# Department of Computer Science

## Spring 2020 - Seminar Series
## "Evolving Cooperation in the Iterated Prisoner's Dilemma"

**Thursday - January 16, 2020**
**HEC - 356**
**11:00 a.m. - 12:00 p.m.**

**Abstract:** The Prisoner's Dilemma is a simple two-player game in which two accomplices have been captured by the police and are being interrogated separately. Each has two choices: to cooperate with their accomplice and refuse to confess; or to defect by confessing and implicating their accomplice. The reward (symmetrically, penalty) that each receives depends not only on their own action but also that of the other player. In the Iterated Prisoner's Dilemma (IPD), the players play multiple rounds of the game allowing them to learn about their opponent's actions and act accordingly.

The Iterated Prisoner's Dilemma has been studied in great detail in fields as diverse as economics, computer science, psychology, politics, and environmental studies. This is due, in part, to the intriguing property that its Nash Equilibrium is not a globally optimal solution. Many researchers have used evolutionary computation to evolve effective strategies for IPD. Typically treated as a single-objective problem, a player's goal is to maximize their total reward. Mittal and Deb created a multi-objective version of the game by including minimization of the opponent's reward as an additional objective.

Here, we explore the role of mutual cooperation in IPD player performance. We implement a multi-objective genetic algorithm in which each member of the population belongs to one of four sub-populations: selfish, communal, cooperative, and selfless, the last three of which *use mutual cooperation as an optimization objective*. Game play occurs among all members, without regard to sub-population, while crossover and selection occur only within a sub-population. Our evolved players are tested against a population of Axelrod's strategies and the Gradual strategy. Testing solely using self score, we find that players evolved with mutual cooperation as an objective perform very well. In some cases, our cooperative players completely dominate the competition. Thus, learning to play nicely with others is a successful strategy for maximizing personal reward.

***Dr. David Mathias***
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**Bio:** David Mathias is on the faculty of the Department of Computer Science at the University of Wisconsin – La Crosse. He holds a B.S. in Computer Science from the University of Delaware and a D.Sc. in Computer Science from Washington University in St. Louis. After twelve years at the Ohio State University, he took an accidental three-year sabbatical to hike in the Swiss Alps. On returning to the US, he landed in Florida which is both much flatter and much hotter. There, he joined Florida Southern College where he founded the Department of Computer Science. Eventually, the Florida heat drove him to Wisconsin in what his wife considers a classic overreaction. His primary research interest is genetic algorithms though he has begun to dabble in multi-agent systems.