Optimal flocking of boids using a genetic algorithm

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Boids [Reynolds, 1987]

- Artificial Life program
- Used to simulate flocking
- Simple behavior rules

Figure: From `http://www.columbia-audubon.org/birds-in-big-numbers-flocks-of-blackbirds-and-starlings/`

Boid rules

Separation

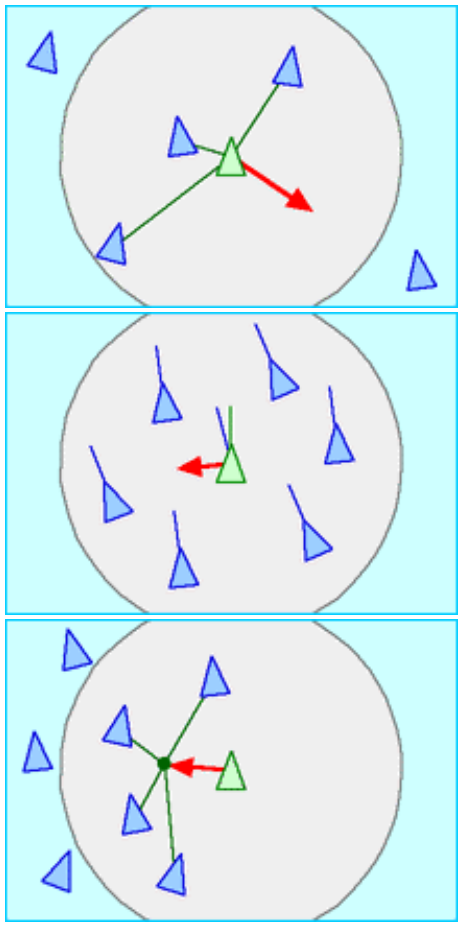
Boids steer away from each other when too close, to avoid crashing into each other.

Alignment

Steer towards the average heading of local flockmates, aligning their directions.

Cohesion

Steer towards the average position of local flockmates.



Additions: Predators and boid removal

- Predators: chase nearest prey boid
- Prey boids are removed if a predator gets sufficiently close
- Predators flee if too many prey boids in close proximity

Computing the force

- The force on a boid is a weighted sum of the steering forces:

$$\text{force} = c_1 \times \text{Separation} + c_2 \times \text{Alignment} + c_3 \times \text{Cohesion}$$

- Chromosome of i-th boid:

$$\mathbf{c^{(i)}} = \begin{bmatrix} c_1 & c_2 & c_3 \end{bmatrix}$$

This project

- Goal: Find design (set of boid coefficients $\mathbf{x} = \{c^{(i)}\}_{i=1}^{N}$) that minimizes the number of deceased prey boids.
- This will be done using a genetic algorithm. For each generation, real-valued crossover is performed on the survivors to form the next generation. Mutation is added in the form of $\mathcal{N}(0, \sigma^2)$ noise.
- Hypothesis: Over many generations, the algorithm will find good parameters for flocking.

References

Reynolds, C. W. (1987)

Flocks, Herds, and Schools: A Distributed Behavioral Model, in Computer Graphics

21(4) (*SIGGRAPH '87 Conference Proceedings*) pages 25-34.