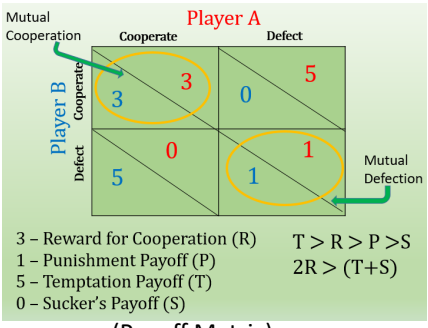
Figure 1

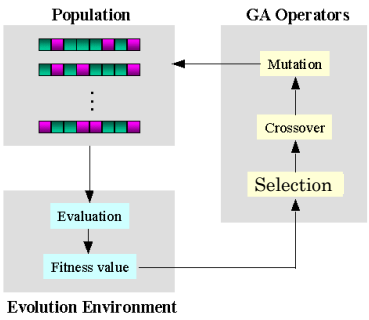


(Payoff Matrix)

Prisoner's Dilemma

The Prisoner's Dilemma is a hypothetical situation where two people are arrested and imprisoned. Each prisoner can either defect by testifying that the other committed the crime, or cooperate with the other by remaining silent. If both defect, they get 4 years in prison, and if they both cooperate, they get 2 years in prison. However, if one defects while the other cooperates, then the one who defected will go free while the other serves 5 years. This can be converted into the payoff matrix by subtracting the jail time from 5, because we want to maximize payoff (unlike jail time). From the payoff matrix, we see that the dominant strategy for both players is to always defect because it always gives better payoffs when compared to cooperation (5>3 and 1>0). However, we see mutual cooperation gives better payoff than mutual defection. Herein lies the dilemma.

Figure 2



Source: www.ewh.ieee.org

Genetic Algorithm

A GA works by first randomly generating a population of strategies. Then, it evaluates each strategy by playing it against all the other strategies 100 times. After that, it applies the selection, crossover, and mutation operators to make a new population. One cycle of this is a generation. The GA repeats this until the population converges.

Figure 3

We represent our strategies in the GA by a 4^M bit binary array, where M is memory size. Each location in the array represents a unique situation for the last M moves, and the state of the bit determines what move will be played next by the strategy. The diagram on the right shows an example for M=2.

