

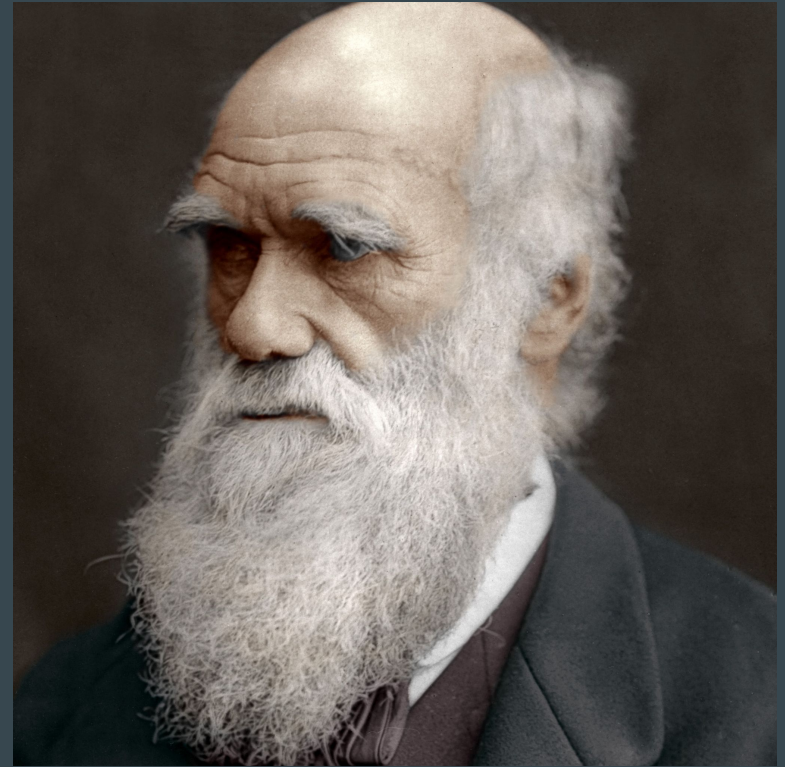
# Modeling Natural Selection and Trait Evolution using NetLogo



