Genetic Algorithms

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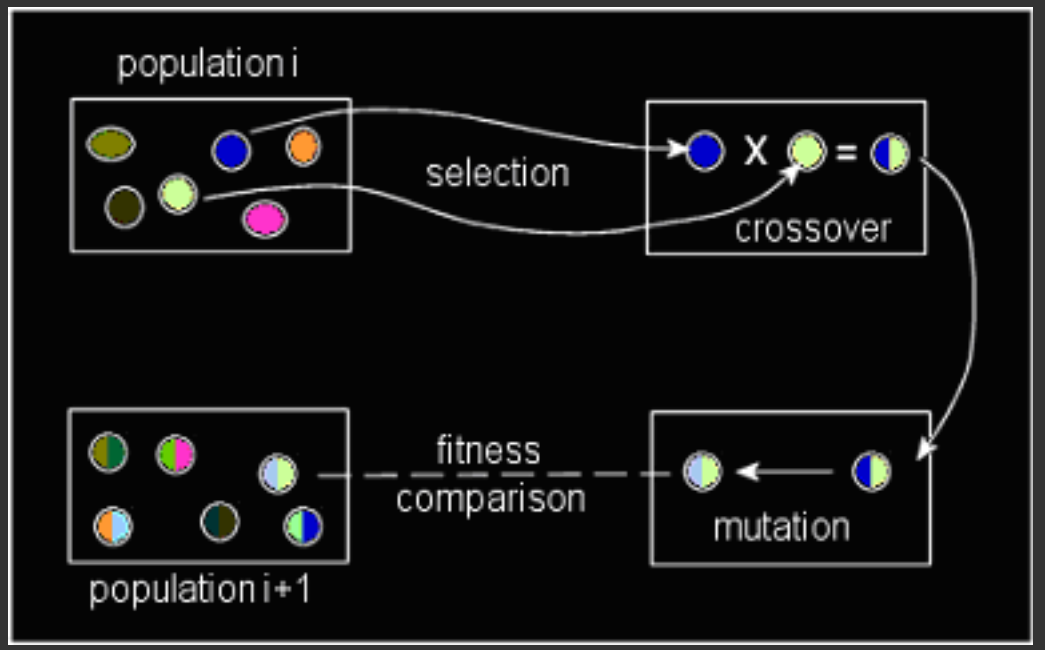
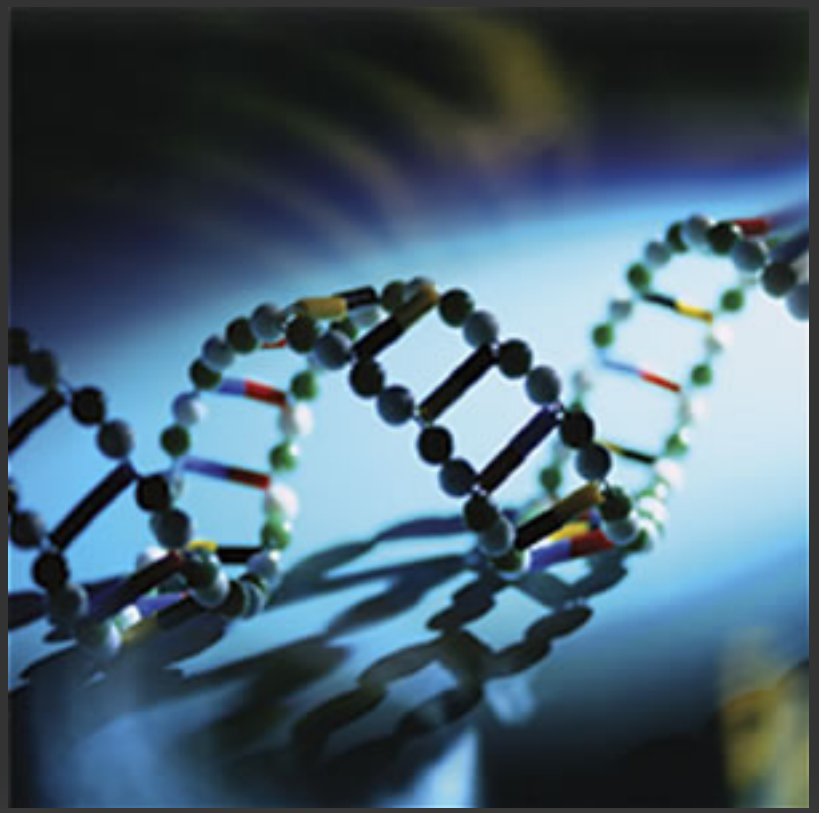
Advantages of Genetic Algorithms

