

Title: Basketball Stats Tracker

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Course: Data Structures and Object-  
Oriented Programming

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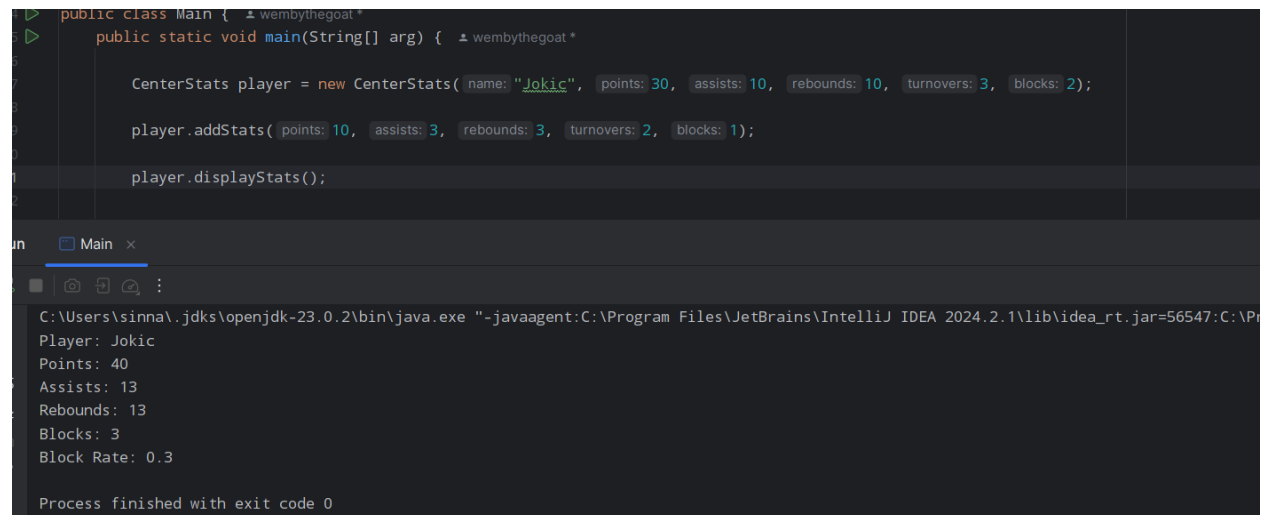
### 1. Project description:

The Basketball Stats Tracker was developed to operate as a comprehensive system for recording and analyzing basketball players and game statistics. It helps coaches, players, and analysts track performance trends, make strategic decisions, and monitor improvements over time. For example, a coach can input stats for players after a game, such as points scored and rebounds, and use the application to identify high-performing players and areas for improvement. Game-specific stats, such as total fouls and turnovers, can also be monitored to gauge team performance.

## 2. Program features with Screenshots:

a) Adding Player Stats: Users can input player details (name, points, assists, rebounds, blocks, etc.) based on their position (Guard, Forward, Center) using specific methods like `addStats(points, assists, rebounds, blocks)`.

Center position:



```
public class Main {  
    public static void main(String[] arg) {  
        CenterStats player = new CenterStats("Jokic", 30, 10, 10, 3, 2);  
        player.addStats(10, 3, 3, 2, 1);  
        player.displayStats();  
    }  
}
```

Player: Jokic  
Points: 40  
Assists: 13  
Rebounds: 13  
Blocks: 3  
Block Rate: 0.3  
Process finished with exit code 0

```
/**  
 * Adds the provided stats to the player's existing totals.  
 * @param points The number of points scored by the player.  
 * @param assists The number of assists made.  
 * @param rebounds The number of rebounds secured.  
 * @param turnovers The number of turnovers committed.  
 * @param blocks The number of blocks recorded.  
 */  
public void addStats(int points, int assists, int rebounds, int turnovers, int blocks) {  
    if (points < 0 || assists < 0 || rebounds < 0 || turnovers < 0 || blocks < 0) {  
        throw new IllegalArgumentException("Stats cannot be negative.");  
    }  
    super.addStats(points, assists, rebounds);  
    this.blocks += blocks;  
}
```

