Evolutionary Computing

Practical assignment part 1

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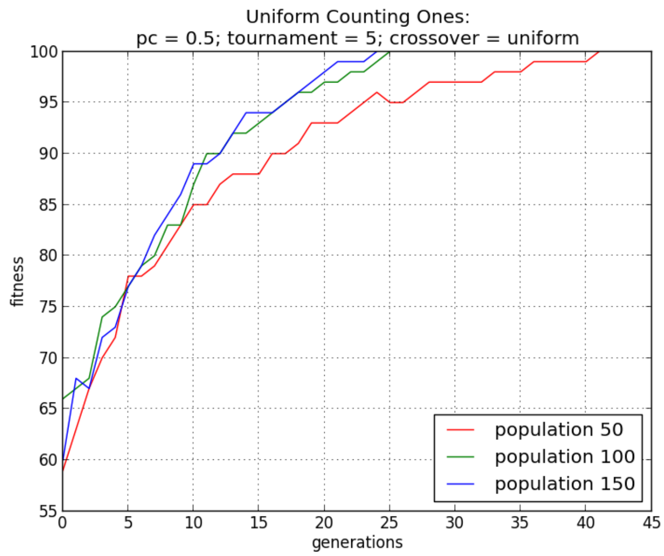
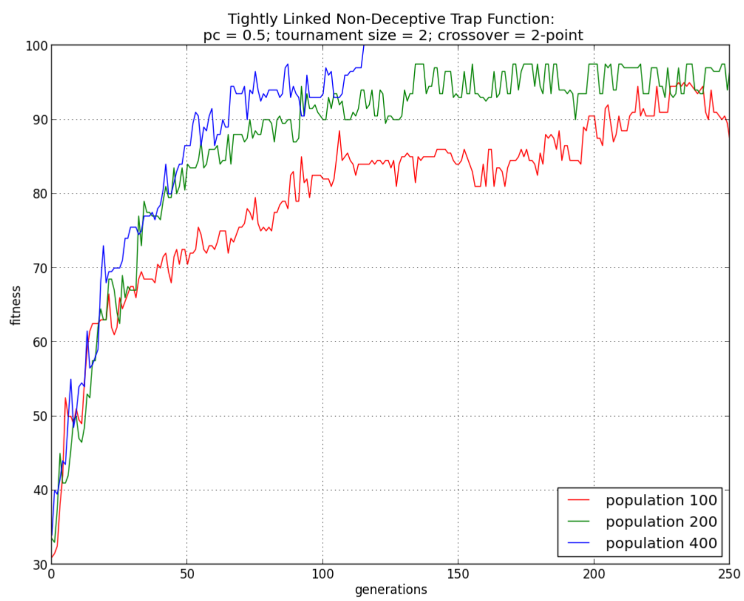
Population

The Uniform Counting Ones Problem required the smallest population to find the optimum. It consistently found the optimum at the size of 100.

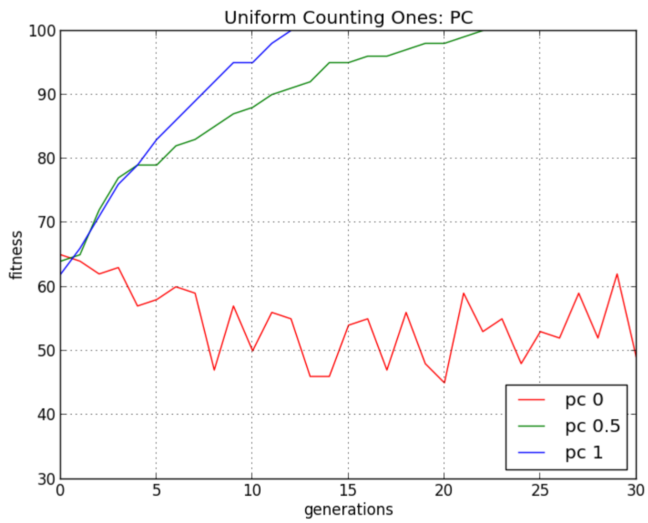


The Linear Counting Ones problem, however, required a much larger population of 350 to consistently find the optimum in a reasonable amount of time. Smaller populations than this found near-optimal solutions, but never found the optimum before reaching the iteration limit.

The Deceptive Trap Function performed similarly regardless of population size. Populations of 100, 200, and 400, all converged within 100 generations, and stayed within a few fitness points of each other for the whole run.



The Tightly Linked Non-Deceptive Trap Function was able to find the optimum in fewer than 150 generations with a large population of 400. Smaller populations converged in a manner similar to the Deceptive function. The Randomly Linked function, on the other hand, was able to find the optimum occasionally with a population as small as 100, although it only found solutions consistently with a size of 400. Neither of the Non-Deceptive functions was able to find the optimum all the time, even with a population of 500. A population of perhaps 800 would allow them to always find the optimum. The randomly-linked trap functions consistently underperformed the tightly linked ones.

