Evolution simulation using a Genetic Algorithm in Unity

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Introduction & Motivation

Project Theme

- Creating a simplified Unity based simulation of the evolutionary processes found in nature

Motivation

- Visualize evolutionary adaptation in real-time
- Observe emerging survival strategies

Theoretical Background

Genetic Algorithms

- Based on natural selection principles
- Survival of the fittest

Key Mechanisms

- Selection through environmental pressure
- Random mutation of offspring
- Predator-prey relationships*

Individual Representation & Parameters

Genetic Traits:

- Speed (0.1 - 60.0)
- Size (0.5 - 6.0)
- Vision Range (1.0 - 60.0)
- Wander Time

State Variables:

- Energy Level
- Generation Number
- Behavioral State
- Current Target

Visual Representation

- Color-coded states (Red: Low Energy, Green: High Energy, Blue: Looking for mate, Pink: Hunting)
- Size scales with genetic trait
- Generation number displayed

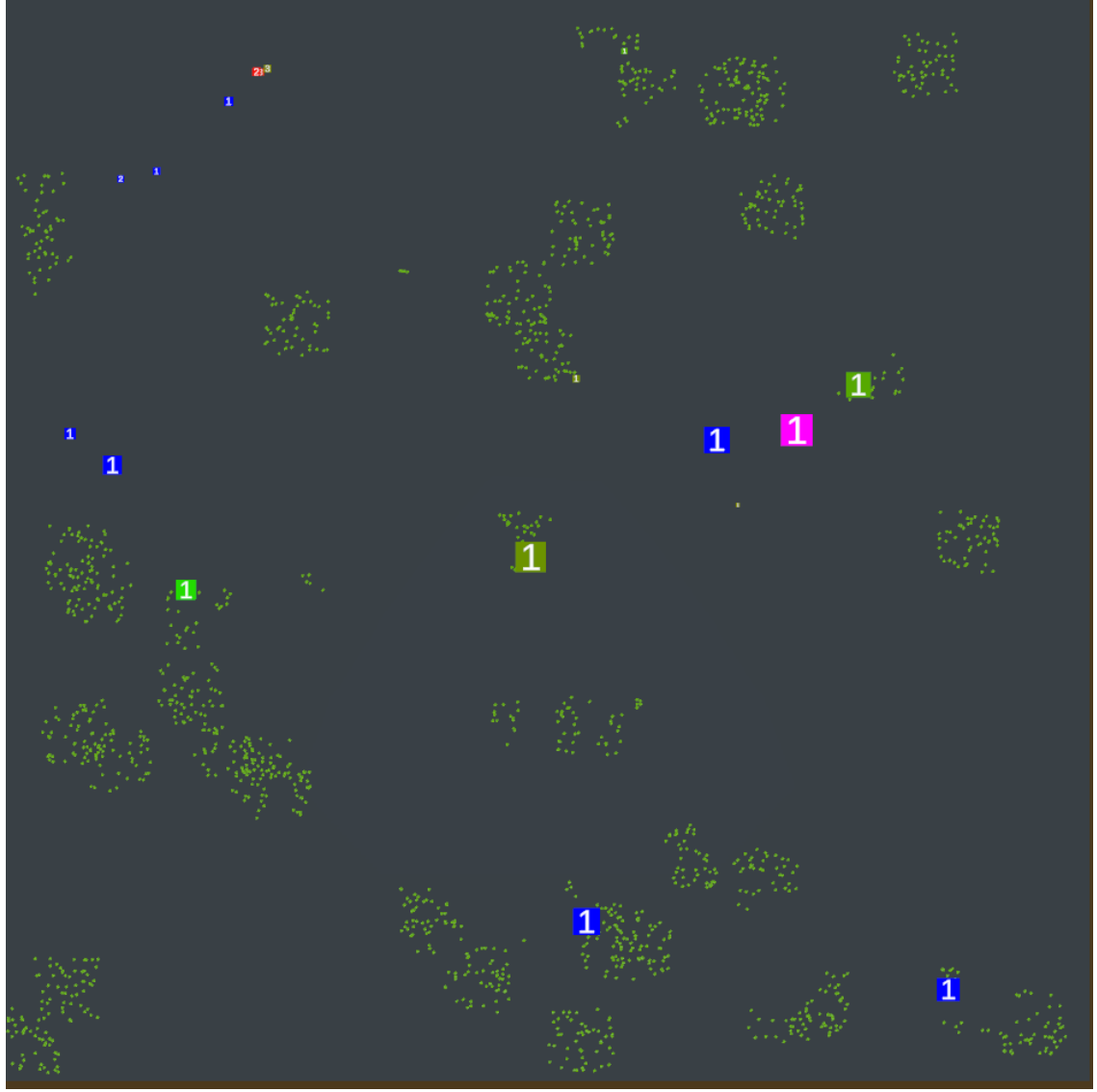

Figure: Cool Graphics

Fitness & Behavior System

Implicit Fitness Function

Energy usage (every physics update):

$$E_{usage} = E_{base} + (V_r \times M_v) + (S \times M_s) + (Sz \times M_{sz}) * Time.deltaTime$$

Behavioral Hierarchy

Priority order:

1. Flee from predators
2. Hunt prey (if energy is over a threshold)
3. Seek mates (if energy is over a threshold)
4. Move towards food (if food is detected)
5. Wander randomly

Results & Conclusions

Observed Patterns

- Low food environment - Decreased size and increased speed and vision range
- Normal food environment - Increased diversity, evolution of predators
- Abundant food environment - Even higher diversity, increased population density

Conclusions

- Real-time visualization of evolutionary processes
- Demonstrated evolution process over generations