# EVOLVING REACTIVE MICROMANAGEMENT CONTROLLER FOR REAL-TIME STRATEGY GAMES

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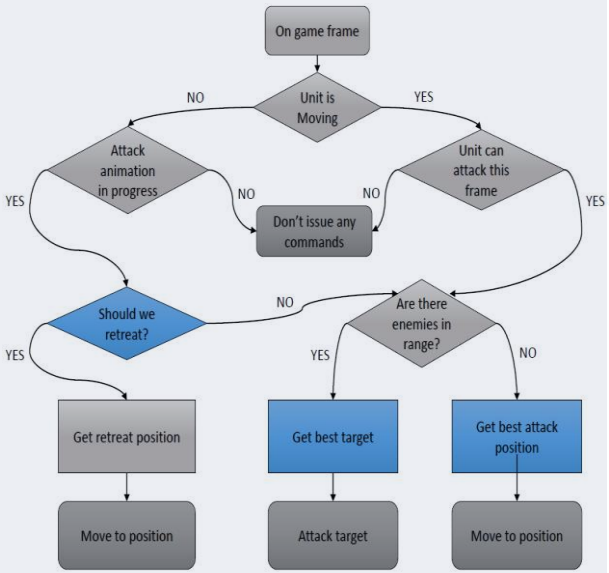
## 1. Creating the Reactive Micro-Controller




Parts of the controller using paramateres trained by Genetic Algorithms (GA) are highlighted blue:

1. Selecting an attack target
2. Selecting an attack position
3. Deciding when to retreat

These decisions are using simple functions to score the current game state. **Parameters** of these functions are **optimised** using our GA.

*1. Attack target scoring function:*

$$Score_{AT} = (D_e.p_1) - (HP_e.p_2) + (L_e.p_3)$$

*$D_e$ – **damage** of a given enemy unit*
*$HP_e$ – sum of the remaining **Hit Points and Shields***
*$L_e$ – equals 100 if the is in **lethal** danger, otherwise it equals 0*

## 2. Changing the Controller's parameters


The Controller issues specific commands to each unit, trying to optimise the army performance (micro-management).

We **implemented** and tested the solution in a classic RTS game *StarCraft: Brood War*, which was accesed using BWMirror and BWAPI.


## 3. Genetic Algorithm

Genotype:


Fitness (calculated at the end of the game):

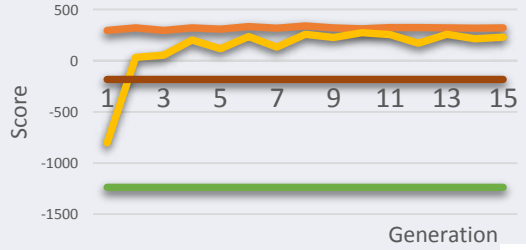
$$Score = \sum_{i=1}^{n} HP_{fi} - \sum_{j=1}^{m} HP_{ej}$$

Roulette Wheel Selection (with slight elitism), Uniform Cross-over and Uniform Mutation (10% chance) were used in our GA (population of 32 individuals).

Results:

3 scenarios with different types of enemy units were chosen for the training.

Our results were compared to the built-in AI in StarCraft and UI Alberta bot.




Interesting behavioral patterns emerged for each used scenario. Link to video:

| | Avg. Score | | | Best Score | | |
|---|---|---|---|---|---|---|
| Controller | 124.42 | 140.506 | -278.29 | 274.5 | 253.937 | -225.9 |
| Built-in AI of SC | -1239 | -384 | -97.6 | -1239 | -384 | -97.6 |
| UI Alberta | -184 | 109 | -282 | -184 | 109 | -282 |
| Scenario no. | 1st | 2nd | 3rd | 1st | 2nd | 3rd |

KEY REFERENCES

SSCAIT, Student StarCraft AI Tournament, 2015 | Linden et.al, Procedural generations of dungeons, IEEE Trans. Comp. Intell. and AI in Games, 2013 | Lin, Emergent Tactical Formation Using GA in RTS Games, Techn. and Applic. of AI, 2011, | Liu et.al., Evolving Effective Micro Behaviors in RTS, University of Nevada, 2014.