Xinyu Tian

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RESEARCH INTERESTS

Interdisciplinary research in Computer Science, Data Science, and Economics. My research interests lie in Artificial Intelligence, Multi-agent System, Game Theory on Distributed Systems, and Blockchain mechanisms. My current research focuses on converting *artificial intelligence* into *social intelligence* by Web 3.0 Decentralized Cooperative AI designs and blockchain mechanism designs.

EDUCATION

08/2019 – 05/2023 **Duke University (Duke) / Duke Kunshan University (DKU)**

B.S. in Interdisciplinary Studies (Data Science, Duke) *Durham, NC, U.S.*
B.S. in Data Science (DKU) *Kunshan, Jiangsu, China*

Courses:

Algorithm and Database (CS), Computer Organization and Programming (CS), Computational Microeconomics (CS&Econ), Introduction to AI (CS), Advanced Linear Algebra (Math), Numerical Analysis and Optimization (Math), Bayesian and Modern Statistics (Statistics), Statistical Machine Learning (Statistics), Data Acquisition and Visualization (Statistics).

HONORS & AWARDS

2022 **Summer Research Scholarship** | 12,800CNY, Duke Kunshan University

2021 **Summer Research Scholarship** | 12,800CNY, Duke Kunshan University

National 2nd Prize in 2021 China Youth Cup Mathematical Contest in Modeling.

Dean's List for the Fall 2021 Term.

2019 **Full Admission Scholarship** | 680,000CNY, merit-based, 100% of 4-year DKU tuition.

GRANTS

05/2022 **Ethereum Academic Grants** | Ethereum Foundation

- Research fellow and student leader, *"Staking Mechanism Design: Ethereum 2.0 for Good"*.
- Co-initiated the research proposal with Prof. Luyao Zhang (Co-PI), Prof. Yulin Liu (Co-PI), and Zesen Zhuang (research fellow) from SciEcon CIC.

09/2022 **Devcon Grants** | Ethereum Foundation

- Program chair, supervised by Steering Committee: Prof. Luyao Zhang and Prof. Yulin Liu from SciEcon CIC.

WORKING-IN-PROGRESS

2022 **On Blockchain We Cooperate: An Evolutionary Game Approach**, with Prof. Luyao Zhang.

- Accepted (and presented by Prof. Luyao Zhang) at the 33rd International Conference on Game Theory, Stony Brook Center for Game Theory, Stony Brook University, Stony Brook, NY 11794-4383, July 18– 21, 2022.
- Draft to be available online in November.

Industry 4.0 Open Education Resource (OER) Publication Initiatives

Series No.3: Computational Microeconomics.

- "*Game theory in Paradox: Yin and Yang in Distributed System*", with Prof. Luyao Zhang.

PUBLICATIONS

2021 **Meta-Learning Based Breast Abnormality Classification on Screening Mammograms**, with Wang, Yu, Mingjie Song

- Published at 2021 International Conference on Computer Engineering and Application (ICCEA), June. DOI: 10.1109/ICCEA53728.2021.00038.

09/2021 – Present **Industry 4.0 Open Education Resource (OER) Publication Initiatives**

Series No.1: Innovate on the Internet Computer.
Ebook ISBN: 978-1-7923-8394-6, DOI: 10.21428/bfffc129.db13dd8d

- Chapter 6 *"The Phonebook"*. With Zesen Zhuang and Prof. Luyao Zhang (DKU). Chapter 13 *"On the Mechanics of Blockchain Security"*. With Prof. Fan Zhang (Duke), Prof. Luyao Zhang (DKU), and Zesen Zhuang. Chapter 14 *"Tokeneconomics: When Macro and Micro Economics Unite in Finance"*. With Prof. Ye Li (Duke), Prof. Luyao Zhang (DKU), and Zesen Zhuang. Chapter 19 *"A Conversation on Cryptography, Trust Machine, and Cyber Planet Construction"*. With Prof. Kevin Mo (Peking University), Prof. Luyao Zhang (DKU), and Tianyu Wu.

Series No.2: Intelligent Economics: An Explainable Approach
DOI: 10.21428/aa21bfc0.841ff112

- Chapter co-author for five chapters: *"Software and Packages for Empirical Research: Statistic Tests, Econometrics, and Machine Learning"*, *"Python Packages for Economics: Model and Simulation"*, *"Tech Editor Instructions"*, *"oTree Instructions for Behavioral Experiments"*, *"How Gradescope: user experience reflections"*. With Prof. Luyao Zhang (DKU), Tianyu Wu, Zesen Zhuang, Chenyu Wang, and Jingwei Li.

SELECTED RESEARCH

07/2022 – Present **Cooperative AI in Decentralized Systems: A Multi-Agent Reinforcement Learning Approach**

DKU Signature Work (equivalent to Senior Thesis), mentored by Prof. Luyao Zhang.

