Graded Assignment 1 - Genetic Algorithms

For this assignment, you will need to provide a Jupyter notebook with a working Python implementation of Genetic Algorithms (GAs) that can solve the 8 Queens problem, an extended and optimised version of this implementation, and a report explaining and contextualising your work.

This assignment will be marked out 100. 40 marks will be awarded for the basic implementation, 30 marks will be awarded for extensions and optimisations to the basic code, and 30 marks will be awarded based on the quality of your report.

To get you started, you might want to use the provided notebook with skeleton code from the 8 Queens notebook in the Foundations of Artificial Intelligence unit, but you are also welcome to write your notebook from scratch.

Task 1 (40%): Solve the 8 Queens problem using a genetic algorithms approach. You may use the pseudocode from Russell and Norvig provided in the course content, or an alternate source, provided it is properly cited.

Full marks for this section will be awarded for any submission which is able to find a solution to the puzzle in 30 seconds or less, from a random population. Your code should clearly demonstrate that a genetic algorithms approach has been used, through print statements, appropriate variable/class/function names, and/or code comments. Partial marks are available for limited functionality. No Python packages that provide off-the-shelf implementation of GAs or substantial aspects of GAs should be used, basic packages such as numpy should be perfectly sufficient for implementation.

Task 2 (30%): Adapt and extend your solution for a wider class of problems, e.g. n-Queens for $n \neq 8$ and/or optimise your code to solve the problem faster. For clarity, the extended/optimised code should be written separately to the basic code, so that the improvements are clear. The marks for this part will be awarded based on how successful and far-reaching these extensions/optimisations are. For optimisations, algorithmic improvements should be prioritised rather than the use of non-GA specific Python techniques or packages. High marks for this section will require work of exceptional quality and might require spending time on this assignment beyond the provided estimates.

Task 3 (30%): Write a 1-2 page report detailing the algorithmic and implementational choices you have made, and justify them using the course content and external literature. You should discuss both your basic implementation and the extended/optimised version. High marks for this section will require very sophisticated command of the theoretical underpinnings of GAs, and extensive engagement with a range of external literature, and might require spending time on this assignment beyond the provided estimates.