Missouri University of Science and Technology — Department of Computer Science
Fall 2022 — **CS 5408: Game Theory for Computing**

SYLLABUS

Instructor: *Sid Nadendla* — **Email:** *nadendla@mst.edu*

1 Course Information

Course Website:	https://sid-nadendla.github.io/teaching/FS2022_GTC/index.html
Lecture Venue:	Room 104, Humanities and Social Sciences Building
Lecture Time:	Tuesdays & Thursdays – 11:00 AM - 12:15 PM
Instructor's Office Location:	313 Comp Sci Building
Instructor's Office Hours:	Friday – 3:00 PM - 4:00 PM (Venue: TBD)
Instructor's Contact Details:	nadendla@mst.edu, (573) 341-4090
Grader's Name and Email:	Benjamin Hansen, bjh2ct@mst.edu
Grader's Office Hours:	Wednesday – 3:00 PM - 4:00 PM (Venue: TBD).

2 Intended Audience & Prerequisites

Students taking this class are expected to have a strong foundation in linear algebra ('C' or better grade in Math 3108), algorithms ('C' or better grade in Comp Sci 2500), along with basic background in probability theory and/or statistics ('C' or better grade in one of Stat 3113, Stat 3115, Stat 3117, or Stat 5643.).

3 Textbook

In this course, we will not be following any one textbook. However, students are encouraged to refer to one or more recommended books[1] from the following (non-exhaustive) list:

- Roger B. Myerson, "Game Theory: Analysis of Conflict," Harvard University Press, 1991.
- Drew Fudenberg, Jean Tirole, "Game Theory," MIT Press, 1991.
- Tamer Başar and Geert Jan Olsder, "Dynamic Noncooperative Game Theory," SIAM, 2nd Ed., 1999.
- Martin J. Osborne, "An Introduction to Game Theory," Oxford University Press, 2003.
- Noam Nisan *et al.* (Editors), "Algorithmic Game Theory, " Cambridge University Press, 2007.
- John von Neumann and Oskar Morgenstern, "Theory of Games and Economic Behavior," 60th Anniversary Commemorative Edition, Princeton University Press, 2007.
- Yoav Shoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations," Cambridge University Press, 2008.
- Herbert Gintis, "Game Theory Evolving: A Problem-Centered Introduction to Modeling Strategic Interaction," Princeton University Press, 2nd Ed., 2009.

[1] Links to free electronic copies of the books will be provided on the course website, if they are available.

- David Easley and Jon Kleinberg, "Networks, Crowds and Markets: Reasoning about a Highly Connected World," Cambridge University Press, 2010.

4 Description

Game theory is a powerful framework that models strategic interactions between competing entities in various domains such as economics, computer science, business, politics and transportation. This course introduces the mathematical and computational foundations of game theory, and its applications particularly in computer science (e.g., cybersecurity, robotics and networking). Topics include rationality, noncooperative game models (e.g., normal form, extensive form), solution concepts (e.g., Nash equilibrium, subgame perfect equilibrium), effects of information asymmetry (e.g., Bayesian games), dynamical settings (e.g., repeated games), strategic alliances (e.g., cooperative game theory), and mechanism design (e.g., auctions).

5 Course Objectives

- Develop analytical thinking to model individual/group rationality in diverse decision-making contexts.
- Gain mastery in modeling strategic interactions under different informational vignettes using games.
- Become proficient in applying/finding relevant solutions for different games.
- Develop the ability to model and solve games in dynamic settings using richer solution concepts.
- Cultivate the ability to reason how/why autonomous decision makers form strategic alliances (teams).
- Design strategic mechanisms to achieve desired objectives when the participating agents act rationally in their own respective manner.

