FS2017

COEVOLUTION ANALYSIS

COMP SCI 5401 FS2017 ASSIGNMENT 2C

GRANT BROADWATER
GRBCP5@MST.EDU
Assignment 2c

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Methodology

This CoEA implemented is a single-population coevolution and tree based genetic programming search for the optimal iterated prisoner dilemma problem. For each new generation, the algorithm first generates all new children without calculating any of the new fitness's until each of the children are created. Once all the children are created, the algorithm calculated the fitness for each of the newly created children. It does this by randomly selecting a user-configurable amount of other individuals from a pool containing the population and all of the newly created children. This selection process is uniform random. The newly created child then plays the IPD simulation for a user configurable amount of iterations. The fitness against this opponent is inversely proportional to the amount of time the newly created child spent in jail as a result of its strategy. This process is repeated for each of the randomly selected opponents, and the newly created child's fitness is an average of its fitness's from each opponent.

Experimental Setup

For this experiment, the fitness is compared to the co-evolutionary fitness sampling percentage to see which sampling percentage provides the best fitness. The measured fitness values are 10%, 25%, and 50%. The results of these experiments will then be statistically analyzed against each other to see which of the sampling percentage values produces the most optimal individuals. The analysis will be done first by using an f-test to determine if the two samplings have equal variances. Then a t-test will be used to determine which sampling level yields the better solutions. These tests will use an alpha level of 5%.

Discussion

As can be seen, the absolute fitness when compared against a tit-for-tat strategy does not vary from any of the variations. For all three of these sampling percentage levels the absolute fitness corresponds with the prisoner always cooperating. More variation is seen when comparing against other strategies in the population, but only slightly. And based on analysis from the log files, I would assume that this variation would also level out amongst all three of these trials and go away if permitted more fitness evaluations and thus more generations. There does appear to be an average correlation to average fitness and sampling percentage. As each individual is evaluated amongst more individuals, the average fitness of the population rises closer to the optimal fitness where all individuals always cooperate. This implies that as each individual prisoner is paired up against more prisoners in the population, the more likely the average prisoner in the population is to learn to always cooperate. This is likely only possible due to the fact the first 2k iterations do not count, so as to sort out all of the defects that are created in the randomly generated initial memory environment.

Conclusion

In conclusion there is a lot more research which could still be done to tune the effectiveness of the EA even further. For example, as mentioned earlier increasing the number of fitness evaluations may cause the variation in composite fitness to subside towards the optimal value. This may also allow the trend for average fitness to continue to increase with more fitness evaluations available. If this is the case it would be possible for the average fitness to rise all the way to the level of optimal fitness where every individual in the population is choosing to always cooperate. In this case one single individual could benefit from defecting. Another point to look into is some of the trials produce very large trees. These trials may stand to benefit from an increased parsimony pressure.