Cartesian vs. Polar in a Predator-Prey System
Computer Systems Lab 2009-2010

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June 14, 2010

1 Abstract

This project aims to use an agent-based system to model two different predator-prey systems. The first is in Cartesian x,y, the second is in Polar r,θ. From there, any differences between the predictions of the models will be ascertained.

2 Introduction/Goal

The purpose of this project is to ascertain any differences between choosing Polar coordinates or Cartesian coordinates for a predator-prey model.

3 Background

Understanding of different ways to model population and a cursory understanding of the Lotka-Volterra equations is essential to understand population modeling in general The Lotka-Volterra equations are a set of differential equations governing how population behaves when the two interact with each other. It assumes simple exponential growth/decay for each group, the predator and the prey, and adds a factor to decrease, for the prey, or increase, for the predator, the populations based on interactions between the two populations. Polar and Cartesian are the two most common ways to

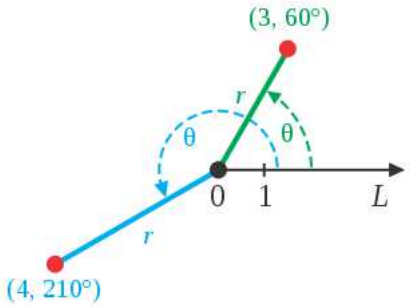

Figure 1: Some vectors in Polar Coordinates

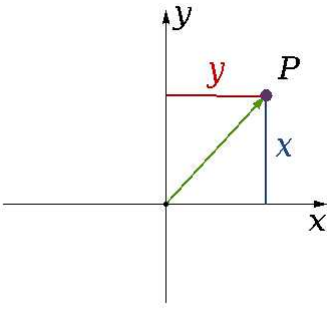

Figure 2: Cartesian Coordinates

express coordinates in two dimensions. Cartesian expresses coordinates in terms of x, horizontal distance traveled, and y, vertical distance traveled. Polar expresses coordinates in terms of r, distance from the origin, and θ, counterclockwise angle from the Polar axis, the x-axis in Cartesian.

4 Procedure

Python was be used to implement the simulations and TKinter for a graphical model. Differences, if any, between the Cartesian and Polar models will be found. Because of the way computers handle coordinates, x increases as you move right, but y increases as you move down the screen. Similarly, r

increases as you move away from the top left-corner, the origin in cartesian, and theta will increase in a clock-wise direction.

5 Results

The biggest difference discovered between the two choices was the placement of organisms. The majority of agents in the Polar program tended toward the origin while the Cartesian program had the agents in seemingly random positions. From these results, it is clear to see that Cartesian is the better choice in this case. Potentially, this could be expanded to any agent-based modeling simulation. This could also be expanded into 3D comparing Cartesian, Spherical, and Cylindrical Coordinate systems

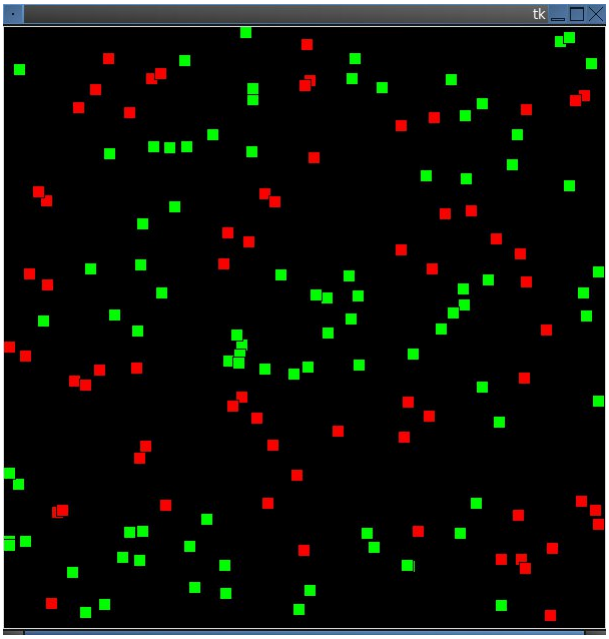

Figure 3: A picture of the Cartesian program

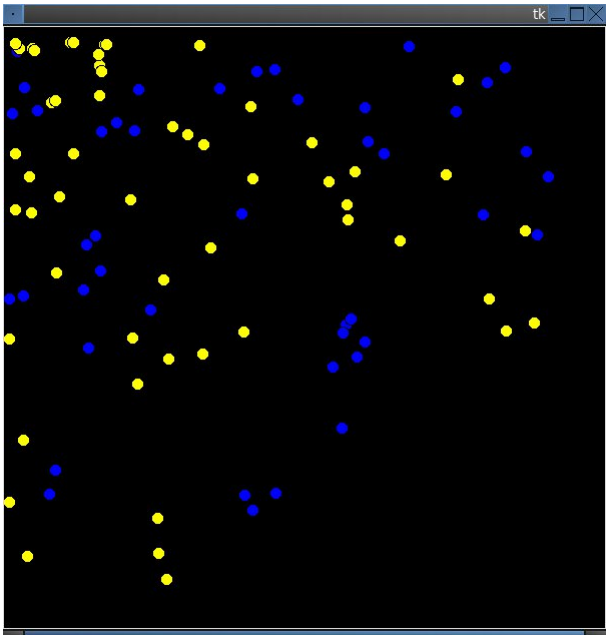

Figure 4: A picture of the Polar program