

## Computational Intelligence and Applications / NCTU Spring 2017

### Program Assignment #3 (due: 5/16/2017)

You can use any programming language and platform of your choice: C++, C#, Matlab, Java, python, ... I will not actually run your code.

The goal of this program assignment is to implement an ant colony algorithm to solve a problem. Our target problem here is to find the optimal path between two points in a 2-D space. The topology of the space is given by a function of elevation  $h(x,y)$  on a grid. The ants move from grid points to grid points; each movement can only be to one of the four neighbors of its current location.

The general goal is to find a path that is both short and smooth (minimal elevation change along the path). Specifically, if the path consists of the points  $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$ , the cost function is given by

$$\alpha \sum_{i=1}^{n-1} [h(x_{i+1}, y_{i+1}) - h(x_i, y_i)]^2 + \beta(n-1)$$

Here  $\alpha$  and  $\beta$  are adjustable weights.

Several data files containing sample topologies are provided. A data file contains the following:

Line #1: size of grid (an integer)  $N$ ; the grid is  $N \times N$

Lines #2~( $N+1$ ): the elevation function (each line is a row)

Line #( $N+2$ ):  $x_s y_s x_d y_d$  (the starting and destination points)

The origin (0,0) is at the bottom-left corner of the grid, so all the coordinates are nonnegative.

You need to submit a report (limited to 10 pages) describing

- Methods you have implemented.
- Experiments you have done, and the results.
- Analysis - Are the results what you expect? Why?

Include your code listing as an appendix of your report. The code should be well documented. The code listing is not included in the 10-page limit.

Submit your report electronically through e3.

The grading is based on the following:

- Correctness of your implementation
- Quality of your experiments and analysis
- Quality of your presentation
- Quality of your code and documentation

Late submission policy: 10% credit deduction for each day late; up to 7 days late accepted.

Note: You are only required to submit 3 of the 4 programming assignments that will be posted. So you can choose not to do this one, which means that you will need to do all the other three.