By Daniel Cohen-Cobos

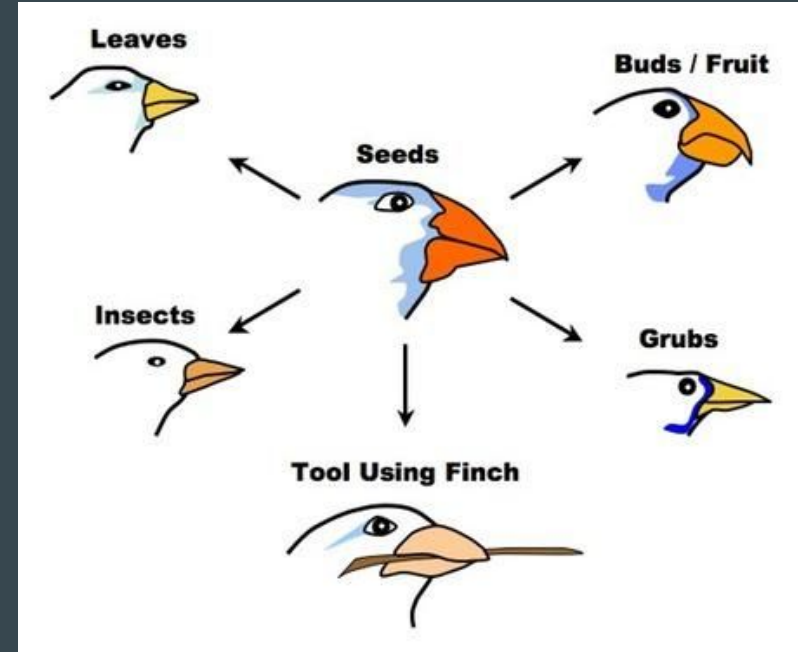
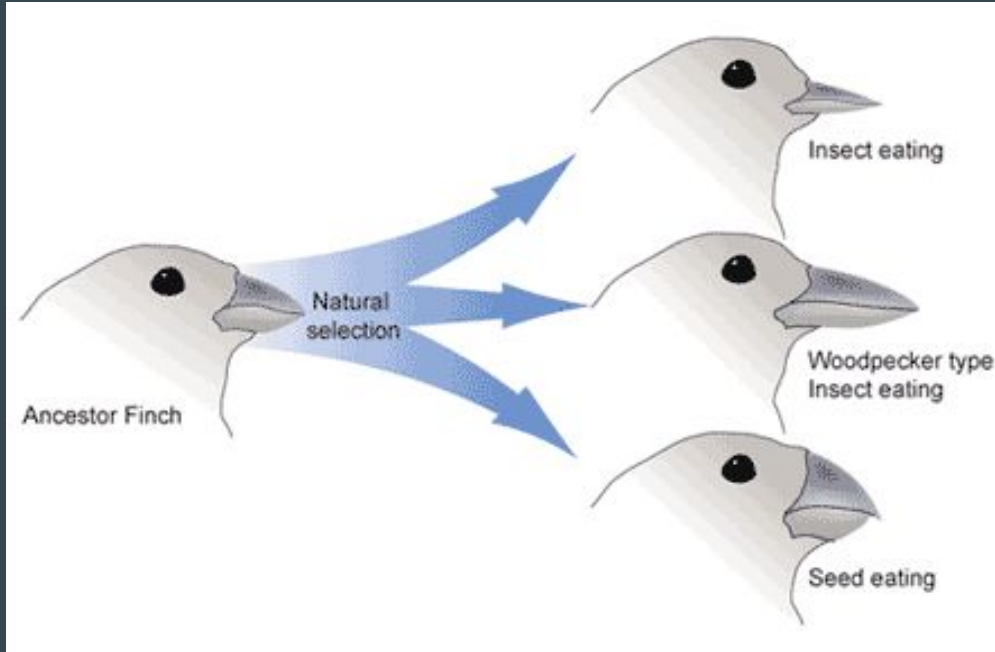
# Main Idea

- Natural Selection
- The Origin of Species



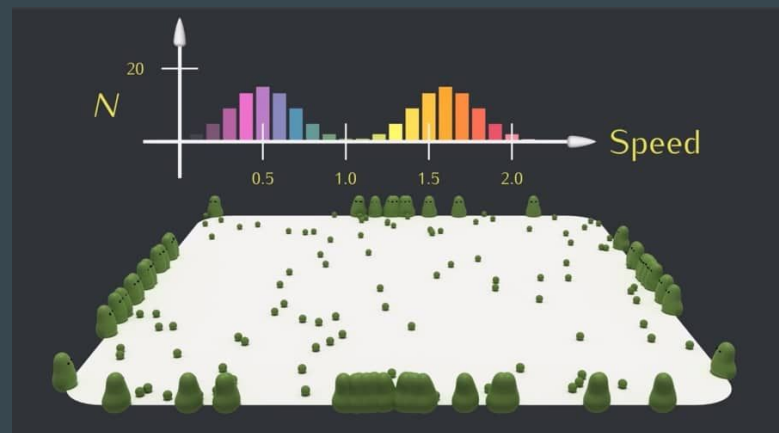
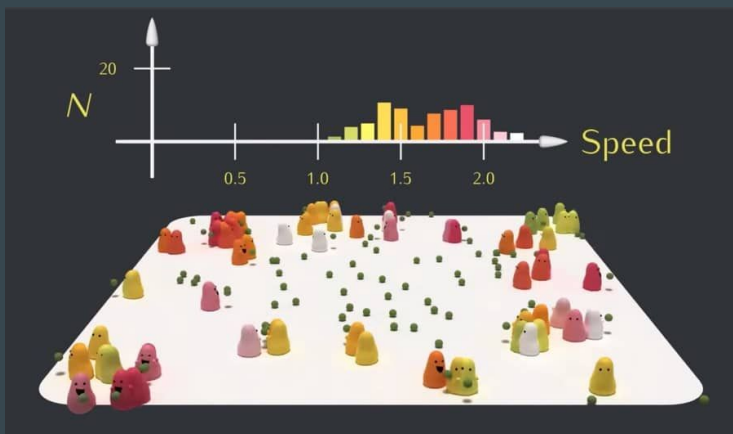
Charles Darwin (1809-1882)

