

Sheet

```

###

from Model import Model
from GameHistoryAnalysis import GameHistoryAnalysis
import matplotlib.pyplot as plt

###

number_of_agents = 50
generations = 1200
game = 'PD'
learning_mechanism = 'GA'
agent_computation_capacity = 4
tokens = 3
timeout = 100

model = Model(number_of_agents, agent_computation_capacity, tokens, generations, learning_mechanism,
model.run_model())

###

gha = GameHistoryAnalysis(model.game_history, number_of_agents)
gha.plot_average_payoff()
gha.plot_average_regular_game_payoff()

###

gha.plot_total_communication()
gha.plot_total_regular_communication()

###

gha.plot_cooperation_percentage()

###

gha.plot_average_chat_length()
gha.plot_average_regular_chat_length()

###

gha.plot_number_of_unique_conversations()

###

gha.plot_NCD_agents()

###

gha.plot_CRC_agents()

###

gha.plot_CD_agents()

###

# Investigation into token number relative to cooperative epochs for 1, 2, 3, 4 Tokens, averaged over
number_of_agents = 50
generations = 1000
game = 'PD'
learning_mechanism = 'GA'
agent_computation_capacity = 2
tokens = 2
timeout = 100

iterations = 5
states = 8

cooperative_epochs_by_state = []

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avg_percent_outcomes_by_states_by_tokens = []
for s in range(states):
    print('Starting Computation for computational capacity of ' + str(s))
    cooperative_epochs = [[], [], [], []]
    avg_percent_outcomes_by_tokens = []
    for t in range(4):
        print('Starting Computation for communication tokens: ' + str(t))
        total_coop_epochs = 0
        avg_percent_outcomes = [0, 0, 0]
        for i in range(iterations):
            print('Starting Iteration ' + str(i))
            model = Model(number_of_agents, s+1, t+1, generations, learning_mechanism, timeout, game)
            model.run_model()
            gha = GameHistoryAnalysis(model.game_history, number_of_agents)
            total_coop_epochs += gha.cooperative_epochs

            total = sum(gha.outcome_frequency)
            percent_outcomes = [(gha.outcome_frequency[m]/total) * 100 for m in range(3)]
            avg_percent_outcomes = [avg_percent_outcomes[j] + percent_outcomes[j] for j in range(3)]
            avg_percent_outcomes = [avg_percent_outcomes[k]/iterations for k in range(3)]
            avg_percent_outcomes_by_tokens.append(avg_percent_outcomes)
            cooperative_epochs[t] = (total_coop_epochs/iterations)
        avg_percent_outcomes_by_states_by_tokens.append(avg_percent_outcomes_by_tokens)
        cooperative_epochs_by_state.append(cooperative_epochs_by_state)

for t in range(4):
    plt.plot([cooperative_epochs_by_state[p][t] for p in range(states)], label=str(t)+' Tokens')
plt.ylabel('Cooperative Epochs / 1000 Generations')
plt.xlabel('States')
plt.show()

for t in range(4):
    plt.plot([avg_percent_outcomes_by_states_by_tokens[p][t] for p in range(states)], label=str(t)+'
plt.ylabel('Game Outcomes / 1000 Generations')
plt.xlabel('States')
plt.show()

```

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Starting Computation for computational capacity of 0
Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 2
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for computational capacity of 1
Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
Starting Iteration 0

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Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 2
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for computational capacity of 2
Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
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Starting Iteration 1
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Starting Iteration 4
Starting Computation for communication tokens: 2
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Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for computational capacity of 3
Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
Starting Iteration 0
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Starting Computation for communication tokens: 2
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Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for computational capacity of 4
Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
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Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 2
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for computational capacity of 5
Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
Starting Iteration 0
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Starting Iteration 2
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Starting Computation for communication tokens: 2
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Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for computational capacity of 6
Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
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Starting Iteration 3
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Starting Computation for communication tokens: 2
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Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for computational capacity of 7
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Starting Computation for communication tokens: 0
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 1
Starting Iteration 0
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Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 2
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Starting Iteration 3
Starting Iteration 4
Starting Computation for communication tokens: 3
Starting Iteration 0
Starting Iteration 1
Starting Iteration 2
Starting Iteration 3
Starting Iteration 4
```







