remaster  22631.721
Heartbeat                         22056.629
Afterthought                      21599.564
A Change Is Gonna Come            20414.317
Bones                             18860.916
```

```
FEEL.                                 18696.637
Bad Ones (feat. Tegan and Sara)       18558.247
Love It If We Made It                 17018.248
```

```
# Plotting the Top 10 Songs
top_ten_tracks.plot(kind='bar', figsize=(10, 6))
plt.title('Top 10 Songs by Total Play Time')
plt.xlabel('Songs')
plt.ylabel('Total Play Time (seconds)')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



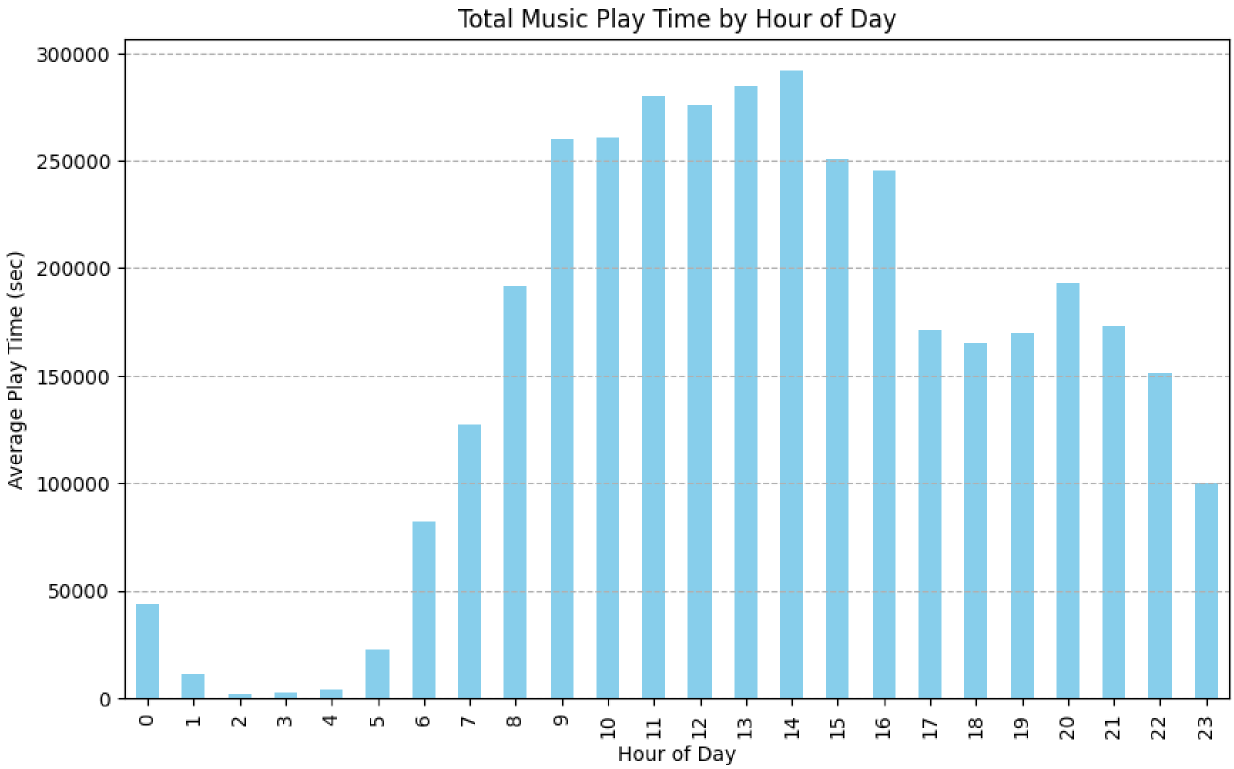
# Part 3: Further analysis

## 3.0 Average listening time by hour

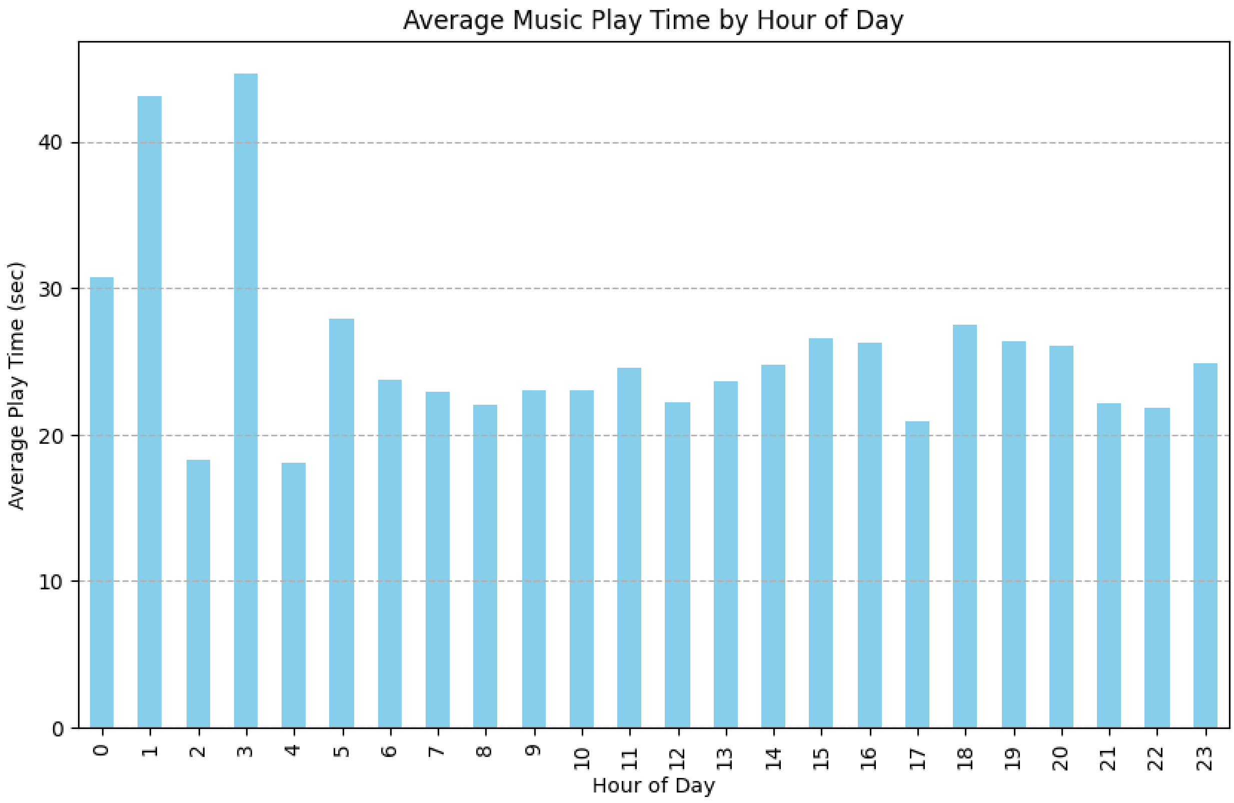
Generate a plot that displays the average amount of time that music is played for each hour of the day.

```
# Creating a new DataFrame with only endTime and secPlayed column
music_play_df = df3[['endTime', 'secPlayed']]

# Extracting the hours from the endTime
music_play_df['endHour'] = music_play_df['endTime'].dt.hour
```

```
# Grouping by the hours and total the play time
total_play_time_per_hour = music_play_df.groupby('endHour')
['secPlayed'].sum()

# Grouping by the hours and average the play time
average_play_time_per_hour = music_play_df.groupby('endHour')
['secPlayed'].mean()

# Plot the result
plt.figure(figsize=(10, 6))
total_play_time_per_hour.plot(kind='bar', color='skyblue')
plt.title('Total Music Play Time by Hour of Day')
plt.xlabel('Hour of Day')
plt.ylabel('Average Play Time (sec)')
plt.xticks(range(0, 24))
plt.grid(axis='y', linestyle='--')

# Show the plot
plt.show()
```



```
# Plot the result
plt.figure(figsize=(10, 6))
average_play_time_per_hour.plot(kind='bar', color='skyblue')
plt.title('Average Music Play Time by Hour of Day')
plt.xlabel('Hour of Day')
plt.ylabel('Average Play Time (sec)')
plt.xticks(range(0, 24))
plt.grid(axis='y', linestyle='--')

# Show the plot
plt.show()
```