**Calculates the player's block rate per game:**

```
/**
 * Calculates the player's block rate per game.
 * This metric represents the average number of blocks made by the player over a given number of games.
 * @param totalGames The total number of games played. Must be zero or a positive integer.
 * @return The block rate
 */
public double calculateBlockRate(int totalGames) { 5 usages 1 wembythegoat
    if (totalGames == 0) {
        return 0;
    }
    return (double) blocks / totalGames;
}
```

```
public class Main { 1 wembythegoat *
    public static void main(String[] arg) { 1 wembythegoat *
        CenterStats player = new CenterStats( name: "Shaquille O'Neal", points: 20, assists: 8, rebounds: 12, turnovers: 3, blocks: 5);
        double blockRate = player.calculateBlockRate( totalGames: 10);
        System.out.println("Block Rate: " + blockRate);
    }
}
```

in Main x

C:\Users\sinna\.jdk\openjdk-23.0.2\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\lib\idea\_rt.jar=58

Block Rate: 0.5

Process finished with exit code 0

Guard position:

```
4 public class Main { ① wembythegoat *
5     public static void main(String[] arg) { ① wembythegoat *
6
7         GuardStats player = new GuardStats( name: "Steph curry", points: 30, assists: 10, rebounds: 5, turnovers: 3, steals: 2);
8
9         player.addStats( points: 20, assists: 3, steals: 3);
10
11         player.displayStats();
12
13     }
14 }
```

Run Main x

```
C:\Users\sinna\.jdk\openjdk-23.0.2\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\lib\idea_rt.jar=
Player: Steph curry
Points: 50
Assists: 13
Steal: 5
Assist-to-turnover Ratio: 2.1666666666666665

Process finished with exit code 0
```

```
52 /**
53  * Updates the player's statistics by adding new game stats.
54  * @param points The number of points scored in the game.
55  * @param assists The number of assists recorded.
56  * @param steals The number of steals made.
57  */
58 public void addStats(int points, int assists, int steals) { 5 usages ① wembythegoat
59     if (points < 0 || assists < 0 || rebounds < 0 || turnovers < 0) {
60         throw new IllegalArgumentException("Stats cannot be negative.");
61     }
62     super.addStats(points, assists, rebounds: 0);
63     this.steals += steals;
64 }
65 }
```

**Calculates the assist-to-turnover ratio for a player:**

```
/**
 * Calculates the assist-to-turnover ratio for a player.
 * This metric represents how efficiently a player distributes the ball
 * while minimizing turnovers.
 * @param turnovers The number of turnovers made by the player.
 * @return The assist-to-turnover ratio.
 */
public double calculateAssistToTurnoverRatio(int turnovers) { 7 usages  👤 wembythegoat
    if (turnovers == 0) {
        return 0;
    }

    if (turnovers < 0) {
        throw new IllegalArgumentException("Turnovers cannot be negative.");
    }

    return (double) assists / turnovers;
}
```

```
/**
 * Calculates the assist-to-turnover ratio for a player.
 * This metric represents how efficiently a player distributes the ball
 * while minimizing turnovers.
 * @param turnovers The number of turnovers made by the player.
 * @return The assist-to-turnover ratio.
 */
public double calculateAssistToTurnoverRatio(int turnovers) { 7 usages  👤 wembythegoat
    if (turnovers == 0) {
        return 0;
    }

    if (turnovers < 0) {
        throw new IllegalArgumentException("Turnovers cannot be negative.");
    }

    return (double) assists / turnovers;
}
```

**Calculates efficiency based on field goal percentage, rebounds, and assists:**

```
/**
 * Calculates efficiency based on field goal percentage, rebounds, and assists.
 * @param fieldGoalMade Number of successful shots made.
 * @param fieldGoalAttempted Number of total attempts.
 * @return Efficiency rating.
 */
public double calculateEfficiency(int fieldGoalMade, int fieldGoalAttempted) {
    if (fieldGoalAttempted == 0) {
        return 0;
    }
    double fgPercentage = ((double) fieldGoalMade / fieldGoalAttempted) * 100;
    return (fgPercentage + super.getRebounds() + super.getAssists()) / 3;
}

public class Main {
    public static void main(String[] arg) {
        ForwardStats player = new ForwardStats("LeBron James", points: 25, assists: 7, rebounds: 10, turnovers: 4, fieldGoalPercentage: 54);

        // Calculate and display efficiency
        double efficiency = player.calculateEfficiency(9, 15);
        System.out.println("Player Efficiency: " + efficiency);
    }
}
```

Player Efficiency: 25.666666666666668

b) Tracking Game Stats: Users can input general game information (date, location, total score) and add individual or team stats for the game.