6 Tentative Schedule & Prospective List of Topics

Topic	**Subtopics**	**# Lectures**
Decision Theory	Revealed Preferences, Utilities, Bounded Rationality, Domination	4
Basic Models	Representation, Nash Equilibrium, Bayesian Games	6
Coalitional Games	Transferable Utility, Core, Shapley Value	4
Exam 1	*Early-Mid October*	1
Dynamic Games	Subgame Perfect Equilibrium, Sequential Equilibrium, Repeated Games	6
Mechanism Design	Social Choice, Revelation Principle, Truthfulness, VCG Auctions	4
Adv. Sol. Concepts	Correlated Equilibrium, Evolutionary Games	2
Exam 2	*Last Week of Classes*	1

7 Grading Information

Students' grades will be calculated based on homework assignments, examinations, quizzes and a project, as shown below:

Assignments (Top-4 of HWs 1-5 + HW6):	60% of total grade
Exams (1 and 2):	30% of total grade
Quizzes (Top-4 of Quizzes 1-5 + Quiz-6):	10% of total grade
Final Grade for Undergrad Students:	$[85-100]$: A, $[70-85)$: B, $[60-70)$: C, $[50-60)$: D, <50: F
Final Grade for Grad Students:	$[85-100]$: A, $[70-85)$: B, $[60-75)$: C, <60: F

All the grades will be posted and maintained on Canvas.

8 Course Policies & Campus Resources

8.1 Required Materials and COVID-19 Contingency Plans

This course will be offered in-person only. In order to have a safe, trustworthy and flexible learning environment, all students are strongly encouraged to get fully vaccinated against COVID-19 infection, including at least one booster dose. A combination of vaccination, masking, social distancing, staying home when you are sick, being cautious about spending time in large groups, and seeking testing when you have symptoms of COVID-19 will be our most effective measures to mitigate against the spread of the virus. There is no requirement to provide proof of immunization, but voluntary reporting of status for faculty and staff is available at MyHR. Students may report vaccination information at https://studenthealth.mst.edu/. Students should work through Care Management (cm@mst.edu), 573-341-4209, if they are quarantined, become ill, or are unable to attend class or take tests on campus. In such a case, students will be provided with a Zoom link, using which classes can be attended in an online synchronous manner until complete recovery.

Students will submit all of their homework assignments via **Gitlab**, regarding which the instructor will discuss in the first class. Quizzes will be conducted on Canvas at the time of the class, regarding which no exceptions will be made whatsoever. Students are strongly encouraged to meet either the instructor, or the grader, and ask questions regarding the assignments before their submission. Instructor will attempt to respond any email question within 24 hours upon their receipt. If the student did not receive any reply within 48 hours, they should send him a reminder under the same email chain.

One Canvas (https://umsystem.instructure.com/) will be primarily used to maintain grades and conduct quizzes. All other information (including lecture notes, assignments and Jupyter notebooks) used in this course will be found only in the course website. In order for this plan to work successfully, students are mandated to have laptops, web cams, scanners[2] (if submitting a hand-written assignment), headsets, microphones, or other resources to learn in an online synchronous setting. Most of these items are available for checkout from the Service Desk in the library.

[2]There are several mobile applications available in different platforms that can use the camera in smart devices to scan documents.

8.2 S&Tconnect

S&T Connect (https://sandtconnect.mst.edu/) S&T Connect enables students to request appointments with their instructors and advisors via the S&T Connect calendar, which syncs with the Outlook Exchange calendar. S&T Connect tracks each student's performance across all courses. S&T Connect Early Alert enables students to be provided with services as needs arise.

8.3 Student Honor Code and Academic Integrity

Students are expected to submit all their assignments, exams and quizzes independently. Incidents involving behaviors such as cheating, plagiarism, or sabotage in an academic context will be reported to the instructor's department chair and the Vice Provost of Academic Support as violations of the Student Academic Regulations. Such reporting is in addition to, and separate from, grade penalties for these violations. For a detailed explanation on academic dishonesty and student honor code, students may refer to the following resources.

- All students are expected to follow the Honor Code, which can be found at this link: https://stuco.mst.edu/documents/honor-code/
- Page 30 of the Student Academic Regulations handbook describes the student standard of conduct relative to the University of Missouri System's Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism and sabotage (http://registrar.mst.edu/academicregs/index.html),
  any of which will be reported to the Vice Provost for Academic Support.
- Other resources for students regarding academic integrity can be found at https://academicsupport.mst.edu/academicintegrity/studentresources-ai/

8.4 S&T Writing Center

The Writing Center's mission is to assist all students in their efforts to become better writers through structured one-on-one conversations with peer consultants. Writing Center consultants are fellow students whose strong writing skills and special training allow them to offer meaningful feedback and guidance. More information can be found at their website and through email: writing@mst.edu

8.5 Accessibility and Accommodations

It is the university's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on a disability, please contact Student Accessibility and Testing at (573) 341-6655, email dss@mst.edu, or visit http://dss.mst.edu/ for information.