- Explore unknown solutions
- Excellent backtracking
- Some systems can be highly parallelized



What Is a Genetic Agent?

- An AI created through a genetic process
  - State machines
  - Neural networks
  - Memetic algorithms



Genetic State Machines

- Commonly used for games

Example: Genetic Mario

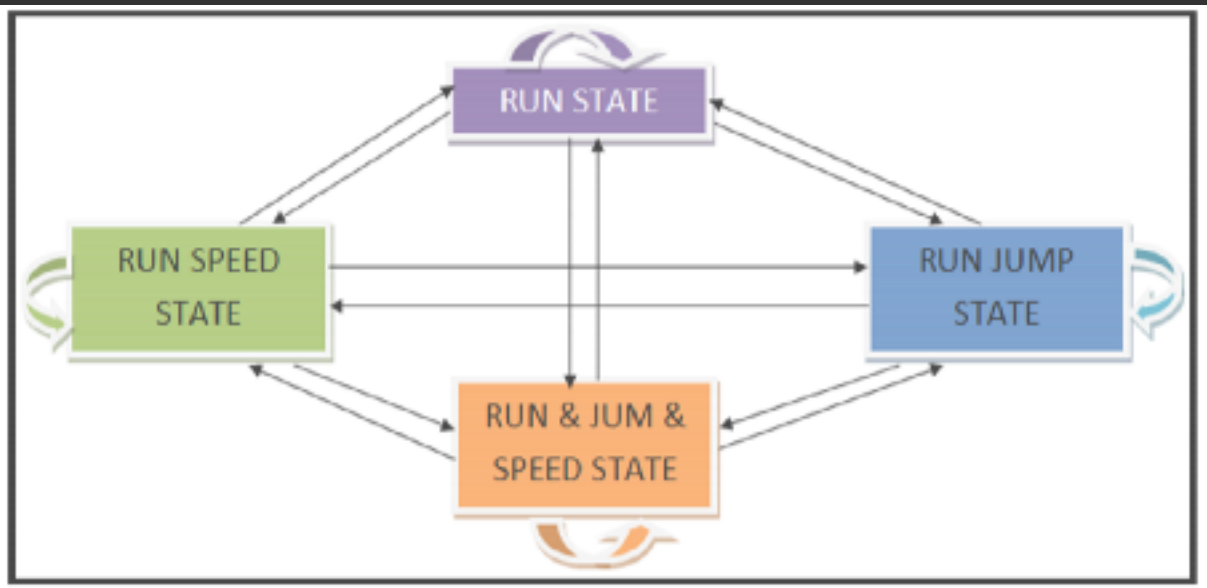


Figure 1. Finite state machine designed for Infinite Mario Bros AI

Genetic AI In Video Games: Mario

- Run State - AI agent will move forward or go to the right hand side of the game.
- Run Jump State - AI agent will move forward and jump over in any necessary condition.
- Run Speed State - AI agent perform move forward and go faster.
- Run Jump Speed State - AI Mario will perform move forward, jump and run faster actions in once.

