

More Monte Carlo and Linear Algebra

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Monte Carlo Review

- What is it?
 - A type of computational algorithm involving random numbers
- Why is it useful?
 - We can calculate things like Pi with it
- How is it done?
 - Generate random inputs, observe outputs, aggregate results

Monte Carlo Pi Calculation

- `srand(43234)`
- Loop for N
 - Pick 2 uniform random floats in $[0,1]$
 - Check if their magnitude is less than 1 (demo)
 - If yes, add 1 to M
- Pi is then $(M / N) * 4.0$

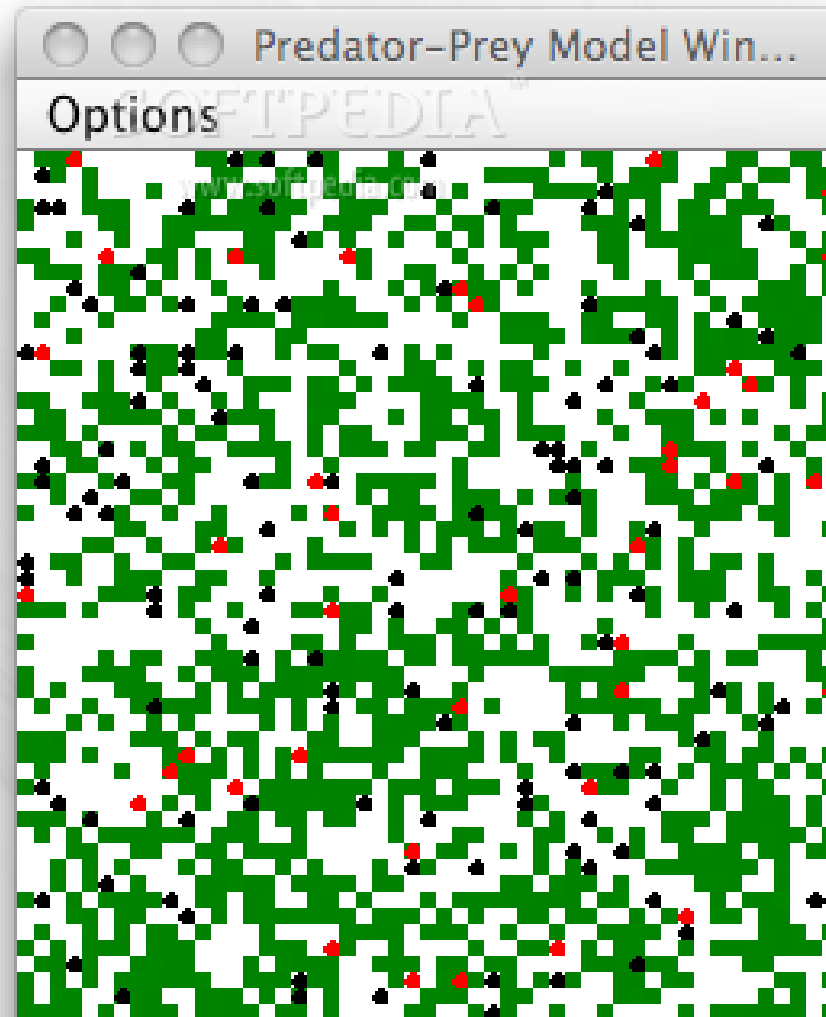
Monte Carlo Pi Calculation

- Yesterday's example:
- X, Y in $(0, 1)$
- Test if $\sqrt{x^2 + y^2} < 1.0$

Calculating chance events

- Can use Monte Carlo for picking simulation parameters
- Useful for Predator-Prey simulations
- For example, what should the chance be, of a fox catching a rabbit?

Predator-prey simulation



Predator-prey

- First approach:
 - Take all factors into account, eg. speed of animals, fitness, weather, terrain, etc.
 - Set up a complicated formula
 - Calculate if the fox catches the rabbit.

Predator-prey

- Second approach - use chance
 - The fox has a 56% chance of catching a rabbit.
 - Generate a random number in $[1, 100]$. If the number is 56 or less, then the fox catches the rabbit.
 - Very simple, does not require complicated maths
 - Modify chance until it feels right - maybe 48% or 60%
 - Produces surprisingly realistic results

Linear Algebra

- More complicated simulations need some linear algebra
- We need to know how to:
 - Make vectors
 - Calculate distances between two points
 - Calculate magnitudes
 - Manipulate vectors

Vectors

- A vector is a coordinate from a certain point
- It can be added, multiplied and manipulated like most conventional numbers
- It is easy to see what is happening, by drawing a graph.
- (rest of vectors in vector handout and on stream)