CS5401 FS2018 Assignment 1d

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I. Best Configuration

For this assignment the author used a Multi-Objective EA to solve the Light Up puzzle. Each solution has three separate fitness values. The first, just called the fitness, is an integer that represents the number of panels that are lit up. The second fitness value, called the shine fitness, is an integer that represents how many bulbs shine on an other bulb. The first fitness, called the wall fitness, is an integer that represents the number of black cells that are not satisfied for the particular solution. While Fitness is to be maximized, Shine Fitness and Wall Fitness are to be minimized.

All parent selection and survival selection operators use now levels of non-domination instead of the fitness, unlike the previous assignment. The levels of non-domination are computed by using a recursive function that takes in two parameters, the population member being inserted and the list that represents the levels of domination. This algorithm will check each level starting from the top, with the top consisting of the members that are not dominated by anyone in the current domination levels list. If the member is not dominated by anyone in the current level it is inserted, if it is dominated by at least one other member then the algorithm tries to insert into the next level. If the member being inserted is dominated by an other solution in the last level, a new level is added with the member being inserted as the only member in this level. Whenever a member in inserted, we check each member in the level and if they are dominated by the new member that was inserted, if it is then remove it from the level and this insertion function using this removed member and the current list as the parameters.

II. Results

First we shall determine what configuration of operators and strategies provide the best results. For used sixteen different configurations. These sixteen consist of all possible combinations that use K tournament and fitness proportional parent selection, k tournament and truncation for survival, and both plus and comma survival strategies. From the Tables I through XVI we can see some immediate results. For the random generated (Tables I, II, III, IV, IX, X, XI, XII) for the experiments that used the same parent and survival selection operators, the experiments that used the plus strategy are larger then the ones that used the comma strategy. For experiments that used the provided puzzle (Tables V, VI, VII, VIII, XIII, XIV, XV, XVI) we can see similar results with a notable exception, for each experiment the shine fitness provides a better result with he mean being lower. This can be seen because this EA utilizes a repair function that removes bulbs that shine on each other. However despite this exception, the other two metrics for each experiment for the provided puzzle produce better results. So the experiments that use the plus strategy provide better results. For example, compare Fig 1 and Fig 2 against each other and it is clear for this experiment that the plus produced the better results. Comparing Fig 3 and Fig 4 yields similar results.

Now we will compare the results of each plus experiment with each other. To do this we will use a test statistics between for four generated experiments and the four provided experiments. First we shall determine if the experiments have similar variances using the F Test for each experiment against each other. Our

$$\alpha = 0.05$$

and our null hypothesis for each test is ”The two variables have the same variance” and our alternative hypothesis is ”The two variables do not have the same variance”. Note: Best Shine Fitness and Best Wall Fitness will not have a test statistic done to them because in every case they are either identical or close enough where statistical software gives an error or 0 for the F test.

For the generated experiments, we can see that for the F test on the average fitness (Table XVII) we fail to reject the null for each case. For the F test on the Best Fitness (Table XVIII) , we can see that the null hypothesis is rejected for each case, this we accept the alternative hypothesis for this case. The F test for the average shine fitness (Table XX), depending on the experiment the null can be accepted or rejected but is accepted twice as much so we shall accept the null hypothesis for this case. Finally for the last F test about the wall fitness (Table XIX) we can see that depending on the experiment the null can be rejected or accepted, but is rejected twice as much, so we shall reject the null hypothesis and accept the alternative hypothesis. So in all, for comparing average fitness and average shine fitness we shall use a t test with two tails and assume the the variances are equal. For comparing best fitness and average wall fitness we shall use a t test with two tails and assume that the variances are not equal. For this T Test let our

$$\alpha = 0.05$$

and our null hypothesis be ”The true difference in mean of the two variables is zero” and out alternative hypothesis be ”The true difference in mean of the two variables is not zero”. For the average fitness we use Table XXV and can see we reject the null hypothesis for each experiment with the exception of the the case of Parent Fitness Proportional paired with Survival K Tournament and Both parent and Survival K Tournaments in which we reject the null hypothesis. For the best fitness