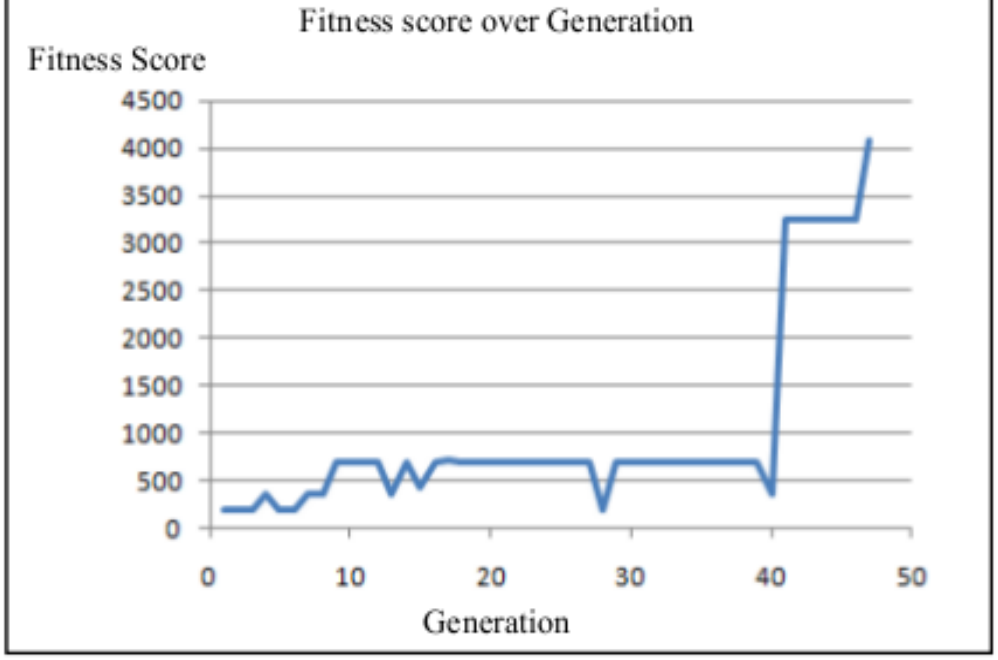
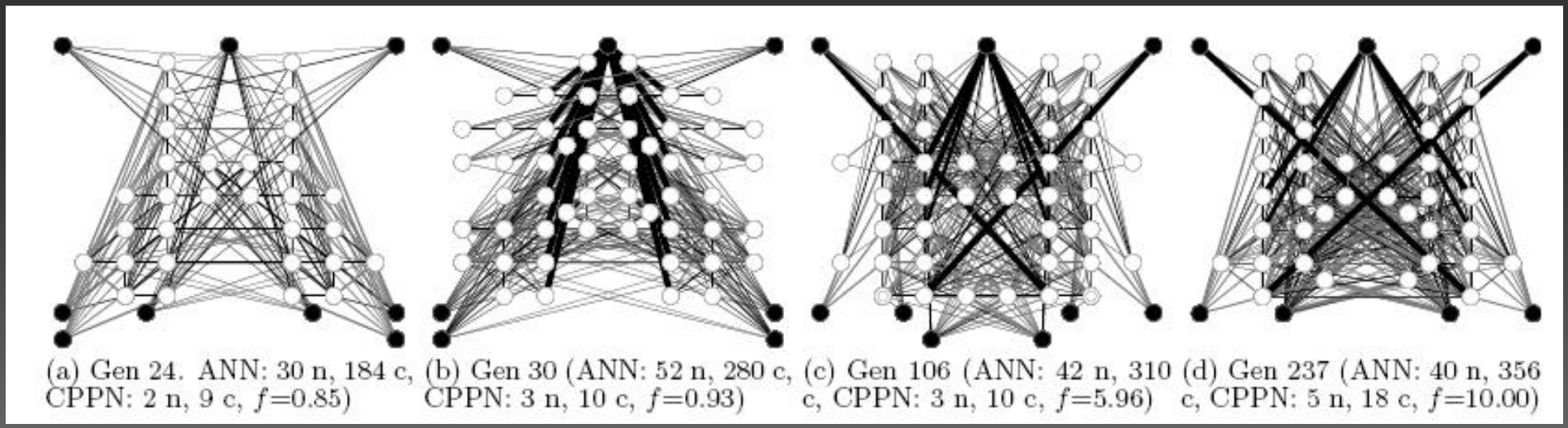


