When Ants Play Chess

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Approach to Strategy

- Sometimes, an overarching strategy has the downfall of minimal adaptability
- Agent based strategies (in which each agent makes its own plans) can be more adaptive to change
  - Each agent wants to satisfy its own needs
- This paper looks at multiple strategy problems from the perspective of designing agent-based algorithms
  - Pengo
  - N-Puzzle
  - Ant Simulation
  - Chess

Pengi

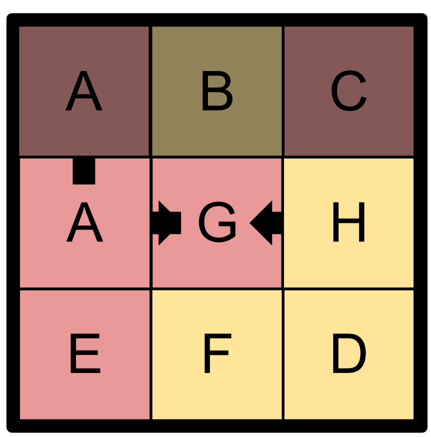
Pengi Algorithm

- Reprogram the game from scratch using agent-based strategies
- These strategies included all of the needed behavior of the game pieces and the penguin
- Through using the behaviors, the game is successfully simulated and the penguin ‘plays’ the game by itself
  - Penguin avoids adversaries and move to goals

N-Puzzle

- Used similar approach to solving Pengi
- Each tile can attack another in the path to its goal
    - That tile will either flee if it can or attack a different tile
- If a tile is in its goal position, it can lock itself
- If a tile attacks another, it can lock it from fleeing to its goal position
- Algorithm is suboptimal but very simple

N-Puzzle Corner Problem



MANTA Experiments

- MANTA is an ant colony simulation
- Ran experiments to see how often sociogenesis would occur
    - They said they wanted “to test hypotheses about the emergence of social structures from the behaviors and interactions of each individual” …but they didn’t?
- When starting a colony, a queen has to forage for food *and* take care of eggs
- Usually a colony will survive once 6 workers hatch
    - The colony will die if the queen starves before that

Simulation Results

Emergent strategy: Don’t deal with both eggs and larvae at the same time

- Closely mirrors what is observed in real ant colonies

Results	Composition	Number	%
Failures with	Eggs	4	6,15%
	Eggs, Larvae	10	15,38%
	Larvae	19	29,23%
	Eggs, Larvae, Cocoons	3	4,62%
	Larvae, Cocoons	7	10,77%
	Eggs, Cocoons	1	1,54%
	Larvae, Workers	2	3,08%
Total Number of Failures		46	70,77%
Total Number of Successes		19	29,23%
Total Number of Experiments		65	100,00%

Table 1 - Successes and Failures of the sociogeneses

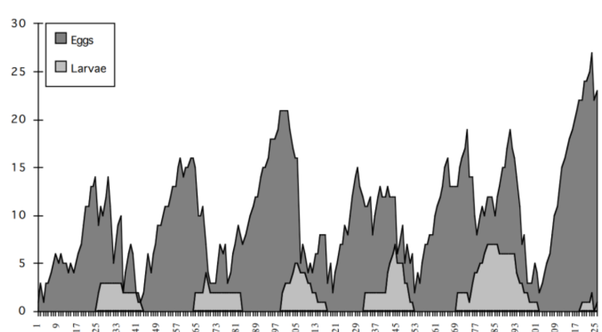


Fig 6 - Populations of eggs and larvae in colony C9

Playing Chess

Basic Rules:

- Each move a piece can make is given a value based on local information
- A random move is chosen out of the highest value moves

Evaluating Moves:

- Add (or subtract) 10 for each piece that sees the square (control of the square)
- Add the material values of all pieces that will be seen (new threats/defense)
- Subtract the piece's material value and control over the square (move risk)

Move Evaluation Example

e2 Control

- White Attackers: +40
- Black Attackers: None

Control = 40

e2 New Vision

- New Defense:  +3 +9
- New Threats: None

New Vision: +12

e2 Risk

- Relinquished Control: -10
- Material Cost: -3

Risk: -13

e2 Mark

- Control: +40
- New Vision: +12
- Risk: -13

Final Mark: 39

a6 Control

- White Attackers: +10
- Black Attacker: -10

Control = 0

a6 New Vision

- New Defense: None
- New Threats:  +1

New Vision: +1

a6 Risk

- Relinquished Control: -10
- Material Cost: -3

Risk: -13

a6 Mark

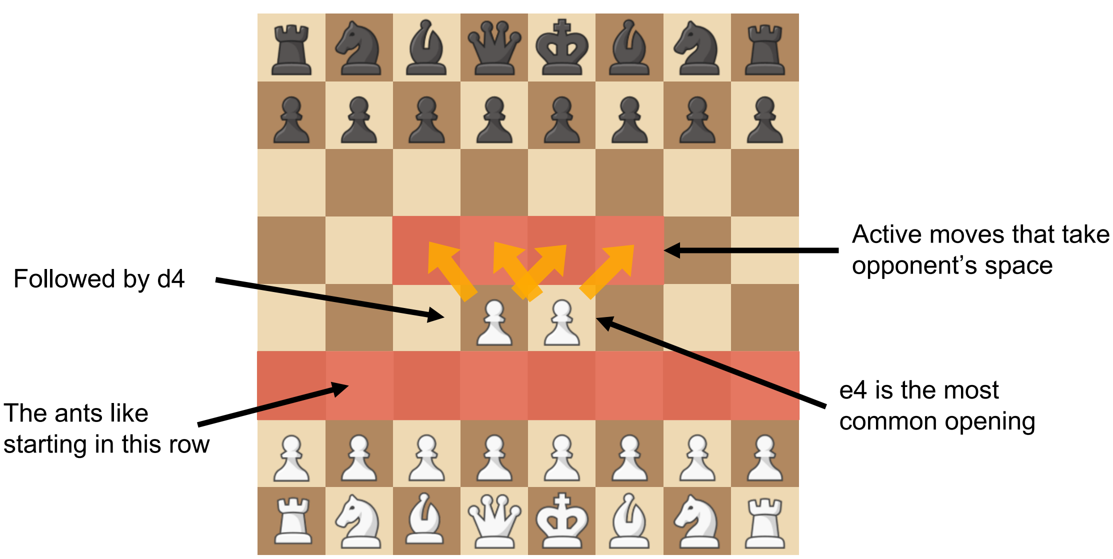
- Control: 0
- New Vision: +1
- Risk: -13

Final Mark: -12

Results

- Went 57(W) - 83(L) - 60(T) against average humans
- Struggled in the opening
  - Not enough threats to react to
- Did well towards the end
  - Came up with clever attacks
  - We think they mean the middle game, not the end game
- Likes to trade pieces
  - That's why it drew so often
- Sometimes seemed to have cohesive strategy
  - Was always short lived
- Got absolutely demolished by the GNU chess engine (first made in the 80s)
  - Couldn't establish any long term coordination

Weaknesses - Spacing



Weaknesses - Future Sight

Questions