

Introduction

- We are
- What are we going to talk about

Analysis

Analysis

- Elements of wining:
 - Build Order
 - Information Gathering
 - Macro
 - Micro
 -

Analysis

- Terran Tactics
 - Timing Attack
 - Pushing
 - Harassment
 -

Analysis

- Unit analysis
 - Marine
 - Vulture
 - Wraiths

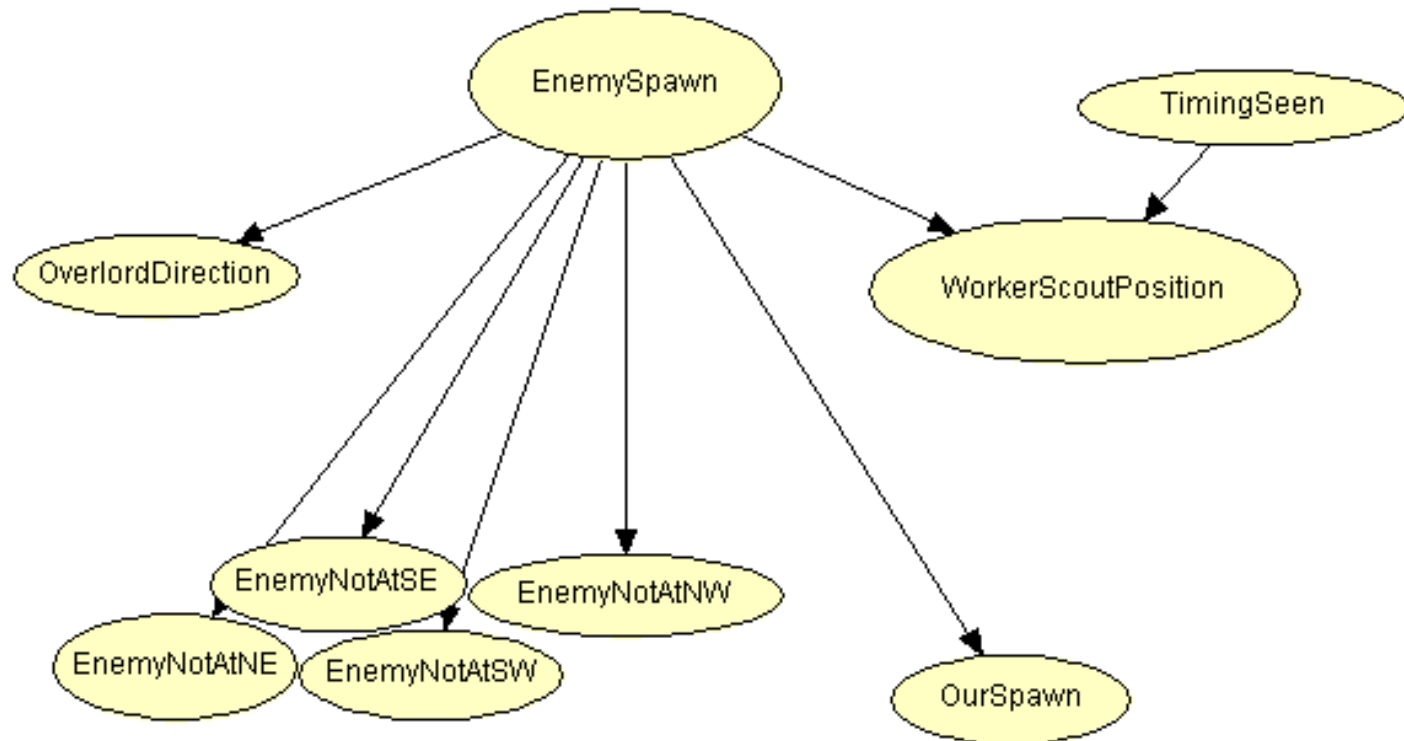
Bayesian Networks

Bayesian Network

- Choice of decision model
 - Bayesian Networks
 - Decision Trees