Figure 2. Fitness score generated from 60% crossover rate

Genetic Neural Networks

- Determining optimum network is difficult
- NEAT : Neural-Evolution of augmenting topologies
- rtNEAT
- HyperNEAT

- Examples
  - NEAT Mario
  - NERO
  - Galactic Arms Race
  - Robocode



(a) Gen 24. ANN: 30 n, 184 c, CPPN: 2 n, 9 c, f=0.85)

(b) Gen 30 (ANN: 52 n, 280 c, CPPN: 3 n, 10 c, f=0.93)

(c) Gen 106 (ANN: 42 n, 310 c, CPPN: 3 n, 10 c, f=5.96)

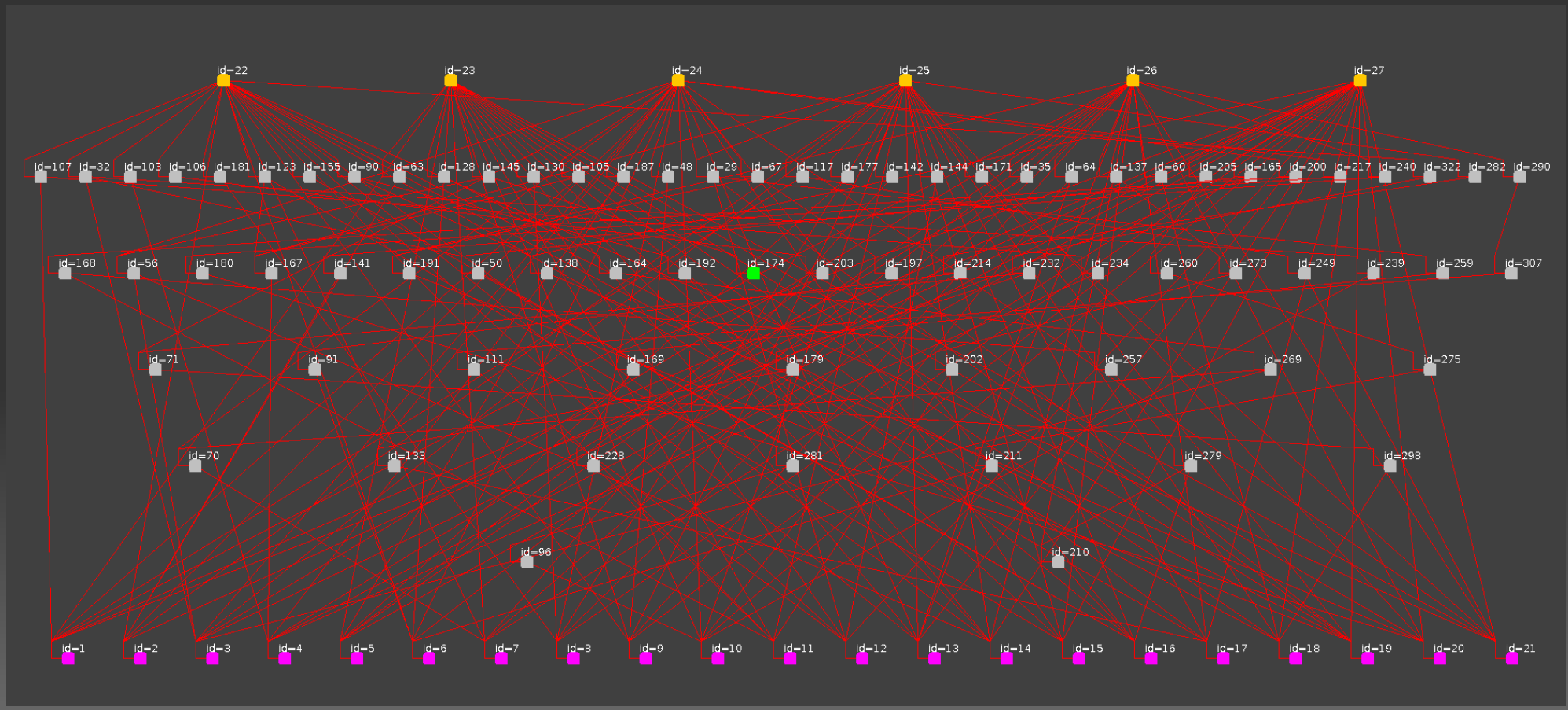
(d) Gen 237 (ANN: 40 n, 356 c, CPPN: 5 n, 18 c, f=10.00)

