

ENGG7302 – Advanced Computational Techniques in Engineering

Assignment 2

Due date: 5pm Monday, 10/10/11.

Where to submit: through the Faculty of EAIT (Hawken building 50) assignment chute. Your submission requires an assignment cover sheet. This is available from <http://www.eng.uq.edu.au/courses.asp>

This assignment is worth 10% of the total marks for the course.

For this assignment, you are required to carry out the process of attempting to solve two different optimisation problems. There is some flexibility in how you do this: in lectures you have seen a number of techniques that could be used (but it may be possible to apply other techniques). In particular, you may choose to implement your own optimisation code, use something that you have used in tutorials or other available routines (e.g. in Matlab). For each problem, you are required to report on your work addressing the following:

- Describe your *approach* to solving the problem (i.e. how did you represent/formulate the problem and what algorithms did you apply) and *justify* your choices (i.e. explain why you took this approach).
(3 marks)
- *Report* your results. This should include your best solution and its corresponding objective function value. In addition, you should provide results that give some indication of how well the algorithm(s) you applied *performed*. This may involve reporting average (and standard deviation) of multiple trials, plots of algorithm progress (best objective function value found as a function of iterations/function evaluations), *analysis* of algorithm parameters, *measures* of computational time and any other information you think relevant. Any source code, script files, etc. that you wrote should be included as an appendix to your assignment.
(5 marks)
- A brief reflection on your work. Were any of your results unexpected? Would you do anything differently if you had another chance at solving the problem?
(2 marks)

Your report for each problem should be about 3 pages of standard text (~11pt font, normal line spacing) in length. Marks will be awarded based on how well your submission addresses the above points.

Problem 1

The population (p) of a small community on the outskirts of a city grows rapidly over a 20-year period:

t	0	5	10	15	20
p	100	200	450	950	2000

As an engineer working for a utility company, you must develop a model to forecast the population into the future in order to anticipate the demand for power. Fit a model to this data of the form:

$$y(t, \mathbf{x}) = x_1 + x_2 t + x_3 t^2 + x_4 e^{x_5 t}$$

Where $\mathbf{x} = (x_1, \dots, x_5)$ is a vector of model parameters to be determined. Fit this model to the data by solving the following (nonlinear least squares) problem:

$$\min_{\mathbf{x}} f = \frac{1}{5} \sum_{t=1}^5 (p_t - y(t, \mathbf{x}))^2$$

Problem 2

Here are 25 city locations represented as 2D Euclidean coordinates (City ID, x , y):

1, 183, 858	6, 807, 1196	11, 889, 1030	16, 887, 753	21, 524, 1198
2, 404, 1055	7, 226, 315	12, 488, 1107	17, 165, 146	22, 530, 780
3, 1151, 292	8, 855, 381	13, 509, 895	18, 413, 506	23, 858, 842
4, 1109, 191	9, 514, 885	14, 152, 667	19, 1109, 458	24, 992, 843
5, 819, 373	10, 1109, 824	15, 855, 1147	20, 1022, 1164	25, 760, 715

Design and implement an Ant Systems algorithm to find the shortest tour connecting all of cities, visiting each city only once and returning to the starting city. Report on the length of the tour using the total Euclidean distance.