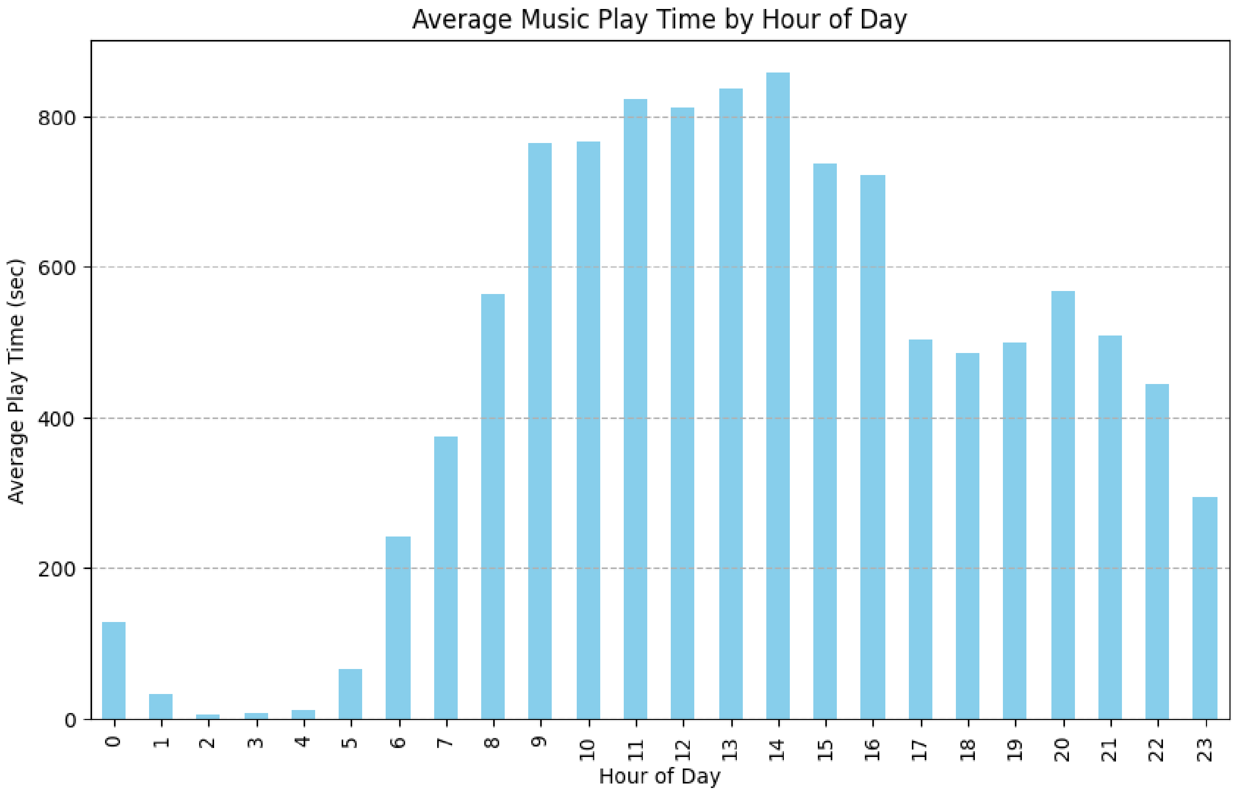
# Observations

Here is one interesting thing to notice if we use the the mean function while groupby it showes more average time in hour 0 to 6 althogh total listening hour is less on that time which can be seen from the previous graph and this is also normal that at that time the user of this data must be sleeping or resting. But the acverage come like this because as there are less skipped song on that time and the average here is shown by the total number of songs(both skipped and unskipped).

So, in the below I tried to deal with it by divinde by the total number days.

```
# Finding the total number days when the music is listened i.e. unique days
days = music_play_df['endTime'].dt.day_of_year
unique_days = days.unique()
total_unique_days = len(unique_days)
```

```python
# Getting average by dividing it by total number of days
mean_play_time_per_hour = total_play_time_per_hour/total_unique_days

# Plot the result
plt.figure(figsize=(10, 6))
mean_play_time_per_hour.plot(kind='bar', color='skyblue')
plt.title('Average Music Play Time by Hour of Day')
plt.xlabel('Hour of Day')
plt.ylabel('Average Play Time (sec)')
plt.xticks(range(0, 24))
plt.grid(axis='y', linestyle='--')

# Show the plot
plt.show()
```



Now this look this look more understandable that how much average time the user has spent on listening in every hour.

## 3.1 Morning music and evening music

I think many people find that some types of music are more suitable for morning listening and some music is more suitable for evening listening. Create a plot that compares the play time of the artists *Leonard Cohen* and *Rage Against the Machine* on an hour-by-hour basis. See if there are any differences.