Genetic AI Experiment: Infinite Mario and NEAT

- Set up experiment running NEAT 4J
- Randomly generate Mario levels of increasing difficulty
- Spent large amount of time tweaking experiment and genetic parameters

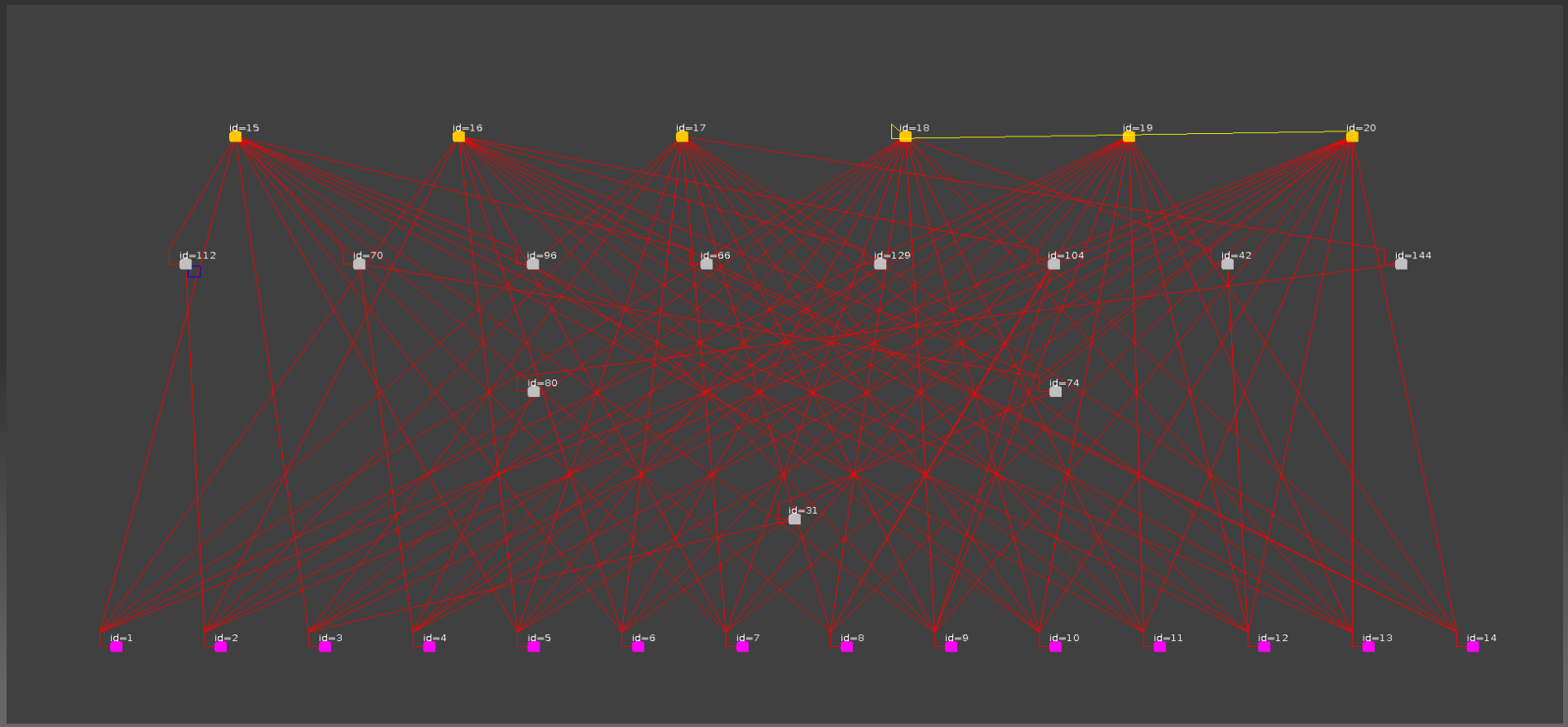
Infinite Mario and NEAT: Results

