Biologically Inspired Computing
Project 2

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Introduction

Evolutionary algorithms evolve to solve a problem, usually these algorithms are evaluated and propagate based on performance via some fitness function. The fine rules for this propagation is defined via various parameters. This paper aims to evaluate the effectiveness of a few popular.

Tournament Size size of tournament during selection based on fitness values

Mutation Amount of mutation, or random change, allowed on a genome

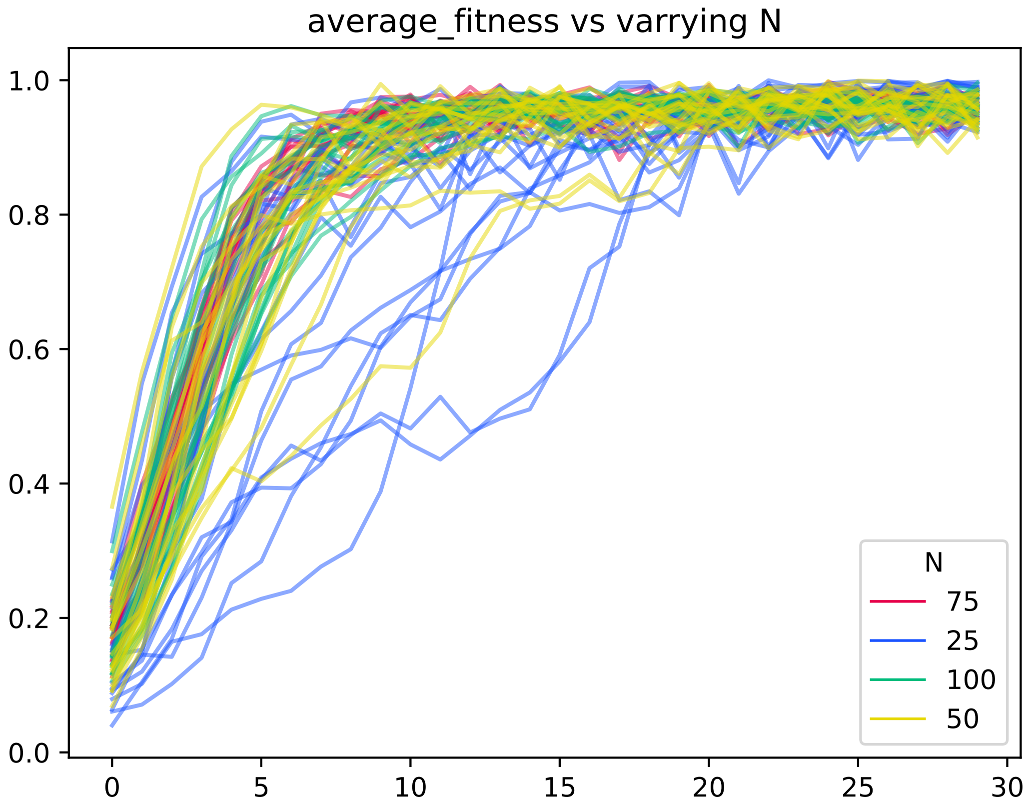
Crossover Amount of data allowed to be crossed over between genomes

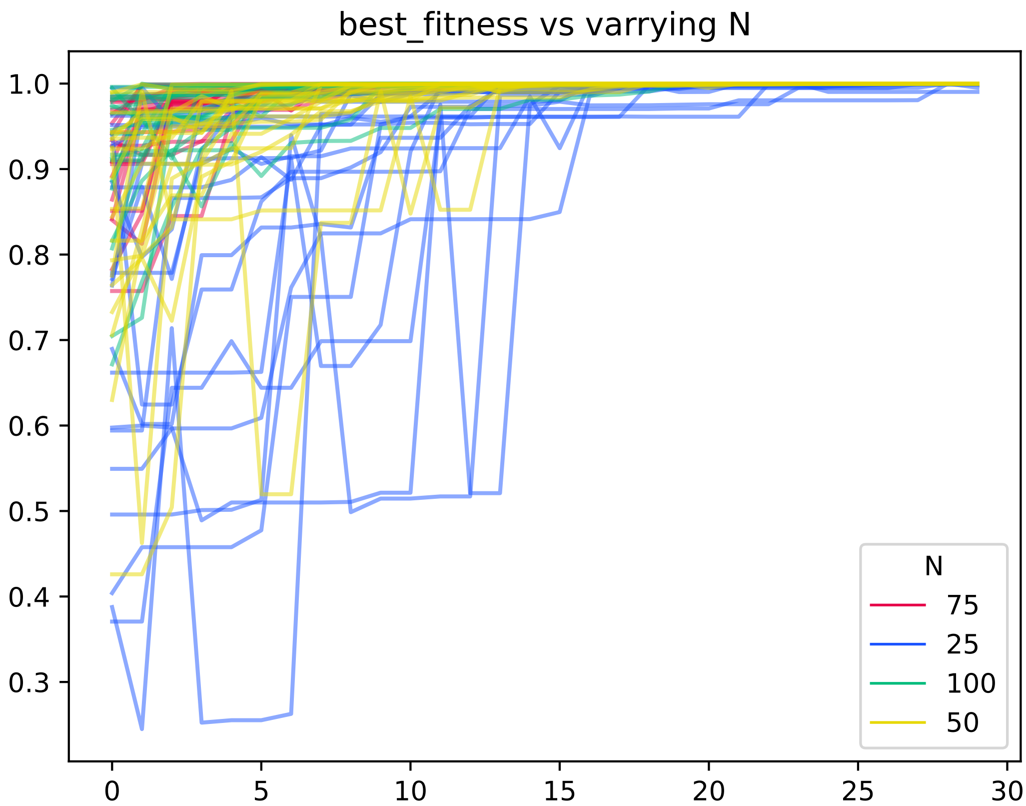
Population Size Size of population for each generation

