

# Modified Langton's Ants Simulation in Pygame

## (Python 3.13)

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### What it does:

- Creates a game window and generates a square grid of customisable dimensions
- Randomly picks 2 squares to initialise the “ants”[red, blue], and assigns them an initial direction.
- They move following a [ruleset](#), involving pheromones, and probabilistic paths.
- The parameters of the simulation that can be customised are as follows:

GRID\_SIZE: The number of small squares along the edge of the grid.

SQUARE\_SIZE: The pixel dimension of each small square.

WIDTH and HEIGHT: The dimensions of the game window, derived from GRID\_SIZE and SQUARE\_SIZE.

WHITE, BLACK, RED, PHER\_RED, BLUE, PHER\_BLUE: The colors (R,G,B) used in the game.

PHEROMONE\_DECAY\_TIME: The time it takes for pheromones to decay.

FPS: The frames per second, which controls the speed of the simulation.

### Observations:

1. The original Langton's ant does not include the use of pheromones, only the basic movement rules. Hence the original implementation is deterministic and predictable in its approach and when made correctly, will almost always give the same output, and a predictable “highway” structure that continues to build indefinitely.
2. This implementation includes another logic involving pheromones, which introduce a certain randomness in the simulation making it impossible to predict. Every run of the game creates a different black and white pattern. The 2 ants also always had different paths(as expected).
3. As a result of the probabilistic nature of this simulation, there wasn't any formation of such “highways”, and it is unlikely that they will ever form in the provided conditions.

### Conclusion:

This implementation successfully demonstrates how the introduction of pheromones disrupts the structured predictability of the original Langton's Ant, creating a more chaotic and biologically inspired simulation with emergent, dynamic behaviors.