**Adds the provided points to the team's total score:**

```
/**
 * Adds the provided points to the team's total score.
 * @param points The number of points to be added to the total score.
 */
public void addScore(int points) {
    if (points < 0) {
        throw new IllegalArgumentException("Points cannot be negative");
    }
    totalScore += points;
}
```

**Calculates the team's efficiency based on total score, fouls, and turnovers:**

```
3 public class Main {
4     public static void main(String[] arg) {
5         TeamGameStats teamGameStats = new TeamGameStats( "2020-05-10", "MetLife Stadium", 100, 15, 21);
6         double efficiency = teamGameStats.calculateTeamEfficiency();
7
8         System.out.println("Team Efficiency: " + efficiency);
9     }
10 }
11
```

run Main x

C:\Users\sinna\.jdk\openjdk-23.0.2\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\lib\idea\_rt.jar=56866:C:\Program Files\JetB

Team Efficiency: 2.7777777777777777

Process finished with exit code 0

```
* Calculates the team's efficiency based on total score, fouls, and turnovers.
* Efficiency is defined as the ratio of total score to the sum of fouls and turnovers.
* @return The team's efficiency
*/
public double calculateTeamEfficiency() {
    if (totalFouls == 0 && totalTurnovers == 0) {
        return getTotalScore();
    }
    return (double) getTotalScore() / (totalFouls + totalTurnovers);
}
```



**Adds the provided points and turnovers to the team's game statistics. Also increases the total fouls randomly within a range of 0 to 4. Also displays the stats:**

```

C:\Users\sinnal\jdk\openjdk-11.0.10\bin> javac *.java
Game Player Stats:
Player: Stephen Curry
Points: 30
Assists: 10
Steal: 3
Assist-to-turnover Ratio: 5.0
-----
Player: Shaquille O'Neal
Points: 20
Assists: 8
Rebounds: 12
Blocks: 5
Block Rate: 0.5
-----
Player: LeBron James
Points: 25
Assists: 7
Rebounds: 10
Field Goal Percentage: 2.0%
Efficiency Rating: 22.3333333
-----

1  : java.util.List;
2
3  : class Main {
4  :     @SuppressWarnings("unused")
5  :     public static void main(String[] arg) {
6  :         List<PlayerStats> playerStatsList = new ArrayList<>();
7
8  :         PlayerStats player1 = new GuardStats("Stephen Curry", points: 30, assists: 10, rebounds: 5, turnovers: 2, steals: 3);
9  :         PlayerStats player2 = new CenterStats("Shaquille O'Neal", points: 20, assists: 8, rebounds: 12, turnovers: 3, blocks: 5);
10
11        playerStatsList.add(player1);
12        playerStatsList.add(player2);
13
14        PlayerGameStats gameStats = new PlayerGameStats("2025-05-10", "Madison Square Garden", totalScore: 110, playerStatsList);
15
16        PlayerStats player3 = new ForwardStats("LeBron James", points: 25, assists: 7, rebounds: 10, turnovers: 4, fieldGoalPercentage: 2);
17        gameStats.addPlayerStats(player3);
18
19        gameStats.displayStats();
20
21        //List<PlayerStats> players = new ArrayList<>();
22        //players.add(new GuardStats("Stephen Curry", 30, 8, 4, 2, 2));
23        //players.add(new ForwardStats("LeBron James", 25, 10, 9, 3, 50.0));
24        //players.add(new CenterStats("Joel Embiid", 28, 4, 12, 2, 5));
25    }
26}

/**
 * Adds a player's statistics to the list of player stats for the game.
 * @param player The PlayerStats object representing the player's game stats.
 */
public void addPlayerStats(PlayerStats player) {
    if (player == null) {
        throw new IllegalArgumentException("You can't add a null player");
    }
    playerStats.add(player);
}

@Override
public void displayStats() {
    System.out.println("Game Player Stats: ");
    for (PlayerStats player : playerStats) {
        player.displayStats();
        System.out.println("-----");
    }
}

```

d) Sorting and Filtering: Players are sorted by points using Comparable and can be sorted by rebounds or assists using a Comparator.

