CS6480: AI ORACLES FOR MULTIAGENT ECONOMIC SYSTEMS

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
AI Oracles for Multiagent Economic Systems

Subject Code
CS - Computer Science
Course Number
6480

Academic Unit
Computer Science (CS)

College/School
College of Computing (CC)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
CS2402 Introduction to Computational Probability Modeling
AND CS3334 Data Structures
AND CS4487 Machine Learning

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course studies how artificial intelligence can be used as an oracle in multiagent economic systems. Students learn to specify the inputs and outputs of an AI oracle, use its predictions or recommendations in platform and economic decisions, and analyse how agents respond strategically to oracle-assisted rules. Through modelling exercises, computational labs, and small-scale simulations, students formulate economic objectives as explicit and testable requirements and verify whether system outcomes satisfy them.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Model multiagent economic systems in terms of agents, information, utilities, AI-oracle inputs and outputs, economic rules, strategic responses, and outcomes.			x	
2	Critically examine assumptions underlying AI-mediated economic systems and apply selected economic solution concepts and analytical tools to explain strategic behaviour and outcomes.		x	x	
3	Specify, use, and evaluate AI oracles, and construct small-scale simulations for selected economic and platform applications.			x	x
4	Formulate economic objectives as explicit and testable requirements, and develop verification procedures to determine whether AI-mediated outcomes satisfy these requirements.			x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Lectures will focus on multiagent modelling, selected solution concepts, AI systems as decision-making oracles, and formulation and verification of system requirements.	1, 2, 4	2 hours/week

2	Tutorials and labs	Tutorials and labs provide students with guided practice in oracle specification, strategic modelling, AI-tool use, small-scale simulation, interpretation, and verification.	1, 2, 3, 4	1 hour/week
3	Applied project	Students complete a selected AI-mediated multiagent system combining problem formulation, oracle use, modelling or simulation, testable requirements, verification, and limitations.	1, 2, 3, 4	Across the semester

Additional Information for LTAs

The emphasis is on the appropriate use and evaluation of AI oracles rather than on implementing complex AI models from first principles.

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks	Allow Use of GenAI?
1	Problem sets on multiagent modelling and strategic analysis	1, 2	20	-	No
2	Computational labs on AI-oracle use, simulation, and verification	1, 3, 4	25	For tasks in which generative AI is permitted, students must disclose the tools used and explain how they were used. Students remain responsible for independently verifying generated code, models, analysis, data, and references. Generative AI must not replace students' own reasoning, interpretation, or verification work.	Yes

3	Applied project report and presentation	1, 2, 3, 4	25	For tasks in which generative AI is permitted, students must disclose the tools used and explain how they were used. Students remain responsible for independently verifying generated code, models, analysis, data, and references. Generative AI must not replace students' own reasoning, interpretation, or verification work.	Yes

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the continuous assessment and 30% of the maximum mark for the examination must be obtained.

Applied Project

The project examines a selected AI-mediated multiagent economic system. Possible topics include:

- an advertising auction using AI-predicted conversion probabilities;
- a recommender system with exposure-fairness requirements;
- a matching market using AI-generated compatibility scores;
- auto-bidding agents in sponsored search;
- marketplace ranking with strategic sellers; or
- multiagent negotiation or bargaining using large language models.

The report must include a problem formulation, a formal model, a specification of the AI oracle's inputs and outputs, an economic or platform decision rule, modelling or simulation results, explicit verification requirements and results, economic interpretation, and limitations. Implementation of a complex AI model from first principles is not required.

Assessment Rubrics (AR)

Assessment Task

Problem sets (for students admitted in Semester A 2024/25 & thereafter)

Criterion
Accuracy and clarity of formal models; correct application of selected solution concepts; sound economic reasoning.

Excellent
(A+, A, A-): High

Good
(B+, B, B-): Significant

Fair
(C+, C, C-): Moderate

Marginal
(D): Basic

Failure
(F): Not even reaching marginal levels

Assessment Task
Computational labs (for students admitted in Semester A 2024/25 & thereafter)

Criterion
Appropriate oracle specifications; correct modelling and simulation; valid verification; interpretation and reproducibility.

