ARENA OF RATINGS: ULTIMATE EDITION

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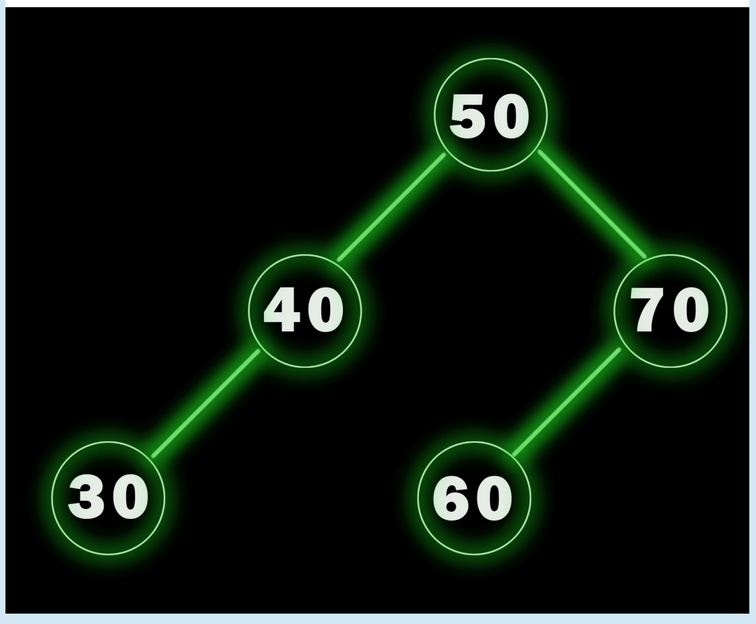
INTRODUCTION

Arena of Ratings uses a **Binary Search Tree (BST)** for instant matchmaking. Unlike slow standard lobbies, it ensures pairing takes **milliseconds**, even with thousands of players.

OBJECTIVE

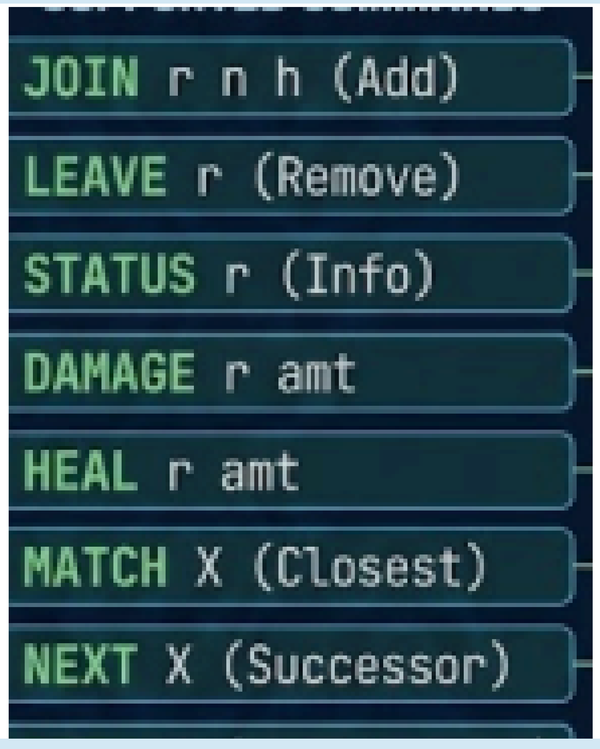
High-Performance Matchmaking Engine
- **Instant Match**
- **Dynamic Ranking**
- **Seamless Player Management at Scale**

METHODS




```
struct Node {
    int rating;
    std::string name;
    long long hp;
    Node *left, *right;
    int sz;

    Node(int r, std::string n,
        : rating(r), name(n),
};
```



RESULTS

Time Complexity: O(h)
Space Complexity:
- **O(N) space efficiency.**

Real-Time Feedback:
- **Uses ANSI color codes for Success, Red for Error).**

```
Welcome to the Arena of Ratings Engine.
Type 'HELP' for a list of commands.

Arena> JOIN 400 KF 4
JOINED
Arena> JOIN 200 KF 4
JOINED
Arena> JOIN 100 KF 4
JOINED
Arena> JOIN 50 KF 4
JOINED
Arena> JOIN 150 KF 4
JOINED
Arena> JOIN 300 KF 4
JOINED
Arena> VISUAL

--- VISUAL TOPOLOGY ---
[400] KF (4HP)
|__ [200] KF (4HP)
    ---- [100] KF (4HP)
    |   ---- [50] KF (4HP)
    |   |__ [150] KF (4HP)
    |__ [300] KF (4HP)
----------------------
Arena>
```

```
Welcome to the Arena of Ratings Engine.
Type 'HELP' for a list of commands.

Arena> HELP

=== ARENA OF RATINGS: COMMAND LIST ===
  VISUAL                  : Draw the tree struct
  SAVE <file>             : Save arena to disk
  LOAD <file>             : Load arena from disk
  JOIN <r> <n> <h>        : Add a player
  LEAVE <r>               : Remove a player
  STATUS <r>              : Show player details
  DAMAGE <r> <a>          : Reduce player HP
  HEAL <r> <a>            : Increase player HP
  MATCH <r>               : Find closest opponent
  NEXT <r>                : Find next higher play
  PREV <r>                : Find next lower playe
  RANGE <L> <R>           : List players in range
  RANK <r>                : Count players with lo
  KTH <k>                 : Find k-th smallest pl
  DUEL <A> <B>            : Measure tree distance
  STATS                   : Show system diagnosti
  CLEAR                   : Clear the screen
  EXIT                    : Quit the program
=======================================

Arena>
```

```
Arena> LEAVE
Error: Usage LEAVE <rating>
Arena> LEAVE 0
NOT FOUND
Arena> LEAVE 100
LEFT
Arena>
```

CONCLUSION

```
Arena> STATS
PLAYERS 0
MIN NONE
MAX NONE
HEIGHT -1
LEAVES 0
Arena>
```

The Arena of Ratings demonstrates the power of BSTs for real-time matchmaking. By achieving O(log N) efficiency, the engine guarantees instant pairing and dynamic ranking, solving the latency issues found in standard linear systems.

ACKNOWLEDGEMENTS

I express my gratitude to my instructor for their mentorship in designing the efficient algorithms used in this project.