- Mario made it to level 3 difficulty (out of 11) after 500 generations
- Mario would learn easy techniques first



Infinite Mario and NEAT: Results Cont.

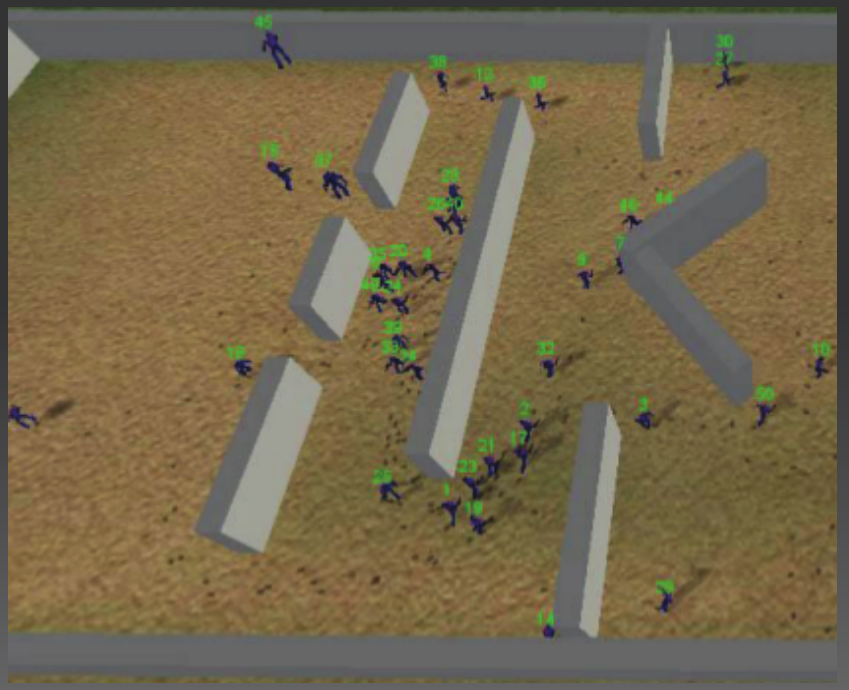
- Mario had problems with too many inputs
- NEAT wouldn't save
- Java took too long for large nets with recurrent links
- Somewhat useless heuristics for Mario