1 Graphs

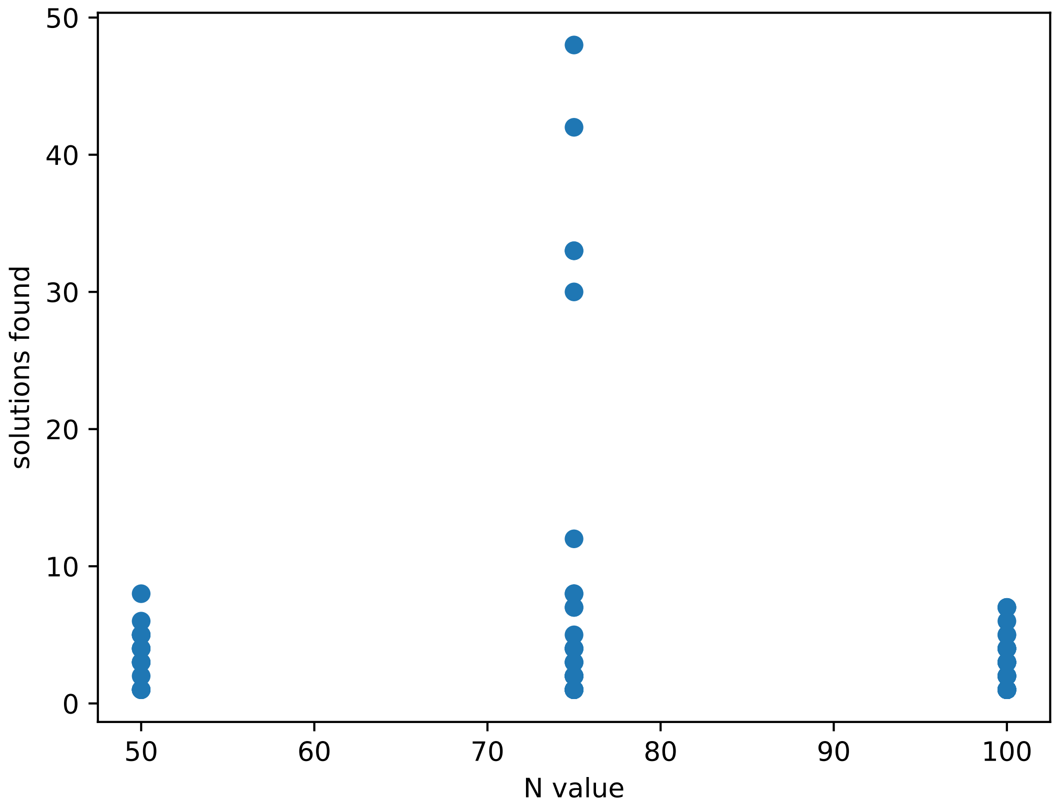
Below are graphs of each fitness over generation for each parameter. In these graphs only one parameter is changing, the rest are held constant.

