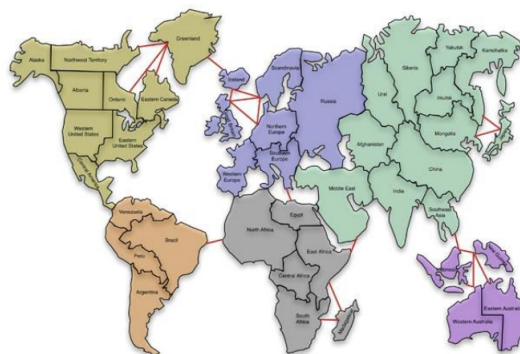# Risk Board Game Strategy Assessments

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## 1 Background

"The individualist without strategy who takes opponents lightly will inevitably become a captive."[1]



[4]

### 1.1 History

Risk was originally produced by parker brothers, now a division of hasbro. It was invented by the French film director Albert Lamorisse in 1957 and it was originally called "The Conquest of the World."[2]

The creator of the game anticipated that it should take 90 minutes to complete, but many players end up with the board occupying their tables for days at a time.[3] With varying strategies and fragile alliances, Risk can be a drawn-out, yet intellectually fulfilling game.

### 1.2 Rules

Risk is a turn-based for two to six players. In the standard Risk Game, Earth has six continents and 42 regions.

At the start of the game, players choose countries into which they place one army. This is the claiming phase. Only one army may be placed in any region during the claiming phase. At the beginning of each player's turn (after the claiming phase) they will receive bonus troops for continents that they own completely.

After claiming, players will then place armies into regions that they own. This happens, again, one at a time until everyone has placed all their starting armies.

Then players may choose to attack other regions. They may only attack bordering regions. Attackers can use up to three dice, if they have at least three troops. Otherwise, they may only use one die for each troop. Defenders roll up to two dice. The attacker and the defender then sort their dice and compare them. (Attacker's highest vs defender's highest AND attacker's second highest vs defender's second highest) For each die that is greater in this comparison, that player kills one opposing army in the battle. Defenders win ties.

In most versions of Risk, there is some sort of card

system. Players could trade in cards for armies or attempt to accomplish some secret mission as dictated by the cards for an even larger army bonus. To simplify the problem that we were approaching, we decided to omit the use of cards in our project.

## 2 Intricacies

### 2.1 In theory

The start of the game can set you up for success or failure. The player must not underestimate the importance of their choices while claiming territories.

Strategies are numerous. Watching your opponents' moves and attempting to understand what their intent is can be the key to victory. The AI that we implemented in our assessment of strategies was not advanced enough to emulate this kind of behavior. Given more time, this may have been possible through exhaustive searching. However, human intuition is more powerful than machinery when it comes to identifying deceit.

### 2.2 In practice

Representing the board internally was not too difficult. It ends up being an undirected graph.
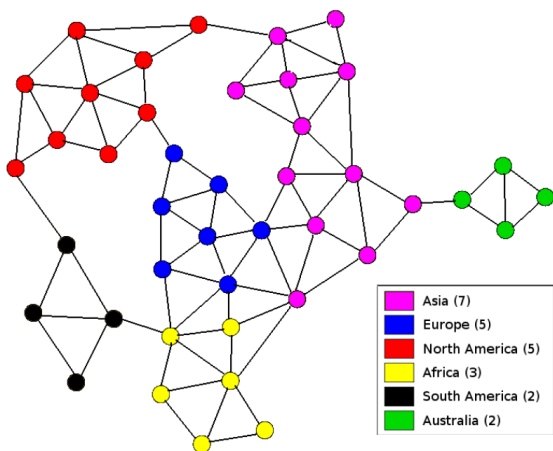


However, other parts of our design did end up taking a lot of time to conceptualize. We knew that we wanted to utilize the resources at our disposal and design a parallel algorithm. At first we thought that

perhaps there was some parallelism that we could utilize within each simulated game. In fact, there is. Each "player" or strategy could enumerate all of its possible moves and then make a decision. Nevertheless, we decided against implementing this since our primary desire was to treat a game as an atomic event and simulate each game in parallel so that we could discover at least a win/loss rate for each strategy. And we could not come to any conclusions with any desirable degree of confidence without getting a large enough dataset. With more time both things could have been implemented, but as it stands, we ran many games in parallel.

We took a simple object-oriented approach to designing what a strategy would be. We designed an interface that each strategy would inherit from. All strategies would have to implement five functions:

1. claim()

2. place()

3. attack()

4. defend()

5. fortify()

Each function mirrors one of the stages of the game.

