

## SYLLABUS

**Instructor:** *Sid Nadendla*

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### 1 Course Information

<b>Course Website:</b>	<a href="https://sid-nadendla.github.io/teaching/FS2021_GTC/index.html">https://sid-nadendla.github.io/teaching/FS2021_GTC/index.html</a>
<b>Lecture Venue and Time:</b>	220 Computer Science; Tuesdays & Thursdays – 11:00 AM - 12:15 PM
<b>Instructor's Office Location:</b>	313 Comp Sci Building
<b>Instructor's Office Hours:</b>	Friday – 4:00 PM - 5:00 PM (preferably over Zoom)
<b>Instructor's Contact Details:</b>	nadendla@mst.edu, (573) 341-4090
<b>Grader's Name and Email:</b>	Benjamin Hansen, bjh2ct@mst.edu
<b>Grader's Office Hours:</b>	Wednesday – 4:00 PM - 5:00 PM.

### 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<sup>1</sup> 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.
- David Easley and Jon Kleinberg, "Networks, Crowds and Markets: Reasoning about a Highly Connected World," Cambridge University Press, 2010.

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<sup>1</sup>Links to free electronic copies of the books will be provided on the course website, if they are available.

## 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	3
Basic Models	Representation, Eliminating Dominated Strategies, Nash Equilibrium	6
Adv. Sol. Concepts	Correlated Equilibrium, Evolutionary Games, Bayesian Games	5
<b>Midterm 1</b>	<i>First Week of October</i>	1
Dynamic Games	Subgame Perfect Equilibrium, Sequential Equilibrium, Repeated Games	5
Coalitional Games	Transferable Utility, Core, Shapley Value	3
<b>Midterm 2</b>	<i>Week before Thanksgiving Break</i>	1
Mechanism Design	Social Choice, Revelation Principle, Truthfulness, VCG Auctions	4
<b>Project Presentations</b>	(Out-of-class slots will be considered)	

## 7 Grading Information

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

<b>Assignments (Top-4 of HWs 1-5 + HW6):</b>	40% of total grade
<b>Midterm Exam (2):</b>	30% of total grade
<b>Quizzes (Top-4 of Quizzes 1-5 + Quiz-6):</b>	10% of total grade
<b>Project (1):</b>	20% of total grade
<b>Final Grade for Undergrad Students:</b>	[85 – 100]: A, [75 – 85): B, [60 – 75): C, [50 – 60): D, < 50: F
<b>Final Grade for Grad Students:</b>	[85 – 100]: A, [75 – 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 as a whole. However, to provide a safe, trustworthy and flexible learning environment, the instructor will teach the class (in-person) using a transparent face-shield in a classroom setting, and will also record every lecture in FS'21. These lecture recordings will be posted on YouTube as a private recording and shared with students only when needed.

Note that face coverings are required in all meeting spaces on campus, including instructional spaces, regardless of vaccination status, by faculty, staff, students, and visitors when social distancing is not possible. This policy will be reviewed on September 15, 2021. Since the campus is enforcing a strict mask-mandate even in classrooms, please note that students will **not** be allowed to enter into the class if they do not wear a face covering, unless an exception has been formally made to a student by our campus administration. Although there is no requirement to provide proof of immunization, voluntary reporting of status for faculty and staff is strongly encouraged at MyHR. For more details, please visit <https://coronavirus.mst.edu> to learn about the campus policy.

If quarantined, or are unable to attend class or take tests on campus due to any illness, students are advised to work through Care Management (cm@mst.edu), 573-341-4209. In such a case, the instructor will provide a Zoom link to the class until the student totally recovers.

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. As long as the campus remains open, in-class exams will be planned during lecture hours. However, in case of rampant spread of COVID-19 infection on campus in the midst of FS'20, the campus can mandate all the instructors to switch to online instruction, in which case, in-class exams will be replaced by take-home exams.

In order for this plan to work successfully, students are mandated to have laptops, web cams, scanners<sup>2</sup> (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.

<sup>2</sup>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&Tconnect enables students to request appointments with their instructors and advisors via the S&Tconnect calendar, which syncs with the instructor's Outlook Exchange calendar. S&Tconnect tracks each student's performance. S&Tconnect Early Alert enables students to be provided with services. S&Tconnect training is provided by Rachel Morris at [rachelm@mst.edu](mailto:rachelm@mst.edu) or 341-7600.

<https://canvas.mst.edu/> ("Starfish" icon on left toolbar)

## 8.3 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](mailto:sdsmst@mst.edu), visit <http://dss.mst.edu/> for information.

## 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](mailto:writing@mst.edu)

## 8.5 Student Success Center

SSC was developed as a campus-wide initiative to foster a sense of responsibility and self-directedness to all S&T students by providing peer mentors, caring staff, and approachable faculty and administrators who are student centered and supportive of student success. The Student Success Center in Toomey Hall was designed for students to visit and feel comfortable about utilizing the campus resources available.

Visit the SSC at 198 Toomey Hall; 573-341-7596; [success@mst.edu](mailto:success@mst.edu)

Facebook: <https://www.facebook.com/SandTssc>,

Web: <https://studentsuccess.mst.edu/>

## 8.6 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 online.

## 8.7 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.

## 8.8 Student Honor Code and Academic Integrity

- All students are expected to follow the Honor Code, which can be found at this link: <http://stuco.mst.edu/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 <http://academicsupport.mst.edu/academicintegrity/studentresources-ai>

## 8.9 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.

## 8.10 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](mailto:sdsmst@mst.edu), visit <http://dss.mst.edu/> for information.

## 8.11 Nondiscrimination, Equity, and Title IX

Missouri University of Science and Technology is committed to the safety and well-being of all members of its 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 Collected Rules and Regulations University of Missouri, Missouri S&T requires that all faculty and staff members report, to the Missouri S&T Equity Officer, any notice of discrimination disclosed through communication including but not limited to direct conversation, email, social media, classroom papers and homework exercises.

Missouri S&T's Equity Officer and Title IX Coordinator is Chief Diversity Officer Anitra Rivera. Contact their office at (573) 341-6038; 203 Centennial Hall) to report violations of the university's nondiscrimination policies, including Title IX. To learn more about resources and reporting options (confidential and non-confidential) available to Missouri S&T students, staff, and faculty, please visit <http://titleix.mst.edu>.

## **8.12 Classroom Egress Maps**

For all in-person instruction, faculty should explain where the classroom emergency exits are located. Classroom egress maps are posted at <http://designconstruction.mst.edu/floorplan/>.