N

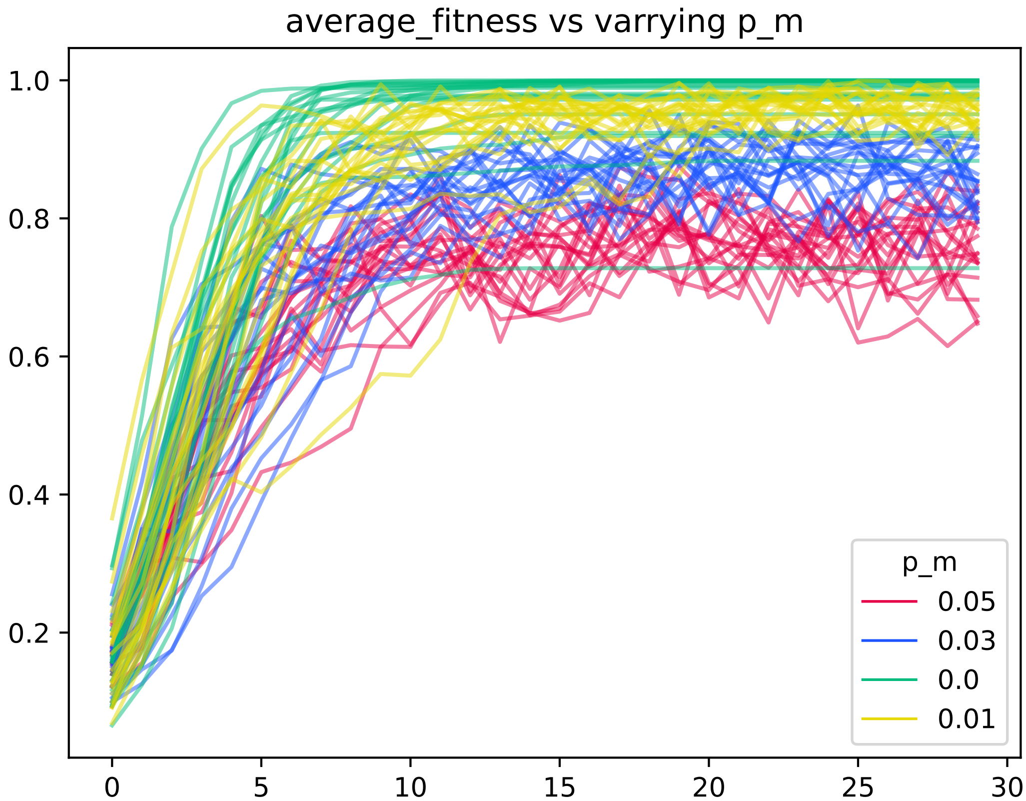

average_fitness vs varrying N
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
N
75
25
100
50



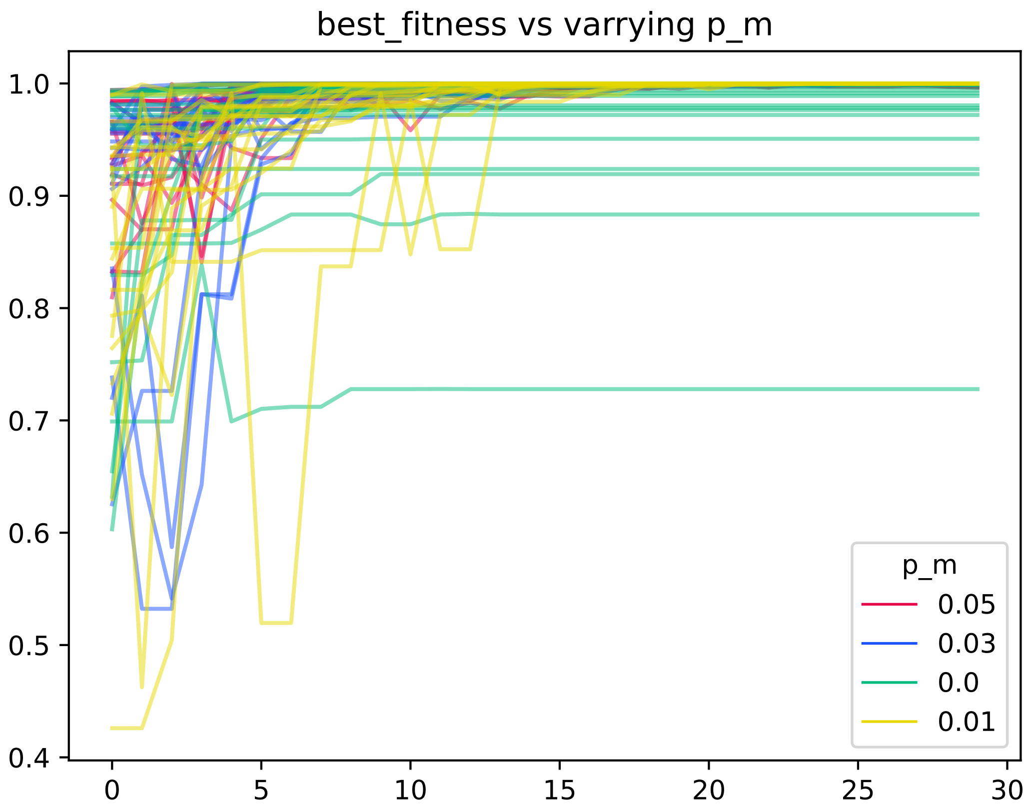
The most we can glean from this is larger initial population helps with fitness but there appear to be diminishing returns, this becomes especially obvious when you look at the plot of N values vs solutions found, No solutions were found at low values of N, but the most solutions were found at the intermediate value 75.


