

The Educational Value of Genetic Algorithms

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Senior Year at Calvin CS

All seniors must either

- Do an internship (1 semester), or
- Complete a Senior Project (2 semesters)
- IS majors must do an internship

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Senior Project

- Student proposes the idea
- Proposal is approved by a faculty board
- Do the project one-on-one with an advisor
- Honors project: publishable and/or distributable

What are Genetic Algorithms?

- Use Natural Selection as a paradigm for problem-solving
- Evolve a population of solutions through “breeding”
- Sometimes classified under “Learning Algorithms”, sometimes “Search Algorithms”

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How are GAs useful?

- Algorithm is independent of the problem
- Find creative solutions (e.g. patents on chip design)
- Scale to very large search spaces

My Project: Galapagos

- Develop a programming framework for GAs
- Educate students about using frameworks with Galapagos

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Develop Galapagos to be usable

- Intuitive Framework
 - Minimize coding needed for the “quick example”
 - Use many metaphors in code (e.g. Mate, Fitness, Survival, etc.)
- Provide Add-ons for teachability
 - XML driver
 - Built-in examples
- Produce documentation

Technical Specifications on Galapagos

- Written in Java 5.0, using Eclipse
- Highly configurable: 17 operators for 6 categories
- Very extensible: documentation for custom operators
- Used Test-Driven Development with JUnit
- 3700+ lines of code in 100+ classes
- XML compatibility uses JavaBeans
- Open Source (GNU GPL License on SourceForge.net)

Evaluated Project with Mock Laboratories

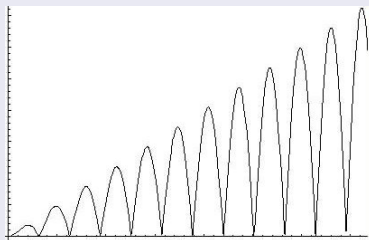
- Volunteer labs
- Pre-tested with professors and seniors

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Examples used in Tutorials

- Guess a 30 digit number, using a list of digits as genomes
- Optimize a function with many local optima



$$f(x) = |x \sin x|$$

Research Conclusions

- GAs are valuable if the students understand the basics
- Crucial components
 - Explaining vocabulary is the key to teaching GAs
 - Must minimize set up time in labs
 - Use simple, but instructive examples

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Personal Lessons

- CS tutorials are difficult to write!
- Improved my problem-solving abilities
- Helped me with teaching
- Was a lot of fun along the way

Acknowledgements

- Professor Frens, advisor and tester
- Professor Vander Linden, tester
- Justin Kent, tester
- Remington Steed, tester

Project Website

<http://GalapagosGA.sourceforge.net>