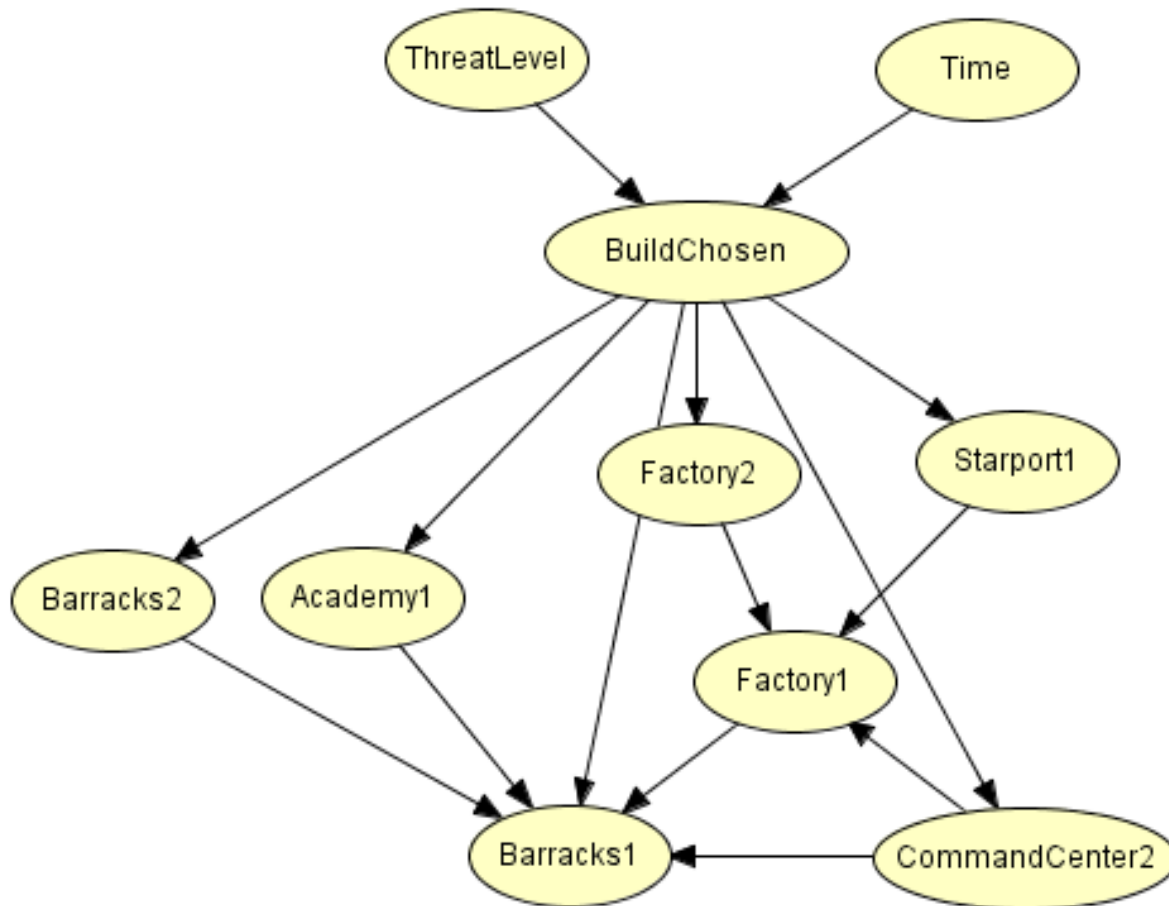
Bayesian Network

- Spawn Prediction



Bayesian Network

- Threat level prediction – tvt



Potential Fields

Potential Field In General

- Attractive behavior

$$Attractive = \begin{cases} f * c & \text{if } d > s \\ 0 & \text{else} \end{cases}$$

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-

- Repulsive behavior

$$Repulsive = \begin{cases} -f * c & \text{if } d > s \\ 0 & \text{else} \end{cases}$$