**Compares this player's assist-to-turnover ratio with another player:**

```
public class Main { ① wembythegoat *
    public static void main(String[] arg) { ① wembythegoat *
        // Create two player objects (assuming subclasses like GuardStats)
        PlayerStats player1 = new GuardStats( name: "Chris Paul", points: 15, assists: 12, rebounds: 4, turnovers: 3, steals: 1);
        PlayerStats player2 = new GuardStats( name: "John Stockton", points: 10, assists: 14, rebounds: 5, turnovers: 2, steals: 0);

        // Compare the players based on assist-to-turnover ratio
        int comparisonResult = player1.compareTo(player2);

        // Display comparison result
        if (comparisonResult < 0) {
            System.out.println(player1.getName() + " has a lower assist-to-turnover ratio than " + player2.getName());
        } else if (comparisonResult > 0) {
            System.out.println(player1.getName() + " has a higher assist-to-turnover ratio than " + player2.getName());
        } else {
            System.out.println(player1.getName() + " and " + player2.getName() + " have equal assist-to-turnover ratios.");
        }
    }
}
```

Main x

C:\Users\sinna\.jdk\openjdk-23.0.2\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\lib\idea\_rt.jar=57126:
Chris Paul has a lower assist-to-turnover ratio than John Stockton

Process finished with exit code 0

```
/**
 * Compares this player's assist-to-turnover ratio with another player's.
 * @param o the object to be compared.
 * @return A negative integer if this player's ratio is lower, zero if the ratios are equal
 */
@Override ① wembythegoat
public int compareTo(PlayerStats o) {
    return Double.compare(calculateAssistToTurnoverRatio(turnovers), calculateAssistToTurnoverRatio(o.turnovers));
}
```

## Compares player's efficiency:

```
4 ▶ public class Main { ① wembythegoat *
5 ▶     public static void main(String[] arg) { ① wembythegoat *
6         ForwardStats player1 = new ForwardStats( name: "Kevin Durant", points: 25, assists: 6, rebounds: 9, turnovers: 3, fieldGoalPercentage: 50);
7         ForwardStats player2 = new ForwardStats( name: "Giannis Antetokounmpo", points: 30, assists: 5, rebounds: 12, turnovers: 4, fieldGoalPercentage: 52);
8
9         int comparisonResult = player1.compareTo(player2);
10
11         if (comparisonResult < 0) {
12             System.out.println(player1.getName() + " has lower efficiency than " + player2.getName());
13         } else if (comparisonResult > 0) {
14             System.out.println(player1.getName() + " has higher efficiency than " + player2.getName());
15         } else {
16             System.out.println(player1.getName() + " and " + player2.getName() + " have equal efficiency.");
17         }
18     }
19 }
```

Run Main x

C:\Users\sinna\jdk\openjdk-23.0.2\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\lib\idea\_rt.jar=57284:C:\Program Files\JetBrains\IntelliJ  
Kevin Durant has lower efficiency than Giannis Antetokounmpo

```
/**
 * Compares this player's assist-to-turnover ratio with another player's.
 * @param o the object to be compared.
 * @return A negative integer if this player's ratio is lower, zero if the ratios are equal
 */
@Override ① wembythegoat
public int compareTo(PlayerStats o) {
    return Double.compare(calculateAssistToTurnoverRatio(turnovers), calculateAssistToTurnoverRatio(o.turnovers));
}
```

***Compares this center player's block count with another center player:***

```
4 public class Main { // wembythegoat
5     public static void main(String[] arg) { // wembythegoat
6         CenterStats player1 = new CenterStats( name: "Shaquille O'Neal", points: 20, assists: 8, rebounds: 12, turnovers: 3, blocks: 5);
7         CenterStats player2 = new CenterStats( name: "Dwight Howard", points: 18, assists: 6, rebounds: 10, turnovers: 4, blocks: 7);
8
9         // Compare the players based on their block count
10        int comparisonResult = player1.compareTo(player2);
11
12        // Display comparison result
13        if (comparisonResult < 0) {
14            System.out.println(player1.getName() + " has fewer blocks than " + player2.getName());
15        } else if (comparisonResult > 0) {
16            System.out.println(player1.getName() + " has more blocks than " + player2.getName());
17        } else {
18            System.out.println(player1.getName() + " and " + player2.getName() + " have the same number of blocks.");
19        }
20    }
21    //List<PlayerStats> players = new ArrayList<>();
22}
```

run Main x

C:\Users\sinnal\jdk\openjdk-23.0.2\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\lib\idea\_rt.jar=57535:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\bin" -Dfile.encoding=UTF-8

