**Project Proposal**

**Abstract**

Genetic algorithms (GAs) developed out of the field of evolutionary computing in the 20th century, as a method to solve function optimisation problems inspired by Darwinian natural selection. They traditionally involve using the operations of selection, recombination and mutation to maintain and evolve a population of candidate solutions (genotypes) to a problem, iteratively developing a better solution as the genotypes move up the fitness landscape. This traditional approach has proven its strength on a variety of tasks, from setting weights for neural networks (Whitley, 95) to path planning for UAVs (Guang, 05), however most GA implementations neglect another feature present in most animal evolution, sexual selection. Since evolving, gender has largely remained a feature of most species, seemingly offering survival benefits to these organisms, and so it appears to be a worthwhile feature to model in a GA. The contribution of this project will thus be to present and analyse the performance of a novel sexual selection-based genetic algorithm, comparing its performance in terms of fitness achieved and population diversity with a non-gendered GA on a number of problems, and answering the question of whether sexual selection improves genetic algorithms’ search capabilities.

**Proposal**

This project will aim to study the effects of incorporating sexual selection into a genetic algorithm, analysing the merit of adding sexual selection into the mix. I will base my work upon the microbial genetic algorithm (Harvey, 96), which is a bare-bones implementation of a GA (making it suitable to build a lightweight sexual GA), building upon it and adding sexual selection operators based on the papers by (Sanchez-Velazco, 03) and (Drezewski, 07). In general, previous attempts to include gender in GAs has resulted in considerably more complex algorithms, or has only implemented a low-level sexual aspect, however this project will attempt to build a more minimal sexual GA to simplify the problem, taking inspiration from the microbial GA mentioned above. This project’s potential advantages are thus two-fold: firstly, the successful construction of a simple sexual GA may encourage more widespread use of it versus traditional GAs; second, a lightweight implementation of a sexual GA could in fact bring performance increases over other sexual GAs, and so make it stand out as a worthwhile evolutionary algorithm.

Therefore, the key goal of this project, and the one I shall keep in mind as work progresses, is to analyse whether sexual selection is beneficial for the performance, both in best and average fitness obtained, and population diversity (measured by how well the populations spread out into local optima, as in (Drezewski, 07)), of a genetic algorithm. Alongside this goal, I will be attempting to construct a minimalised version of a sexual GA. The performance of the novel GA will be measured against the classic microbial GA, and the results of the sexual GAs of the authors above, to analyse whether sexual selection appears to improve overall performance or not.

The first task in completing this project will be to produce a basic draft of a sexual genetic algorithm, reproducing the features used by (Sanchez-Velazco, 03) and adapting them to the microbial GA from (Harvey, 96). I will be using the gendered GA of (Sanchez-Velazco, 03) since it seems to be a fairly straightforward implementation of sexual selection, and there is sufficient explanation of the workings of their algorithm to reproduce it.

Once a specification of the algorithm is complete, I will then implement it in program code and simulate it. To code the algorithm, I will use Python, since I am well acquainted with the language, and it has numerous useful tools and packages for statistical analysis, data manipulation and graph plotting. The implementation will be simulated on some toy problems, to verify functionality, and then I will encode a number of more useful problems to test the true performance.

The problems I will run the algorithm on will be taken from (Sanchez-Velazco, 03) and (Drezewski, 07), as these offer simple specifications of the functions used, or the tasks performed, such as the Travelling Salesman Problem, and it will allow me to compare the performance of my algorithm with those in these papers. Furthermore, I will utilise the performance measures used in these papers, to ensure that I can perform proper comparisons between all the algorithms, especially considering (Drezewski, 07) measures the population diversity of its sexual GA.

Upon obtaining some results about the performance of my algorithm, I will do an initial analysis of how it is performing with respect to the goals of my assignment, to make sure there are no wild findings before adding to the implementation. Following this, I will then update the algorithm and further incorporate sexual selection features from the papers, continuing in this fashion as far as I can in the time frame. Possible extra features to add to the algorithm include some element of geographical separation, as in (Drezewski, 07).

Analysis of the performance of the algorithm will involve running the simulation many times on the specified problems, and obtaining average performance scores across the whole population, average best fitness scores, and population diversity scores based upon how much of the population ends up in a good local optimum. The performance of my algorithm will be compared to a non-sexual microbial GA, and the results of the sexual GA in (Sanchez-Velazco, 03).

**Citations**

*Drezewski, Rafał; Cetnarowicz, Krzysztof.* Sexual Selection Mechanism for Agent-Based Evolutionary Computation*, 2007. Department of Computer Science, AGH University of Science and Technology. Krakow, Poland.*

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*Whitley, Darrell.* Genetic Algorithms and Neural Networks*, 1995. Genetic Algorithms in Engineering and Computer Science, p191- 201. Colorado, USA.*