solutions found
N value
0
10
20
30
40
50
60
70
80
90
100

1.1 Mutation

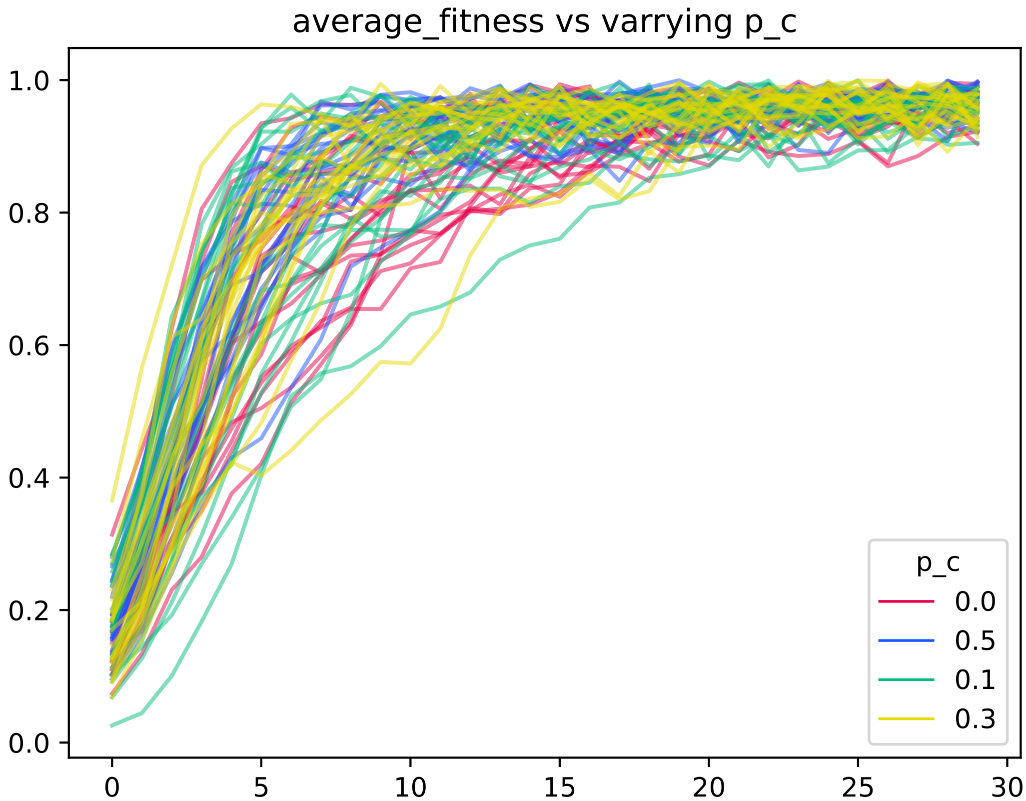


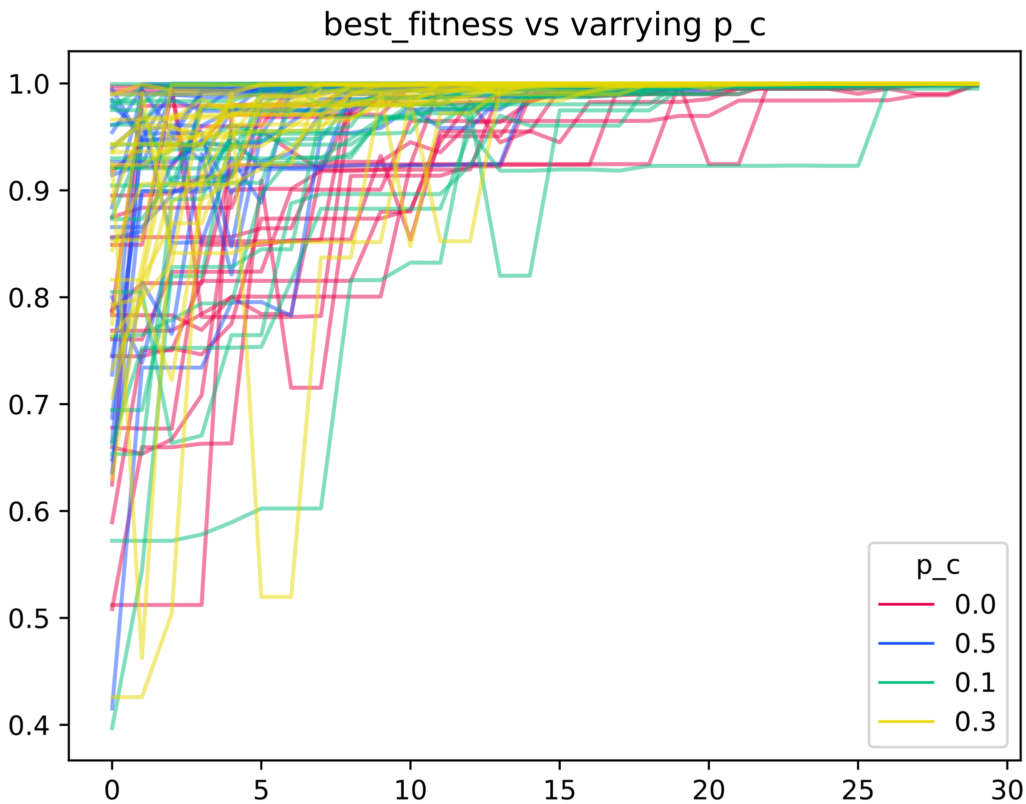
average_fitness vs varrying p_m
1.0
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
p_m
0.05
0.03
0.0
0.01



Mutation has the strongest separation out of all of the parameters, low mutation values result in better fitness. However its effect on diversity is also distinct and will be discussed later. The consequence for this can be seen in the best fit graph, where the lack of diversity results in the low mutation values finding local maxima more frequently.