-

-

- From vector to
number

Our Potential Field Function

- Behavior is determined by + or –
- due vs de
- (2de - due)

$$\textit{MaximumDistancePositioning} = \begin{cases} f_{MDP} \times (2de - due) & \text{if } de < sr \\ 0 & \text{if } de > sr \end{cases}$$

Changed When Implementing Potential Field

- All forces are positive
- Forces are learned

Reinforcement Learning

- Generalization of Q-Learning

Environment Variables

A State is defined as the combination of all the following characteristics:

- Distance to Ally
 - Distance from Current Tile to Ally
 - Distance to Center of Squad
 - Distance from Current Tile to Center of Squad
 - Distance to Enemy
 - Distance from Current Tile to Enemy
 - Distance to Cliff or Edge
 - Distance from Current Tile to Cliff or Edge
 -
 -
- | |
|--------------------|
| Number of units |
| Health Lost |
| Damage Dealt |
| Number of Units |
| Time |
| Weapon's Cool Down |
| Shooting Range |

Reinforcement Learning

Generalization Formulas

- Q-Approximation
-
- $\hat{Q}_f = f_{MDP}(2de - due) + f_{AU}(2da - dua) + f_{EAC}(2dc - duc) + f_S(2ds - dsv) + f_{CD}(2de - due)$
- Reward

$$R(s) = C_1 numberOfUnits - C_2 healthLost + C_3 damageDealt + C_4 numberOfKills - C_5 time$$

Updating Rules

Maximum Distance Positioning

$$f_{MDP} \leftarrow f_{MDP} + \alpha[R(s) + \gamma(\max(\hat{Q}_f(a', s'))) - \hat{Q}_f(a, s)](2de - due)$$

Ally Units

$$f_{AU} \leftarrow f_{AU} + \alpha[R(s) + \gamma(\max(\hat{Q}_f(a', s'))) - \hat{Q}_f(a, s)](2da - dua)$$

Edges and Cliffs

$$f_{EAC} \leftarrow f_{EAC} + \alpha[R(s) + \gamma(\max(\hat{Q}_f(a', s'))) - \hat{Q}_f(a, s)](2dc - duc)$$

Squad

$$f_S \leftarrow f_S + \alpha[R(s) + \gamma(\max(\hat{Q}_f(a', s'))) - \hat{Q}_f(a, s)](2ds - dsv)$$

Cooldown

$$f_{CD} \leftarrow f_{CD} + \alpha[R(s) + \gamma(\max(\hat{Q}_f(a', s'))) - \hat{Q}_f(a, s)](2de - due)$$

Algorithm

- Image that i'm still doing

TEST

Building a test



Figure of StarEdit – a Starcraft BroodWar map editor

Base case

- Testing without Reinforcement learning, and potential fields

Test results from first map

| Players | Produced units | Killed units | Lost units |
|-----------------------|----------------|--------------|------------|
| Player with vultures | 5 | 9 | 5 |
| Player with Zerglings | 30 | 5 | 5 |

Test results from second map

| Players | Produced units | Killed units | Lost units |
|----------------------|----------------|--------------|------------|
| Player with vultures | 5 | 5 | 5 |
| Player with marines | 20 | 5 | 5 |

Base case

- Testing with potential fields, but not reinforcement learning

Test results from second map

| Players | Produced units | Killed units | Lost units |
|-----------------------|----------------|--------------|------------|
| Player with vultures | 5 | 30 | 0 |
| Player with Zerglings | 30 | 0 | 30 |

Test results from second map

| Players | Produced units | Killed units | Lost units |
|----------------------|----------------|--------------|------------|
| Player with vultures | 5 | 6 | 5 |
| Player with marines | 20 | 5 | 6 |

Will it converge?

- Which Alpha and Gamma values?
- How many iterations is needed?