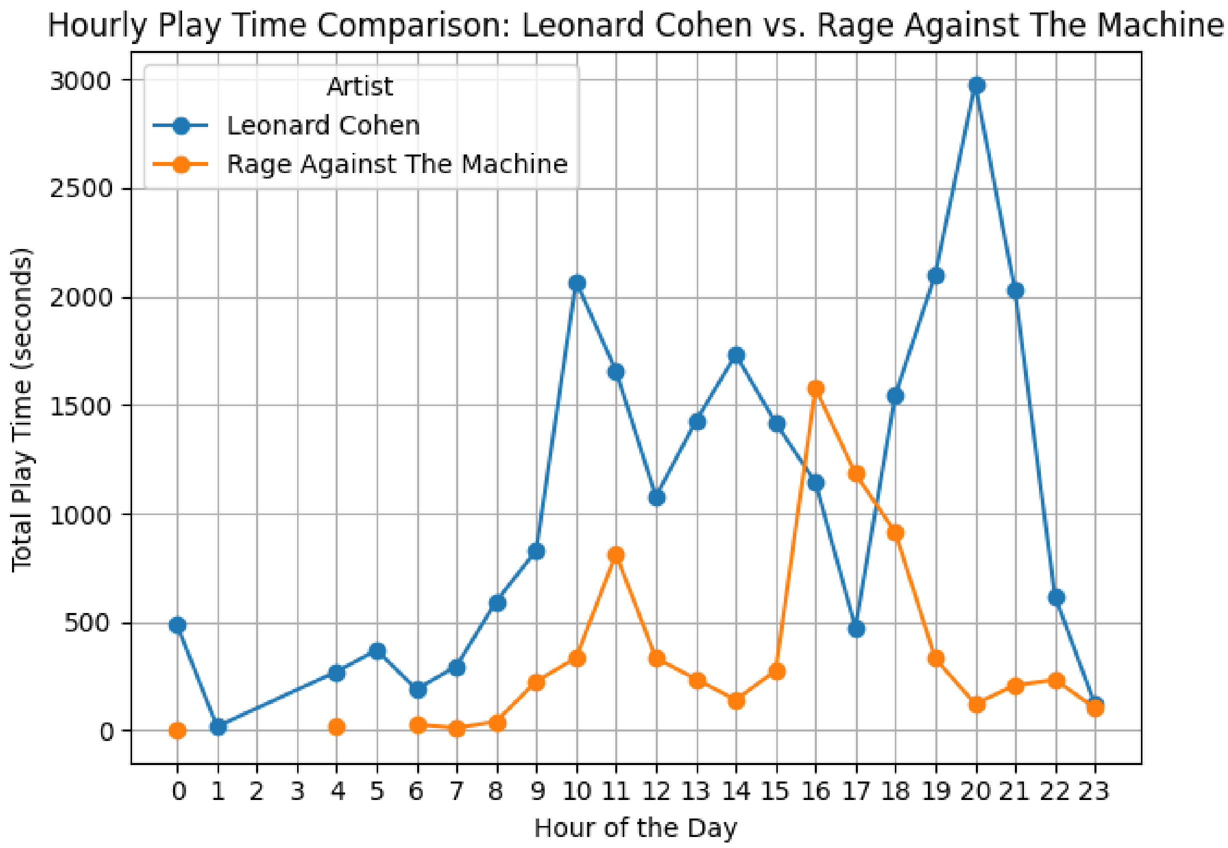
```python
# Creating a new DataFrame with only Leonard Cohen and Rage Against
The Machine
relevant_artists_df = df3[df3['artistName'].isin(['Leonard Cohen',
'Rage Against The Machine'])]

# Extracting the hours from the endTime
relevant_artists_df['hour'] = relevant_artists_df['endTime'].dt.hour

# Grouping by hour and artist, and sum the play time
hourly_playtime_comparison = relevant_artists_df.groupby(['hour',
'artistName'])['secPlayed'].sum().unstack()
```

```
/var/folders/2k/4yf6q3p91dn305kq0h_z85300000gn/T/
ipykernel_63153/2126971822.py:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  relevant_artists_df['hour'] = relevant_artists_df['endTime'].dt.hour
```

```python
hourly_playtime_comparison
```

```
artistName  Leonard Cohen  Rage Against The Machine
hour
0                 486.593                     2.024
1                  19.065                       NaN
4                 271.905                    17.242
5                 371.150                       NaN
6                 190.543                    28.610
7                 296.875                    12.516
8                 595.872                    42.402
9                 829.501                   226.606
10               2068.587                   335.398
11               1657.468                   813.869
12               1078.065                   334.003
13               1425.191                   238.100
14               1731.914                   141.379
15               1418.022                   276.347
16               1142.896                  1577.069
17                475.653                  1183.734
18               1545.162                   913.117
19               2101.166                   332.719
20               2978.077                   123.206
21               2028.490                   208.668
22                619.896                   234.753
23                121.525                   104.835
```

```
# Plotting the results
plt.figure(figsize=(10, 6))
hourly_playtime_comparison.plot(kind='line', marker='o',
linestyle='-')
plt.title('Hourly Play Time Comparison: Leonard Cohen vs. Rage Against
The Machine')
plt.xlabel('Hour of the Day')
plt.ylabel('Total Play Time (seconds)')
plt.xticks(range(24))
plt.grid(True)
plt.legend(title='Artist')
plt.tight_layout()
plt.show()

<Figure size 1000x600 with 0 Axes>
```