1.2 Crossover





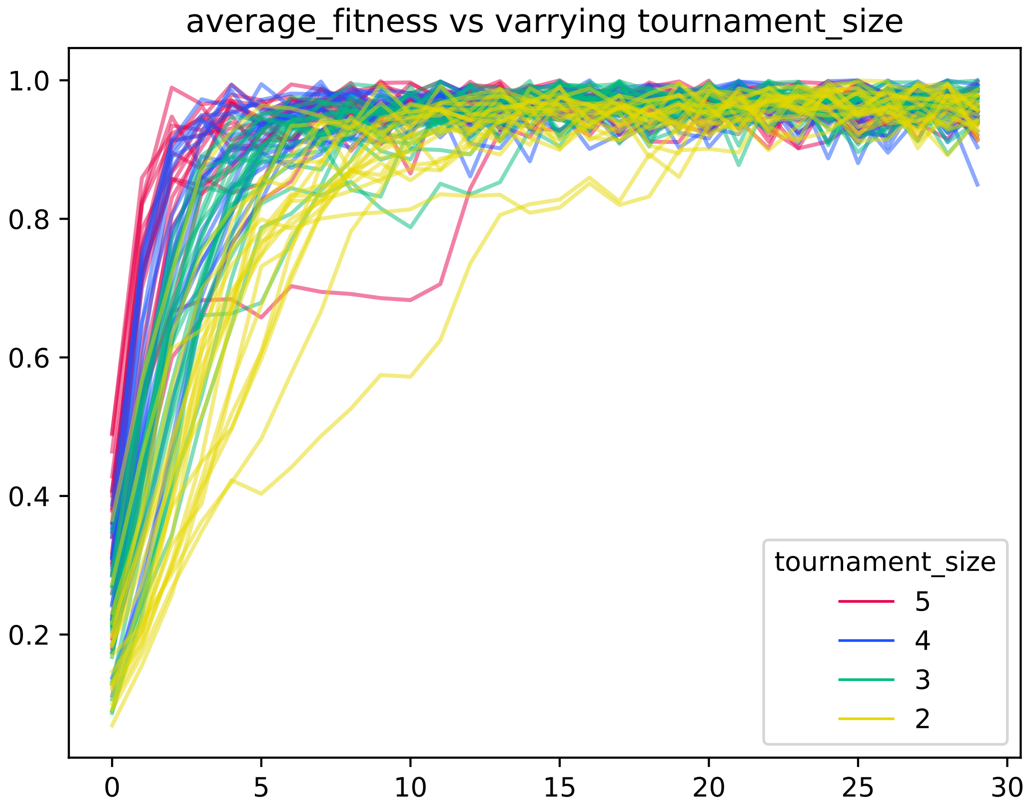
Crossover has the least separation of all of the parameters, the primary insight I can take away from this is that a higher crossover value tends towards faster convergence, all parameter values do seem to find maximal values eventually.

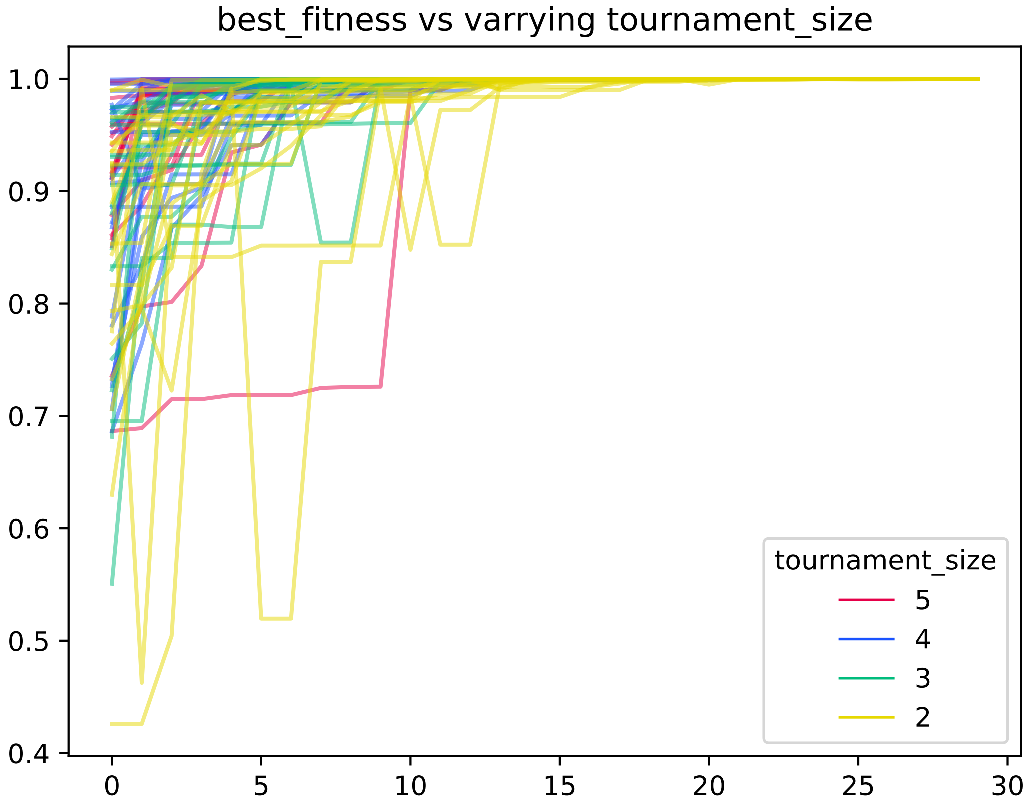
1.3 Mutation and Crossover

Mutation and Crossover are closely linked. Fitness values are significantly worse if only one or the other are set during a generation. Below is a table of the number of solutions found compared to mutation and crossover parameter settings.

