Report on Chain Reaction Game

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Introduction

I was told to build an instance of the game **"Chain Reaction"**, where I used **python** and its famous game library **pygame**. I have kept 3 playing modes:

- **Human vs Human**
- **Human vs AI**
- **AI vs AI**

Experimental Setup

The first mode is very casual, it does not need any AI involvement. So no heuristics or minimax search algorithm were needed. For the next two modes, I kept option for the following **5** heuristic evaluation functions:

1. **Orb difference heuristic** : Measures the number of red orbs and the number of blue orbs, and their difference is the heuristic value. Count of red orbs - count of blue orbs is the heuristic value for the red player, and the negative is the heuristic value for the blue player.
2. **Territory heuristic** : Measures the current color of all the cells, where cell color means the color of the orbs the cell is holding. If no orb is held by a cell, I used the term "null" as the cell color; and such cells had no impact in this heuristic evaluation. Actual heuristic value is found in the same way as before.
3. **Mobility heuristic** : This is even smarter. Finds the possible cells a particular colored orb can be kept in. Similar way was followed for finding the heuristic value.
4. **Critical mass proximity heuristic** : A cell that had only one orb less than its critical mass was supposed to be a critical cell; and was a threat to the other colored cell as it was about to burst. A good heuristic in action.
5. **A combined heuristic** : This is basically a weighted sum of the previous 4 heuristics.

And ultimately, a **Minimax Search Algorithm** that uses one of the heuristics to find the best possible next move for a player.

For testing purpose, I set the **time limit to 5 minutes**, made changes to the depth limits and the heuristics each time; and noted down the results. The results are shown in a table on the next section.

Results

Below are the experimental data found from playing the game with different AI heuristics and different search depths:

Table 1: **Human vs AI**

Heuristic	Search depth	Elapsed time	Winning player	Moves taken	Remarks
Orb_diff	4				
Mobility	3				
Territory	4				
Combined	2				
Critical mass	4				

Table 2: **AI vs AI**

Heuristic		Search depth		Elapsed time	Winning Player	Moves taken	Remarks
Red AI	Blue AI	Red AI	Blue AI				
Orb_diff	Critical	4	3				
Combined	Mobility	2	4				
Critical	Territory	3	4				

Discussion