# Trait Evolution



# Previous Work

Primer's Simulating Natural Selection  
Youtube video



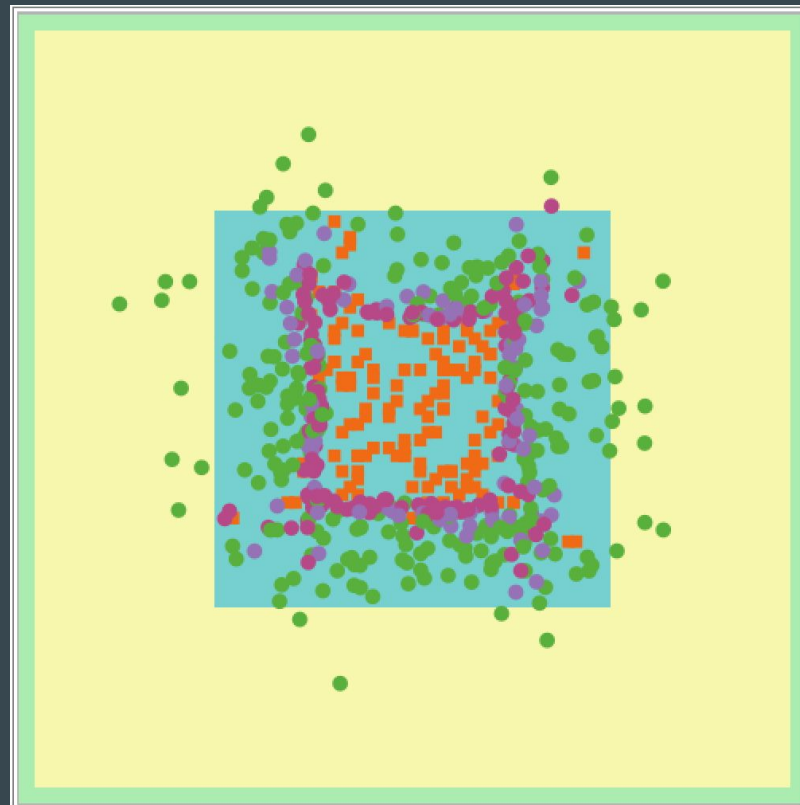
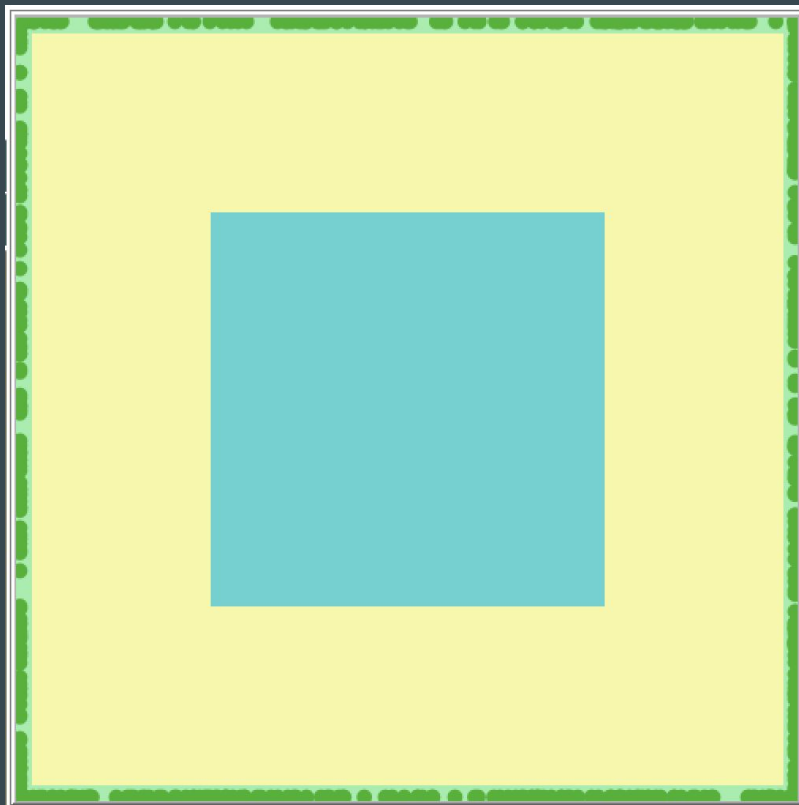
# Agent-Based Programming

