Syllabus, Fall 2022, for OIDD 3190: Advanced Decision Systems: Agents, Games, and Evolution (AGE)

1:45–3:15p.m., Tuesdays and Thursdays. Room: TBA

Canvas:

`https://canvas.upenn.edu/courses/1664488`

GitHub:

`https://github.com/stevenokimbrough/AGE/`

Professor Steven O. Kimbrough, Instructor
Office hours: T & R 10:00–11:30 and by appointment

August 9, 2022

Contents

1 Highlights

- This course is about interdependent (alias strategic) decision making. In these situations there are at least two players (alias agents, decision makers) who make choices and receive rewards in part based on the choices made by other decision makers.

- Interdependent decision making suffuses business, government, politics, and everyday life.

- Doing strategic decision making well is often hugely challenging. The course is in part about making good decisions in strategic contexts.

- Game theory is a branch of applied mathematics that models contexts of strategic interaction (CSIs, alias games). We will advert to game theory as appropriate, but our scope of attention is much broader than game theory in the narrow sense. (More broadly, people speak of the theory of games.)

- There are many reasons to study interdependent decision making. In this course we will focus on:

  a. Supporting individual decision making ("the problems of players")

  b. Explaining and understanding social phenomena ("problems of societies")

  c. Supporting interventions, especially design of institutions

2 In a nutshell...

OIDD 3190, "Agents, Games, and Evolution," is about interdependent decision making, also known as strategic or game-theoretic decision making. This kind of decision situation arises everywhere there is social interaction. It is a lively area of study, with negotiation just one of many contexts of strategic interaction. It has been studied and applied in business, government, military, policy, interpersonal, and many other contexts. The main goal of the course is to survey the topic of strategic decision making and, in doing so, to teach how to do it well by arranging for experiences and reflections on them (i.e., we'll play games in the course). The course has two main foci. The first is strategic decision making "in the wild," as evidenced in war, foreign policy, business, governance, romance, etc. The second is modeling of contexts of strategic interaction. Here our principal tools will be Game Theory and its analytics results, and game simulations. We shall touch lightly on Game Theory, although we will cover its basics and its essential concepts will be useful throughout the course. We will conduct simulations using Agent-Based Modeling and NetLogo. Prior programming experience is not required. Students will, however, be exposed to agent-based models (ABM) and related AI techniques.

3 Class Description

OPIM 3190, "Agents, Games, and Evolution," explores applications and fundamentals of strategic behavior.

The course is about strategic decision making in the sense of game theory. That is, we study decision making situations in which what an agent gets depends upon its decisions as well as decisions made by other agents.

The main goal of the class is:

- To deepen the student's understanding of strategic interactions—games—in the social and economic spheres.

To this end, our objectives are to study and explore:

1. The key concepts and findings of the theory of games (broadly, the study of interdependent decision making, subsuming game theory).

   These will be useful for understanding and analyzing contexts of strategic interaction.

2. Strategic analysis.

   This is the interpretation of circumstances in terms of agents, interests, strategies, and interaction. We will study good examples of strategic analysis and we will undertake exercises in it.

3. Strategy discovery and selection.

   This is about how to play games and play them successfully. We will study this by playing games and by observing computational investigations of games.

4. Institution design.

   This is about choosing rules of play that result in desired outcomes. We will focus on common pool resource problems.

5. Strategic modeling and explanation.

   This is about developing game models that can explain observed phenomena. We focus on problems of cooperation as well as a variety of other phenomena.

The design of the course emphasizes learning about decision making in games by actually playing (making decisions in) games and reflecting upon what ensues. Thus, the new design of the course makes it resemble in many ways the design of the negotiations courses. There, students engage in a series of negotiations and discussions about them. Here, we will engage in a series of games calling for careful strategic decision making, and we will discuss what happened after play is complete. The games we play and discuss will range across a variety of applications, including business applications. Throughout, we will emphasize games that are realistic representations of real world situations, rather than stylized, very abstract games.

The course will continue to include topics that arise throughout the social sciences. The topics include—and we shall study—trust, cooperation, market-related phenomena (including price equilibria and distribution of wealth), norms, conventions, commitment, coalition formation, and negotiation. They also include such applied matters as design of logistics systems, auctions, and markets generally (for example, markets for electric power generation).

