Ranking in the AR Tennis App.

The rankings are calculated by analyzing all match results stored in the app, focusing on points earned, win percentages, and other performance metrics. The system rewards players for their wins, participation, and the margins of their victories, ensuring a balanced and competitive leaderboard.

1. Points System

- **Winning a Match**: Each player on the winning team earns **3 points**. For doubles, both players on the winning team get 3 points each.
- **Losing a Match**: Each player on the losing team earns **1 point**. Again, in doubles, both players get 1 point each.
- **Tie**: In the case of a tie, all players involved (whether singles or doubles) receive **1.5 points** each.

This system rewards winning but also gives credit for participation, so every match counts toward your ranking.

2. Tracking Wins, Losses, and Matches Played

- The system keeps count of:
  - **Wins**: How many matches a player has won.
  - **Losses**: How many matches a player has lost.
  - **Total Matches Played**: The sum of all matches a player has participated in.
- These stats help determine a player's **Win Percentage**, calculated as:
  - Win % = (Number of Wins ÷ Total Matches Played) × 100
  - For example, if you've won 4 out of 10 matches, your win percentage is 40%.

3. Game Difference

To account for how convincingly a player wins or loses, the system calculates the **game difference** for each match:

- For each set (e.g., a score of 6-4), the game difference is the number of games won by one team minus the games won by the other (e.g., 6 - 4 = +2 for the winning team, -2 for the losing team).
- The total game difference for a match is averaged across all sets played in that match.
- For each player:
  - If you're on the winning team, the average game difference is added to your tally.
  - If you're on the losing team, it's subtracted.
  - In doubles, both players on a team share the same game difference for the match.
- The **Game Difference Average** is then calculated as:
  - Game Diff Avg = Total Game Difference ÷ Total Matches Played

- This metric rewards players who win sets by larger margins, reflecting their dominance on the court.

4. Games Won

- The system also tracks the total number of **games won** in all sets across all matches.
- For example, if a set score is 6-4, the winning team's players are credited with 6 games, and the losing team's players with 4 games.
- This helps distinguish players who consistently win more games, even in close matches.

5. Recent Performance Trend

To show how a player is performing lately, the system looks at their **last 5 matches** and creates a trend:

- **W** for a win (if the player's team won the match).
- **L** for a loss (if the player's team lost and it wasn't a tie).
- Ties are not included in the trend.
- The trend is displayed as a sequence, like "W L W W L", so you can see a player's recent form.

6. Ranking Players

Once all the stats are calculated, players are ranked based on the following criteria, in this order:

1. **Total Points**: Players with more points rank higher.
2. **Win Percentage**: If players have the same points, the one with the higher win percentage ranks higher.
3. **Game Difference Average**: If win percentages are equal, the player with the higher average game difference ranks higher.
4. **Total Games Won**: If game differences are equal, the player with more games won ranks higher.
5. **Player Name**: As a final tiebreaker, players are sorted alphabetically by name.

Each player is then assigned a rank (e.g., 🏆 1, 🏆 2) based on their position in this sorted list.

7. Doubles Partnership Stats

For doubles players, the system also tracks how well you perform with different partners:

- It counts the number of matches played with each partner, along with wins, losses, and ties.
- It calculates the total game difference for each partnership.
- This helps identify your **most effective partner**—the one with whom you have the best win rate and game difference.

8. Different Ranking Views

The app provides three ranking views:

- **Combined**: Includes all matches (singles and doubles) to rank players overall.
- **Doubles**: Only considers doubles matches, focusing on team performance.
- **Singles**: Only considers singles matches, highlighting individual skill. Each view uses the same logic but filters the matches accordingly, so you can see how you stack up in different formats.

Why This System Works

- **Fairness**: The points system rewards wins but also gives credit for playing, encouraging participation.
- **Depth**: By considering win percentage, game difference, and games won, the rankings reflect not just who wins but how well they play.
- **Transparency**: The recent performance trend lets everyone see who's on a hot streak or needs to step up.
- **Flexibility**: The system works for both singles and doubles, with extra insights for doubles partnerships.

This ranking system ensures everyone in the AR Tennis community can see their progress, celebrate their successes, and find the best partners to dominate the court!

Technical Over view with code references

The technical summary of the point allocation and ranking calculation logic used in the AR Tennis application.