NetLogo

- Turtles
- Patches
- The Observer

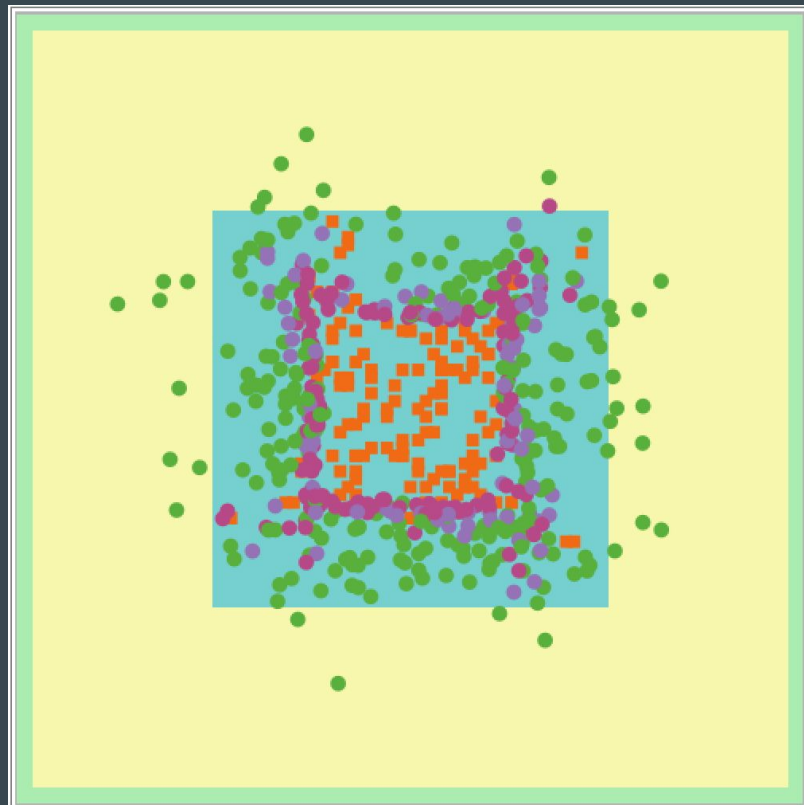


# Model



# Traits

- Speed
  - Higher speed on phase 1
  - Lower speed on phase 2
- Awareness
  - Better analysis of surroundings
  - Worse orientation
- Orientation
  - Better orientation
  - Slower move overall
- Violence
  - Ability to steal one unit of food
  - Only one unit of food