we use Table XXVI and can see we reject the null hypothesis for every case and accept the alternative hypothesis. For the average wall fitness we use Table XXVII and we see we reject the null hypothesis in all but one case, that being the case of Parent Fitness Proportional with Survival Tournament vs. Parent Fitness Proportional with Truncation, so in that particular case we fail to reject the null hypothesis. For the average shine fitness we use Table XXVI and see that we fail to reject the null hypothesis for every case. For in general we can say the there is no statistical significance for which EA has the best average shine fitness, however there is a statistical significant difference for the average fitness, best fitness, and average wall fitness of the experiments. Thus the algorithm with the best average in the fitness category is the statically best algorithm for that category of fitness. By using Tables I through IV we can see the means and standard deviations of the generated experiments that use the plus strategy. From these tables we can see that the algorithm with the best average fitness and the best best fitness is the EA which uses Parent Fitness Proportional and Truncation (Table II). The algorithm with the best average wall fitness is the experiment which uses parent and survival K tournaments, however this difference is very small. So overall the best algorithm configuration for the generated experiments is the configuration in that uses the plus strategy, parent fitness proportional selection, and truncation.

For the provided experiments, we can see that for the F test on the average fitness (Table XXI) that we fail to reject the null hypothesis for almost every case. For the F test on the best fitness (Table XXII) we can see that the null hypothesis is rejected for nearly every case, so we accept this alternative hypothesis. The F test for the average shine fitness (Table XXIII) shows us we fail to reject the null hypothesis for nearly every case, so we accept the alternative hypothesis. For the F test for he average wall fitness (Table XXIV) we can see that the we fail to reject the null hypothesis for nearly every case as well. By these results, we shall use a T test with two tails assuming that the variances are equal for average fitness, average shine fitness, and average wall fitness. This means we are using a T test with two tails assuming unequal variances for the best fitness. For these series of T test let our

$$\alpha = 0.05$$

and our null hypothesis be "the true mean difference between the two variables is zero" and the alternative hypothesis be "the true mean difference between the two variables is not zero". For the average fitness T Test on Table XXIX we can see that we reject the null hypothesis for nearly every case with the exception of two: Parent Fitness Proportional with Survival K tournament vs. Parent K tournament with truncation and Parent K tournament with truncation vs. Parent and Survival K tournament. So for these two cases there is no significant difference between them. For the best fitness T test on Table XXX we reject the null hypothesis for nearly every case also with the exception of two: Parent Fitness Proportional with survival K tournament vs. Parent Fitness Proportional with truncation and Parent Fitness Proportional with survival K tournament vs. Parent and Survival K tournaments. So there is not a significant difference between all other cases except these two for best fitness. For the T test on average shine fitness on Table XXXI we can see that the null hypothesis is rejected for half of the cases, the cases in which it is not rejected are: Parent Fitness Proportional with survival K tournament vs. Parent Fitness Proportional with truncation, Parent Fitness Proportional with survival K tournament vs. Parent K tournament with truncation, and Parent Fitness Proportional with truncation vs. Parent K tournament with truncation. For for the three cases listed there is no statistical significance between the three. For the average wall fitness T test on Table XXXII we ca see see that the null hypothesis is rejected for every case except one: Parent Fitness Proportional with survival K tournament vs. Parent and Survival K tournaments. For this case in particular we may say it is not statically significant. With these results we will state that the algorithm with the best mean for each fitness category is the best algorithm for that category (Cases where there is some insignificance, are treated as equals). We can use Tables V through VIII to see the means and standard deviations of the provided experiments. By these tables we can say that the algorithm with the best average fitness and best average shine fitness is the configuration of plus strategy with Parent K tournament selection and Truncation survival. (Table VIII). For best best fitness and best average wall fitness, the configuration would be the one that uses the plus strategy, and parent and survival K tournaments. (Table VII). By this result, these two configurations are about equal since out of the four best values to have they each have two. However since the configuration which uses the plus strategy with Parent and Survival K tournaments made better local optimum solutions than the other, we shall take that as the best configuration for the provided experiments.

The charts that correspond to the best configuration for generated experiments are Fig 5 and Fig 4. The charts that correspond to the best configuration for the provided experiments are Fig 11 and Fig 12.