1. Core Ranking Logic: `calculate_rankings()`

The entire ranking process is handled by the `calculate_rankings(matches_to_rank)` function. This function takes a pandas DataFrame of matches as input and outputs a ranked DataFrame of players along with detailed partnership statistics.

Data Accumulation

The function initializes several `defaultdict` objects from Python's `collections` module to store player statistics as it iterates through matches. This is efficient as it automatically handles the creation of a new entry for any player encountered for the first time.

- `scores = defaultdict(float)`: Stores the primary ranking points for each player.
- `wins = defaultdict(int)`: Counts the total number of matches won.
- `losses = defaultdict(int)`: Counts the total number of matches lost.
- `matches_played = defaultdict(int)`: Counts the total number of matches a player has participated in.
- `games_won = defaultdict(int)`: Accumulates the total number of games a player has won across all sets.
- `game_diff = defaultdict(float)`: Accumulates a player's average game difference from each match.
- `partner_stats`: A nested `defaultdict` to store detailed statistics for doubles partnerships.

Per-Match Processing

The function iterates through each match in the `matches_to_rank` DataFrame. In each iteration, it performs the following steps:

1. **Game Difference Calculation:**
    - For each match, it calculates the total game difference from the perspective of Team 1 (`match_gd_sum`). It does this by parsing the score of each valid set (e.g., '6-4' results in a difference of +2).
    - It then computes the *average* game difference for that specific match (`match_gd_avg`) by dividing `match_gd_sum` by the number of sets played. This normalizes the impact of two-set versus three-set matches.

2. **Point & Statistic Allocation:**
    - The system allocates points based on the match outcome (`winner` column):
        - **Win:** Players on the winning team each receive **3.0 points**. Their `wins` count is incremented.
        - **Loss:** Players on the losing team each receive **1.0 point**. Their `losses` count is incremented.
        - **Tie:** All players in the match receive **1.5 points**.
    - For every match, the `matches_played` count is incremented for all participants.
    - The `game_diff` for each player is updated by adding or subtracting the `match_gd_avg` calculated for that match. Winners have it added, and losers have it subtracted.
    - The `games_won` for each player is updated by summing the raw number of games they won in each set.

2. Final Ranking and Tie-Breaking

After processing all matches, the function aggregates the collected data to produce the final rankings.

1. **Final Stat Calculation:** It iterates through every player recorded in the `scores` dictionary and calculates final metrics:
    - `Win %`: Calculated as `(wins / matches_played) * 100`.
    - `Game Diff Avg`: The total accumulated `game_diff` is divided by `matches_played`. This results in the player's average game differential across all their matches.
2. **Sorting and Ranking:** A new DataFrame (`rank_df`) is created. The final rank is determined by sorting this DataFrame based on a strict hierarchy of criteria. This tie-breaking logic is critical:
    - **Primary Key:** `Points` (descending)
    - **Secondary Key:** `Win %` (descending)
    - **Tertiary Key:** `Game Diff Avg` (descending)
    - **Quaternary Key:** `Games Won` (descending)
    - **Final Tie-Breaker:** `Player` name (ascending, for alphabetical consistency)

Once sorted, a "Rank" column is generated based on the player's position in the sorted DataFrame.

3. Ancillary Functions

`get_player_trend()`

The "Recent Trend" string (e.g., "W L W W L") displayed in the rankings is generated by the `get_player_trend(player, matches, max_matches=5)` function. This function isolates a player's most recent five matches, determines the outcome ('W' or 'L') for each, and concatenates them into a display string. This is purely for informational purposes and does not affect the point calculation or ranking order.

4. Application Context and Filtering

In the main application, the `calculate_rankings()` function is called within the "Rankings" tab. The user's selection from the `ranking_type` radio buttons ("Combined", "Doubles", "Singles") determines which matches are passed to the function.

- If "Doubles" is selected, the main `matches` DataFrame is first filtered to include only rows where `match_type == 'Doubles'`.
- If "Singles" is selected, it's filtered for `match_type == 'Singles'`.
- If "Combined" is selected, the entire `matches` DataFrame is passed without filtering.

This mechanism allows the single, robust `calculate_rankings()` function to generate different, context-specific leaderboards based on a filtered subset of the overall match data.