

Space Base Race

Algorithms with a Purpose

October 25, 2014

1 Introduction

Welcome, explorers, to the Space Base Race. The year is 2048 and recent probing has revealed that there is a motherload of dogecoin on Mars. The mining corporations have hired you to go and claim land on Mars. Due to regulations, you can only claim land if you build something on it. But be warned, there will be tough competition from others who want a bite out of the dogecoin fortune. Brace yourselves and go forth with grace, chase first place to become the Space Base Race Ace.

2 Terminology

player	a single entity in a game, representing a team of up to 4 humans
match	a set of games played with the same 3 other players
game	a single round played within a match
turn	a single phase of a game where a player can build a base
base	a playing piece made of a set number of squares in a configuration
map	the playing board, a modified 20×20 grid (see Fig. 1)
bonus	a tile on the map worth more points (denoted by dogecoin)

3 Rules

1. Each game is played between 4 players in the order: Red, Yellow, Green, Blue.
2. Each turn consists of a player building a base or skipping.
3. Each player can starting building bases from a designated corner of the map.
4. Bases cannot overlap other bases or blocked tiles (denoted by crater).
5. New bases MUST share a corner with a base of the same player and CANNOT share a side with a base of the same player (see Fig. 3 and Fig. 4).

6. As long as the built base satisfies the previous rule, it can share a side with a base built by a different player.
7. Bases must be selected from a set of available bases (see Fig. 2), when a base is placed it is removed from the set.
8. A game ends when there are 4 skips in a row or no more possible moves.

4 Scoring

Score per game:

$$\sum_{b \in B} m_b f(b)$$

B = set of bases played

m = multiplier

f = base score function

Base score function is the block size of base.

Base multiplier is 1.

If a base is on top of a bonus block, multiplier is 3 for that base.

5 Tournament

5.1 Seeding

- Each player matched with 3 bots.
- The 3 bots will NOT be identical to the bot given on the game server.
- 1 game played with the player starting in the Red position (first to play).
- Player score for game is used for seeding the group stage.

5.2 Group Stage

- Total score resets to 0.
- n tournament groups of 16 players, each created from the seeding (see Fig. 5).
- Number of groups depends on the number of registered teams (there may be bots used as fillers).
- 4 games per match, each player will play in each position.
- Score is sum of points earned in each position.

- Ties broken first by highest scored game in a match then by seeding rank.
- Top 2 players of each match will advance.
- 1st and 2nd place in the group will advance to the brackets stage.

5.3 Brackets

- Total score resets to 0, scoring same as groups.
- Seeded by score in final match before brackets.
- 4 games per match, each player will play each position.
- Top 3 players are the top 3 players from the final match.

6 Tips

- This game shares an uncanny resemblance to Blokus.
- At the core, this is a knapsack problem (http://en.wikipedia.org/wiki/Knapsack_problem), which is to maximize

$$\sum_{i=1}^N v_i x_i$$

subject to the condition

$$\sum_{i=1}^N w_i x_i \leq W, x_i \in 0, 1$$

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- You can treat the other 3 players as a single opponent and use modified 2-player game algorithms. (http://en.wikipedia.org/wiki/Game_theory) may be relevant.