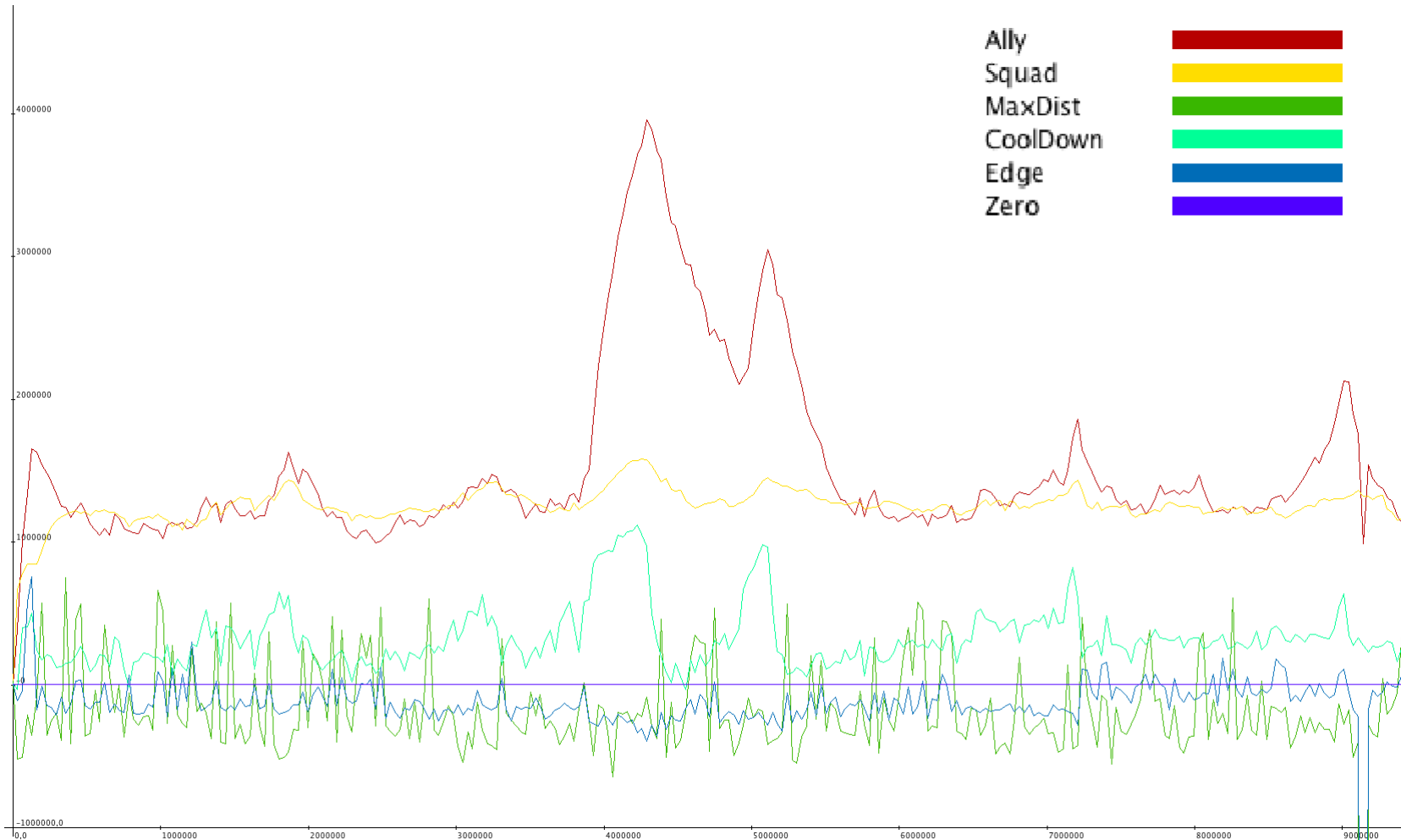
Will it converge?

