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CS420
Lab 4
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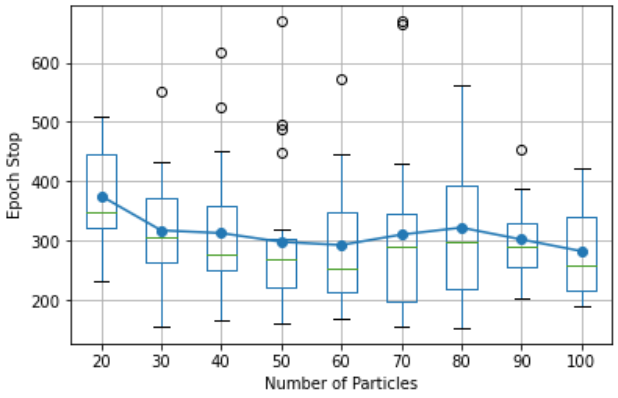
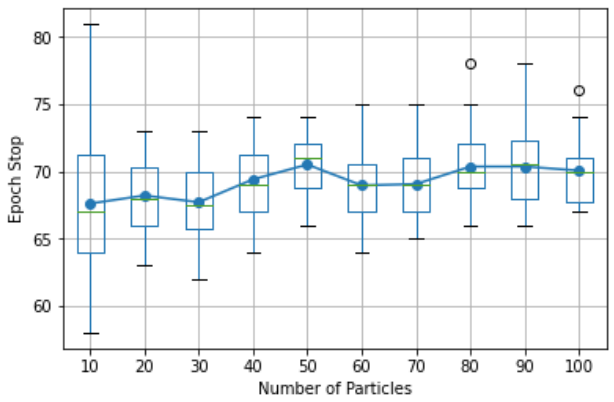
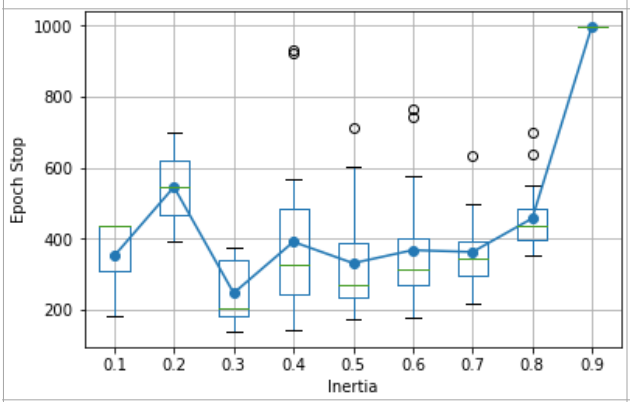
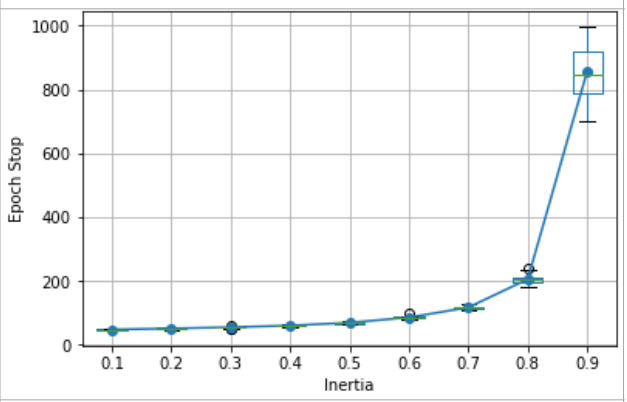
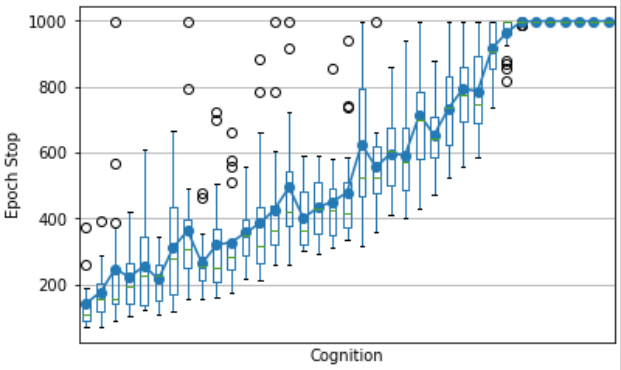
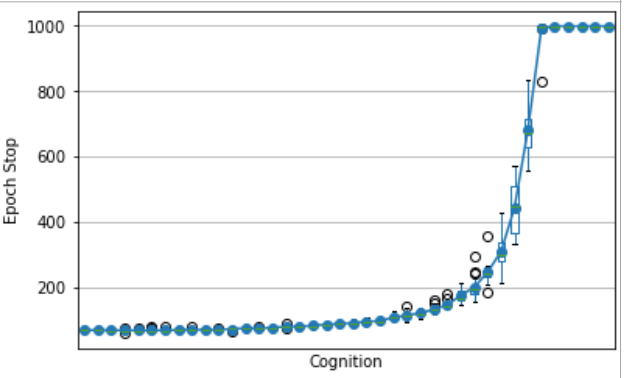
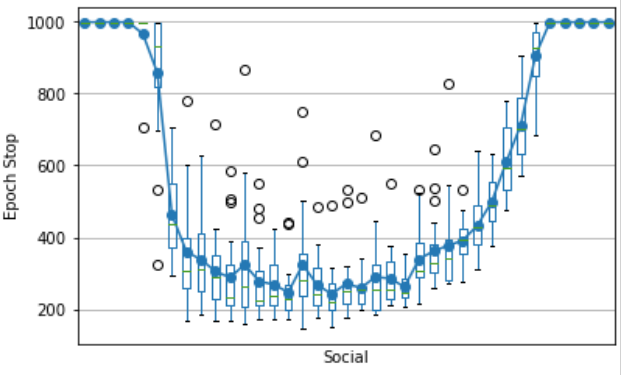
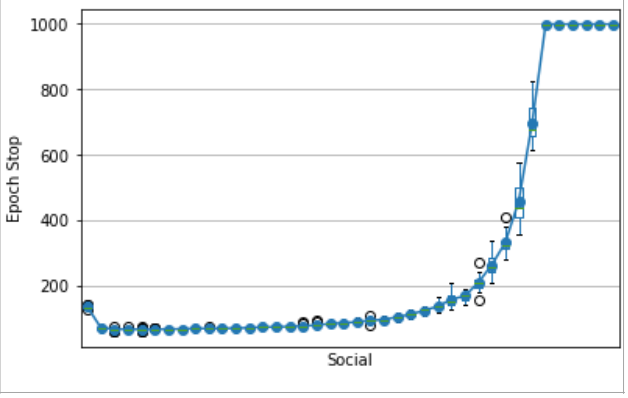
How big of an impact can parameter selection have on performance?
Parameter selection can have a large impact on performance. Some parameters have a larger impact on the speed at which they converge while others impact whether they converge at all. For example, if the *inertia* is 1.0 it will not converge regardless of the particle swarm optimization code (Rosenbrock or Booth). On the other hand, the 1.0-2.5 range of *social* values converges the quickest on average for the Booth code. For the sake of symmetry, I included the graph for the *number of particles* parameter (Booth) regardless of the fact that it converges on every run.

