

# Swarm intelligence

## Assignment 3

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# Assignment 3

- Group Work (maximum 3 students per group)
- Using the NetLogo framework: A powerful multi-agent modeling environment
- Assignment requirements
  - I. Implementing PSO algorithms
  - II. Experiments performed on the implemented algorithms
  - III. Reporting the implementation and the experiment results
- Detailed information will be provided
- Submission deadline: 31.12.2019

# I. Implementing PSO Algorithms

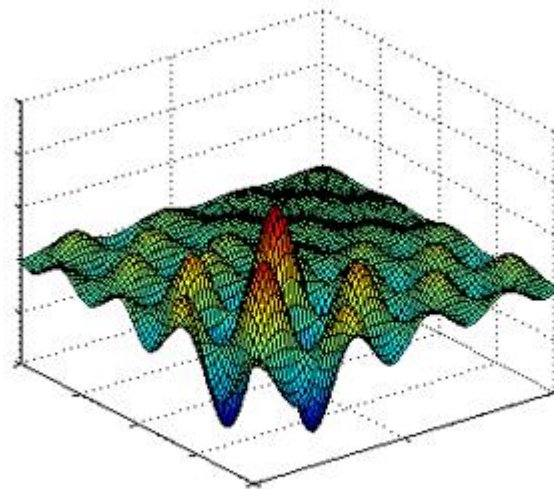
- We recommend to start with provided NetLogo template
  - User Interface for setting configurations
  - Incomplete PSO algorithm
  - Some functionalities are dummy or missing
- Implement PSO algorithms with extensions
  - According to the description (to be provided)
- You will be given a pool of options, from which you can select
  - different objective functions
  - Different exception handling options

# Example of objective function

## 2. Shubert function

$$f(x, y) = \left( \sum_{i=1}^5 i \cos((i+1) * x + i) \right) \left( \sum_{i=1}^5 i \cos((i+1) * y + i) \right)$$

with  $-100 < x, y < 100$



Shubert function

## II. Experiments

- Perform experiments on the algorithms, you have implemented
- Your experiments should cover topics covered in the lecture
  - Especially PSO parameter tuning
  - E.g. influence of parameter on the performance
  - E.g. Convergence behavior of the PSO
- You will be given only the general frame
  - Start with playing with different
    - settings
    - options
    - parameter
  - Think about experiments suitable for the options, you have selected
  - Relate your experiment design to the topics covered in the lecture:
  - Construct scenarios, comparisons of cases, etc. that explain facts related to lecture topics

## II .Experiments

- Think about statistical confidence
- I.e. repeat your experiments sufficient number of times
- The template provides possibilities to
  - repeat the same experiment with different sittings
  - Save / load particular experiments
  - Switch between different modus

# III. Reporting

- Your report should consist of at least
  - An abstract describing the main concern
  - Description of your implementation
    - Don't copy your code in the report
    - Rather a high-level description:
      - ✓ The methods you used
      - ✓ Why
      - ✓ your experience, etc.
  - Description of your experiments
    - Describe your experiments clearly
    - State the goal of each experiment
    - Explain your choice of experiments
    - Relate your choice and explanation
      - to the options you have selected
      - To the topics of the lecture

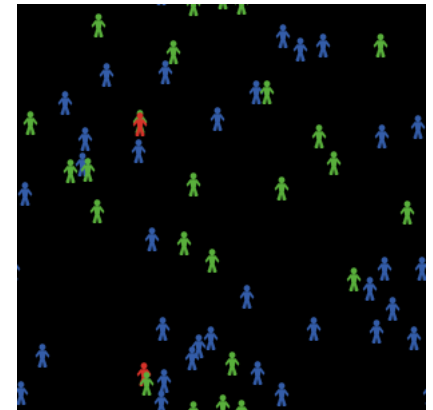
# Report

- Result and Analysis
  - you don't need to report all of the individual results
  - Rather averages and summaries
  - Analyze these results related to the lecture topics
  - Conclude your work



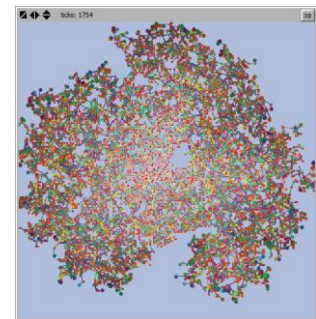
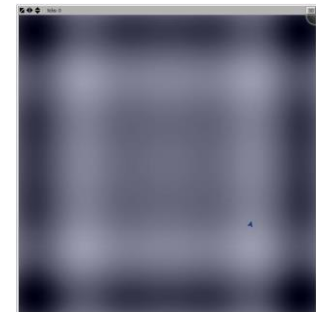
# NetLogo Framework

- More info about NetLogo: <https://ccl.northwestern.edu/netlogo/>
  - Many videos
  - Many Samples
- NetLogo simulation considers three aspects
  - Environment (it calls it world)
  - Agents (it calls them turtles)
  - A time progress (it calls it tick)
- NetLogo provides programable interface that enables
  - Configuring the world
  - Creating arbitrary number of turtles
  - Defining how turtles behave
    - Interaction with each others
    - With world
    - Over time



# Environment

- The world simulates the environment
- Consists of a grid of cells
- Grid cells are called patches
- Dimensions of the grid are configurable
- Patches can be assigned values
  - This is how topology is defined
- Environment topologies can be realized by
  - assigning the desired values to the patches
  - In our assignment this simulates fitness functions
- NetLogo provides easy interface accessing patches
  - Individual access
  - Collective access



# Agents

- Agents are called turtles
- Arbitrary number of turtles can be created, using simple function calls,
- Each turtle is automatically assigned a data structure
  - With basic information like coordinate, color, ect.
  - It can be easily extended to other own information
- NetLogo provides easy interface accessing turtles
  - Individual access
  - Collective access

- [Demo Swarm Particles Optimization \(NetLogo\)](#)
- [Assignment Template](#) (to be downloaded from TUWEL)