IMGD 3000 - Technical Game Development I: Intro to AI in Games, Part 2

by

Robert W. Lindeman

gogo@wpi.edu

Motivation

- Particle systems can add nice realism to an environment
  - Fairly simplistic "rules"
  - No collision detection
- NPCs can be implemented in a similar fashion
  - Complex behavior ⇒ more-complex rules
  - Combination of "standard" and special purpose algorithms

Sample Uses of AI in Games (recap)

- □ Bad guys guarding something
- □ Bad guys looking for you
- □ Bad guys trying to beat you to something
- □ Bad guys trying to beat you (literally)
- □ Good guys working with you
- □ Other people just minding their own business

Flocks, Herds, and Schools

- A ***flock*** consists of a group of discrete ***boids*** moving in a visually complex fashion.
- There appears to be some central control, but evidence indicates that the motion is just the aggregate result of individual object motions.
- Problem
  - How do we simulate the motions of a flock in games?

Behavioral Systems

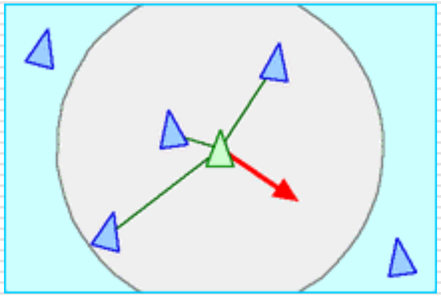
- □ Special instance of particle systems
- □ **Flock** is a group of objects that exhibit the general class of polarized (aligned), non-colliding, aggregate motion.
- □ **Boid** is a simulated bird-like object, *i.e.*, it exhibits this type of behavior. It can be a fish, dinosaur, *etc.*
- □ Allow each object to determine its own behavior

General Approach

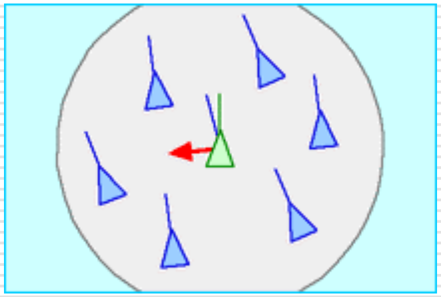
- Each boid maintains
  - An internal state
  - A set of behaviors
- Fits very nicely into a C++ (Java, etc.) **class**
  - Each boid is an instance of this class
- Three main behavioral rules
  - Separation
  - Alignment
  - Cohesion

Three Rules

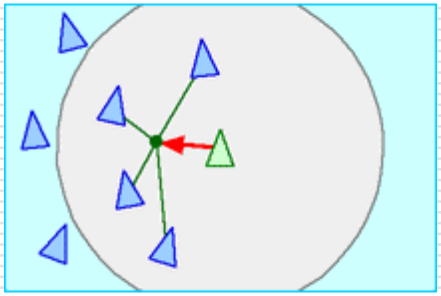
- Separation
  - Steer to avoid crowding local flockmates



- Alignment
  - Steer towards the average heading of local flockmates



- Cohesion
  - Steer to move toward the average position of flockmates

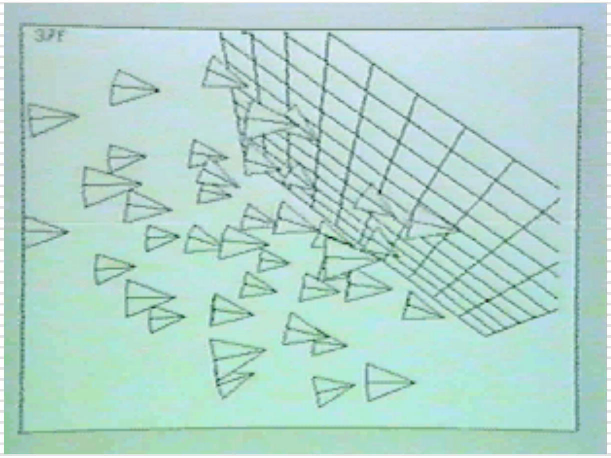


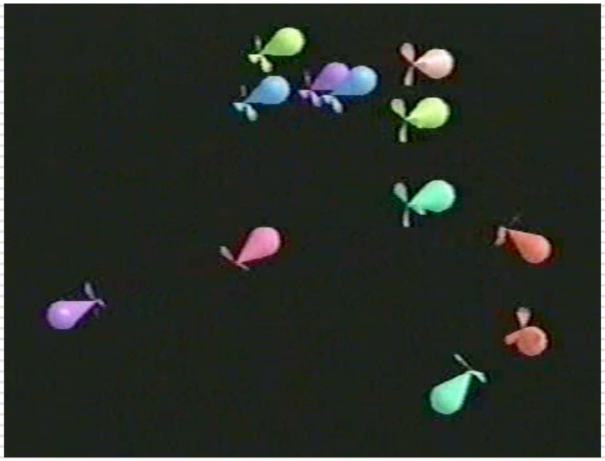
Three Rules, Restated

- Avoid collisions with neighbors and obstacles
- Attempt to match velocity (speed and direction) of neighbors
- Attempt to stay close to neighbors
- These are not orthogonal
  - Collision avoidance helps establish a minimum distance to neighbors
  - Velocity matching maintains it

Boid Brain

- □ Each boid has access to whole scene
- □ Each one only considers flockmates in neighborhood
  - Typically defined using a radius
  - Think of fish in murky water, birds in fog



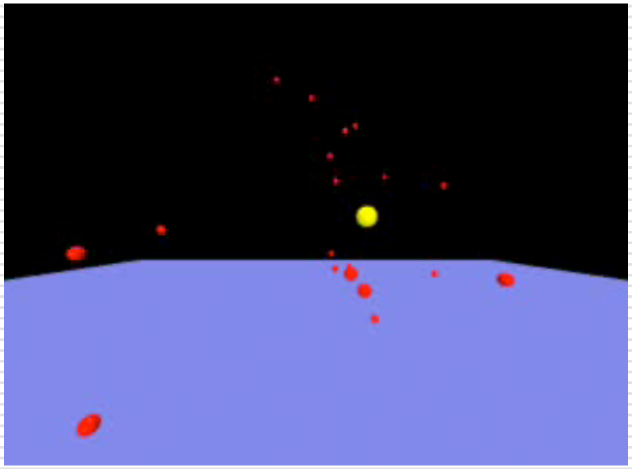


More Rules?

□ What else could you do with this?

More Rules?

- □ Seek and flee
  - ■ Food vs. Food?
- □ Pursue and Evade
- □ Wander
- □ Arrival
- □ Containment
- □ Wall following
- □ Path following
- □ Leader following



Problems with Behavioral Techniques

- Trade control for automation
  - Difficult to get ***exact*** desired effect
- Solution: Follow the leader
  - How to define leader
- Solution: Use only for background
  - Use something else for foreground characters
- Need to consider ***every*** boid
  - O(n^2) complexity!
  - How can we fix this?

Behavioral Systems: Examples

- □ Bats and penguins in *Batman Returns*
- □ All battle scenes in *Lord of the Rings*
- □ Most battle scenes in *Star Wars*

- □ Add some stochastic behaviors in order to deter uniformity

References

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