- Running tests with different values



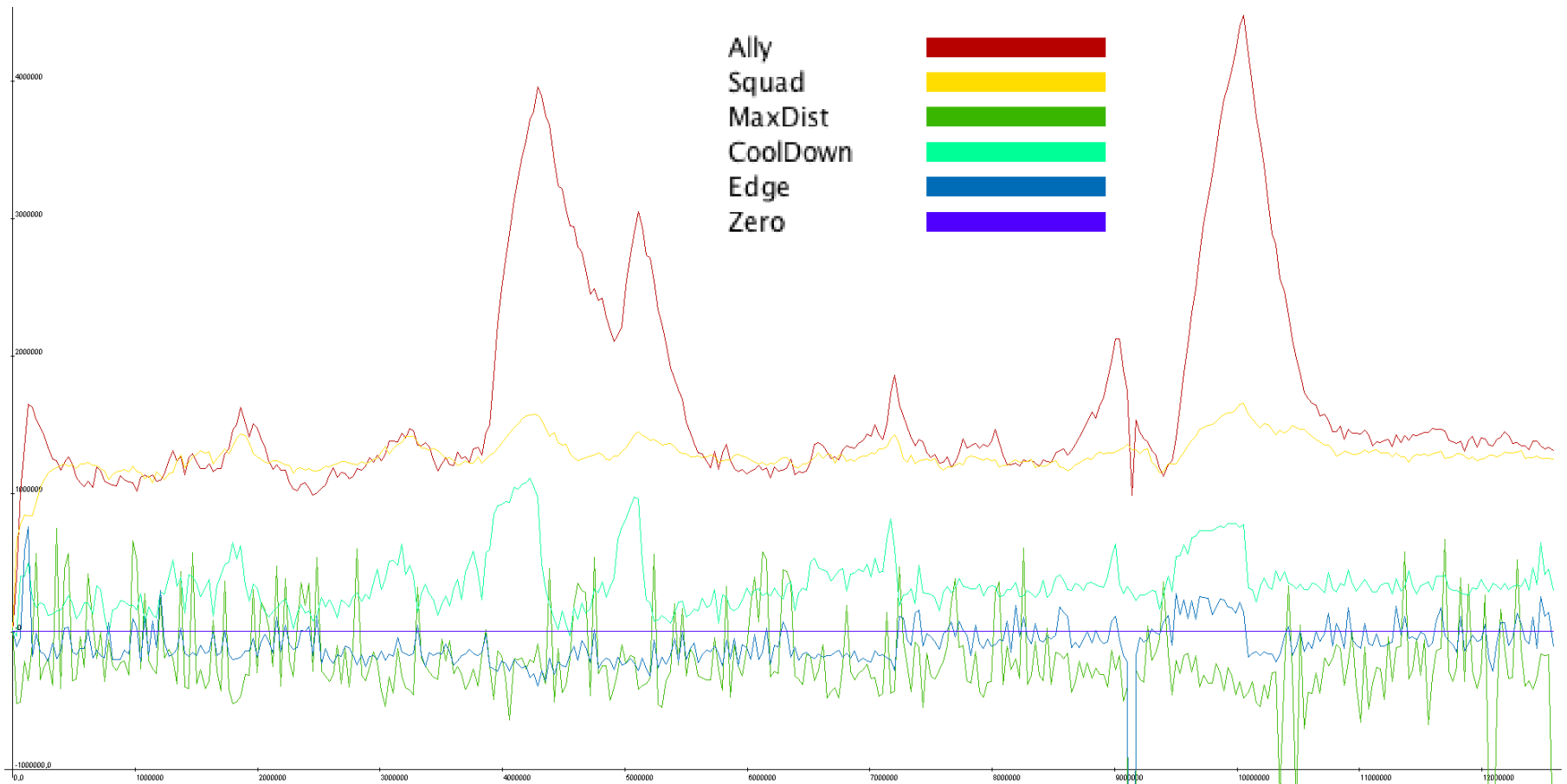
Will it converge?

- Values Alpha 0,2 and Gamma 0,9 (30852)



Will it converge?

- Values Alpha 0,4 and Gamma 0,6 (135936)



Conclusion