In addressing these topics we focus on the practical problem of finding effective strategies for agents in strategic situations (or games). Our method of exploration will be experimental: we review and discuss experiments on the behavior of agents in strategic (or game-theoretic) situations.

Computer programming is neither required nor discouraged for the course. The instructor invites, and will support, projects using NetLogo (as well as other environments). Many of the computational demonstrations and experiments we will examine are available as NetLogo programs (http://ccl.northwestern.edu/netlogo/). Students are not, however, at all required to undertake programming exercises, in NetLogo or in any other environment.

Students completing the course can expect to come away with:

- Substantial experience with decision making in realistic games.

- Solid understanding of what is known and what is not known about the problem of designing procedures for strategic behavior,

- Familiarity with the principal methods, and results of applying those methods, for the modeling of human agents and design of artificial agents in strategic contexts, and

- Deepened appreciation for contexts of strategic interaction.

* * *

Strategic, or game-theoretic, topics arise throughout the social sciences. The topics include—and we shall study—trust, cooperation, market-related phenomena (including price equilibria and distribution of wealth), norms, conventions, commitment, coalition formation, and negotiation. They also include such applied matters as design of logistics systems, auctions, and markets generally (for example, markets for electric power generation).

In addressing these topics we focus on the practical problem of finding effective strategies for agents in strategic situations (or games). Our method of exploration will be experimental: we review and discuss experiments on the behavior of agents in strategic (or game-theoretic) situations.

In focusing on the design and behavior of artificial agents in strategic (or game-theoretic) situations, we will be especially concerned with strategic contexts of commercial import, such as markets, bargaining, and repeated play. We shall dwell on effective agent learning techniques, including evolutionary methods and reinforcement learning. A main theme in the course is the inherent difficulty, even unknowability, of the problem of strategy acquisition.

We will rely mainly on computational experiments (or simulations), in distinction to analytic mathematical methods, for studying strategy formation and strategic behavior (either by individuals or by groups). Much of the class work will be devoted to discussing and interpreting computational experiments that have been reported in the literature, or that can be undertaken with tools provided in

class. In doing so, we draw upon the rapidly growing literature in agent-based modeling and agent-based simulation. Agent-Based Computational Economics (for example, `http://www.econ.iastate.edu/tesfatsi/ace.htm`) and other terms have come to denote active communities of research and application. We shall draw upon them.

Computer programming is neither required nor discouraged for the course. The instructor invites, and will support, projects using NetLogo (as well as other environments). Many of the computational demonstrations and experiments we will examine are available as NetLogo programs (`http://ccl.northwestern.edu/netlogo/`). Students are not, however, at all required to undertake programming exercises, in NetLogo or in any other environment.

4   Required Texts and Materials

There is nothing necessary to purchase. Our main texts will be:

- *Agents, Games, and Evolution,* by Steven Orla Kimbrough, (Kimbrough, 2012). ISBN-13: 9781439834701, ISBN-10: 1439834709

  This should be available as an ebook on Canvas via the library.

  See `https://github.com/stevenokimbrough/AGE/` *errata1.zip* for fixes to earlier printings of the book.

- NetLogo. Software tool for agent-based modeling. Available at `https://ccl.northwestern.edu/netlogo/`.

- *Lecture Notes* for most classes will be posted on Canvas. These notes are required or suggested readings, as indicated. "Instructor handout" in the syllabus normally refers to material that appears in these notes.

In addition, various other readings will be assigned. These will generally be handed out or made available online.

Other readings and handouts will be freely available on Canvas.

5   Class Schedule

1. Introduction

   A game for this class is above all a context of interdependent decision making. We are interested in games in order to explain social phenomena and the world we live in, and to support good decision making. We shall study games from two main perspectives. First, we shall study various game models (also called games, confusingly). Second, we shall study games in the wild, as they naturally occur. The two modes together offer rich, nuanced, and useful knowledge for understanding and participating in interdependent decision making.