III. Validity Forced

In order to tell if the forced validity option provides a statistically significant change, we ran an generated experiment with the configuration of plus strategy with parent and survival K tournaments. We shall perform a F test comparing the two runs, let αand our null and alternative hypothesis be as defined as above. Table XXXIV shows that we fail to reject the null hypothesis in all cases, so we will perform a T test with two tails and assume that the variances are equal. The T Test results from Table XXXV show is that we reject the null hypothesis for average fitness, best fitness, and average wall fitness. We fail to reject for the average shine fitness so this fitness category is not statistically significant. The algorithm with the better means in the average fitness, best fitness, and average shine fitness categories is the statically better algorithm. By comparing the means and standard deviations from Tables XXXIII and III we can see that the better algorithm is in fact the one which uses forced validity plus uniform random (Table III). So by this result we can say the algorithms that use forced validity plus uniform random are the statically better algorithms. The graphs correspond to the configuration that

used uniform random and forced validity are Fig 9 and Fig 10. The graphs corresponding to the configuration that used only uniform random is Fig 7 and Fig 8

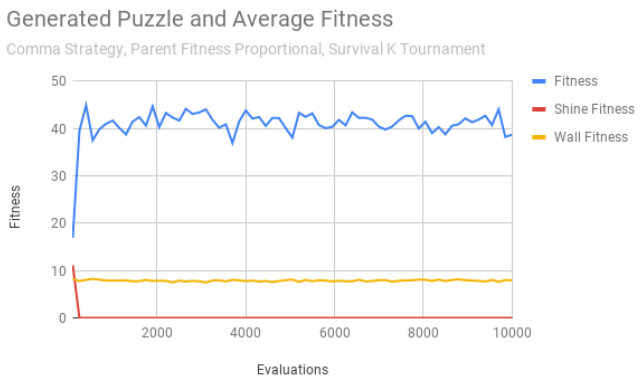

Fig. 1.

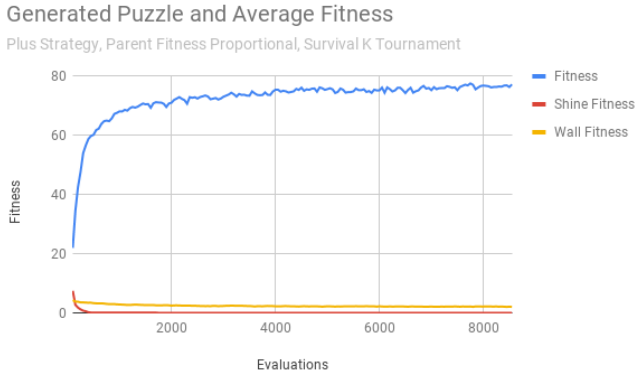

Fig. 2.

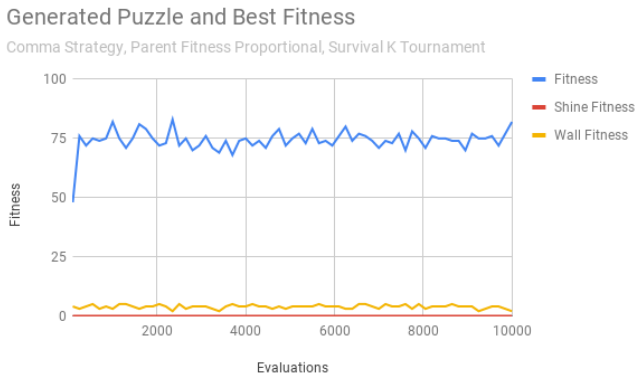

Fig. 3.

Fig. 4.

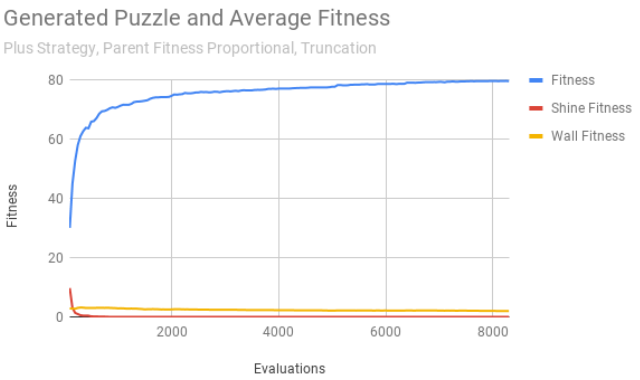

Fig. 5.