Excellent
(A+, A, A-): High

Good
(B+, B, B-): Significant

Fair
(C+, C, C-): Moderate

Marginal
(D): Basic

Failure
(F): Not even reaching marginal levels

Assessment Task
Applied project (for students admitted in Semester A 2024/25 & thereafter)

Criterion
Problem significance; coherent model and oracle-assisted decision process; explicit verification requirements; interpretation, limitations, and communication.

Excellent
(A+, A, A-): High

Good
(B+, B, B-): Significant

Fair
(C+, C, C-): Moderate

Marginal
(D): Basic

Failure
(F): Not even reaching marginal levels

Assessment Task
Final examination (for students admitted in Semester A 2024/25 & thereafter)

Criterion
Understanding and application of multiagent modelling, strategic analysis, AI-oracle specifications, and verification methods.

Excellent
(A+, A, A-): High

Good
(B+, B, B-): Significant

Fair
(C+, C, C-): Moderate

Marginal
(D): Basic

Failure
(F): Not even reaching marginal levels

Assessment Task
Problem sets (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Accuracy and clarity of formal models; correct application of selected solution concepts; sound economic reasoning.

Excellent
(A+, A, A-): High

Good
(B+, B): Significant

Marginal
(B-, C+, C): Moderate

Failure
(F): Not even reaching marginal levels

Assessment Task

Computational labs (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Appropriate oracle specifications; correct modelling and simulation; valid verification; interpretation and reproducibility.

Excellent
(A+, A, A-): High

Good
(B+, B): Significant

Marginal
(B-, C+, C): Moderate

Failure
(F): Not even reaching marginal levels

Assessment Task
Applied project (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Problem significance; coherent model and oracle-assisted decision process; explicit verification requirements; interpretation, limitations, and communication.

Excellent
(A+, A, A-): High

Good
(B+, B): Significant

Marginal
(B-, C+, C): Moderate

Failure
(F): Not even reaching marginal levels

Assessment Task
Final examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Understanding and application of multiagent modelling, strategic analysis, AI-oracle specifications, and verification methods.

Excellent
(A+, A, A-): High

Good
(B+, B): Significant

Marginal
(B-, C+, C): Moderate

Failure

(F): Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- AI-oracle framework: Tasks, inputs, outputs, prediction, recommendation, uncertainty
- Multiagent economic systems: Agents, information, preferences, utilities, rules, outcomes
- Strategic behaviour: Best responses, incentives, manipulation, selected equilibria
- AI-assisted decisions: Ranking, pricing, matching, recommendation, allocation
- Auctions and advertising: Bidding, AI-predicted values, sponsored ranking, auto-bidding
- Matching and recommendation: Compatibility, stability, exposure, feedback loops
- Platform incentives: Welfare, revenue, user utility, creator incentives
- Learning and adaptation: Repeated interaction, feedback, regret, behavioural adaptation
- Oracle reliability: Errors, bias, uncertainty, distribution shift, manipulation
- Requirement formulation: Efficiency, fairness, stability, robustness, auditability
- Verification methods: Metrics, simulation, deviation checks, sensitivity, stress tests
- Governance and responsible use: Transparency, oversight, accountability, limitations

Reading List

Compulsory Readings

	Title
1	Lecture Note

Additional Readings

	Title
1	Yoav Shoham and Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press, 2009.
2	Tim Roughgarden, Twenty Lectures on Algorithmic Game Theory, Cambridge University Press, 2016.
3	Alvin E. Roth, Who Gets What - and Why: The New Economics of Matchmaking and Market Design, Houghton Mifflin Harcourt, 2015.
4	Jason D. Hartline, Mechanism Design and Approximation, selected chapters, online manuscript.
5	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th edition, Pearson, 2020.
6	Selected research papers on AI-assisted decision-making, recommender systems, advertising auctions, market design, platform economics, algorithmic auditing, and verification, updated by the instructor.