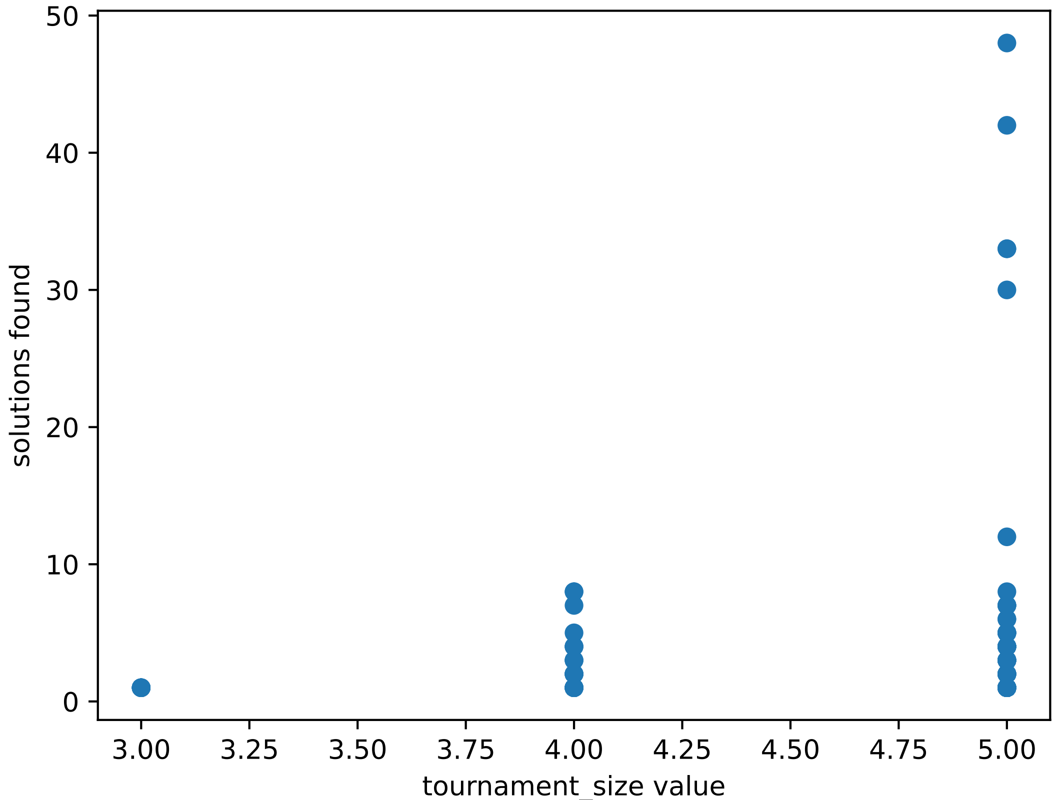
	Solutions Found
Mutation and Crossover	120
Just Mutation	15
Just Crossover	0