"Decision theory is the theory of rational decision making" (Peterson, 2017, page 1). It is foundational to what we are after in this course. Decision theory as practiced is a broad and open body of knowledge contributed to by decision theorists proper, psychologists, philosophers, economist, computational scientists and many others. We recognize two kinds of decision contexts: parametric decisions and strategic decisions. The latter is our primary subject. Strategic decisions are what decision makers make in contexts of interdependent (aka strategic) decision making.

- Course overview
- A quick overview of decision theory

Assigned reading:

a. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 1)

b. *An Introduction to Decision Theory* (Peterson, 2017, chapter 1)

2. Decision theory, 1: Risk and Uncertainty

We explore models of decision making under certainty, under its extreme opposite, ignorance (aka uncertainty), and under an intermediate form, risk in which the decision maker has access to probability information that bears on matters.

- Certainty and Ignorance
- Risk

Recommended reading:

a. *Decision Theory: A Brief Introduction* (Hansson, 2005, chapters 1–4)

3. Decision theory, 2: Utility and game theory

Game (and for that matter, decision) models measure their outcomes numerically, with what are called utilities. There are two main ways to do this, with ordinal utilities and with cardinal utilities.

Game theory is a branch of decision theory that seeks to develop rigorous models of contexts of strategic interaction and then to analyze and solve them. The pertinent literature is vast. We touch on essential concepts in this class. Game theory is part of the conceptually broader theory of games. The course is about this broader idea, but includes some game theory proper. Here, games in strategic form among others and equilibrium concepts.

- Utility
- Game theory, 1

Assigned reading:

a. *Decision Theory: A Brief Introduction* (Hansson, 2005, chapter 5)

4. Canonical games & beyond; tragedy of the commons

   We review a number of important game models, including Prisoners Dilemma, Stag Hunt, Chicken, Battle of the Sexes and so on. We consider their uses and limitations, including multiple equilibria. And we introduce the tragedy of the commons. Main topics:

   (a) Examples from the canon of games.

   (b) Game concepts: Strategic (normal) form games. Extensive form games. Nash equilibrium. Pareto optimality. Conditions of play: one-shot, anonymous, payoffs, utility, etc.

   (c) Too many equilibria and moving the boundaries of the classical theory

   (d) Problems of cooperation

   (e) The tragedy of the commons

   Slide deck:

   AGE-cooperation-1-hardin-beamer.pdf

   Assigned reading(s):

   a. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 4)

   b. "The Tragedy of the Commons," by Garrett Hardin Hardin (1968). File: `hardin-tragedy-commons.pdf`

   c. "Cues of Being Watched Enhance Cooperation in a Real-World Setting" Bateson et al. (2006). File on Canvas: `Biology Letters 2006 Bateson.pdf`.

5. Cooperation, 1

   Cooperation is the "cement of society" (Elster, 1989) and a great unsolved problem in decision theory because there is no generally accepted theory of why it should occur so prevalently in a world of self-interested agents. We begin to examine cooperation here, including why it is a puzzle, and will continue off and on throughout the class.

   We start in on discussion of Axelrod's very important and influential tournaments with Prisoners Dilemma games, at the heart of cooperation puzzles.

   - The problem(s) of cooperation
   - Axelrod, 1

   Assigned reading(s):

   a. *The Evolution of Cooperation* (Axelrod, 1984, chapter 1)

6. Cooperation, 2

   More on Axelrod's Prisoners Dilemma tournaments. Then more on tournaments generally as a tool for analysis of game models.

   - Axelrod, 2
   - tournaments

   Assigned reading(s):

   a. *The Evolution of Cooperation* (Axelrod, 1984, chapter 2)
   b. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 3)

7. ABMs and modeling strategic interaction, 1

   Agent-based models (ABMs), a form of artificial intelligence tool, and other forms of simulation, are popular, natural, and indeed invaluable tools for analysis of games. NetLogo is a free modeling (and programming) environment for building ABMs. We will use many NetLogo models during the course. Here, we introduce the tool (it's simple and easy to learn), introduce various applications of the tool pertinent to the course, and begin to see how to program in NetLogo, which was originally designed for middle school students. Nevertheless it is a powerful environment for developing ABMs.

