LESSONS LEARNED AND RECOMMENDED STRATEGIES FOR GAME DEVELOPMENT COMPONENTS IN A COMPUTER LITERACY COURSE

Robert Collier and Jalal Kawash
The ACM Special Interest Group for Computer Science Education (SIGCSE 2014)

Abstract

The challenges that instructors face attempting to motivate novice programming students are amplified when the students are not pursuing degrees or careers in computer science. For the programming module of our course for non-computer science majors we assigned a video game programming deliverable that we expected would engage students and enhance their experiences. After extensive analyses of the survey responses of 245 enrolled students we were surprised to learn that, although the majority believed the game programming experience enhanced their learning overall, another majority reported that the project itself was not enjoyable. Through qualitative analysis we have identified several key areas that seem to have detracted from the overall level of enjoyment, and in this paper we follow this investigation with discussion surrounding how these issues could be remedied in the future. These recommended strategies will bolster student enjoyment and motivation in future offerings and we believe this discussion will prove very useful to other instructors planning to employ game programming components.
Using Video Game Development to Engage Undergraduate Students of Assembly Language Programming

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The ACM Special Interest Group for Information Technology Education (SIGITE 2013)

Abstract

It is widely accepted that the instruction of programming in assembly language is often a challenging and frustrating experience, both to educators and undergraduate students. Although little can be done to simplify the curriculum, it is absolutely crucial that frustration not compel students to abandon the subject. Our use of game development in a second-year course affords a unique opportunity to present this complex subject, without omission, in such a way as to create an experience that most students find entertaining. The results of a class survey indicated that 65% of participants agree or strongly agree that the experience was enjoyable (with only 11% in disagreement). We conclude that this ensures a sufficiently engaging experience that offsets the tedium inherent to the subject. The consensus of most students was that the complexity of video game design does not detract from their enjoyment of the course and contrarily has a positive impact on their learning overall. This position is supported by additional survey results.
AN EMPIRICAL APPROACH TO THE MEASUREMENT OF INTERCHROMOSOMAL DISTANCES IN THE GENETIC ALGORITHM

Robert Collier and Mark Wineberg
The Genetic and Evolutionary Computation Conference (GECCO 2012)

Abstract

Data visualizations, population diversity measurements, and cluster analyses are all invariably constructed from measures of distance or dissimilarity, and it is recognized that any measure of the distance between points should represent the manner and ease with which an algorithm or process can move from one point towards another. For the genetic algorithm, this traversal is largely accomplished by mutation and recombination, but in spite of this, measures like the Hamming distance and the edit distance are still used to assess the distance between population members. This represents a significant problem, because these measures were not designed with the genetic algorithm in mind and they do not consider how the genetic operators will actually traverse genotypic space. The need for distance measures to be accurate and representative cannot be overstated, but for the complex traversals of the genetic algorithm, it is exceedingly difficult to determine whether one measure is any more representative than another. To address this need, this paper will introduce an empirical approach to distance measurement, and since the resultant values are derived from actual traversals, the distance measured is guaranteed representative, and can be used as a baseline against which other measures can be evaluated.
DEPICTIONS OF GENOTYPIC SPACE FOR EVALUATING THE SUITABILITY OF DIFFERENT RECOMBINATION OPERATORS

Robert Collier, Christian Fobel, Gary Grewal, and Mark Wineberg
The Genetic and Evolutionary Computation Conference (GECCO 2012)

Abstract

When the genetic algorithm recombines two parent genotypes, the differences between them define a genotypic subspace, and any offspring produced should be confined to this subspace. Although this might seem insignificant, those recombination (or crossover) operators that violate this principle can direct a search away from the region (in genotypic space) that contains the two parent genotypes. This is contrary to the task for which the recombination operator was originally developed and can be detrimental, so this paper introduces a visualization that can be used to detect violations of this principle. The methodology also inspired the development of a different approach to recombining permutations, and a brief case study shows that an alternative recombination operator that does not violate this principle can be used to achieve a performance improvement over previous attempts to optimize Field-Programmable Gate-Array placements using a genetic algorithm. We believe that this technique will be invaluable for developing additional recombination operators.
GPU APPROACH TO FPGA PLACEMENT BASED ON STAR+

Christian Fobel, Gary Grewal, Robert Collier, Deborah Stacey
The International Northeast Workshop on Circuits and Systems Conference (NEWCAS 2012)

Abstract

While simulated-annealing is currently the most widely used method for performing FPGA placement, it does not scale to very large designs. Modern many-core architectures (including GPUs) offer a promising alternative to traditional multi-core processors for improving runtime performance. In this work, we propose a GPU-accelerated simulated-annealing variant for FPGA placement. Our approach uses the Star+ wirelength model along with a novel method of efficiently generating large sets of independent swap operations, providing a high level of parallelism. Speedups from 5.4- 89.2x (median 20.2x) were achieved over a single-core CPU-only implementation.
A Formal and Empirical Analysis of Recombination for Genetic Algorithm-Based Approaches to the FPGA Placement Problem

Robert Collier, Christian Fobel, Laura Richards, and Gary Grewal
The Canadian Conference on Electrical and Computer Engineering (CCECE 2012)

Abstract

To reduce the compilation times for Field Programmable Gate Arrays, genetic algorithms have been proposed for performing placement. However, the quality of solutions produced by these methods, so far, has been inferior to that produced by other search methods. In this paper, we show how traditional recombination operators, employed by the genetic algorithm when performing placement, fail to produce offspring solutions that are confined to the solution subspace defined by the parent solutions. This violates a fundamental principle that should govern the behavior of the recombination operator. We explore this flaw in detail, and propose a novel recombination operator that yields very statistically significant performance improvements, when tested with standard benchmarks.