

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

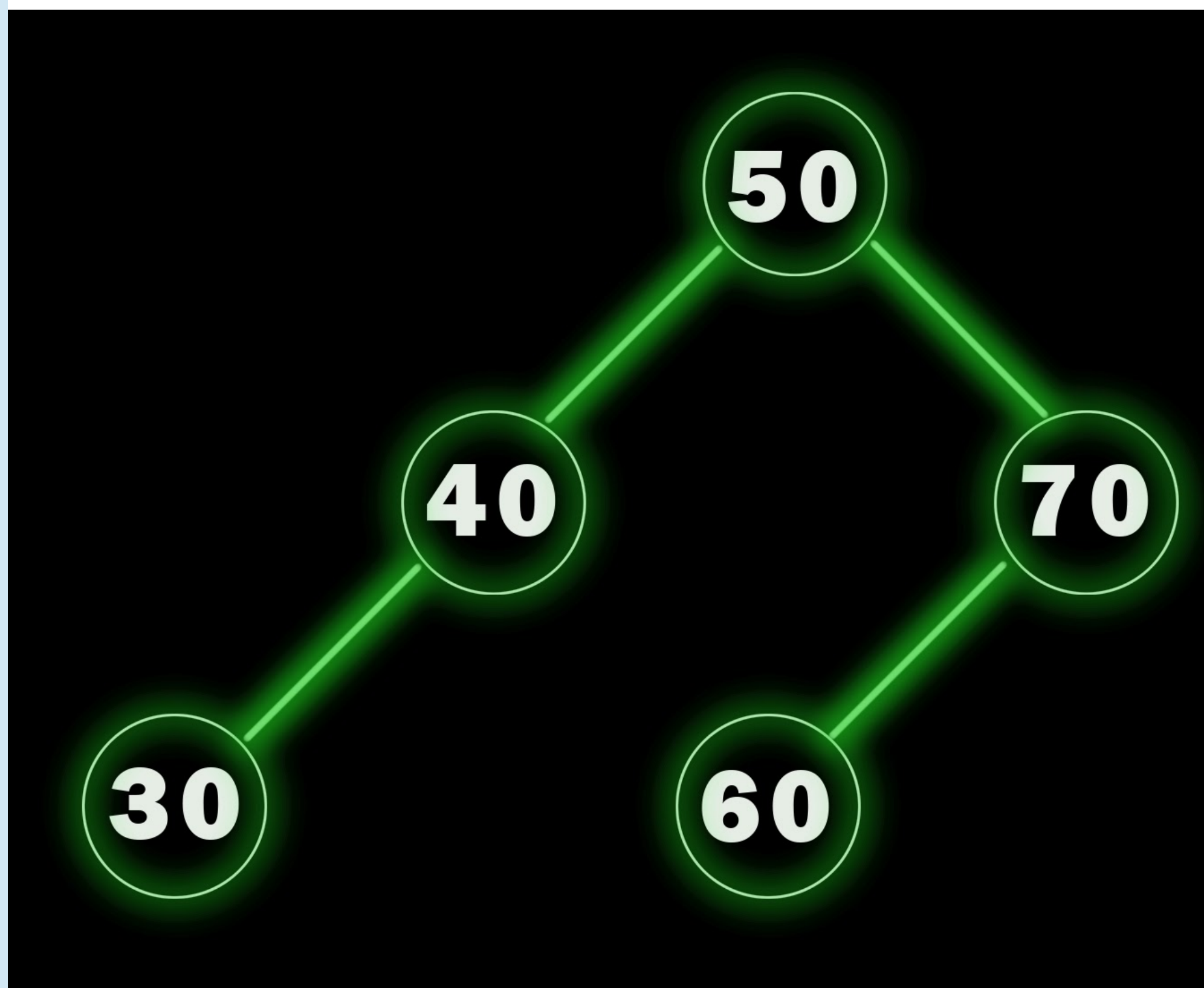
High-Performance Matchmaking Engine

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),
    };
};
```

- JOIN r n h (Add)
- LEAVE r (Remove)
- STATUS r (Info)
- DAMAGE r amt
- HEAL r amt
- MATCH X (Closest)
- NEXT X (Successor)

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 KE 4

JOINED

```
Arena> JOIN 50 KF 4
```

JOINED

```
Arena> JOIN 150 KF 4
```

Joined
Area: 10TN 300 KE 41

JOINED

Arena> VISUAL

```
--- VISUAL TOP
EUC001 ME (UUB)
```

[400] RF (4HP)

---- [100] KF (4HP)

----- [50] KF (4HP)

```
| |__ [150] KF (4HP)
```

|_ [300] KF (4HP)

Arrears

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 structure
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 player
PREV <r>                    : Find next lower player
RANGE <L> <R>              : List players in range
RANK <r>                    : Count players with lower rank
KTH <k>                     : Find k-th smallest player
DUEL <A> <B>               : Measure tree distance
STATS                       : Show system diagnostics
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.