8.6 Student Success Center

The Student Success Center (SSC) supports student development through individualized tutoring, peer-to-peer life skill coaching, and campus programming – all while providing free coffee and hot beverages! The SSC was developed to provide additional assistance for students academically and help bolster non-academic life skills. All student Miners are encouraged to utilize the SSC's free services to get timely support and to enhance their ST Miner Experience. Visit the SSC at 198 Toomey Hall, contact us at success@mst.edu, or join us on social media @sandtssc.

8.7 Student Counseling Center

Any of us may experience strained relationships, increased anxiety, feeling down, alcohol/drug misuse, decreased motivation, challenges with housing and food insecurity, etc. When your mental well-being is negatively impacted, you may struggle academically and personally. If you feel overwhelmed or need support, please make use of S&T's confidential mental health services at no charge. Learn more at https://counseling.mst.edu/resources/.

8.8 Statement about Copyright, FERPA, and Use of Video

It is vitally important that our classroom environment promote the respectful exchange of ideas. This entails being sensitive to the views and beliefs expressed during discussions whether in class or online. Please obtain instructor permission before recording any class activity. It is a violation of University of Missouri policy to distribute such recordings without authorization and the permission of all who are recorded. More information is provided here: https://www.umsystem.edu/ums/elearning/policies.

8.9 Well-Being and UCARE

Link: https://go.mst.edu/ucare-report
Any of us may experience strained relationships, increased anxiety, feeling down, alcohol/drug misuse, decreased motivation, challenges with housing and food insecurity, etc. When your mental well-being is negatively impacted, you may struggle academically and personally. If you feel overwhelmed or need support, please make use of S&T's confidential mental health services (https://wellbeing.mst.edu/) at no charge. If you are concerned about a friend or would like to consult with a Care Manager, please make a UCARE referral (https://stuaff.mst.edu/ucare/) for support and assistance.

8.10 Health and Well-Being CANVAS Course

Link: https://umsystem.instructure.com/enroll/G3LY3G
The Health and Well-Being Canvas Course offers the Miner Well-Being Certification Program, a semester-long certification where participants can engage with campus-wide services and initiatives and develop skills that contribute to personal well-being and student success. Students can enroll in the free course at any time.

8.11 Accessibility and Accommodations

It is the university's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on a disability, please contact Student Disability Services at (573) 341-6655, sdsmst@mst.edu, visit http://dss.mst.edu/ for information.

8.12 Nondiscrimination, Equity, and Title IX

Missouri S&T is committed to the safety and well-being of our campus community, and to creating an environment free from discrimination and harassment.

The University does not discriminate on the basis of race, color, national origin, ancestry, religion, sex, pregnancy, sexual orientation, gender identity, gender expression, age, disability, protected veteran status, and any other status protected by applicable state or federal law. As used in this policy, the word "sex" is also inclusive of the term "gender." Additionally, US Federal Law Title IX states that no member of the

university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Violations of this law include sexual harassment, sexual assault, dating/domestic violence, and stalking.

In accordance with the University of Missouri's Collected Rules and Regulations, all faculty and staff are required to report any information concerning discrimination disclosed through communication including, but not limited to, direct conversation, email, social media, classroom papers and homework exercises to the Equity Officer/Title IX Coordinator.

To report violations of the university's nondiscrimination polices (including Title IX), or to learn more about resources and reporting options (confidential and non-confidential) available to Missouri S&T students, staff, and faculty, please contact

Equity Officer and Title IX Coordinator: Dr. Paul Hirtz
Phone: (573) 341-7734
Location: 900 Technology Drive, Suite 500
E-mail: equity@mst.edu

8.13 Classroom Egress Maps

In order to prepare for any future emergencies, students should be well-aware of classroom egress maps, which are posted at http://designconstruction.mst.edu/floorplan/.