### 3.2 Analysing skipped songs

Determining whether a song was skipped or listened to can be challenging. For this analysis, we'll simplify by defining a skipped song as any track played for less than 30 seconds. Conversely, a song played for 30 seconds or more is considered listened to. Add a column to your DataFrame to reflect this criteria: set the value to 1 if the song was played for less than 30 seconds (indicating a skipped song), and 0 if it was played for 30 seconds or longer.

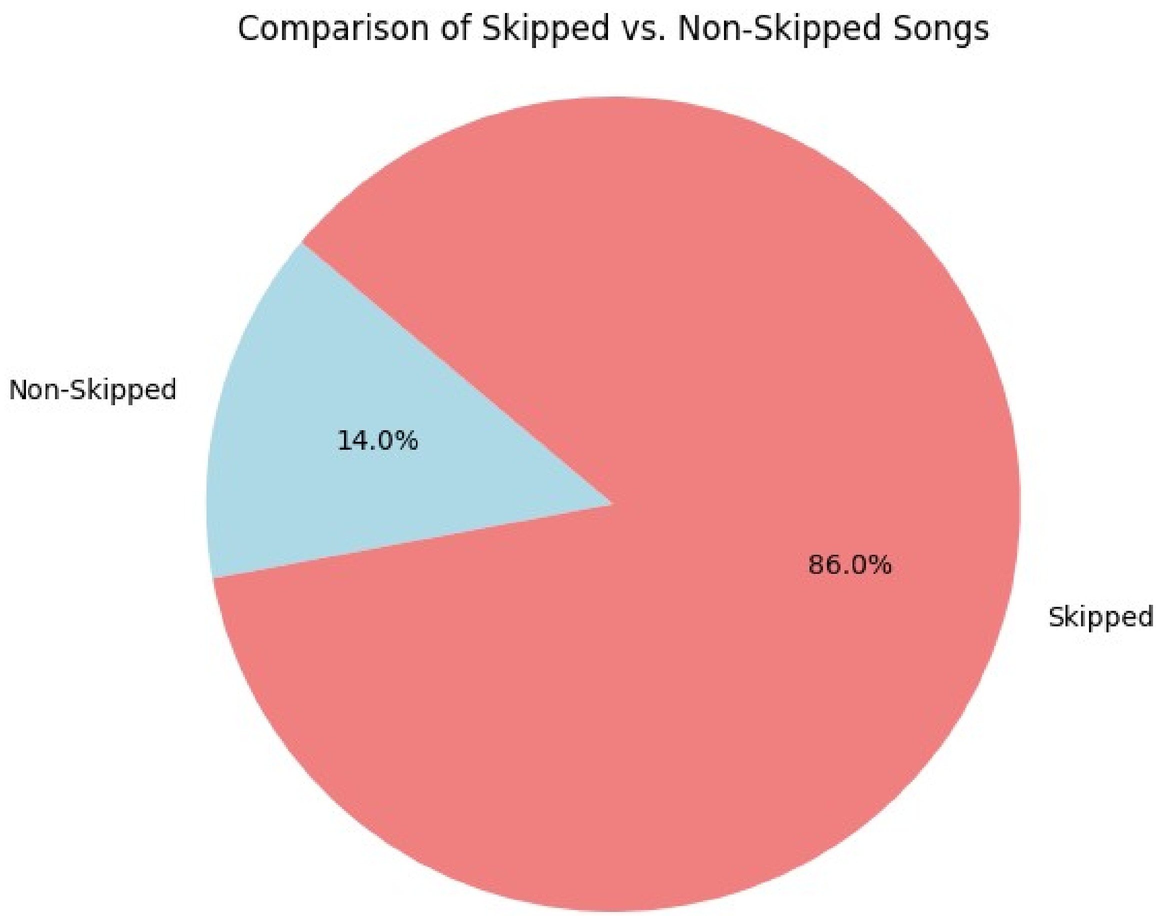
```
# Adding new column skipped songs

skippedTrack = []

for i in df3['secPlayed']:
    if i < 30 :
        skippedTrack.append(1)
    else:
        skippedTrack.append(0)

df3.insert(4, 'skippedTrack', skippedTrack)

df3.head()
```

```
                  endTime      artistName                  trackName  \
10881 2023-01-01 01:17:00   Ariana Grande                    7 rings
10882 2023-01-01 01:17:00   Ariana Grande                    7 rings
10883 2023-01-01 01:17:00   Ariana Grande                  positions
10884 2023-01-01 01:17:00       Peach Pit             Being so Normal
10885 2023-01-01 01:17:00  Kelly Clarkson  Santa, Can’t You Hear Me

       secPlayed  skippedTrack
10881      0.139             1
10882      0.487             1
10883      0.417             1
10884      2.205             1
10885      0.278             1
```