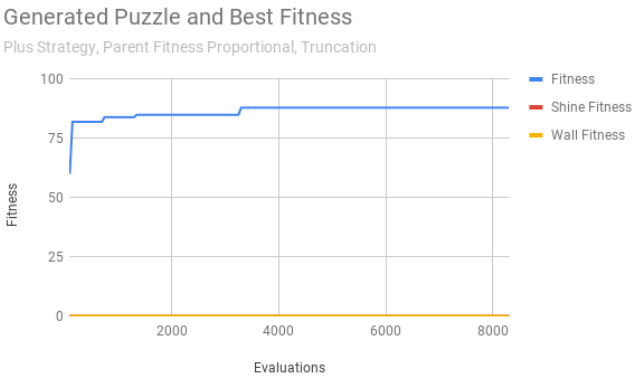

Fig. 6.

TABLE I
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING PLUS STRATEGY, PARENT FITNESS PROPORTIONAL, SURVIVAL K TOURNAMENT

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average Fitness	72.42058824	0.104	2.402941176	7.046132323	0.6313209595	0.3916474792
Best Fitness	87.00588235	0	0.01176470588	3.668992185	0	0.1081438497

TABLE II
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING PLUS STRATEGY, PARENT FITNESS PROPORTIONAL, TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	75.66820606	0.1149515152	2.374812121	6.078056779	0.8040658935	0.303651288
Best	86.39393939	0	0	2.851394545	0	0

TABLE III
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING PLUS STRATEGY, PARENT AND SURVIVAL K TOURNAMENTS

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	72.89100503	0.07733668342	2.325678392	6.415046312	0.6736448741	0.2868241588
Best	84.63316583	0	0.07035175879	2.508793732	0	0.3257863477

TABLE IV
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING PLUS STRATEGY, PARENT K TOURNAMENT, TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	70.69999497	0.09585929648	4.613718593	6.756796397	0.6554853783	0.427754356
Best	81.47738693	0	2.025125628	4.073595836	0	0.1569013693

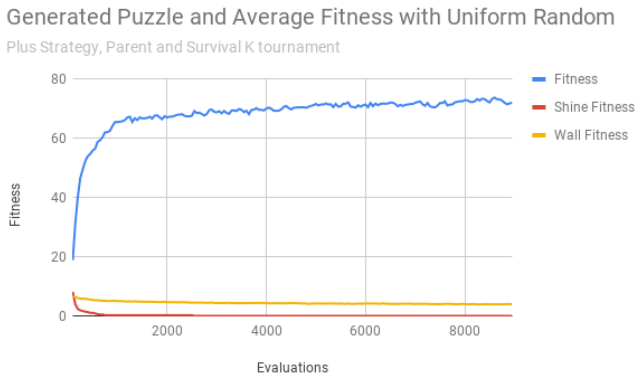

Fig. 7.

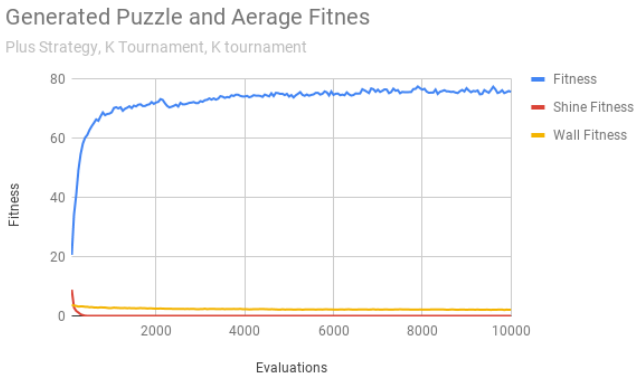

Fig. 9.

Fig. 8.

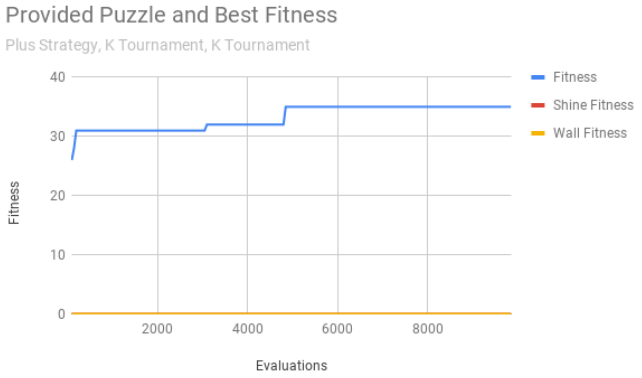

Fig. 10.