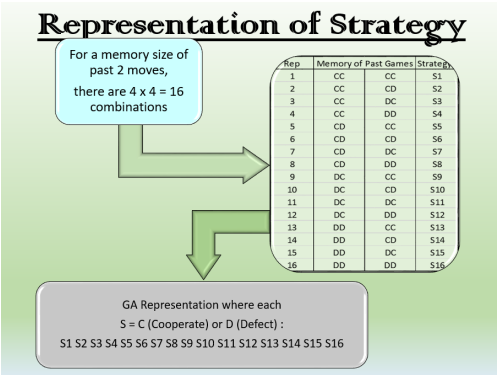


Figure 4

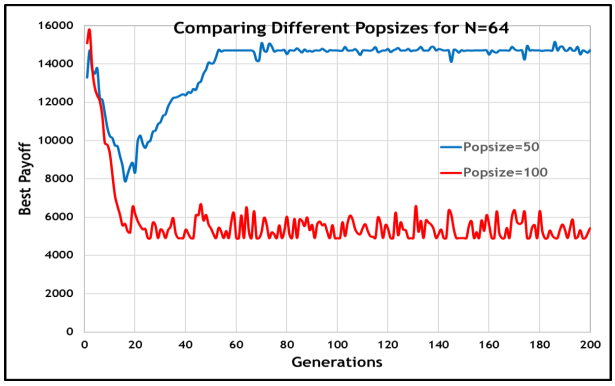


Figure 5

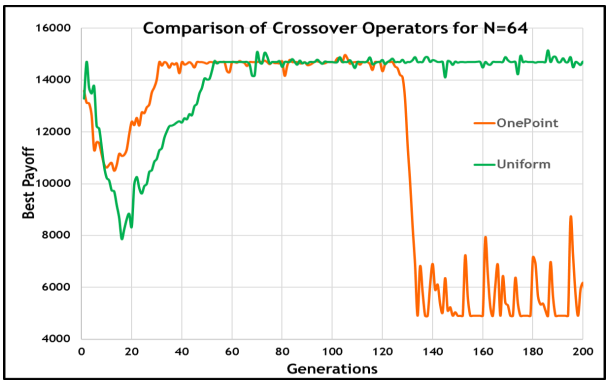


Figure 6

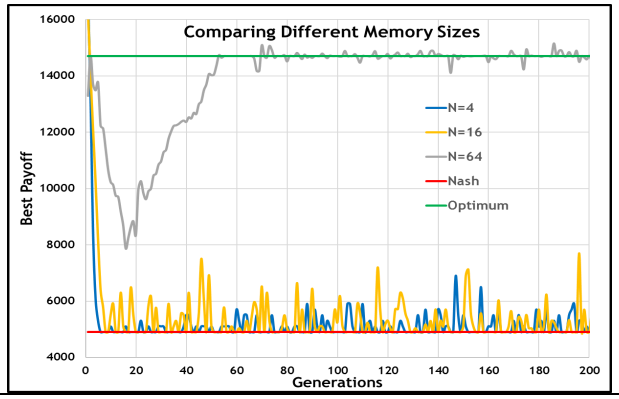
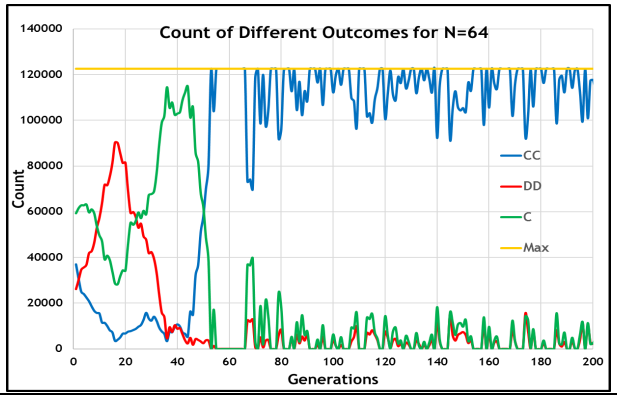


Figure 7



Figure

Memory Size (M)	Strategy Length (N=4^M)	Best Payoff (% of Optimum)	Avg. Payoff (% of Optimum)	CC Count (% of Total)	DD Count (% of Total)	C Count (% of Total)
1 Game	4	5860.8 (40%)	5546.304 (38%)	281.2 (0%)	111822 (91%)	10396.8 (8%)
2 Games	16	7583.2 (52%)	7089.548 (48%)	24566.6 (20%)	94196.4 (77%)	3737 (3%)
3 Games	64	14715.4 (100%)	14464.988 (98%)	116755.4 (95%)	2002 (2%)	3742.6 (3%)

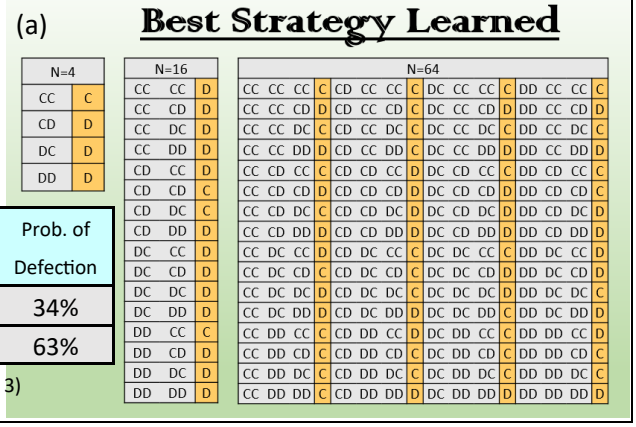
CC- Mutual Cooperation

DD- Mutual Defection

C- Single Cooperation

Figure 9

(a)



(b)

#Opponent Defections	Prob. of Defection
0 or 1	34%
2 or 3	63%

(Memory Size 3)