Scientific Programming Assignment 3

MPhil in Computational Biology

December 7, 2016

If there are errors found, I will update the assignment on the web at `http://github.com/sje30/rpc2016`

Due date: 2017-01-12 23:45

Please submit your report to Moodle as a PDF: NO OTHER FORMATS ARE ACCEPTED. Name your file `spa1_XXX.pdf`, where XXX is your CRSid. (For example, I would save my file as `spa3_sje30.pdf`.)

Your report must be a maximum of fifteen pages, excluding the appendix. (List your code in the appendix.) This course work will consist of 50% towards your overall mark for this module.

Only R packages that come installed by default with a R installation can used for this assignment. If in doubt, check with Stephen whether you can use a particular package.

Include in your report an appendix containing your R code.

1 Travelling salesman problem [25 marks]

Compare the following two methods to solve the travelling salesman problem:

1. Simulated annealing (Schneider, 2014)
2. Genetic algorithms (Larrañaga et al., 1999).

Write a report that compares the two methods, describing the key decisions that you had to make when implementing each algorithm. Demonstrate your algorithms on tours where the optimal solution is known (`http://comopt.ifi.uni-heidelberg.de/software/TSPLIB95/`).

2 Self organising maps [25 marks]

(a) Implement the Kohonen self-organising network and show how it maps a two-dimensional input space onto a two dimensional output space (as in Figure 5.4 of (Beale and Jackson, 1990)). To get started, read chapter 5 of (Beale and Jackson, 1990). [12 marks]

(b) Implement a version of image compresssion using the Kohonen network (Amerijckx et al., 1998). How does your method compare to Singular Value Decomposition (White, 2009). (You can use the code from the SVD page, as long as you cite it.) [13 marks]

Hint: if part (a) is too challenging, you may instead use R's algorithm for k means clustering in part (b), but note why you did this, and what disadvantage this has compared to the self-organising network.

References

Amerijckx, C., Verleysen, M., Thissen, P., and Legat, J. D. (1998). Image compression by self-organized kohonen map. *IEEE Trans. Neural Netw.*, 9(3):503–507.

Beale, R. and Jackson, T. (1990). *Neural Computing - An Introduction*. CRC Press.

Larrañaga, P., Kuijpers, C. M. H., Murga, R. H., Inza, I., and Dizdarevic, S. (1999). Genetic algorithms for the travelling salesman problem: A review of representations and operators. *Artificial Intelligence Review*, 13(2):129–170.

Schneider, T. (2014). The traveling salesman with simulated annealing, r, and shiny. `http://toddwschneider.com/posts/traveling-salesman-with-simulated-annealing-r-and-shiny`. Accessed: 2016-12-7.

White, J. M. (2009). Image compression with the SVD in R. `http://www.johnmyleswhite.com/notebook/2009/12/17/image-compression-with-the-svd-in-r/`. Accessed: 2016-12-7.

All references are available from `https://paperpile.com/shared/lNKK5w`