Workshop

Day 4:
The continuous GA

Functional Programming and Intelligent Algorithms
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Faculty of Engineering and Natural Sciences
Ålesund University College

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1 Workshop overview

1.1 Topics

Today's topics include:

- Components of the continuous (real-valued) GA, including selection, pairing, mating, and mutation.
- Optimising 1D and 2D test functions using a continous GA.

1.2 Reading material

Compulsory reading to be studied *before* this workshop is Chapter 3 in Haupt & Haupt (2004) on continuous (real-valued) GAs.

1.3 Specific learning outcomes

After completing this workshop, including self-study, reading and exercises, the students should be able to

- explain the components and algorithmic flow of the continuous (real-valued) GA.
- demonstrate typical effects of changing parameters of the continuous GA.
- differentiate binary and continuous GAs with respect to selection, pairing, mating and mutation mechanisms.

- implement and modify their own continuous GAs, with particular attention to the choice of cost function, to suit a variety of problems.

1.4 Schedule

We begin at 8.15 with a status update and a recap. Today's workshop will then roughly follow the schedule below:

08.15 Status update/recap.

08.45 The continuous GA.

09.30 Workshop rest of the day.

2 Exercises

2.1 Components of the continuous GA

Exercise 2.1: Draw a diagram of the algorithmic flow of the continuous GA. How does it differ from the algorithmic flow of the binary GA?

Exercise 2.2: Although a continuous GA uses continuous (real-valued) numbers, it still has a limitation in precision. Explain why.

Exercise 2.3: Normalisation/unnormalisation:

(a) Explain the process of normalisation and suggest some reasons why the values of variables (genes) need to be normalised.

(b) Suppose the upper bound on variables is 80 and the lower bound is -20, what does a normalised variable value of 0.5 correspond to?

Exercise 2.4: Explain why simple point crossover methods have limited use in a continuous GA.

Exercise 2.5: The blending method:

(a) Explain the blending method for mating and create an example to aid your explanation.

(b) Given an initial population of continuous variables, suppose the highest variable value for any individual (chromosome) is 0.8 and the lowest is 0.3. What can you say about the variable values for the next generations if you use the blending method for mating?

Exercise 2.6: Extrapolation method:

(a) Explain the extrapolation method for mating and create an example to aid your explanation.

(b) What is the main advantage of the extrapolation method versus the blending method?

Exercise 2.7: Extrapolation/crossover method of Haupt & Haupt (2004):

(a) Explain the extrapolation/crossover method of Haupt & Haupt (2004) for mating and create an example to aid your explanation.

(b) The method limits variables to the bounds of their parents. How would you modify the method to allow variable values outside parent bounds?

3 Homework

- Complete all the exercises above.
- Read through (again!) the specific learning outcomes in Section 1.3 to check which outcomes you have not attained yet. Study today's material and prepare questions for tomorrow about learning outcomes you have missed.
- Prepare for Day 5 by reading about the receding horizon genetic algorithm (RHGA) by Bye (2012), which is available on Fronter.

References

Bye, R. T. (2012). A receding horizon genetic algorithm for dynamic resource allocation: A case study on optimal positioning of tugs. *Series: Studies in Computational Intelligence*, *399*, 131–147. Springer-Verlag: Berlin Heidelberg.

Haupt, R. L., & Haupt, S. E. (2004). *Practical Genetic Algorithms*. Wiley, 2nd ed.