- Applying the idea of "Blockchain as Decentralized AI" within a game theoretical framework on a generalized Byzantine Fault Tolerance (BFT) blockchain consensus protocol with reinforcement-learning agents, and to solve the equilibrium conditions.
- Conducting a comparative study on the consensus protocol designs on Ethereum (PoS blockchain) and Algorand (Pure PoS blockchain) by blockchain simulation and implement our framework to test the safety, liveness, and validity on the blockchains.
- Guiding future blockchain consensus protocol designs in policy parameters.

08/2021 – 10/2022 **On Blockchain We Cooperate: An Evolutionary Game Perspective**

Jointly First Author, with Prof. Luyao Zhang from DKU

- Individually initialized the research proposal, including the key research idea to model blockchain consensus achievement process as an evolutionary game and individually finished an outline for a mathematical proof.
- Built a game-theoretical model including (1) a generalized BFT blockchain consensus protocol as the game environment in extensive form, (2) bounded-rational imitative learning strategical agents, (3) utility functions for agent incentives, (4) solution concepts based on social welfare and evolutionary stable strategy, and (5) three equilibria.

- Our Honest Stable Equilibrium guarantees blockchain safety, liveness, and validity. With an easy-to-achieve initial condition, all the agents in a committee would be incentivized to play the honest strategy and blockchain security is attained.
- Analyzed the linkage to policy parameter on PoS Ethereum blockchain.
- Contributed to five disciplines including consensus in di stributed systems, game theory, evolutionary game theory, bounded rationality, and cooperative AI.

02/2022 – Present **Staking Mechanism Design: Ethereum 2.0 for Good**

Research Fellow, funded by Ethereum Academic Grants, Ethereum Foundation
With Prof. Luyao Zhang and Prof. Yulin Liu from SciEcon CIC

- Participated in Ethereum Merge Data Challenge with data visualization based on Ethereum validator data and beacon chain block data between 12/2020 – 10/2022, retrieved from Web3.py and ethereum2-etl libraries.
- Writing two academic reviews about (1) the applications of the staking mechanism in different blockchains and DeFi, and (2) data analysis of Ethereum governance changes after applying the staking mechanism.
- Simulating Ethereum blockchain and applying a game-theoretical framework to analyze how the staking mechanism supports Ethereum security, scalability, and sustainability.

02/2022 – Present **Metaversity**

Research Fellow, prepare for DFINITY Developer Grants
With Prof. Luyao Zhang and Prof. Yulin Liu from SciEcon CIC

- Designed the virtual architectures of Metaversity on Shiku Metaverse.
- Developed a dynamic and interactive dashboard for real-time Internet Computer blockchain on-chain governance Neural Network System (NNS) data analysis to enhance the blockchain transparency and advise stakeholders' participation in NNS.
- Developing an online experiment platform for behavioral research in economics on the Internet Computer blockchain.

05/2022 – 08/2022 **An AI-Driven DKU Explorer**

Summer Research Scholar, funded by the DKU 2022 Summer Research Scholarship
Supervised by Prof. Feng Tian from DKU

- Developed the UI and an AR frontend with Unity3D ARFoundation for a mobile App to label virtual elements onscreen.
- Used C# for frontend functionality design and C# - objective C interaction for mobile app design on the iOS system.
- Collaborated in building the backend with an embedded YOLO v3 algorithm for object detection and return the results to the frontend.

05/2021 – 08/2021 **Decentralized Application: The Phonebook**

Developer, Chapter Co-Author on OER Series No.1 Chapter 6.

- Developed a decentralized application (DApp) on the Internet Computer blockchain； used Vue.JS and Vuetify for the frontend architecture and Motoko as the programming language for the backend; and wrote the tutorial documentation on OER Series No.1.

01/2021 – 04/2021 **Introduction to Deep Learning: Theory and Application**

Online Project-based Program, supervised by Prof. Mark Vogelsberger from MIT.

- Re-trained a medium-size AMDIM model based on the CBIS-DDSM database and showed

the superiority of AMDIM (accuracy: 78%) in cross-category classification in comparison with ResNet101 (accuracy: 71%).

08/2020 – 12/2021 **Truth and Deception in the Congressional Response to Black Lives Matter**
Student Researcher at DKU Environmental Research Center (DKU ERC)
Funded by the DKU 2021 Summer Research Scholarship
Supervised by Prof. Charles Chang from DKU

- Researched on the real attitude of the American congress to #BlackLivesMatter issue with crawling 4TB tweets data of the U.S. congress in the last 10 years with Twitter API.
- Established a BERT model for Nature Language Processing (NLP) to do a sentiment analysis task.