# Mathematics of Traits

Trait distribution

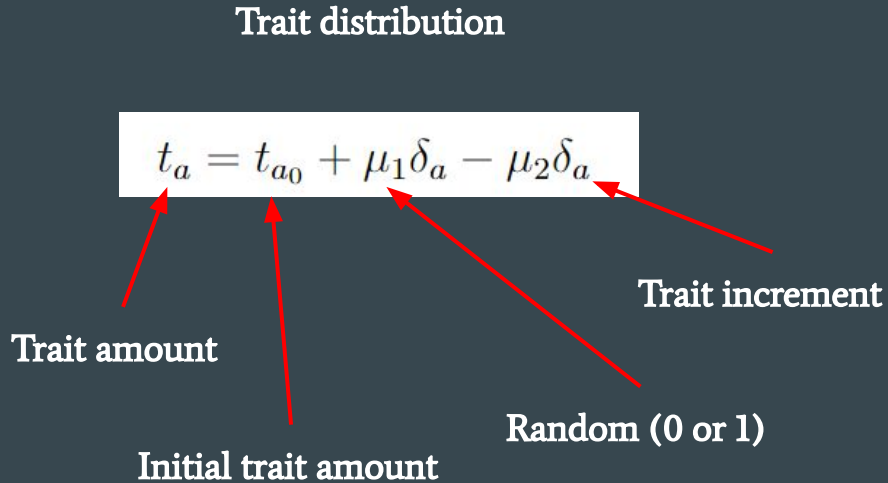
$$t_a = t_{a_0} + \mu_1 \delta_a - \mu_2 \delta_a$$

Trait amount

Initial trait amount

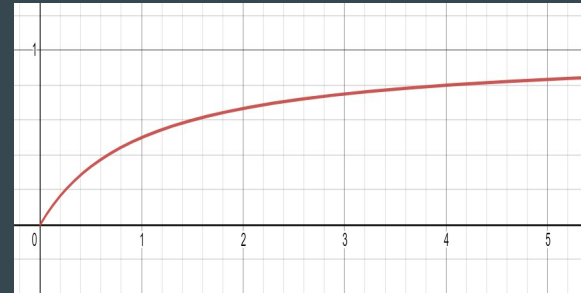
Trait increment

Random (0 or 1)

A diagram illustrating the components of the trait distribution equation. The equation  $t_a = t_{a_0} + \mu_1 \delta_a - \mu_2 \delta_a$  is shown in a white box. Four red arrows point from labels below to terms in the equation: 'Trait amount' points to  $t_a$ , 'Initial trait amount' points to  $t_{a_0}$ , 'Random (0 or 1)' points to  $\mu_1$ , and 'Trait increment' points to  $\delta_a$ .