NERO

Neuro-Evolving Robotic Operatives

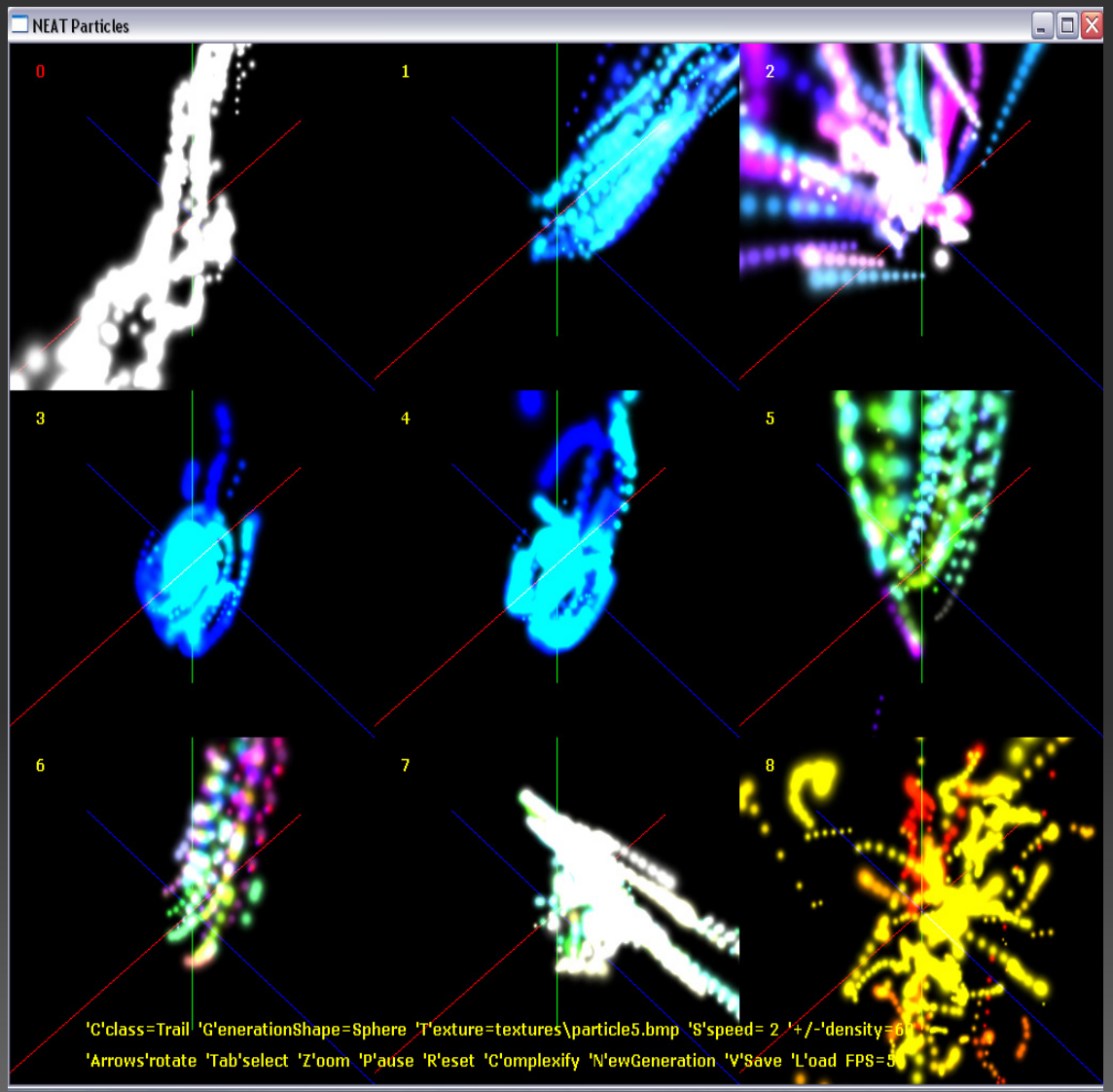
- rtNEAT
- Capture the flag type game
- Users can see adaptations in real time



Galactic Arms Race

- 32 player game
- "Space Diablo"
- Content driven by players
- cgNEAT: content generation

Galactic Arms Race Cont.



