Drone Swarm Stories

**Self Learning Particle 2D**

**Simulation**

**Purpose** - Core environment for particle AI to interact with the goal and boundaries

* Particle
  + Moves in any direction on 2D plane
  + Contains AI that determines acceleration/movement
  + Detects when it enters goal area to update fitness
  + Detects boundaries - if particle exits bounds, playthrough ends with negative fitness
* Goal
  + Fixed position, optionally movable later
  + Particle reaching the goal increases reward
* Boundaries
  + Define the area for the particle and goal
  + Exiting boundaries ends playthrough with a negative reward
* Timer/playthrough
  + Each simulation has a set duration
  + At the end, a fitness score is calculated based on goal interaction, efficiency and survival
  + AI adjusts settings for the next playthrough (learning loop)

**UI**

**Purpose** - Allow user to monitor and control the simulation

* Title: “Self Learning Particle 2D”
* Next Button: Switch to next project simulation
* Description Panel: Explains project (bottom of window)
* AI Playthrough Button: Start/trigger AI self-improvement cycle
* AI Node Display: Visual representation of AI parameters / nodes
* Stop Button: Stop the current playthrough
* Speed Setting: Adjust simulation speed for faster/slower training

**AI**

**Purpose** - Control particle movement and learning behavior

* Determines particle acceleration and direction based on inputs (goal position, distance to boundaries)
* Fitness calculation
  + Positive reward for reaching the goal (equation will be developed later)
  + Negative penalty for hitting boundaries or failing to reach the goal within the timer
* AI improvement loop
  + After each playthrough, AI parameters are adjusted based on fitness score
  + Prepares for the next generation/playthrough

**Future Extensions / Notes**

* Ability to track multiple particles simultaneously (parallel learning)
* Adjustable goal positions and/or moving goals
* Visualization of particle paths during playthrough

**Genetic AI layer**

**Genetic Particle 3D**

**Particle Physics Constraints**

**Self Balancing AI**

**Physics Constraints**

**Real World Application**

**Threaded AI**

**Drone Controller**

**Drone Swarm Simulation**

**Real World Application**