### 3.3 Plotting skipped songs

Create a pie-chart that compares amount of skipped songs to amount of non-skipped songs.

```
# Step 1: Group the DataFrame by the 'skipped' column and count the
occurrences
skipped_counts = df3.groupby('skippedTrack').size()

# Step 2: Plot the results in a pie chart
plt.figure(figsize=(8, 6))
plt.pie(skipped_counts, labels=['Non-Skipped', 'Skipped'],
autopct='%1.1f%%', startangle=140, colors=['lightblue', 'lightcoral'])
plt.title('Comparison of Skipped vs. Non-Skipped Songs')
plt.axis('equal')  # Equal aspect ratio ensures that pie is drawn as a
circle.
plt.show()
```



### 3.4 Artists by percentage of songs skipped

For each artist in the dataset, calculate which percentage of their songs was skipped. Store this information in a new DataFrame called `df_skipped`. Store the percentage of skipped songs in a new column named `SkipRate` **Example:** If an artist has **100** songs in your dataset and **25** of these were skipped, the percentage of skipped songs for this artist would be $\frac{25}{100} = 25\%$

```
# Grouping the DataFrame by the 'artistName' column
grouped_by_artist = df3.groupby('artistName')

# Calculating the total number of songs and the number of skipped
songs for each artist
total_songs = grouped_by_artist.size()
skipped_songs = grouped_by_artist['skippedTrack'].sum()

# computing the percentage of skipped songs for each artist
skip_rate = (skipped_songs / total_songs) * 100

# Creating a new DataFrame to store the percentage of skipped songs
```

```
for each artist
df_skipped = pd.DataFrame({'TotalSongs': total_songs, 'SkippedTrack':
skipped_songs, 'SkipRate': skip_rate})

# Display the new DataFrame
df_skipped

               TotalSongs  SkippedTrack    SkipRate
artistName
10cc                   28            19   67.857143
2Pac                  513           442   86.159844
3 Doors Down            2             1   50.000000
4 Non Blondes         122            88   72.131148
50 Cent                28            19   67.857143
...                   ...           ...         ...
squeeda                 3             2   66.666667
tenkousei.             37            37  100.000000
trxxshed                2             1   50.000000
xander.                 8             3   37.500000
Édith Piaf            155           146   94.193548

[956 rows x 3 columns]
```

## 3.5 Comparing artists by skip-rate

Find the `three` top artists with the lowest skip-rate and the `three` with the highest. Print their names, along with their skip-rate.

```
# Finding three top artists with lowest skip-rate
print(df_skipped['SkipRate'].nsmallest(3))

artistName
Gloria Gaynor     0.000000
Roc Boyz         11.111111
LACES            14.285714
Name: SkipRate, dtype: float64

# Finding three top artists with highest skip-rate
print(df_skipped['SkipRate'].nlargest(3))

artistName
A Problem Squared    100.0
Acid Ghost           100.0
Albert Hammond Jr    100.0
Name: SkipRate, dtype: float64
```

