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COMSCI/ECON 206

# Computational Microeconomics

Autumn 2025



昆山杜克大学  
DUKE KUNSHAN  
UNIVERSITY

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**Dates:** August 18, 2025, – October 10, 2025

**Meeting time:** MoWe 2:45 PM - 5:15 PM

**Location:** IB 2025

**Course format:** Seminar (+ Field Trip)

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## COMSCI/ECON 206 — Final Research Proposal

**Play to innovate: An Interdisciplinary Approach from Game Theory to Mechanism Design**

Due: Sunday Oct. 15, 11:00 P.M. (BJT) • Weight: 20%

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## Objectives — COMSCI/ECON 206 Final Research Proposal

The Final Research Proposal synthesizes the learning journey of *Computational Microeconomics*. Building on **Problem Set 1 (game theory foundations)** and **Problem Set 2 (mechanism design applications)**, it asks students to frame an original question connecting economics and computation. Proposals should formalize strategic environments, implement computational tools (Python, NashPy, oTree), and compare theoretical predictions with human or AI-agent behavior. Ideas may grow from **classroom simulations, coding labs, or peer discussions**, where strategic interaction and bounded rationality were explored. The **field trip to innovation hubs** further inspires projects addressing auctions, voting, blockchain, or sustainability challenges. The final output includes a reproducible GitHub repository, a written proposal, and a symposium presentation, demonstrating mastery of theory, coding, and critical evaluation while cultivating DKU's principles of communication, collaboration, global perspective, purposeful engagement, and wise leadership

### Title Page

Your report must begin with a professionally formatted title page that includes the following five elements:

1. **Title and Author**

- Provide a clear and concise project title.
- List the full name(s) of the author(s).
- 2. **Contribution to Sustainable Development Goals (SDGs)**
  - Include a statement specifying which of the **United Nations' SDGs** your research contributes to.
  - Briefly explain how your project aligns with these goals (e.g., promoting quality education, reducing inequalities, fostering sustainable cities, advancing responsible innovation).
- 3. **Acknowledgments**
  - Express gratitude to the professor and classmates for their constructive feedback and guidance throughout the semester.
  - Acknowledge additional sources of support, including AIGC tools, open-source communities, or collaborators as appropriate.
- 4. **Disclaimer**
  - Insert the following statement verbatim:

*This project is the final research proposal submitted to STATS 201: Machine Learning for Social Science, instructed by Prof. Luyao Zhang at Duke Kunshan University in Autumn 2025.*
- 5. **Statement of Intellectual and Professional Growth**
  - Provide a short reflective paragraph on how the project contributed to your **intellectual development** (research design, technical mastery, interdisciplinary thinking) and **professional growth** (collaboration, ethical reflection, communication).
  - Highlight specific ways the project enhanced your skills in applying machine learning to social science.

## **Body — COMSCI/ECON 206 Final Research Proposal**

### **Part 1. Strategic Game Foundations (from PS1)**

- **Objective:** Formalize a strategic game, identify equilibrium concepts (Nash, SPNE, Bayes–Nash, etc.), and evaluate efficiency and fairness.
- **Methods:**
  - Use **NashPy/QuantEcon** for equilibrium computation.
  - Deploy **Game Theory Explorer (GTE)** for extensive-form analysis.
  - Conduct **oTree sessions** with classmates and compare to **LLM play**.
- **Output:** Theoretical solutions, computational results, and comparative analysis of equilibrium predictions vs. human/AI outcomes.

## Part 2. Mechanism Design & Auctions (from PS2)

- **Objective:** Extend game-theoretic foundations into **mechanism design** by analyzing the **winner's curse** and testing human vs. AI strategies.
- **Methods:**
  - Select an auction format (first-price, common-value, etc.).
  - Design treatments and controls to test bounded rationality.
  - Run simulations with LLMs and compare to theoretical predictions and behavioral evidence.
- **Output:** Revised and extended analysis from PS1, auction experiments, and mechanism design insights.

## Part 3. Voting & Institutions (from week 6 reflection)

- **Objective:** Connect theory to practice by designing a **simplified voting issue** inspired by real-world cases or field trip observations (e.g., UN climate action, blockchain governance).
- **Methods:**
  - Apply **Nobel insights**: Arrow's impossibility, Buchanan on institutions, Hurwicz–Maskin–Myerson on mechanism design, Shapley–Roth on matching, and Acemoglu–Johnson–Robinson on legitimacy.
  - Propose an **innovative or hybrid voting rule**, integrating computation (e.g., blockchain consensus, reinforcement learning, algorithmic matching).
  - Test designs through classroom simulations, coding, or prototype implementation.
- **Output:** Forward-looking mechanism design proposal, bridging classroom theory, Nobel frameworks, and experiential learning.



## Part III – Supplementary Materials, GitHub Repository & Submission

### 1. Supplementary Materials in the Report

- **GitHub Link:** Include the repository URL in the *Supplementary Materials* section of your PDF report.
- **Poster:** Submit your project poster in both the report appendix and the repository. This will also be used for the Final Symposium.
- **Demo Video (optional but encouraged):** Embed the video in your repository README.

## 2. GitHub Repository Requirements

Your repository is as important as the written report. It demonstrates reproducibility, transparency, and professional practice, consistent with **FAIR & CARE data governance principles** for replicability.

### Repository Structure

```
<Project-Name>:<An Interdisciplinary Study>/
├── economist/          # Theoretical analysis (game theory, welfare, fairness)
├── computational_scientist/ # Python scripts, Jupyter notebooks, solver outputs
├── behavioral_scientist/  # oTree apps, human experiment results, LLM transcripts
├── mechanism_design/     # Auction/voting design
├── visualizations/       # Figures, payoff matrices, equilibrium diagrams, voting charts
├── docs/                 # Project documentation
│   ├── Report.pdf        # Final report
│   ├── Poster.pdf        # Symposium poster
│   └── FieldTripReflection.md# Reflection linking field experience to methodology & impacts
└── README.md            # Root README with project overview
```

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### Root README.md Must Include:

1. **Project Title and Abstract** – Clear and concise summary of your research.
2. **Authors and Roles** – Each contributor's role (Economist, Computational Scientist, Behavioral Scientist, Mechanism Designer).
3. **Disclaimer** –  
*This repository supports the final research proposal submitted to COMSCI/ECON 206: Computational Microeconomics, instructed by Prof. Luyao Zhang at Duke Kunshan University in Autumn 2025.*
4. **Acknowledgments** – Professors, classmates, LLMs, and open-source communities (NashPy, QuantEcon, GTE, oTree, etc.).
5. **Statement of Growth** – Reflection on intellectual and professional development across PS1, PS2, classroom collaborative learning experiences and the field trip towards the final proposal.
6. **Table of Contents** – With clickable links to folders and files.
7. **Navigation Instructions** – Guide for reviewers to locate:
  - Code for equilibria computation, mechanism design, and simulations.
  - Visualizations and outputs.
  - Documentation (final report, poster, field trip reflection).
8. **Embedded Media** – Poster and demo video (via Markdown embedding or links).