7 Diagrams

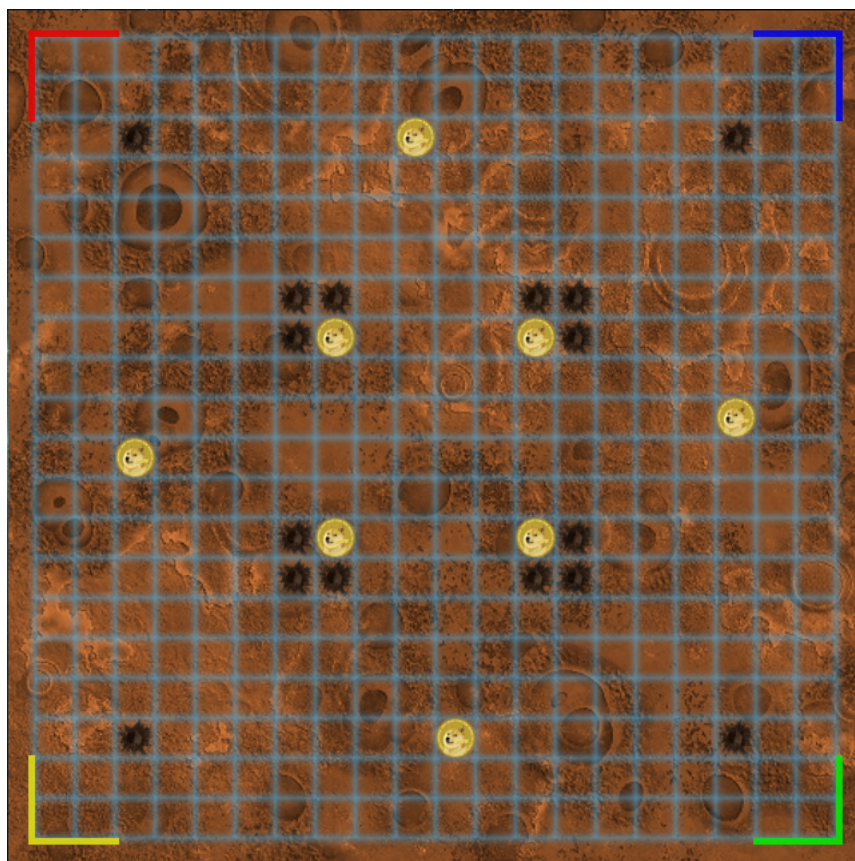


Figure 1: Starting map

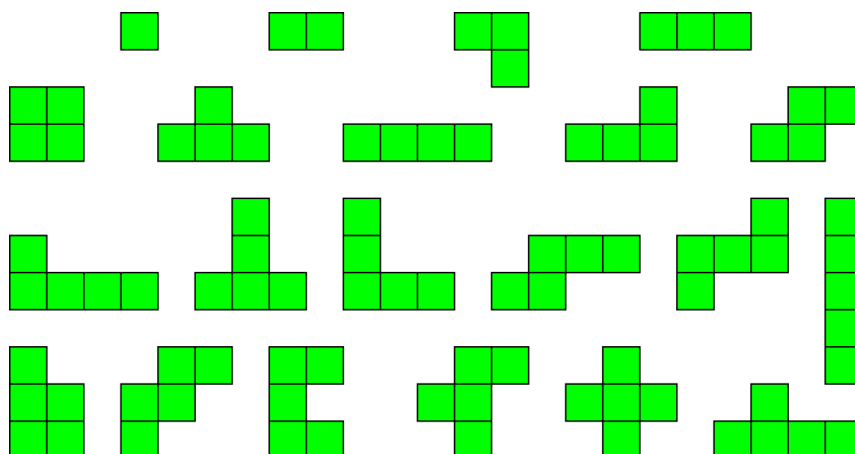


Figure 2: List of bases

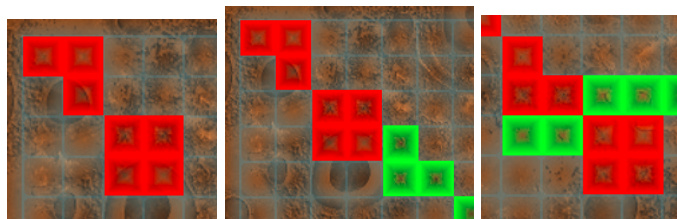


Figure 3: Legal moves

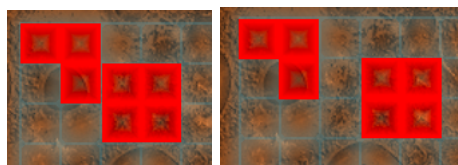


Figure 4: Illegal moves

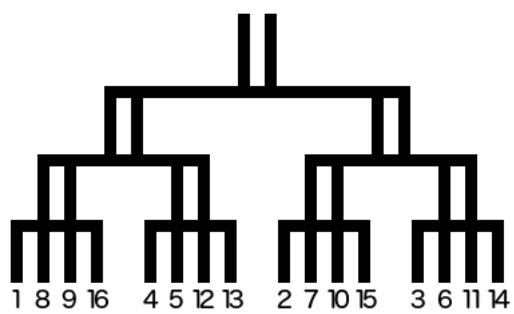


Figure 5: Sample tournament bracket