# Part 4: God Is a Data Scientist - The Ariana Deep-Dive

## 4.0 Ariana-DataFrame:

Create a new DataFrame called *df_ariana*, containing only rows with music by Ariana Grande.

```
# Creating a dataframe with only rows with music by Ariana Grande
df_ariana = df3[df3['artistName'] == 'Ariana Grande']

df_ariana
```

```
                   endTime     artistName                          
trackName  \
10881  2023-01-01 01:17:00  Ariana Grande                          7
rings
10882  2023-01-01 01:17:00  Ariana Grande                          7
rings
10883  2023-01-01 01:17:00  Ariana Grande                           
positions
10887  2023-01-01 01:17:00  Ariana Grande                       Santa
Baby
10888  2023-01-01 01:17:00  Ariana Grande     Right There (feat. Big
Sean)
...                    ...            ...                           
...
167415 2023-12-07 17:46:00  Ariana Grande           Almost Is Never
Enough
167422 2023-12-07 20:51:00  Ariana Grande                           
needy
167428 2023-12-07 21:13:00  Ariana Grande                    pete
davidson
167435 2023-12-07 21:13:00  Ariana Grande  off the table (with The
Weeknd)
167436 2023-12-07 21:14:00  Ariana Grande                          my
hair

        secPlayed  skippedTrack
10881       0.139             1
10882       0.487             1
10883       0.417             1
10887      12.293             1
10888      22.929             1
...           ...           ...
167415     28.483             1
167422     26.220             1
167428      0.603             1
167435     13.448             1
167436     23.757             1

[19337 rows x 5 columns]
```

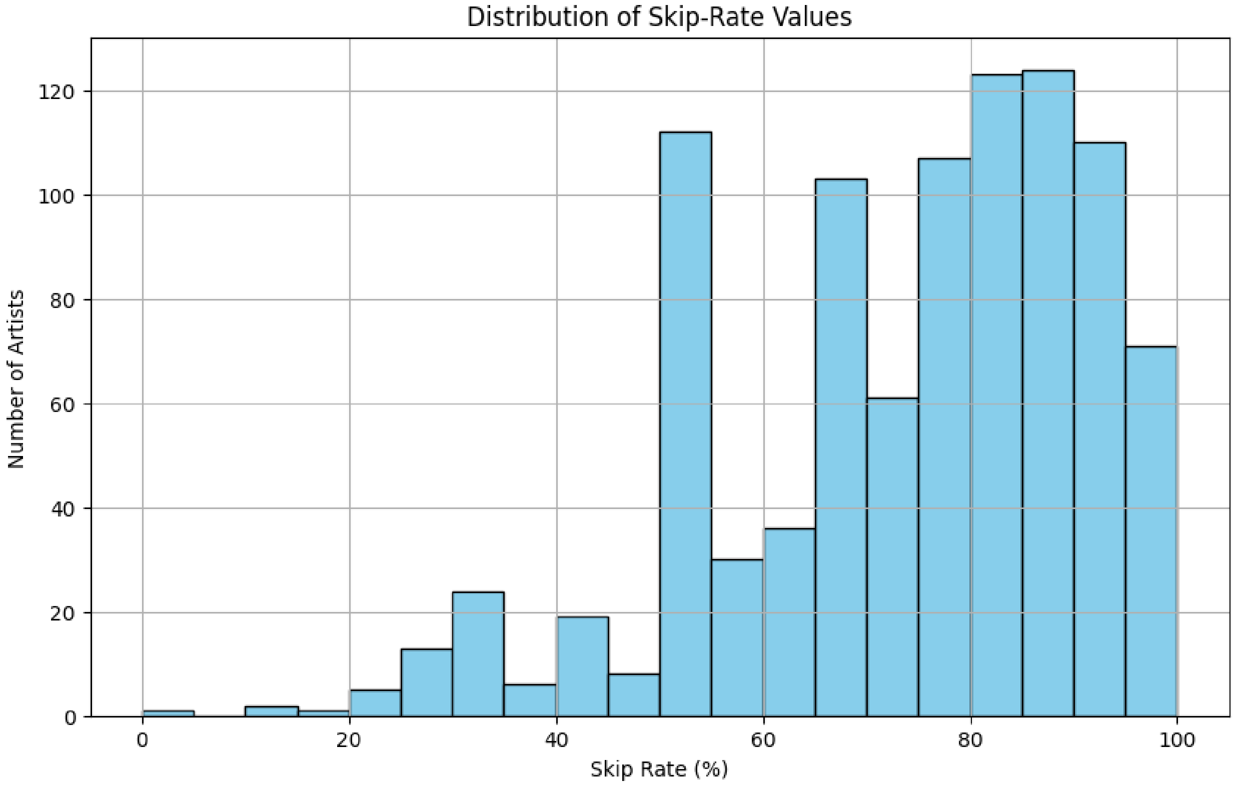
```
df_ariana.info()

<class 'pandas.core.frame.DataFrame'>
Index: 19337 entries, 10881 to 167436
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   endTime       19337 non-null  datetime64[ns]
 1   artistName    19337 non-null  object
 2   trackName     19337 non-null  object
 3   secPlayed     19337 non-null  float64
 4   skippedTrack  19337 non-null  int64
dtypes: datetime64[ns](1), float64(1), int64(1), object(2)
memory usage: 906.4+ KB

df3.info()

<class 'pandas.core.frame.DataFrame'>
Index: 156539 entries, 10881 to 167438
Data columns (total 5 columns):
 #   Column        Non-Null Count   Dtype
---  ------        --------------   -----
 0   endTime       156539 non-null  datetime64[ns]
 1   artistName    156539 non-null  object
 2   trackName     156539 non-null  object
 3   secPlayed     156539 non-null  float64
 4   skippedTrack  156539 non-null  int64
dtypes: datetime64[ns](1), float64(1), int64(1), object(2)
memory usage: 7.2+ MB
```

