Course Syllabus

Program and Course Code	Computing and Information Science CIS603
Course Title	**Multi-agent Systems**
Credit Hours	3
Instructor	Jacob Crandall
Contact Information	Email : jcrandall@masdar.ac.ae Phone: extension 9136
Office Hours	TBD
Bulletin Course Description	This course is an advanced course on multi-agent systems, which deals with the analysis and design of distributed entities that interact with each other in both cooperative and non-cooperative domains. Topics include: cooperative and non-cooperative game theory, social choice, mechanism design, auctions, repeated games, distributed optimization, multi-agent learning and teaching, and other selected topics.
Pre-requisites	CIS507 (Design and Analysis of Algorithms) or CIS501 (Data Mining: Finding the Data and Models that Create Value) or instructor permission.
Co-requisites	None
Topics in Mathematics	Discrete mathematics, distributed optimization, probability and utility theory, linear programming, dynamic programming
Fraction of the Course Requiring Proficiency in Mathematics	50%
Course Objectives (Learning Outcomes of the Course)	After completing this course, students will be able to: - Converse intelligently about the core principles of game theory, social choice theory, mechanism design, and multi-agent learning - Select appropriate solution concepts as goals of algorithms designed for multi-agent systems - Compare and contrast the various themes, mathematical problem structures, and algorithms from the multi-agent systems literature - Design and implement multi-agent algorithms (using appropriate mathematical structures) that effectively interact with other intelligent agents

Week	Course Topics and Contents	Readings
1	Introduction to multi-agent systems and games	Class notes
2	Utilities and preferences, minimax, and best response	MAS Ch. 3-4, notes on game theory
3	Nash equilibria, Pareto optimality, and extensive form games	MAS Ch. 4-6, notes on extensive-form games
4	Other perspectives, repeated games	Passion Within Reason, Axelrod 1-54
5	Repeated games continued	Axelrod, Littman & Stone
6	Mid-term exam, Overview of multi-agent decision theory	Notes on Fictitious Play
7	**Mid-semester break**	

8	Belief-based learning and satisficing learning	Notes on Fictitious Play, Karandikar *et al.*
9	Leading and Following	MAS Ch. 7, Littman & Stone
10	Dynamic programming and reinforcement learning	Notes
11	Expert Algorithms	Foster & Vohra, Exp3, EEE
12	Social Choice	MAS Ch. 9
13	Mechanism Design	MAS Ch. 10
14	Auctions	MAS Ch. 11
15	Selected Topics	
16	Final Exam	

Relationship of course objectives to program outcomes	
Program Outcome 1	Demonstrate appropriate depth and breadth of knowledge that is at the frontier of their disciplines
Program Outcome 3	Understand and value diverse approaches to solving critical problems in research and to creating new knowledge judged by international standards.
Program Outcome 5	Communicate effectively, in written and oral forms, their research results and/or critique highly complex and diverse matters to diverse audiences.

Course Grading	
Class participation and preparation	10%
Homework Assignments	15%
3 Projects/Labs	45%
2 Exams	30%
Total	100 %

Class/Laboratory schedule and Methodology	
Class	The class meets 15 weeks, 2 lectures per week, 90 minutes each.
Laboratory	
Teaching and learning methodologies	Class periods will consist primarily of lectures and intense discussion among attendees. Participation in discussions is considered critical to learning the material.

Course Materials	
Textbooks	• Y. Shoham and K. Leyton-Brown. *Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations*. Cambridge University Press, 2009. • R. Axelrod. *The Evolution of Cooperation.* Basic Books, 1984. ISBN 0465021212

Recommended Readings	• R. H. Frank. *Passions Within Reason: The Strategic Role of the Emotions*. W. W. Norton & Company, 1988. ISBN 0393960226 • B. Skyrms. *The Stag Hunt and the Evolution of Social Structure*. Cambridge Press, 2003. ISBN-13: 9780521826518
Instructional material and resources	Additional readings materials include papers assessable through links on the course website (in Moodle)