
OFFICE OF STRATEGIC NATIONAL ALIEN PLANNING



GENETIC WORLD SIMULATOR (GWS)

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April 25, 2014

Executive Summary

The Office of Strategic National Alien Planning (OSNAP) has made a substantial investment to research alien ecological systems. The Genetic World Simulator (GWS) is an attempt to simulate an alien world with various parameters in order to discover the potential weaknesses, patterns, and systems in alien biology and ecology.

GWS simulates a flat-state world with various physical features (water level, oxygen level, heat level) and alien organisms (entities with various characteristics such as growth rate, mutation rate, offensive and defensive mechanisms) to reveal underlying patterns of alien ecology and to discover the potential growth of any alien organisms in a predetermined environment.

Project Description

Genetic World Simulator (GWS) is an expansion of Conway's Game of Life simulation by exploring theoretical alien ecology through a 2D simulation. The simulator hosts several Systems such as Weather, Growth, Mutation, Predation, Movement, and Rendering. The Systems will simulate the world based on clock-ticks and we will explore the possibilities of various alien characteristics and how it will affect the ecological system in the world. The default output will be a 2D visualization in real-time.

The clock tick rate will be user-definable, in order to speed up or slow down the rate of simulation. The user will also be able to see the growth of the ecosystem and how it will interact with the weather systems in real time. There will possibly be a "multilayer" plane that will show the ground level, "weather" level, and "growth" level (2D plot of characteristics such as growth rate, reproduction rate, etc).

The world simulator will host the various systems in the world, and will produce 2D graphical output to be viewed locally, or remotely as a stream of data (and accelerated possibly using WebGL). In the local console, we will explore using OpenGL or an abstracted graphical framework to product the output.

Highlevel Architecture

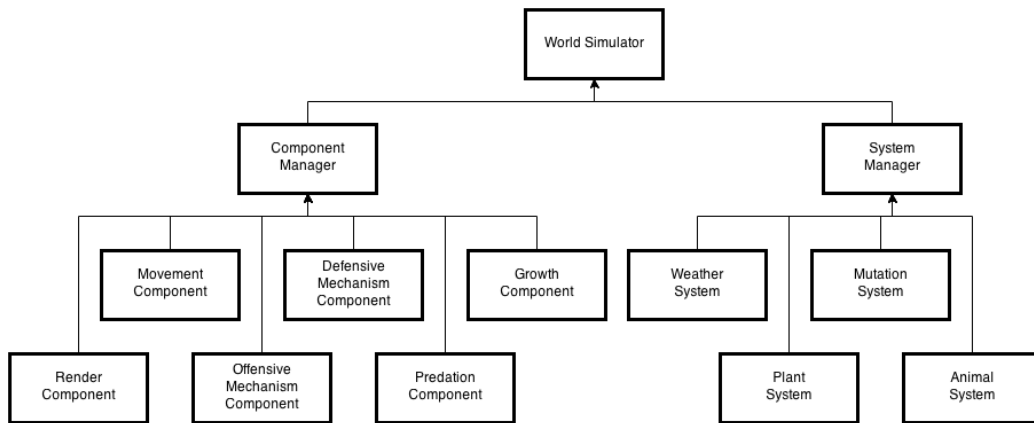


Figure 1: High Level Architecture Diagram

Figure 1 shows a block level diagram of the GWS system and its various parts.

World Simulator This is the host that will house the various Systems of the world to be simulated

Component Manager Manages the components that will make up entities (an entity is a representation of a single organism in the world).

System Manager Manages all the systems that will interact with the world. For example, the WeatherSystem will interact with the oxygen, water, and heat level in the world.

We will utilize object composition in a manner known as Entity-Component Architecture to model alien organisms (entities) in an alien environment

(made up of various Systems). Each entity is made up of different Components in order to provide room for growth and mutation. For example, a kind of alien plant might not have Movement or Offensive components (this particular alien plant cannot move), but will definitely have Growth and Mating components. On the other hand, a different alien plant might be able to move and thus will have a Movement component.

Figure 2 describes a Component system that is similar to what we will implement in our project.