   After some basic instruction in programming NetLogo, students will be fully able to participate in the NetLogo exercises to come. Those students who wish to go further and develop models as part of class work will have an opportunity to do so.

   Main topics:

   (a) Quick introduction to agent-based modeling
   (b) Introduction to NetLogo

   Assigned reading(s):

   a. Download and install NetLogo (it's free) NetLogo Home Page. Retrieve from `https://ccl.northwestern.edu/netlogo/`.
   b. From the *NetLogo User Manual* (which comes with the installation), the three tutorials in the "Learning NetLogo" section:
      - Tutorial #1: Models
      - Tutorial #2: Commands
      - Tutorial #3: Procedures
   c. Romanowska, I., Wren, C. D., & Crabtree, S. A. (2021). Agent-Based Modeling for Archaeology: Simulating the Complexity of Societies. SFI Press. (Romanowska et al., 2021, chapters 1 and 2)
      Link (Has free PDF at this location. File ABMA_color_version.pdf is posted on Canvas.)

Reference material:

a. *NetLogo Users Manual*

b. *NetLogo Tutorial Notes,* chapter 1

8. ABMs and modeling strategic interaction, 2

Agent-based models (ABMs), a form of artificial intelligence tool, and other forms of simulation, are popular, natural, and indeed invaluable tools for analysis of games. NetLogo is a free modeling (and programming) environment for building ABMs. We will use many NetLogo models during the course. Here, we introduce the tool (it's simple and easy to learn), introduce various applications of the tool pertinent to the course, and begin to see how to program in NetLogo, which was originally designed for middle school students. Nevertheless it is a powerful environment for developing ABMs.

Main topics:

(a) Programming in NetLogo

Assigned reading(s):

a. Romanowska, I., Wren, C. D., & Crabtree, S. A. (2021). Agent-Based Modeling for Archaeology: Simulating the Complexity of Societies. SFI Press. (Romanowska et al., 2021, chapters 3 and 4)
Link (Has free PDF at this location. File ABMA_color_version.pdf posted on Canvas.)

b. *NetLogo Tutorial Notes,* chapters 2, 3, and 4.

Reference material:

a. *NetLogo Users Manual*

9. ABMs and modeling strategic interaction, 3

Agent-based models (ABMs), a form of artificial intelligence tool, and other forms of simulation, are popular, natural, and indeed invaluable tools for analysis of games. NetLogo is a free modeling (and programming) environment for building ABMs. We will use many NetLogo models during the course. Here, we introduce the tool (it's simple and easy to learn), introduce various applications of the tool pertinent to the course, and begin to see how to program in NetLogo, which was originally designed for middle school students. Nevertheless it is a powerful environment for developing ABMs.

Main topics:

(a) Topics in NetLogo programming

Assigned reading(s):

a. Romanowska, I., Wren, C. D., & Crabtree, S. A. (2021). Agent-Based Modeling for Archaeology: Simulating the Complexity of Societies. SFI Press. (Romanowska et al., 2021, chapters 5 and 6) Link (Has free PDF at this location. File ABMA_color_version.pdf posted on Canvas.)

b. *NetLogo Tutorial Notes,* chapters 5, 6, and 9

Reference material:

a. *NetLogo Users Manual*

10. ABMs and modeling strategic interaction, 4

Main topics:

(a) BehaviorSpace and post-solution analysis
(b) Example ABMs in strategic modeling

Assigned reading(s):

a. BehaviorSpace documentation in NetLogo

11. Evolutionary Dynamics

The lecture for this class will be pre-recorded because the instructor needs to be out of town on the date.

Once we introduce tournaments and ABMs for games we introduce a kind of dynamic in games. Strategies get played and accrue points, leading to preeminence for some and obscurity for others. The analogy to biological evolution is immediate. Here, we take up this idea directly with evolution and a particular model of it for games, the replicator dynamic. More will follow.

