NSTC Practical 2 – Evolutionary Algorithms

Pre-practical preparation

Read, and understand, the following paper:


Practical

You will be using Python to implement the MGA. If you are unfamiliar with Python, you can pair up with someone who knows it better (or just have a go yourself, and see how you do!). You can search the online documentation to find out what Python functions you need.

The benchmark problems

The **OneMax** (aka the Max Ones) problem: the aim is to search for the bitstring of length $N$ containing the maximum number of ‘1’ bits. (Clearly this is an utterly trivial problem, but that is its advantage here: you already know the answer, so you can understand what your algorithm is doing!)

The **1D Sombrero problem**: the aim is to search for the maximum of the sombrero function, $(\sin x)/x$. (The maximum value is 1, which occurs at $x = 0$.) This function has local optima:

http://mathworld.wolfram.com/SincFunction.html
The Microbial GA

Q1. Panmictic
What does “panmictic” mean?

Q2. MGA, for OneMax
- Implement the MGA algorithm, for OneMax
- Test your implementation.

Q3. Counting the ones
Use $N = 30 – 100$ in the following experiments.

- Run MGA, and examine how it works: how does the fitness change over time?
- Find good values of the recombination and mutation rates.
- On average over many runs, how many fitness evaluations are performed, and how many are accepting moves? How does your answer depend on $N$?
- Does it get stuck in a local optimum? Why/why not?
- In real problems, the fitness function is expensive to evaluate, so you want to minimise the number of evaluations. The number of fitness function evaluations is proportional to the population size $P$ times the number of tournaments run. What is a good trade-off between population size and number of tournaments to minimise this?
- When does MGA outperform SA and/or hill climbing? What do you mean by “outperform”?

Q4. MGA algorithm, for 1D Sombrero
- Implement the MGA algorithm, for 1D Sombrero
- Test your implementation.

Q5. Finding the peak
- Run SA, and examine how it works: how does the fitness change over time?
- Find good values of the recombination and mutation rates. Are they the same as for Q3?
- On average over many runs, how many fitness evaluations are performed, and how many are accepting moves?
- Does it get stuck in a local optimum? Why/why not?
- What is a good trade-off between population size and number of tournaments to minimise fitness evaluations? Is this the same as for Q3?
- When does MGA outperform SA and/or hill climbing? What do you mean by “outperform”?