Langton and his Ant

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1 Description

Langton's ant is a concept devised by Christopher Langton in 1986. Imagine the following situation: there is an infinite grid of white squares and an ant is sitting on one of them, facing upwards. The ant now starts moving and it will follow these rules:

- If the ant is on a white square, it will turn 90° towards the right and take a step forwards into the next square. The square it just left will turn black.
- If the ant is on a black square, it will turn 90° towards the left and take a step forwards into the next square. The square it just left will turn white.

These simple rules will create a rather astounding behaviour: initially there will be quite simple patterns of black and white. Then there is a period of chaos, where no patterns are discernible and eventually the ant will build a so-called highway, 104 repeating steps that make a pattern looking like a street, running off to infinity.

Of course, one does not have to start with a white grid, but can take any initial configuration of black and white squares. It is conjectured, but not proven, that the ant will always eventually build a highway, no matter the initial configuration.

2 Goals

Main goals:

- Write an algorithm describing the behaviour of the ant;
- Implement a graphical representation.

Once this is done, one can experiment:

- different / random starting configurations;
- measure the exact or mean time until a highway is built;
- implement systems with multiple colours;
- study the mean number of times a square gets visited;
- study the distribution of colours;
- ...

3 Details & References

For semesters 2 & 4, no mathematical prerequisites

`https://en.wikipedia.org/wiki/Langton%27s_ant`
`https://arxiv.org/abs/math/9501233`
`https://www.youtube.com/watch?v=1X-gtr4pEBU`