Design Overview for SoNeat

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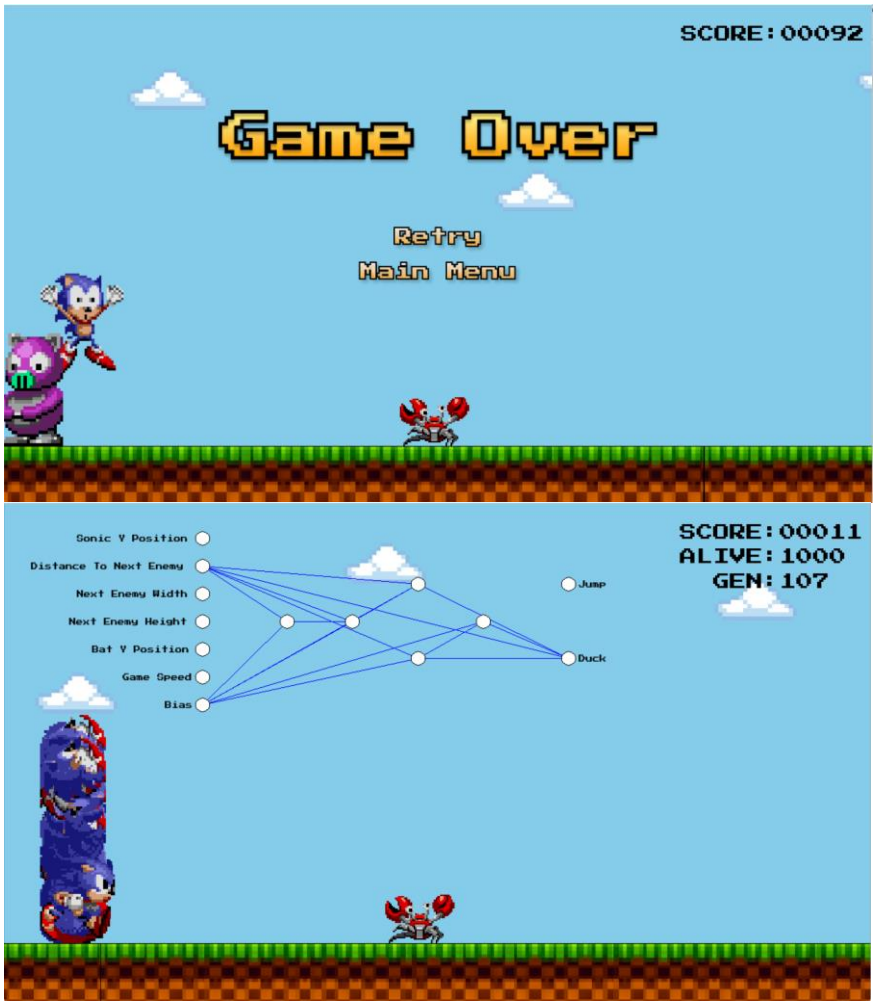
Summary of Program

"SoNeat" is an endless runner game featuring Sonic, where players can either control the character or train their own AI using the NEAT algorithm. The game allows players to observe the AI's learning process in real-time as it navigates obstacles. It provides a unique opportunity to see how a genetic algorithm evolves and adapts, making complex AI concepts more accessible.

This game can be a valuable educational tool, demonstrating the learning process of genetic algorithms in an interactive way. By visualizing how the AI improves over time, players can better understand how genetic algorithms work, making it an engaging way to teach these concepts in classrooms or workshops. This hands-on experience can help learners grasp how AI adapts and optimizes solutions, similar to applications in fields like robotics and autonomous vehicles.