TABLE V
MEANS AND STANDARD DEVIATIONS FOR PROVIDED PUZZLE USING PLUS STRATEGY, PARENT FITNESS PROPORTIONAL, AND SURVIVAL K TOURNAMENT

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	26.24785714	0.2570238095	2.088511905	2.633812187	0.9059593516	0.3358011956
Best	32.88095238	0	0	2.722295447	0	0

TABLE VI
MEANS AND STANDARD DEVIATIONS FOR PROVIDED PUZZLE USING PLUS STRATEGY, PARENT FITNESS PROPORTIONAL, AND TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	26.51363158	0.2140263158	2.471539474	2.840785613	1.064175762	0.3659435031
Best	32.58552632	0	0.3355263158	2.166708001	0	0.4737350385

TABLE VII
MEANS AND STANDARD FOR DEVIATIONS PROVIDED PUZZLE USING PLUS STRATEGY, PARENT AND SURVIVAL K TOURNAMENT

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	26.29811224	0.5342857143	2.039795918	2.67837111	0.9826364328	0.3185543615
Best	33.19897959	0	0	1.944406568	0	0

TABLE VIII
MEANS AND STANDARD DEVIATIONS FOR PROVIDED PUZZLE USING PLUS STRATEGY, PARENT K TOURNAMENT, TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	27.05966332	0.1846582915	2.322286432	2.581336701	0.9728066777	0.3753901047
Best	31.34170854	0	0.1306532663	1.492005327	0	0.3378707472

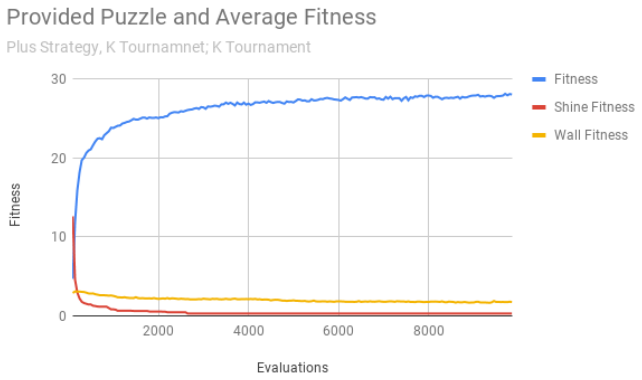

Fig. 11.

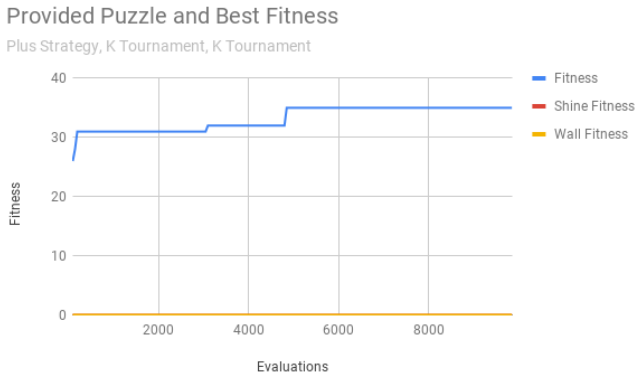

Fig. 12.

TABLE IX
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING COMMA STRATEGY, PARENT FITNESS PROPORTIONAL, SURVIVAL K TOURNAMENT

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	40.99447761	0.1662686567	7.872686567	3.44422366	1.36096761	0.1637031875
Best	74.2238806	0	3.865671642	4.495185625	0	0.8145555097

TABLE X
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING COMMA STRATEGY, PARENT FITNESS PROPORTIONAL, TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	54.84940299	0.1598507463	5.770597015	3.755394456	1.308434749	0.1494624773
Best	76.40298507	0	2.985074627	3.176903874	0	0.4435578372

TABLE XI
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING COMMA STRATEGY, PARENT AND SURVIVAL K TOURNAMENT

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	37.58656716	0.1064179104	8.435373134	3.638320272	0.8710681383	0.1382282736
Best	69.50746269	0	4.597014925	5.067343857	0	0.7988571665

TABLE XII
MEANS AND STANDARD DEVIATIONS FOR GENERATED PUZZLE USING COMMA STRATEGY, PARENT K TOURNAMENT, TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	41.19343284	0.1126865672	7.918656716	3.662840656	0.9223793049	0.1639373081
Best	72.68656716	0	4.328358209	4.771153711	0	0.6603043307