Shaquille O'Neal has fewer blocks than Dwight Howard

Process finished with exit code 0

```
/**
 * Compares this center player's block count with another center player's.
 * @param o the object to be compared.
 * @return A negative integer if this player has fewer blocks,
 *         zero if both players have the same number of blocks,
 *         a positive integer if this player has more blocks.
 */
@Override // wembythegoat
public int compareTo(PlayerStats o) {
    return blocks - ((CenterStats) o).blocks;
}
```

e) Displaying Stats: Stats for players and games are displayed using polymorphic methods like `displayStats()`, which provide customized outputs for different positions (e.g., highlighting assists for Guards).

```
@Override  wembythegoat
public void displayStats() {
    System.out.println("Player: " + getName());
    System.out.println("Points: " + getPoints());
    System.out.println("Assists: " + getAssists());
    System.out.println("Steal: " + steals);
    System.out.println("Assist-to-turnover Ratio: " + calculateAssistToTurnoverRatio(turnovers));
}

4 public class Main { wembythegoat *
5     public static void main(String[] arg) { wembythegoat *
6
7         GuardStats player = new GuardStats( name: "Steph curry", points: 30, assists: 10, rebounds: 5, turnovers: 3, steals: 2);
8
9         player.addStats( points: 20, assists: 3, steals: 3);
10
11         player.displayStats();
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```

f) Data Persistence: Stats can be saved to and loaded from text files using StatsFileManager.

```
public class StatsFileManager { no usages  wembythegoat

    private static final String FILE_NAME = "stats.txt"; 4 usages

    public static void saveStats(List<PlayerStats> players) { no usages  wembythegoat
        try (PrintWriter writer = new PrintWriter(new FileWriter(FILE_NAME))) {
            for (PlayerStats player : players) {
                String classType = player.getClass().getSimpleName(); // Get subclass type
                writer.println(classType + "," + player.getName() + "," + player.getPoints() + "," +
                    player.getAssists() + "," + player.getRebounds() + "," + player.getTurnovers());
            }
            System.out.println("Stats saved to " + FILE_NAME);
        } catch (IOException e) {
            System.err.println("Error saving player stats: " + e.getMessage());
        }
    }

    public static List<PlayerStats> loadStats() { no usages  wembythegoat
        List<PlayerStats> players = new ArrayList<>();
        try (BufferedReader reader = new BufferedReader(new FileReader(FILE_NAME))) {
            String line;
            while ((line = reader.readLine()) != null) {
                String[] data = line.split(regex: " ");
                if (data.length == 6) {
                    String classType = data[0];
                    String name = data[1];
                    int points = Integer.parseInt(data[2]);
                    int assists = Integer.parseInt(data[3]);
                    int rebounds = Integer.parseInt(data[4]);
                    int turnovers = Integer.parseInt(data[5]);

                    PlayerStats player;
                    switch (classType) {
```

```

    if (data.length == 6) {
        String classType = data[0];
        String name = data[1];
        int points = Integer.parseInt(data[2]);
        int assists = Integer.parseInt(data[3]);
        int rebounds = Integer.parseInt(data[4]);
        int turnovers = Integer.parseInt(data[5]);

        PlayerStats player;
        switch (classType) {
            case "GuardStats":
                player = new GuardStats(name, points, assists, rebounds, turnovers, steals: 0);
                break;
            case "ForwardStats":
                player = new ForwardStats(name, points, assists, rebounds, turnovers, fieldGoalPercentage: 0.0);
                break;
            case "CenterStats":
                player = new CenterStats(name, points, assists, rebounds, turnovers, blocks: 0);
                break;
            default:
                throw new IllegalArgumentException("Unknown player type: " + classType);
        }
        players.add(player);
    }
}

System.out.println("Stats loaded from " + FILE_NAME);
} catch (IOException e) {
    System.out.println("Error loading player stats: " + e.getMessage());
}
}

