课程大纲
COURSE SYLLABUS

1.	课程代码/名称 **Course Code/Title**	**博弈论及应用 Game Theory and Its Applications**
2.	课程性质 **Compulsory/Elective**	必修课
3.	课程学分/学时 **Course Credit/Hours**	3/48
4.	授课语言 **Teaching Language**	中英双语 English & Chinese
5.	授课教师 **Instructor(s)**	刘鲁川，金融系 Andy LIU, Department of Finance
6.	先修要求 **Pre-requisites**	无
7.	教学目标 **Course Objectives**	

博弈论是研究多体交互决策的数学科学，是经济学和人工智能的一个理论基础。本门课由算法博弈论入手，介绍博弈论、计算机和机器学习的基本理论和方法，探索机器博弈、网络经济和金融科技中一些前沿课题。

Game theory, as one of mathematical foundations for economics and artificial intelligence, to study interactive decision with multi-agents. The course introduces game theory, theory of computation and machine learning in the perspective of algorithmic game theory. Some of cutting edge issues in algorithmic games, network economy and fintech could be explored.

8.	教学方法 **Teaching Methods**	

通过这门课程学生可以常握策略与合作博弈,和深度与强化学习中基本概念与方法，理解存在性、可计算性和复杂性的基本思想，能够运用算法博弈论和机器学习的方法解决机器博弈、网络经济和金融科技中一些问题。

In this course, students could learn the concepts and methods of noncooperative and cooperative game theory, as well deep and reinforcement learning. They could understand the thoughts of existence of solution concepts, computability and complexity of computation. Students could practice in the fields of AI games, network economy and Fintech through employing algorithmic game theory and machine learning.

9.	教学内容 **Course Contents**	
	Section 1	1. 非合作博弈理论

	策略博弈的架构与解概念；纯和混合策略；纳什均衡和纳什存在性定理；相关均衡
	Strategic Games
	Strategic game format and solutions; Pure and mixed strategies; Nash equilibrium and Nash existence theorem; Correlated equilibrium.
Section 2	2. 动态和重复博弈理论
	动态博弈的架构和概念；信息；子级博弈完美均衡；重复博弈理论；自动机理论及其应用
	Dynamic and repeated game theory
	Game format and notations; Information; subgame perfect equilibrium; Repeated games; Automaton theory and its application.
Section 3	3. 合作博弈理论
	合作博弈的架狗：可转效用与非可转效用；夏普利价值；核；讨价还价。
	Cooperative game theory
	Cooperative game format: TU and NTU; Shapley Value; Core; Bargaining
Section 4	4. 匹配理论及其应用
	两方匹配；算法；多元匹配；应用
	Matching and its application
	Two partite matching; algorithms; Multipartite matching; Application
Section 5	5. 拍卖和机制设计
	拍卖的架构：封闭与开发拍卖；第二价位拍卖；赞助搜索拍卖；机制设计规划；有效性和不可能
	Auction and Mechanism Design
	Auction format: sealed and open; Second-price auction; Sponsored Search auction; The mechanism agenda; Efficiency and impossible

Section 6	计算理论导论 6. 图林机、可计算性和计算复杂性 Turing machine, computability and complexity
Section 7	7. 计算神经网络 神经网络模型；激活函数；方向图形和反馈；网络架构；知识表达；学习的过程和任务。 Neural network Models of Neural network; Activation Function; Directed graph and feedback; Network Architecture; Knowledge presentation; Learning processes and tasks.
Section 8	8. 强化学习 有限马尔可夫决策过程；动态规划；蒙特卡罗模拟；规划与学习 Reinforcement Learning Finite Markov Decision Processes; Dynamic Programming; Monte Carlo Methods; Planning and Learning
Section 9	9. 人工智能与游戏 随机博弈理论，阿尔法围棋 AI and Games Stochastic game theory; Alpha Go
Section 10	10. 分布式技术与区块链 共识机制；拜占庭协议；事实统一与比特币 ; Distributed Ledger Technology and Blockchain Consensus; Byzantine Agreement; Eventual Consistency and Bitcoin

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10.	课程考核 **Course Assessment**
	请再此注明：①考查/考试；②分数构成。 1.　平时作业 20% Assignments 20% 2.　期中考试 40% Mid-Term Test 40% 3.　期末报告 40% Final Presentation 40%
11.	教材及其它参考资料 **Textbook and Supplementary Readings**
	- **Algorithmic Game Theory** 　David Parkes, et al. Economics and Computation (Draft) - **AI and Deep Learning** 　Stuart Russell, et al. Artificial Intelligence: A modern approach, 3rd. ed. 　Ian Goodfellow, et al. Deep Learning, MIT 　Simon Haykin, Neural Networks and Learning Machines, 3rd. Ed. - **Reinforcement Learning** - Richard S. Sutton and Andrew G. Barto:　Reinforcement Learning: - An Introduction