



## SEEDS HackSciArt

### SEED 01-IA

#### RESEARCHERS

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#### 1. ESSENTIAL DIMENSION

*(Objective descriptive information of the scientific seed)*

#### NAME

“The anthill is more than the sum of the ants”

#### KEYWORDS

Optimization, emerging phenomenon, bio-inspired algorithm

#### BRANCH

The area of Computer Science and Artificial Intelligence is usually part of the Computer Science branch, although it is also closely related to Logic and Mathematics.

#### ABSTRACT

We design algorithms (something abstract in the mathematical and computer world) to solve difficult problems, based on metaphors inspired by nature in general, and for this seed in ant colonies in particular.

#### METAPHOR

Complex systems work according to very simple rules at the local level (for example, an ant has its own decision, but it also follows the rest according to the level of pheromones in the environment, which in turn are left by the other ants). The combination of the simple in a setting with many individuals ends up emerging as something complex and very interesting.

## What are the keys that explain the metamorphosis that makes the simple become complex, like a chrysalis that becomes a butterfly?

The ant's level of self-confidence must be combined with the level of trust in its companions for the system to work correctly.

### PHASES OF THE USUAL SCIENTIFIC METHOD

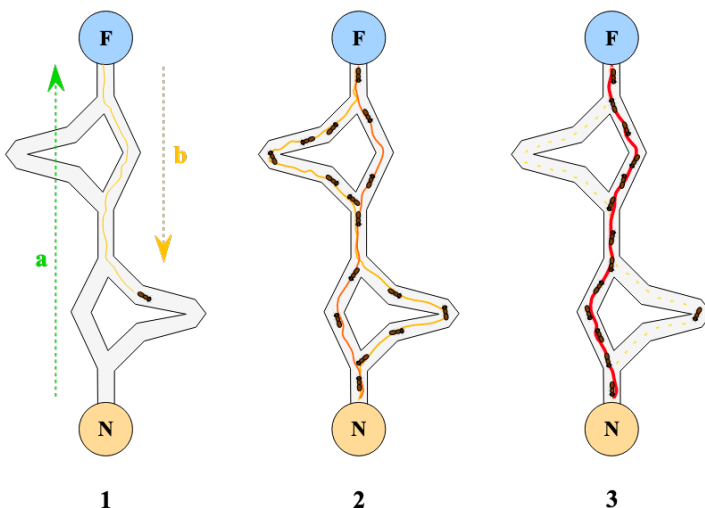
1. State the problem, what do we want to optimize?
2. Design the SIMPLE way in which ONE ant could build any solution (example: how a path is formed between two points of a graph, that is, how to get from one place to another in a city).
3. Design the communication protocol between ants in relation to "how good" is each solution found.
4. Run simulations with "many" ants and "many" rounds of exploration, to see if any good enough solutions are found (ie, which paths have more pheromones because more ants who have passed there have liked them).

### TOOLS

Simulation tools designed in any programming language (eg NetLogo, Python, C, etc)

### RESOURCES

- 1) 01\_Link to toy model in NetLogo  
<https://ccl.northwestern.edu/netlogo/models/Ants>
- 2) 02\_Link to scientific article of an application to the traveling salesman problem (TSP)  
<http://arxiv.org/abs/2203.02228>
- 3) 03\_Link to informative video on Youtube  
<https://www.youtube.com/watch?v=qfeymoF8pb4>



More suggestive images can be found by googling the keywords: "ant colony optimization".

## 2. ADDITIONAL DIMENSIONS

*(The following sections add subjective information from the scientific seed, in order to inspire creatives in the creation of a SciArt work. Some of the sections may not have information if the researcher chose not to specify anything.)*

### SCIENTIFIC MOTIVATION

I love finding inspiration in Nature to design abstract computational models and/or algorithms. For example, ant colony optimization algorithms. It is worth stopping to think about how it is possible that very simple individuals, following very simple rules, are capable of producing “complex” or “intelligent” global results. This is known as an “**emergent phenomenon**”.

The most obvious application of this observation is to design an algorithm to find the shortest path between two (or more) points, although it can be extrapolated to any optimization problem. In this sense, we can say that “**Nature teaches us the way.**”

### METAPHYSICS

The ant's level of self-confidence must be combined with the level of trust in its companions for the system to work correctly. **Are we human beings aware of the importance of the symbiosis between creativity and empathy to reach a better situation?**

### ETHICS

We should not despise individuals who choose alternative paths, because they can open up new horizons for their peers.

To what extent should our ego prevail over the majority opinion?

### COLORS

Brown (because it is the usual result when any other colors are mixed).

### SOUNDS

Constant sequence, rattling.

### AROMAS

Pheromone (what do they smell like? We'll have to ask the ants).

### FLAVORS

Sweet (reward for finding the food).