return players;
}
}

```

```

4 public class Main {
5     public static void main(String[] arg) {
6         List<PlayerStats> players = new ArrayList<>();
7         players.add(new GuardStats( name: "Stephen Curry", points: 30, assists: 8, rebounds: 4, turnovers: 2, steals: 2));
8         players.add(new ForwardStats( name: "LeBron James", points: 25, assists: 10, rebounds: 9, turnovers: 3, fieldGoalPercentage: 50.0));
9         players.add(new CenterStats( name: "Joel Embiid", points: 28, assists: 4, rebounds: 12, turnovers: 2, blocks: 5));
10
11         StatsFileManager.saveStats(players);
12
13         List<PlayerStats> loadedPlayers = StatsFileManager.loadStats();
14         for (PlayerStats player : loadedPlayers) {
15             System.out.println(player);
16         }
17     }
18 }

```

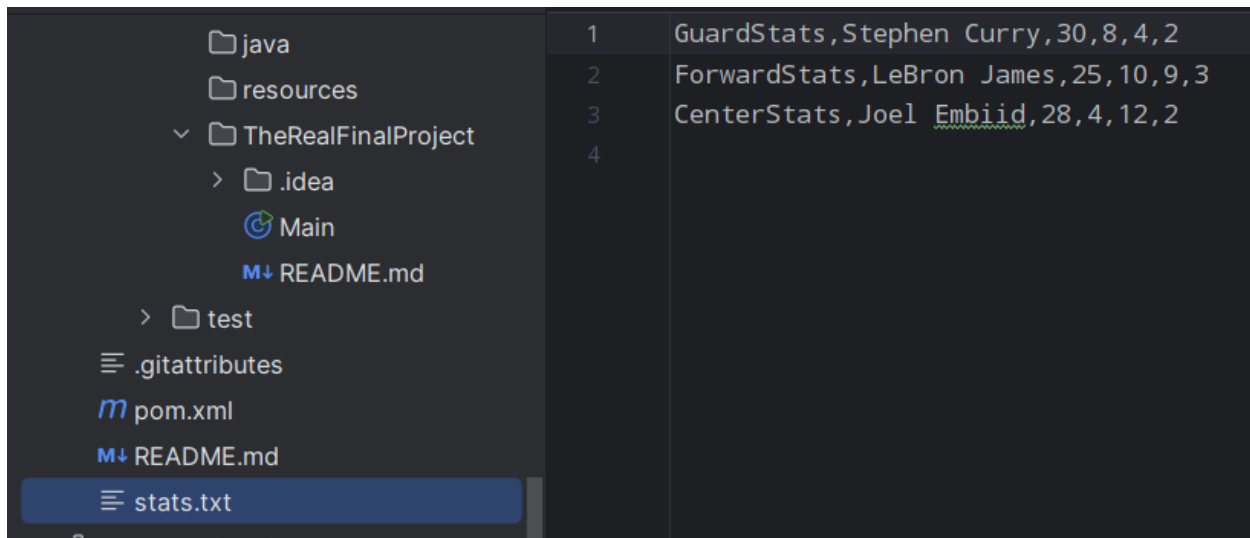
run Main x

```

C:\Users\sinna\jdk\openjdk-23.0.2\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA 2024.2.1\lib\idea_rt.jar=5893
Stats saved to stats.txt
Stats loaded from stats.txt
PlayerStats{name='Stephen Curry', points=30, assists=8, rebounds=4, turnovers=2}
PlayerStats{name='LeBron James', points=25, assists=10, rebounds=9, turnovers=3}
PlayerStats{name='Joel Embiid', points=28, assists=4, rebounds=12, turnovers=2}

Process finished with exit code 0

```



### 3. Challenges Faced:

During development, certain challenges were encountered:

- **Testing Console Output (displayStats()):** Using `ByteArrayOutputStream` was needed to verify printed stats. I remember using this for another past project, but I still needed to relearn a bit about this, and it was one of the hardest things for me in the project
- **Ensuring Correct Sorting Behavior:** Used **Comparable** and **Comparator** for ranking players efficiently. For some of the classes like `GuardStats` and `ForwardStats`, I had to really think about what stat i want to compare with each other.
- **Managing File Persistence:** Ensuring **data consistency** when saving/loading player stats. `TextIO` out of all the material learned this semester, is easily the hardest and complicated one for me. This was the only part of the project where I actively asked for help from my friends. I have always struggled with `linereader` because because at the beginning it really confused me. I also had to relook at how to make a switch case.



## 4. Learning Outcomes:

Throughout this project, the following skills were improved:

- **Java Object-Oriented Programming** (inheritance, polymorphism, method overriding)
- **Unit Testing** (writing JUnit tests for validation): I'm now way more comfortable and confident in my ability to create tests.
- **Sorting Algorithms** (implementing Comparable and Comparator for ranking players)
- **Exception Handling** (ensuring user input validation): Before I used to really forget about putting exceptions in methods because I would be way more focused on creating the method itself. But now, making the exception has become this automatic thing that I do first thing first every time I create a method.
- **Text File Management** (saving and loading player data efficiently): I'm now way more comfortable with TextIO. I wouldn't say it's the best aspect of my coding ability, but I would say that my ability in it has increased. I also comprehend its concept and the reason why we do this more.

## 5. Conclusion

The Basketball Stats Tracker successfully provides a structured system for tracking players and team performance. It leverages object-oriented principles for managing hierarchical player stats and integrates sorting and filtering mechanisms for analysis.

Overall, the project delivers an effective performance monitoring tool for coaches, players, and analysts.