- Each generation the weapon becomes more complex
- Neural nets drive particle generation

Robocode

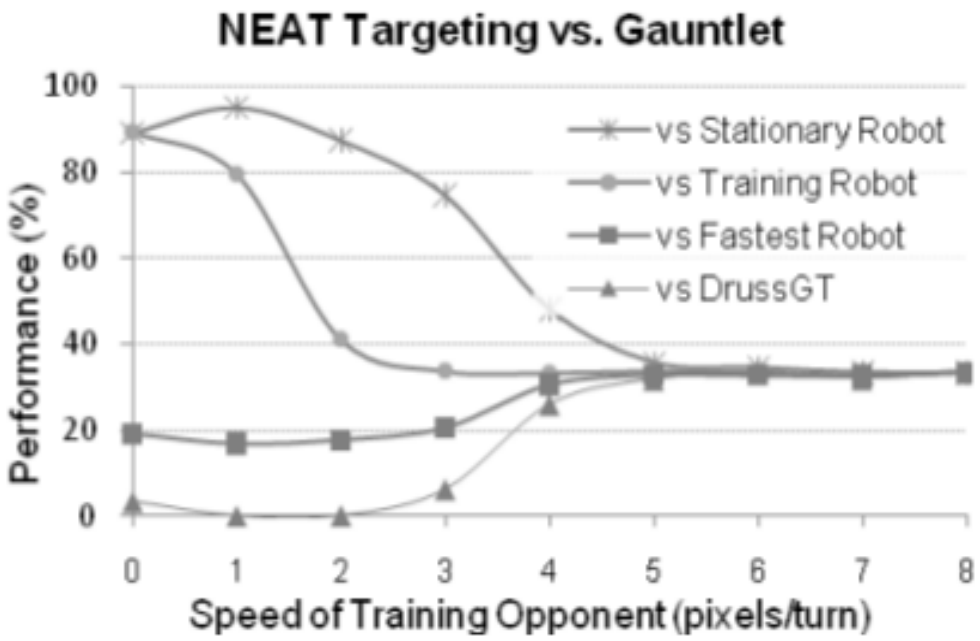
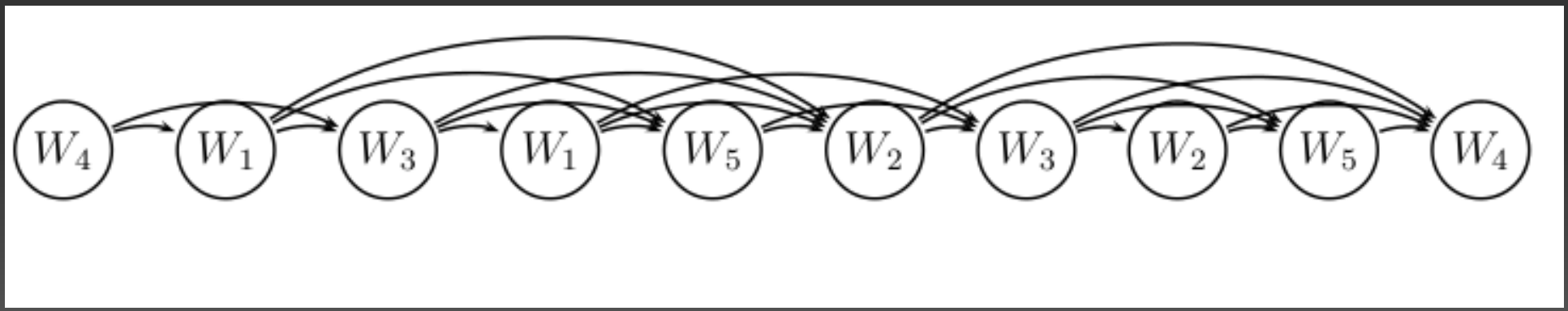


Figure 5: Performance breakdown for NEAT when trained against robots of various speeds. The performance of the developed neural networks is measured against the stationary robot, the fastest robot, DrussGT, and against the training opponent used to develop the network.

- Ran Gauntlet runs
- placed robot in the center
- Findings
  - NEAT performed well in targeting and scanning
  - Took extensive training period
  - Overfitting occurred

Memetic Algorithm

- Memetic algorithm
  - Genetic algorithm paired with a local search
- Used in solving the generalized traveling salesman algorithm
  - Shortest Tour algorithm



Sources / Questions

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