### 4.1 Average skip rate

Create a histogram of the distribution of the skip-rate values of the different artists in your DataFrame `df_skipped`, with skip rates on one axis and number of artists on the other.   Then, retrieve the skip rate for Ariana Grande from your DataFrame `df_skipped`. Run the code in the cell below. Where on this distribution does Ariana Grande fall? Do I skip her songs more than average, or less?

```
# Plotting a histogram of skip-rate values
plt.figure(figsize=(10, 6))
plt.hist(df_skipped['SkipRate'], bins=20, color='skyblue',
edgecolor='black')
plt.title('Distribution of Skip-Rate Values')
plt.xlabel('Skip Rate (%)')
plt.ylabel('Number of Artists')
plt.grid(True)
plt.show()

# Retrieving the skip rate for Ariana Grande
```

```
ariana_grande_skip_rate = df_skipped.loc['Ariana Grande', 'SkipRate']
print("Skip rate for Ariana Grande:", ariana_grande_skip_rate)
```



```
Skip rate for Ariana Grande: 99.52939959662822

count_skipped_artist_df = df_skipped[df_skipped['SkipRate'] >= 90]

count_skipped_artist_df.info()

<class 'pandas.core.frame.DataFrame'>
Index: 181 entries, A Problem Squared to Édith Piaf
Data columns (total 3 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   TotalSongs    181 non-null    int64
 1   SkippedTrack  181 non-null    int64
 2   SkipRate      181 non-null    float64
dtypes: float64(1), int64(2)
memory usage: 5.7+ KB

df_skipped.info()

<class 'pandas.core.frame.DataFrame'>
Index: 956 entries, 10cc to Édith Piaf
Data columns (total 3 columns):
 #   Column        Non-Null Count  Dtype
```

```
---  ------        --------------  -----
 0   TotalSongs    956 non-null    int64
 1   SkippedTrack  956 non-null    int64
 2   SkipRate      956 non-null    float64
dtypes: float64(1), int64(2)
memory usage: 62.2+ KB
```

## Part 4: Questions

Q1: Did I skip a lot of Ariana Grande's songs, or did I not, compared to the rest of the dataset? Answer1: As we can see skip rate is close to 100%, so a lot of songs of Ariana Grande is Skipped. Compare to the rest of the dataset we can see that 20% (181 out 956) of the artist's song skipped more than 80%.  Q2: What might be some possible reasons for Ariana Grande to be my nr.1 artist?  Answe2: In the dataset of 2023 spotify data we can see out of 156539 tracks there are 19337 tracks of Ariana Grande. And so many of songs are skipped so that makes Ariana the no. 1 artist.