1.4 Tournament Size



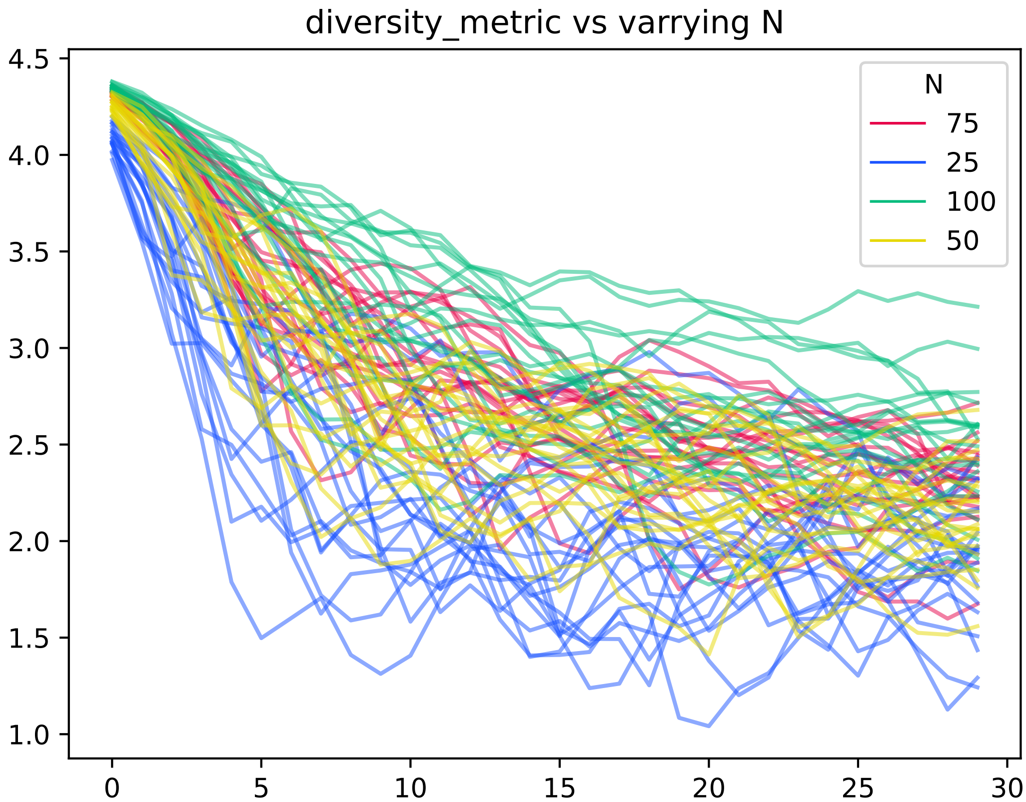


tournament size has a strong effect on convergence rate, larger tournaments cause convergence much more quickly. larger tournament sizes also lead towards higher fitness values, which is more clearly evidenced by the solutions chart below. Higher selection pressure has a strong impact on fitness, however it can lead to a lack of diversity.

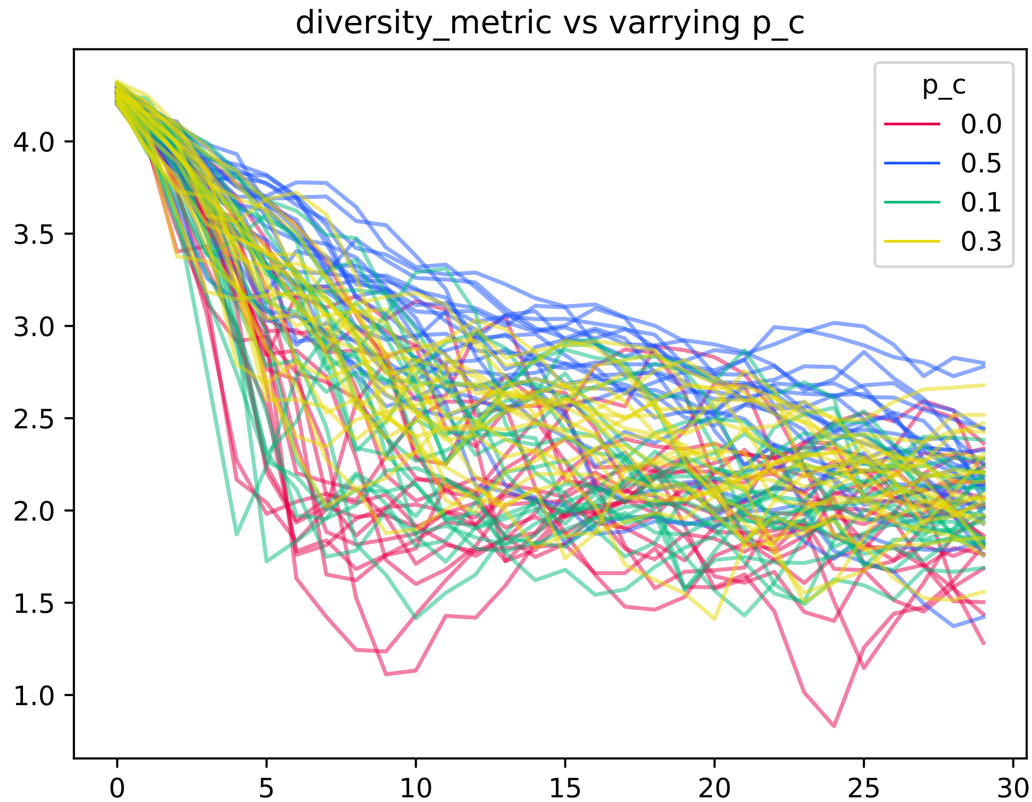


2 Diversity

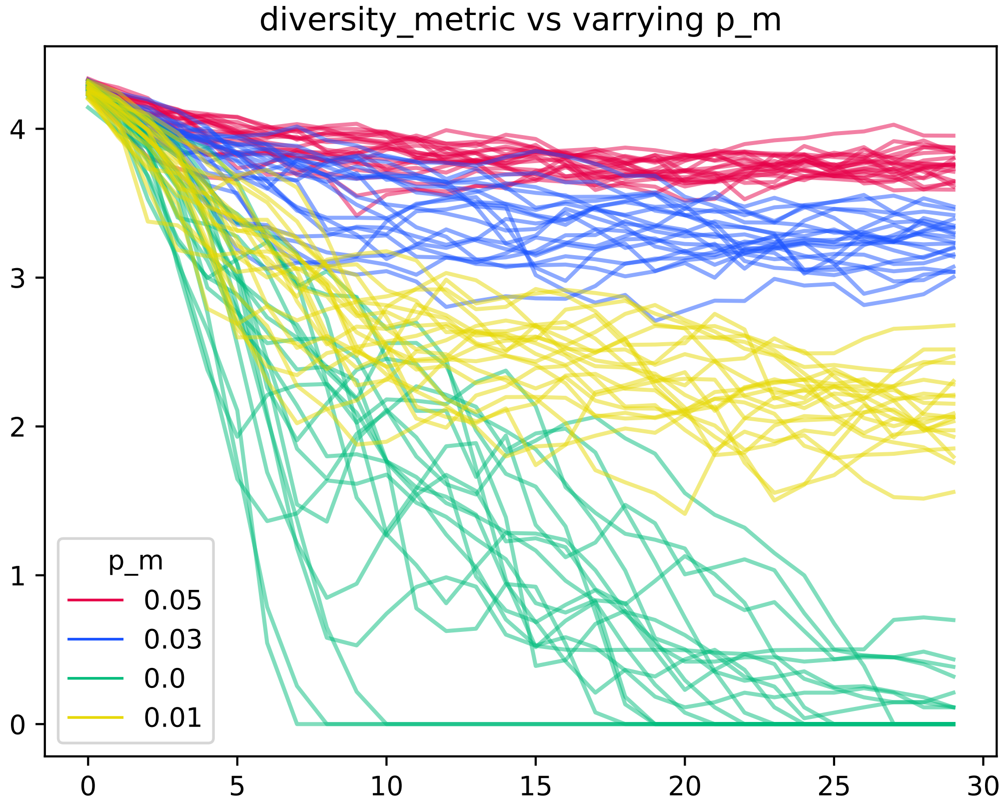
Diversity is another factor in evolutionary algorithms, A higher diversity leads to more varied results which increases the changes of finding global maxima, or at least helps to prevent finding local maxima. Below are graphs similar to those for fitness comparing diversity over fitness for various parameter values, Once again all but one parameter are frozen for each graph.