TABLE XIII
MEANS AND STANDARD DEVIATIONS FOR PROVIDED PUZZLE USING COMMA STRATEGY, PARENT FITNESS PROPORTIONAL, SURVIVAL K TOURNAMENT

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	20.6358209	0.1952238806	3.827910448	2.005373198	1.597976332	0.1584923028
Best	28.79104478	0	1.149253731	1.297285201	0	0.5001130582

TABLE XIV
MEANS AND STANDARD DEVIATIONS FOR PROVIDED PUZZLE USING COMMA STRATEGY, PARENT FITNESS PROPORTIONAL, TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	20.91761194	0.1826865672	3.947761194	2.005115495	1.495353999	0.1740935041
Best	28.88059701	0	1.208955224	1.398293203	0	0.508631957

TABLE XV
MEANS AND STANDARD DEVIATIONS FOR PROVIDED PUZZLE USING COMMA STRATEGY, PARENT AND SURVIVAL K TOURNAMENT

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	20.6880597	0.1634328358	3.814179104	1.881807834	1.337755416	0.1421922435
Best	28.97014925	0	1.23880597	1.445684794	0	0.5529412331

TABLE XVI
MEANS AND STANDARD DEVIATIONS FOR PROVIDED PUZZLE USING COMMA STRATEGY, PARENT K TOURNAMENT, TRUNCATION

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	21.02671642	0.1498507463	3.919253731	1.901333175	1.226581221	0.1613795961
Best	28.88059701	0	1.268656716	1.419799261	0	0.5099640377

TABLE XVII
F TEST FOR AVERAGE FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.05764823315	0.203557104	0.5687521801
Propertional - Trun	0.05764823315	NA	0.4741794898	0.1599176759
K Tourn - K Tourn	0.203557104	0.4741794898	NA	0.4658486947
K tourn - Truncation	0.5687521801	0.1599176759	0.4658486947	NA

TABLE XVIII
F TEST FOR BEST FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.04900540046	0.0000003053462656	0.1610170456
Propertional - Trun	0.04900540046	NA	0.08518173155	0.00000305262849
K Tourn - K Tourn	0.0000003053462656	0.08518173155	NA	0
K tourn - Truncation	0.1610170456	0.00000305262849	0	NA

TABLE XIX
F TEST FOR AVERAGE WALL FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.001129378882	0.00002608294704	0.237276012
Propertional - Trun	0.001129378882	NA	0.4422575579	0.000007171503741
K Tourn - K Tourn	0.00002608294704	0.4422575579	NA	0.0000000294308153
K tourn - Truncation	0.237276012	0.000007171503741	0.0000000294308153	NA

TABLE XX
F TEST FOR AVERAGE SHINE FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.001900176553	0.3846542965	0.6156177487
Propertional - Trun	0.001900176553	Na	0.01736694659	0.006043470847
K Tourn - K Tourn	0.3846542965	0.01736694659	NA	0.7009658009
K tourn - Truncation	0.6156177487	0.006043470847	0.7009658009	NA

TABLE XXI
F TEST FOR AVERAGE FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.3397785478	0.8252734621	0
Propertional - Trun	0.3397785478	NA	0.4382592049	0.2065421426
K Tourn - K Tourn	0.8252734621	0.4382592049	NA	0.6051845532
K tourn - Truncation	0	0.2065421426	0.6051845532	NA

TABLE XXII
F TEST FOR BEST FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.004448594276	0.000006534585006	0
Propertional - Trun	0.004448594276	NA	0.1550702015	0.000000915130854
K Tourn - K Tourn	0.000006534585006	0.1550702015	NA	0.0002250486751
K tourn - Truncation	0	0.000000915130854	0.0002250486751	NA

TABLE XXIII
F TEST FOR AVERAGE SHINE FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.04259527294	0.2794551885	0.3419015296
Propertional - Trun	0.04259527294	NA	0.294657023	0.2363410555
K Tourn - K Tourn	0.2794551885	0.294657023	NA	0.8877788057
K tourn - Truncation	0.3419015296	0.2363410555	0.8877788057	NA

TABLE XXIV
F TEST FOR AVERAGE WALL FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.2781898766	0.4771466143	0.1368498143
Propertional - Trun	0.2781898766	NA	0.06861131397	0.7445262623
K Tourn - K Tourn	0.4771466143	0.06861131397	NA	0.02191056771
K tourn - Truncation	0.1368498143	0.7445262623	0.02191056771	NA