PRESENTATIONS

Spring 2022 **A Glance into the Metaverse: The Importance of Decentralization** ➦
Presented at SciEcon NFT Symposium, SciEcon CIC

Fall 2021 **Decentralized Finance: Cryptocurrency and Blockchain on the Internet Computer** ➦
Presented as Co-Host and MC, at Duke CS+ & SciEcon Symposium
Truth and Deception in the Congressional Response to Black Lives Matter
Presented at DKU 2021 SRS Poster Session

ACADEMIC SERVICES

Fall 2022 **SciEcon Ethereum Merge Meetup**
Program Chair, supervised by Steering Committee: Prof. Luyao Zhang and Prof. Yulin Liu.
Funded by Devcon Grants, Ecosystem Support Program, Ethereum Foundation.

- Initiated the program proposal, drafted the invitation letters and appreciation letters to professors and entrepreneurs, and managed the global food deliver events.
- Interviewed Prof. Fan Zhang from Duke University, Prof. Alex Ruthmann from New York University, Prof. Ye Wang from Macau University, Dr. Diana Gamborino from Bochsler Finance as the distinguished guest speaker to deliver insights on Ethereum 2.0.
- Publishing the final deliverables on the OER series.

Fall 2021 – Present **Industry 4.0 Open Education Resource (OER) Publication Initiatives**
Student Manager, Chapter Author, Associate Editor.

- Authorships could be found in the above Publication section.
- Associate editor for chapters 7, 9, 10, 11, 12, 15, 16, 17, 18, 20, 21, 22 in Series No. 1: Innovate on the Internet Computer.

Fall 2022 **Research Assistant** for *ECON 211 Intelligent Economics: An Explainable Approach*
Teaching Assistant for *STATS 201 Introduction to Machine Learning for Social Science*
Spring 2022 **Teaching Assistant** for *COMPSCI 206 Computational Microeconomics*
Program Co-Chair for SciEcon Blockchain+ Symposium ➦
Fall 2021 **Teaching Assistant** for *ECON 211 Intelligent Economics: An Explainable Approach*
Teaching Assistant for *ECON 101 Economics Principles*
Co-Host and MC for Duke CS+ & SciEcon Symposium ➦
Program Commissioner for SciEcon NFT Symposium ➦
Fall 2020 **Research Assistant** at *DKU Environmental Research Center (ERC)*

PROFESSIONAL EXPERIENCES

06/2022 – 08/2022 **Baidu, Inc.**

Intern, Baidu AI Cloud Group (ACG), Beijing

- Collaborated with senior engineers in building a MLOps pipeline for a large-scale AI practice in computer vision, which integrates 20+ algorithm frameworks, 10+ application scenarios, and provides a general training entrance and an evaluation protocol.
- Built the MLOps pipeline for an OCR task with COCO dataset preprocessing and Paddlepaddle framework integration.
- Wrote an industrial report on AI/ML serving frameworks on Edges.
- Get Baidu Qualified Coder (QC) certification for programming and engineering skills.

06/2021 – 08/2021 **Yonyou Software Co. Ltd.**

Intern, Big Data Department, Remote

- Optimized the Soil Big Data Platform, a remote sensing image integration platform for a fertilizer company, using MongoBD and PostgreSQL for multi-source data management.
- Cleaned unstructured data from 50,000 groups of soil tests, 8,000 groups in the agricultural experimental fields, and 18,000 groups of leading growers' plantations into vector, and merged them with geographic data.

LEADERSHIPS

06/2021 – Present **SciEcon CIC, NPO** ➚

Chair of Communication, Inaugural E-board.
Program chair of SciEcon Insights, with three series: AMA ➚, Research ➚, Innovate ➚.
Program co-chair of SciEcon Sustainability.

- Led SciEcon Insights program for academic research and industrial innovation by leading 30+ student research or innovative projects' initiations, and instructing students' report publications in SciEcon AMA, SciEcon Research, and SciEcon Innovate on Medium.
- Hosted AMA interviews for 20+ professors and entrepreneurs to find out the main concerns and initiated student projects accordingly. Interviewed professors including Prof. Campbell Harvey and Prof. Fan Zhang from Duke University, Prof. Gary Charness from University of California, Santa Barbara, and Prof. Xiaokang Mo from Peking University.

08/2020 – 12/2021 **Duke Kunshan University Residence Life Department**

Resident Assistant

- Organized 20+ university-level events for community diversity, involving 300+ students.
- Led the collaboration of the DKU Student Affairs department, the Campus Activities Board, and the China Enrollment Management, on the event "Fighting for Gaokao". The event includes more than 200 participants on campus and was made as a gift for the class of 2025.
- Was nominated as the "RA of the year" in 2021.

PROFESSIONAL SKILLS

Technical Skills:

- Computer Languages: Python, JAVA, C++, R, C#, C, Go, JavaScript, Motoko, LATEX, Modeling.
- Machine Learning Frameworks: TensorFlow, PyTorch, Paddlepaddle.
- Other Software: MATLAB, R Studio, Tableau.