Do there appear to be optimal values for each parameter? Are the "best" performing values (i.e., those that converge the fastest) the same for each problem?
There are definitely optimal values for each parameter. For example, the *cognition* parameter performs better as you decrease it. The best-performing values are not the same for each problem, but they are close to each other for each parameter except for the *number of particles*. The *social* parameter has differing optimal ranges for each problem: 10-30 for Rosenbrock and 5-25 for Booth. On the other hand, the *number of particles* parameter performance is best at 50 for Rosenbrock and 30 for Booth. This is not very close (50/30 = 1.66 therefore it is a 66% difference in the *number of particles*).

Why do some values perform better than others?
When the *number of particles* is 10 it performs poorly for both Rosenbrock and Booth. This is because having more particles can lead to better exploration (more coverage) of space and improve the chances of convergence. In contrast, the lower *cognitive* values perform better because it widens the search range for each particle. It prevents the particle from focusing on its own best position. This allows the particle to avoid converging on a local optimum instead of a global optimum; thus, increasing performance. The *social* parameter cannot be too high or else each particle will be more focused on maintaining its best position in relation to the rest of the swarm instead of the actual exploration of the space. This probably leads to converging on the wrong optima. On the other hand, a lower value for *social* may cause the convergence to a solution to take longer than necessary. This means that a particular range of social values (typically in the middle) is optimal. *Inertia* values that are too high cause the particles to not exploit the best solution found because it has too much velocity. Lower values lead to further exploitation of optimal found. This prevents the solution from being missed by the particle swarm. While the lower *inertia* can cause the swarm to converge on the wrong optima or converge too slowly, it is better than not exploiting solutions at all (i.e. inertia = 1.0).

Rosenbrock	Booth
	
	
	
	

Rosenbrock	Booth