We would then run a game loop containing several strategies and we would pit them against each other to see which ones win out. In order for a strategy to make good decisions, we had to give it information about the board. We would have the game loop send a GameState object to each strategy when it called each of their functions. One option we had here was to add internal state to each of the strategies. Such state would be used for watching other players' tactics to try to counter them or to keep track of previous moves. To some degree or another, we did utilize this internal state. However, such use was perfunctory since getting a strategy to make intelligent decisions based on the game state alone was a significant challenge.

[4]

# 3  Type of Strategies

## 3.1  Bad Strategy

In order to test our code and make sure everything was working, of course we had to make a very simple strategy. This strategy takes the first available location it finds while claiming, always attacks a set number of times per turn (or less), and generally does other mindless things. This strategy should lose to every other strategy except maybe the pacifist.

## 3.2  Immediate Best Value

This strategy weighs its decisions locally and chooses what it deems to be of the highest value. When considering where to attack, it uses this equation:

$$V = x_1 T/B + x_2 N$$

T represents the troop bonus. B is the number of exposed borders. N is the number of neighboring regions. X is a scaling factor that determines how stable/expansive the strategy will be.

## 3.3  Smallest Continent first

A popular strategy where the player looks to claim either Australia or South America since they are easier to defend due to the limited number of paths into and out of them. It is easy to build up forces as there are only four territories to maintain and the troop bonus is advantageous. This strategy places troops on edges of its continents or near continents desired for conquering.

## 3.4  Continents First

This player strategically seeks to claim each continent and doesn't branch out unless a continent can be claimed. This playstyle is defensive.

## 3.5  Territory First

This player aims to prevent others from claiming continents by securing territories. This playstyle is aggressive.

## 3.6  Prey on the weak

Prey on the weak does what you'd expect. It targets the weakest bordering country. When placing, it always prefers the least-claimed continent.

## 3.7  Prey on the strong

Always attacks the owner of a continent, if possible, so that no extra points are gained. Chooses the strongest territory owned by the strongest opponent to attack, so long as two dice can still be used.

## 3.8  Pacifist

This strategy will never win, but it may perhaps outlive other strategies. It will be easy to determine if a strategy is far too aggressive by comparing it against this strategy. For example, if strategy A is knocked out of the game frequently before the pacifist strategy, then strategy A is too aggressive to be an effective strategy.

## 3.9  Human Controlled

For debugging purposes and getting a real feel for how certain strategies will play out. Matt played a quick game on a condensed map vs the smallest continents first strategy and lost. This provides evidence that the smallest continent first strategy works.

# 4  Probability of outcomes

Your understanding of probabilities can greatly help your chances of not dying early on.

Best probability is having the attacker attack a defender with only one dice.

This would be a great place to add Joseph's calculations.

# 5  Strategy Assessment

## 5.1  Generation

To test the strategies we had to generate them. They were made by creating a class that conforms to the

strategy interface described in the "Intracacies" section.

## 5.2   Simulation

Using MPI, we made a master-slave model with the master issuing matchups and the slaves simulating those games and reporting the results back to the master.
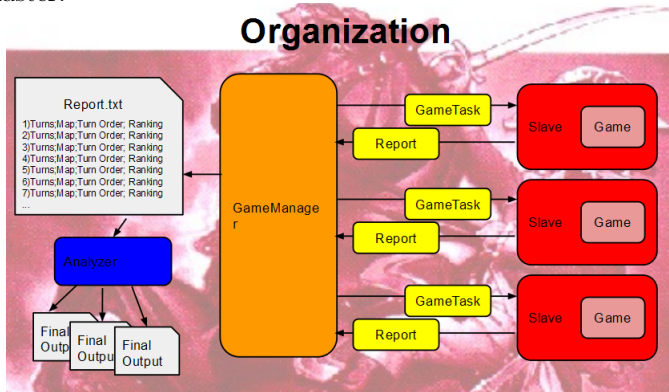


## 5.3   Statistics

These are our results

# References

[1] Sun Tzu, *The Art of War*

[2] Wikipedia contributors, "Risk (game)," Wikipedia, The Free Encyclopedia, accessed April 26, 2014, http://en.wikipedia.org/wiki/Risk_(game).

[3] Keith Veronese, "The Origins and Evolution of the Strategy Board Game RISK," last modified March 30, 2012, http://io9.com/5897532/the-origins-and-evolution-of-the-strategy-board-game-risk.

[4] Garrett Robinson, "The Strategy of Risk," accessed April 26, 2014, http://web.mit.edu/sp.268/www/risk.pdf.