TABLE XXV
T TEST FOR AVERAGE FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.000008940470771	0.5026626821	0.0173261807
Propertional - Trun	0.000008940470771	NA	0.00003219180551	0
K Tourn - K Tourn	0.5026626821	0.00003219180551	NA	0.0009927146189
K tourn - Truncation	0.0173261807	0	0.0009927146189	NA

TABLE XXVI
T TEST FOR BEST FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.002136982213	0	0
Propertional - Trun	0.002136982213	NA	0.000000001782590116	0
K Tourn - K Tourn	0	0.000000001782590116	NA	0
K tourn - Truncation	0	0	0	NA

TABLE XXVII
T TEST FOR AVERAGE SHINE FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.889630938	0.6967090959	0.9037988422
Propertional - Trun	0.889630938	Na	0.6275003266	0.8030601472
K Tourn - K Tourn	0.6967090959	0.6275003266	NA	0.7811619051
K tourn - Truncation	0.9037988422	0.8030601472	0.7811619051	NA

TABLE XXVIII
T TEST FOR AVERAGE WALL FITNESS FOR GENERATED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.4623374287	0.03396673018	0
Propertional - Trun	0.4623374287	NA	0	0
K Tourn - K Tourn	0.03396673018	0.1160007053	NA	0
K tourn - Truncation	0	0	0	NA

TABLE XXIX
T TEST FOR AVERAGE FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.3858423374	0.8573833697	0
Propertional - Trun	0.3858423374	NA	0.4689342047	0.0609827605
K Tourn - K Tourn	0.8573833697	0.4689342047	NA	0.004227510997
K tourn - Truncation	0	0.0609827605	0.004227510997	NA

TABLE XXX
T TEST FOR BEST FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.2815267033	0.2075712103	0.0000000003357770983
Propertional - Trun	0.2815267033	NA	0.006530568435	0.000000004767959207
K Tourn - K Tourn	0.2075712103	0.006530568435	NA	0
K tourn - Truncation	0.0000000003357770983	0.000000004767959207	0	NA

TABLE XXXI
T TEST FOR AVERAGE SHINE FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0.6966193855	0.005691901953	0.4642842474
Propertional - Trun	0.6966193855	NA	0.003873683416	0.7880612269
K Tourn - K Tourn	0.005691901953	0.003873683416	NA	0.000426344352
K tourn - Truncation	0.4642842474	0.7880612269	0.000426344352	NA

TABLE XXXII
T TEST FOR AVERAGE WALL FITNESS FOR PROVIDED EXPERIMENTS. (ROW AND COLUMN HEADERS ARE DENOTED IN PARENT SELECTION - SURVIVAL SELECTION ORDER)

	Propertional - K Tourn	Propertional - Trun	K Tourn - K Tourn	K tourn - Truncation
Propertional - K Tourn	NA	0	0.1568802924	0.000000001244733785
Propertional - Trun	0	NA	0	0.0002223304228
K Tourn - K Tourn	0.1568802924	0	NA	0
K tourn - Truncation	0.000000001244733785	0.0002223304228	0	NA

TABLE XXXIII
MEANS AND STANDARD DEVIATIONS FOR PLUS STRATEGY, SURVIVAL AND PARENT K TOURNAMENTS, AND USING UNIFORM RANDOM INITIALIZATION.

	Fitness Mean	Shine Fitness Mean	Wall Fitness Mean	Fitness SD	Shine Fitness SD	Wall Fitness SD
Average	68.47404494	0.1908988764	4.409550562	6.711587033	0.7421889148	0.4809040688
Best	83.03370787	0	2.117977528	2.8262268	0	0.3234914743

TABLE XXXIV
F TEST BETWEEN CONFIGURATION THAT USED FORCED VALIDITY AND UNIFORM RANDOM VS UNIFORM RANDOM.

Average Fitness	Best Fitness	Average Shine Fitness	Average Wall Fitness
0.5351707078	0.1028700947	0.184471757	0

TABLE XXXV
T TEST BETWEEN CONFIGURATION THAT USED FORCED VALIDITY AND UNIFORM RANDOM VS UNIFORM RANDOM.

Average Fitness	Best Fitness	Average Shine Fitness	Average Wall Fitness
0.0000000002143566656	0.00000001255684286	0.1202303838	0