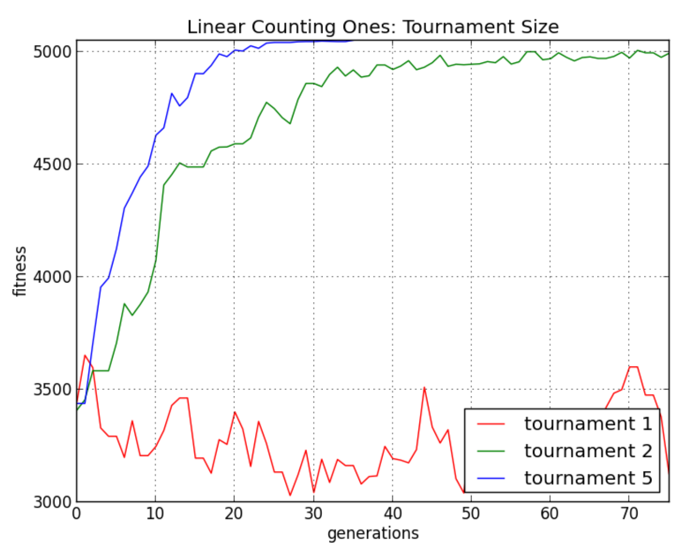


PC

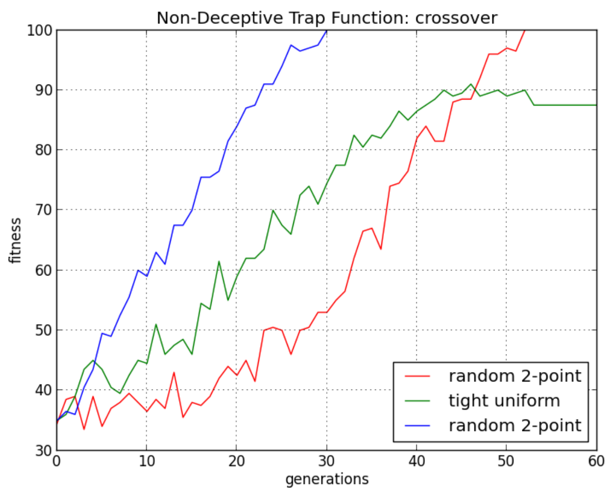
For all problems, a pc value of 1 was best for a population of 100, and a pc value of 0.5 frequently could not find the optimum for the Linear function. A pc value of 0 actually lowered performance throughout the run. For Uniform Counting Ones, where a small population was optimal, a pc of 1 could not consistently find the optimum, and a pc of 0.5 was much better. For the Deceptive Trap Function, a pc value of 0.5 maintained genetic diversity much better, but the final solutions were better with a value of 1. I used a population size of 200 when testing this due to the marginal gains of significantly increasing the size. For the Non-Deceptive Trap Function, genetic diversity was often, though not always, maintained with a pc value of 1. This is likely due to the larger population size I used for the Non-Deceptive function. The two values did not perform significantly differently

Tournament Size

Both Counting Ones problems were best solved with a tournament size of 5, which almost always kept the best solutions from generation to generation and quickly eliminated poor ones, allowing these functions to quickly converge on the optimum. The trap functions, however, converged on poor solutions with such a high tournament size. To maintain genetic diversity, a tournament size of 2 was best for these functions. This caused somewhat erratic

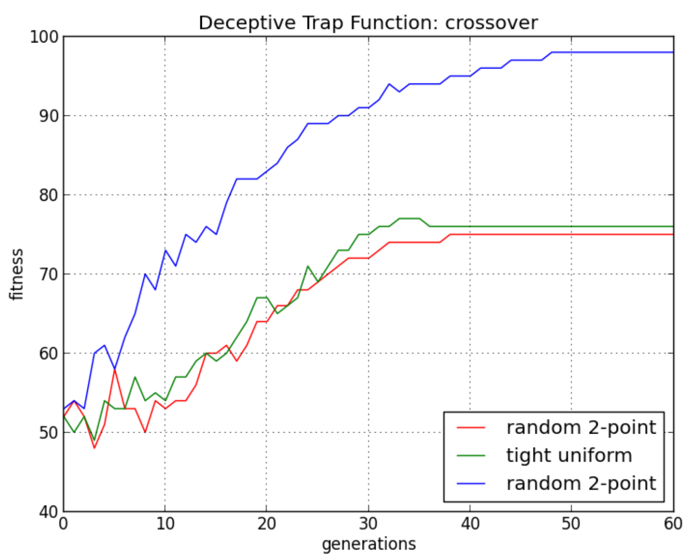


behavior from generation to generation, but it allowed even the deceptive trap functions to achieve fitness values up to 90.



Crossover

The Counting Ones problems were better solved with uniform crossover, while the trap functions performed better with 2-point crossover. Both crossover functions performed similarly for the counting ones functions for a time. However, at the time of convergence, uniform crossover found the optimum, while 2-point hovered just below optimum until it reached the iterations limit. For the Tightly Linked Deceptive Trap Function, neither function found the optimum, but 2-point found much better solutions than uniform. The Randomly Linked Deceptive Trap function with 2-point crossover performed similarly to the Tightly Linked function with uniform. Unlike the Deceptive function, the Randomly Linked Non-Deceptive function eventually outperformed Tightly Linked with uniform crossover, finding an optimum.



Cutoff Point

I found that a cutoff point of 250 generations was more than sufficient for testing any given function and set of parameters. For the sake of visualization, I only show as many generations as necessary.

The optimal parameter values for each problem are:

	Uniform CO	Linear CO	Deceptive TF	Non-deceptive TF
Population	100	350	200	500
pc	0.5	1	1	1
Tournament size	5	5	2	2
crossover	uniform	uniform	2-point	2-point
Successful runs	49	50	Highest fitness: 98	42