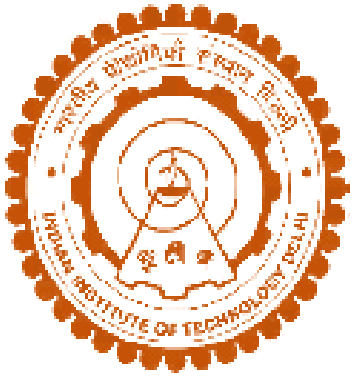
Indian Institute of Technology, Delhi

Design Practices in Computer Science

COP290

Starling Simulation



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Department of Computer Science and Engineering
Indian Institute of Technology, Delhi

Authors :
Udit Jain
(2016CS10327)
Shashank Goel
(2016CS10332)

Supervisor :
Prof. Subhashish Bannerjee

ABSTRACT

We are going to design and implement a Starling Simulation that will help us understand the Flocking behaviour of birds. Computer Science term for this simulation is Boids.

The simulation software will have the following functionalities:

1. We will be able to interactively input or read from a file :
   - Degree of Seperation, Cohesion, Alignment.
   - Speed of boids .
2. We can interactively add / remove *boids and obstacles* based on combination of inputs from keyboard and mouse.
3. Get the color of boids based by grouping on speed, flock, direction .
4. Calcuate and display average Velocity and Accleration vector of boid groups and global flock dynamically.
5. Calcuate and display average Kinetic Energy of boid groups and global flock dynamically.

Future scope of the problem may include:

1. Interactively control the Gravity Acceleration vector and see it's effect on the flock .
2. Adding and measuring the effect of Wind speed / direction and Drag on the flock .

In this design project, we shall work as observers, developers and algorithm enthusiasts to understand the ways and finding different means to approach and tackle the objectives in a more well defined mathematical way.

We shall work with full confidence and zeal to achieve the goal or reach to quite an end of the problem so that using our lemmas, proofs and knowledge, a perfect model can be implemented using a software by some other Computer Explorer. As a matter of interest, we just wish to argue that these things can be computed by our brain so we do hope to find a solution to this problem using machine learning algorithms. Since, Machine Learning algorithms are more or less based on Mathematical matrices, with the use of computer graphics, we expect to find a start with matrices that we have dealt with further in this report.

Contents

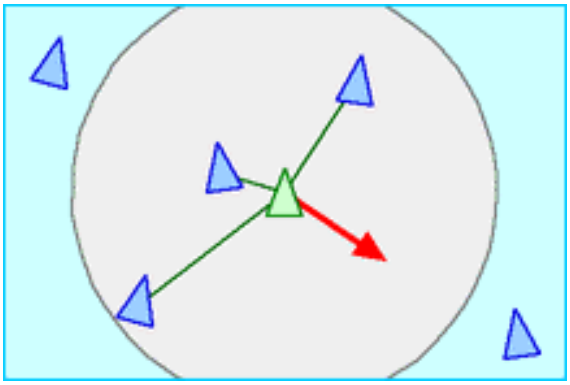
Chapter 1

Introduction

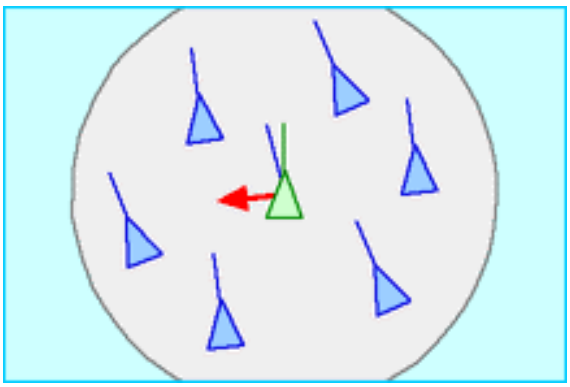
Boids is an artificial life program, developed by Craig Reynolds in 1986, which simulates the flocking behaviour of birds. His paper on this topic was published in 1987 in the proceedings of the ACM SIGGRAPH conference. The name *"boid"* corresponds to a shortened version of *"bird-oid object"*, which refers to a bird-like object.

As with most artificial life simulations, Boids is an example of emergent behavior; that is, the complexity of Boids arises from the interaction of individual agents (the boids, in this case) adhering to a set of simple rules. The rules applied in the simplest Boids world are as follows:

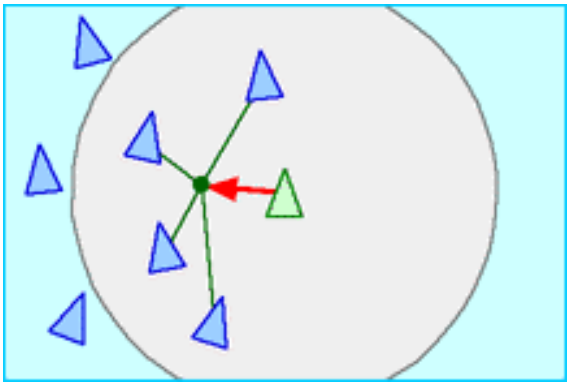
- ***Separation***: Steer to avoid crowding local flockmates.



- ***Alignment***: Steer towards the average heading of local flockmates.



- ***Cohesion***: Steer to move toward the average position (Center of Mass) of local flockmates.



More complex rules can be added, such as obstacle avoidance and goal seeking .

The following objectives are aimed to be discussed in this paper:

- Defining the problem.
- Discussing how a simulation is modeled, what are the diffrent padigrams.
- What set of rules govern bird in flocks.

- What model is to be adopted for interplay of starlings with the environment.
- What parameters can be varied to see interesting patterns.
- Intresting Obeservations on varying diffrent parameters in simulation.

Chapter 2

Defining the Problem

2.1 Introduction

2.1.1 Why do we care about bird flocking patterns ?

2.2 How do we study them ?

Chapter 3

Modelling a Simulation

3.1 Introduction

3.1.1 What's a simulation ?

3.2 Types of Simulations

3.2.1 Key Aspects