Required Roles

Table 1: Game Logic Classes

Class	Type Details	Notes
GameObject <<abstract>>	Abstract, Position, Speed, Collision, Update	The GameObject class serves as a base class for all objects with positions, movement, and interactions in the game environment.
Sonic	Character, Movement, Handle User input	Represents the player character, managing its actions, interactions in the game. Inherit from GameObject
Obstacle <<abstract>>	Defines game barriers, controls interactions and movement.	The Obstacle class is an abstract base inherit from GameObject for specific obstacles, defining shared properties and behaviors

		for different game obstacles.
Ground	Creates continuous ground movement under the player.	Inherits from GameObject; concrete class for visual ground elements. Manages ground scrolling effect.
Bat	Flying obstacle in the game.	Inherits from Obstacle; concrete class for specific bat behavior.
Cloud	Background scenery element.	Inherits from GameObject; concrete class for background visuals.
Crab	An obstacle in the game	Inherits from Obstacle; concrete class for specific Crab behavior.
Hog	An obstacle in the game	Inherits from Obstacle; concrete class for specific Hog behavior.
ObstacleManager	Manages obstacle creation and updates. Spawns, updates, and removes obstacles.	Concrete class; controls obstacle lifecycle and interactions.
ObstacleFactory	Generates obstacle instances dynamically	Static class; centralizes obstacle instantiation logic.
EnvironmentManager	Manages background elements (ground, clouds). Updates and renders background scenery.	Concrete class; controls visual background elements' behavior.

Table 2: UI Classes

Class	Type Details	Notes
IScreenState <<Interface>>	Interface for screen states	Defines methods for managing screen transitions.
MainMenuState	Handles menu navigation and state transitions.	Implements IScreenState; concrete class for main menu logic.
GameScreenState	Handles game flow, player actions, and updates	Implements IScreenState; concrete class for gameplay management.

Table 2: AI Classes

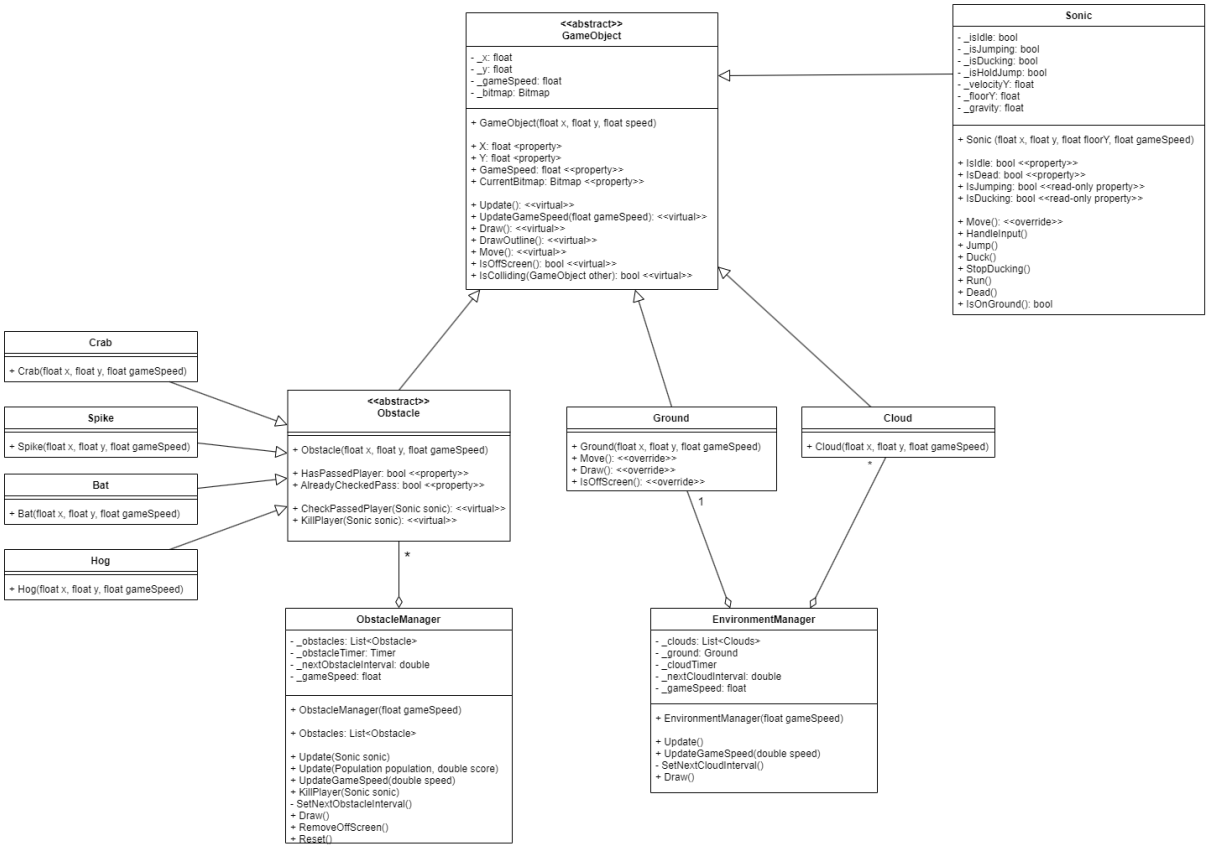
Class	Type Details	Notes
Node	Represents a neural network node	Concrete class; fundamental unit in the neural network structure. Processes input and generates output through connections.
Connection	Links nodes with weighted connections.	Concrete class; essential for network connectivity and weight mutation. Transmits values between nodes with adjustable weights.
Genome	Encodes neural network structure	Concrete class; blueprint for creating and evolving neural networks. Manages nodes, connections, and mutations.
Agent	Represents an AI entity	Holds a genome and interacts with the environment.
Species	Groups similar agents.	Manages species evolution and fitness. Maintains and evolves groups of similar genomes.
Neat	Controls population, evolution, and species	Central class for implementing the NEAT evolutionary process.