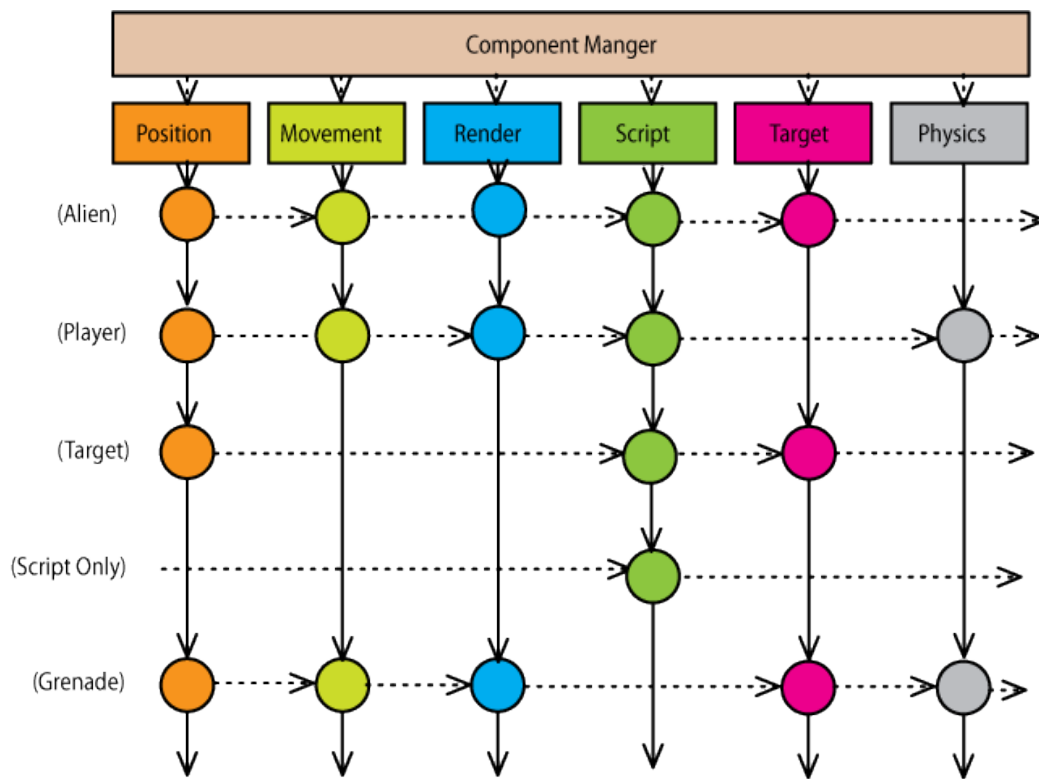


Figure 2 Object composition using components, viewed as a grid.

Figure 2: Component Diagram

Simulator

The core of the simulator is a basic ecological simulation. This N-body simulation will track organisms and systems within the world and apply various rules of growth, mutation, and predation upon entities. The simulator will expose the current location of each simulated object at regular intervals as a list of 2D cartesian coordinates and list of characteristics. This stream will be output to the screen or sent to a web browser which will interpret/display the results in a graphical manner, likely a 2D plot of pixels representing organisms.

Visualization

Visualization is a core component of the project deliverable. However we have not decided to use a local 2D output or to output the data graphically through a web browser (possibly over WebGL).

Parallel Plan

The GWS design includes several places to introduce and explore parallelism.

Task Parallelism The core simulation is run by the various Systems which can all be run in parallel, and shared data can be managed either through a rudimentary message passing mechanism or careful design to minimize shared data.

Data Parallelism All entities are made up of components which are stored in contiguous vectors which will enable vectorization of the code (instruction-level parallelism) and the use of elemental functions across components.

We plan to look at system scaling by varying the number of initial objects in the simulation and the number of systems available. We intend to look at wall clock time to complete a fixed number of simulation steps.

Project Schedule

Week	Deliverable
5	Nail down physical elements to simulate, select 2D technology
6	Basic N-body simulation with mutations, and growth
7	Basic N-body simulation with predation, movement, and weather systems
8	2D output
9	Improving parallel performance and measurement
10	Poster length presentation including measurements