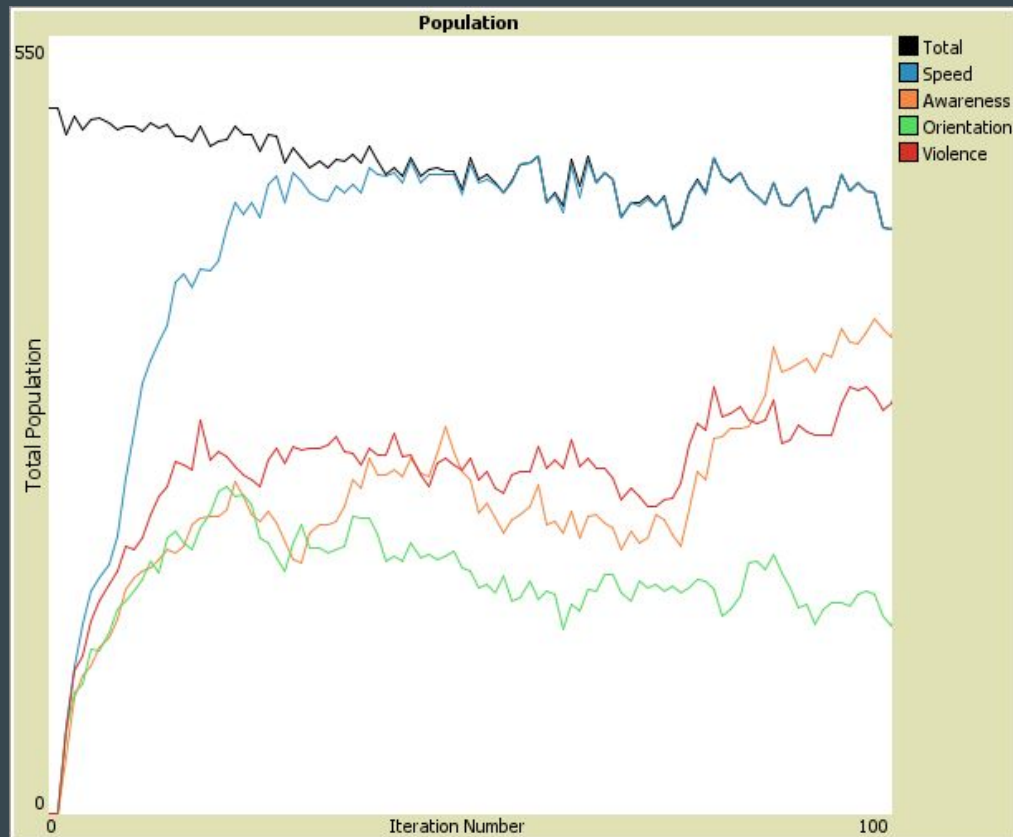
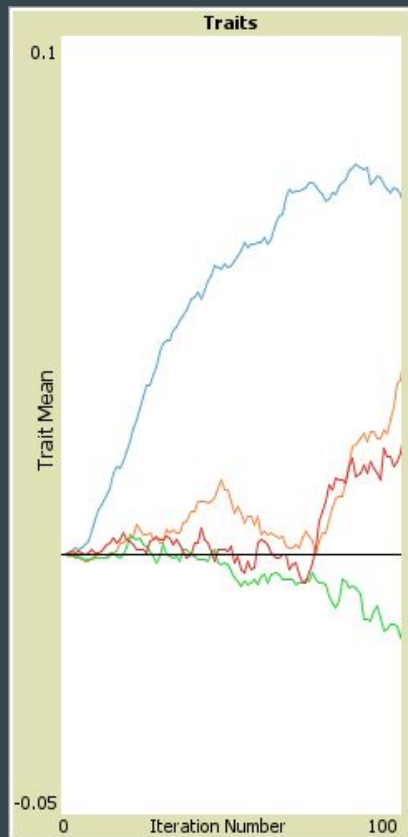
Example of violence trait probability

$$P(t_v) = \frac{t_v}{t_v + \delta_v}$$





# Output



# Presentation images taken from:

## Slide 2

- [https://www.thoughtco.com/thmb/95AqyZYnXljNdzkzRAB76REg2Bw=/3756x3756/smart/filters:no\\_upscale\(\)/CharlesDarwin-5c2c3d7e46e0fb0001a343e3.jpg](https://www.thoughtco.com/thmb/95AqyZYnXljNdzkzRAB76REg2Bw=/3756x3756/smart/filters:no_upscale()/CharlesDarwin-5c2c3d7e46e0fb0001a343e3.jpg)

## Slide 3

- [https://commondescentpodcast.files.wordpress.com/2019/03/evolution\\_sm.png?w=640](https://commondescentpodcast.files.wordpress.com/2019/03/evolution_sm.png?w=640)
- [https://media.cheggcdn.com/media/3ba/3baccdec-f9f3-4d9e-b73b-677a9792c15c/adaptive\\_radiation\\_med-148B0E820B303CAE058.jpeg](https://media.cheggcdn.com/media/3ba/3baccdec-f9f3-4d9e-b73b-677a9792c15c/adaptive_radiation_med-148B0E820B303CAE058.jpeg)

## Slide 4

- <https://i.ytimg.com/vi/0ZGbIKd0XrM/mqdefault.jpg>