

# Scientific Programming Assignment 3

MPhil in Computational Biology

November 29, 2023

If there are errors found, I will update the assignment on the web at

<http://github.com/sje30/sp2023>

**Due date: 2024-01-16 23:45**

Please submit your report to Moodle as a PDF: NO OTHER FORMATS ARE ACCEPTED. Name your file spa3\_XXX.pdf, where XXX is your code.

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 be 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 compression 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://toddschneider.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/dI97KA>