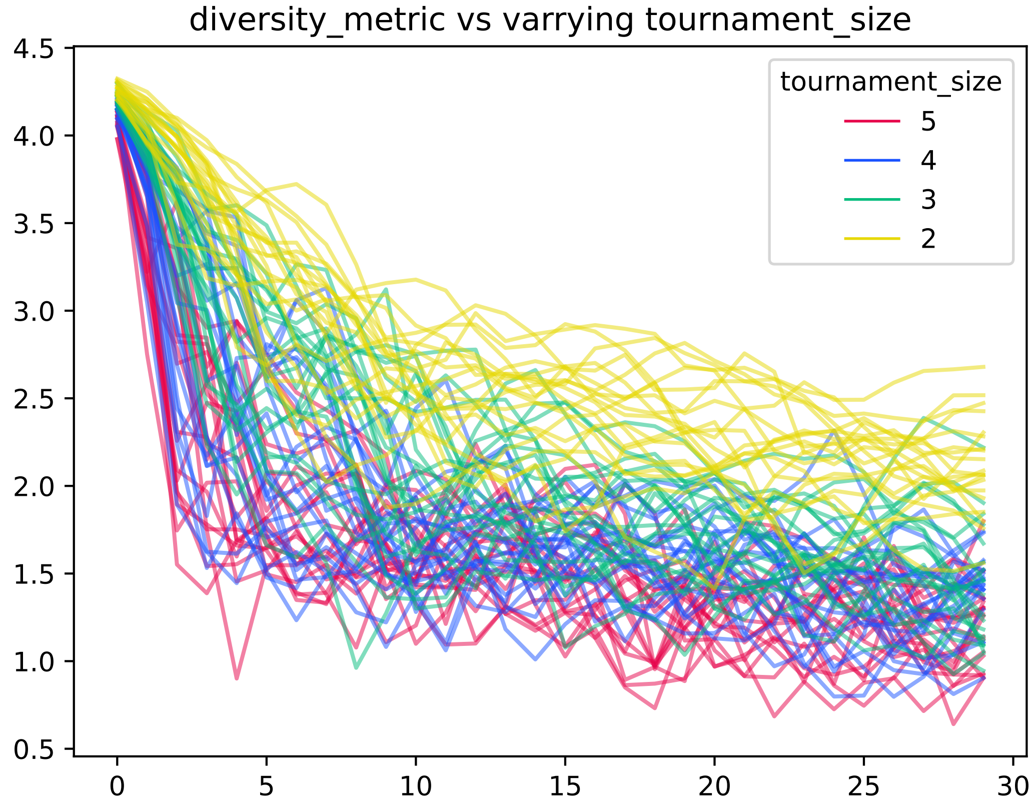


diversity_metric vs varrying N
N
75
25
100
50
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
5
10
15
20
25
30



diversity_metric vs varrying p_c
p_c
0.0
0.5
0.1
0.3
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
5
10
15
20
25
30


diversity_metric vs varrying p_m
p_m
0.05
0.03
0.0
0.01
0
1
2
3
4
0
5
10
15
20
25
30



Population size and crossover have the least significant impacts on diversity, in both cases lower values result in less diversity, this is logical as more crossover of genes and more population gives more room for unique combinations.

Mutation has the strongest effect on diversity by far. With large values maintaining near maximal diversity values and low mutation flat lining rapidly. This makes sense as mutation introduces new random genes into a population, where crossover only move genes around a population, and the other two just effect the size of the population.

Tournament size has the second strongest effect on diversity. Tournament size effects how many parents are selected for evaluation, having a smaller tournament pool increases the change that lower strength individuals will survive and maintains diversity in the system, while a larger tournament pool adds more evolutionary pressure and results in less diversity. This can clearly be identified in the graph.