Table 4: ObstacleType details

Value	Notes
Bat	
Crab	
Hog	
Spike	

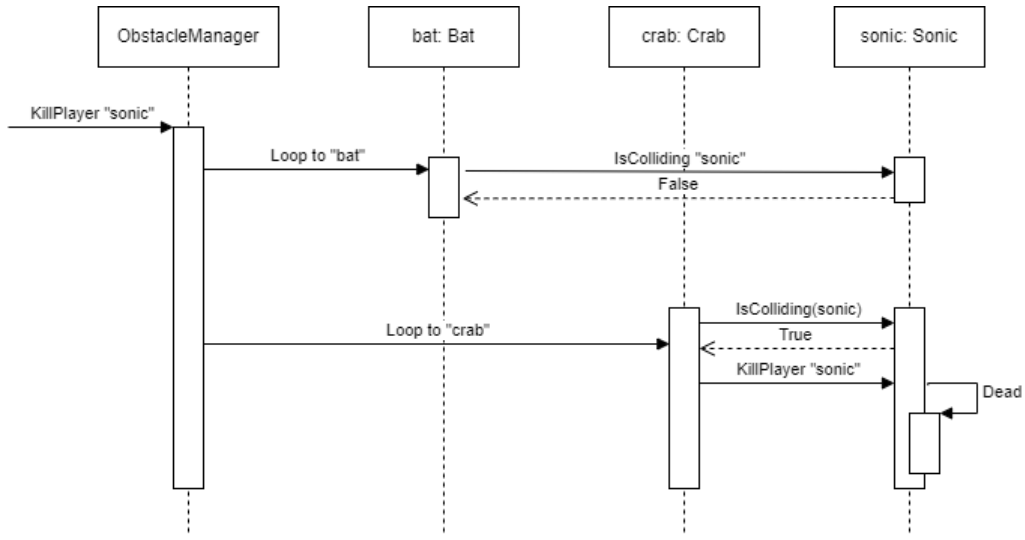
Class Diagram

At the current process, I have only done the basic diagram for the Game Logic.



Sequence Diagram

For each update, all the obstacles will execute KillPlayer to check for collision with the player and kill the player if it collides. For example, the list of current obstacles can be a bat and a crab.



The use of Abstraction

In my program, I use abstraction to manage complexity by creating simplified representations of complex systems. For example, I define an abstract class like Obstacle to encapsulate shared properties and behaviors for all obstacles in my game. Specific obstacles like Bat and Crab inherit from this class, allowing me to implement their unique characteristics without altering the core structure. This approach lets me focus on high-level game mechanics while keeping the code organized and easier to maintain.

The use of inheritance and Polymorphism

In my game, I use **inheritance** by creating an abstract Obstacle class that serves as a blueprint for various obstacles, defining common properties like position, speed, and collision detection methods. Subclasses such as Bat, Crab, and Spike inherit from Obstacle and provide their own specific implementations, like unique movement patterns. **Polymorphism** allows me to handle these different obstacles uniformly; for example, I can store all types of obstacles in a single list and call the Update method on each one, and the appropriate overridden method is executed based on the actual obstacle type.