- Evolution
- The replicator dynamic

Assigned reading(s):

a. Darwin, concluding chapter of *The Origin of Species* Darwin-Origin-Chapt14-1st-ed.pdf on Canvas, online at `http://www.literature.org/authors/darwin-charles/the-origin-of-species/chapter-14.html`.

b. Recommended: *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 18)

c. These *Lecture Notes* on replicator dynamics

12. Spatial and Evolutionary Models

We continue with evolutionary dynamics and add a spatial element not present in the replicator dynamics. Now, agents/strategies are arrayed geographically and encounter neighbors with whom they engage in play. Adding this spacial element will often result in quite surprising system behavior.

- Evolutionary game theory and the replicator dynamics
- Spatial dynamics models

Assigned reading(s):

a. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 5)

13. Framing and Cooperation

With framing we take a naturalistic stance, although framing is a phenomenon that applies far beyond games. But we apply it directly to games and the problem of cooperation with the cooperation afforder game, as perhaps an aspect of accounting for cooperation.

- Framing
- Cooperation afforder game

Assigned reading(s):

a. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 7)

14. Exam #1

Covering classes 1–12.

Exam #1. In class.

15. Skyrms and the Stag Hunt

Brian Skyrms argues that the Stag Hunt game is much under appreciated for its role in maintaining the social order. Much more important than Prisoners Dilemma. We look at his arguments. Whether you agree or not, the Stag Hunt does offer much insight and for the reasons Skyrms adduces. We discuss why.

- The Stag Hunt game in depth
- Replicator dynamics and spatial models

Assigned reading(s):

a. *The Stag Hunt and the Evolution of Social Structure* (Skyrms, 2004, chapters 1–2)
b. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 7)

16. Evolution and the social contract

Two delightful articles that use the replicator dynamic to produce insights into sex ratios, justice, and the strategic phenomenon of commitment. "Evolution does not respect modular rationality" will be explained and its far reaching consequences for understanding game behavior discussed.

- Skyrms, *Evolution of the Social Contract* Skyrms (1996) chapter 1, "Sex and Justice"
- Skyrms, *Evolution of the Social Contract* Skyrms (1996) chapter 2, "Commitment"

17. Two-Sided Matching

Two-sided matching is arguably the most successful application of standard game theory. About 40 markets in the U.S. are said to be organized based on centralized matching of buyers (employers) and sellers (workers). We examine how this works, and departures from the pure theory.

Main topics:

(a) Two-sided matching problems.
(b) Deferred acceptance algorithm
(c) Two-sided matching algorithms
(d) Stable matching problems
(e) Computational solutions
(f) Applications

Slide deck: marriage-matching-beamer.pdf

Assigned reading(s):

a. Gale, D., & Shapley, L. S. (1962). College Admissions and the Stability of Marriage. The American Mathematical Monthly, 69(1), 9–15. Gale and Shapley (1962)

b. AGEbook: (Kimbrough, 2012, chapter 13)

Reference material:

a. Roth, A. E., & Sotomayor, M. A. O. (1990). Two-Sided Matching: A Study in Game-Theoretic Modeling and Analysis. Cambridge University Press.

b. Knuth, D. E. (1997). Stable Marriage and Its Relation to Other Combinatorial Problems: An Introduction to the Mathematical Analysis of Algorithms (Vol. 10). American Mathematical Society.

18. Markets: Monopoly

We now introduce a leaning dynamic in the form of a reinforcement learning algorithm called PROBE AND ADJUST. Heretofore, our agents have been more or less identical with the strategies they play. Now, there is a sense that agents have learning protocols that determine their strategies. This breaks the identity between agents/players and strategies, and points to a whole field of richer, more realistic representations.

In this class we introduce PROBE AND ADJUST and demonstrate its workings in a monopoly market (which is not strategic). We also look at a two-sided market and compare so-called zero-intelligence agents with behavior by human subjects and what economic theory predicts. Surprises ensue.

- PROBE AND ADJUST in monopoly markets
- Zero-intelligence agents

Assigned reading(s):

a. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 9)
b. Recommended: "Allocative Efficiency of Markets with Zero-Intelligence Traders: Market as a Partial Substitute for Individual Rationality" Gode and Sunder (1993)

19. Markets: Oligopoly

We treat the Bertrand and the Cournot models of oligopoly with PROBE AND ADJUST. More surprises ensue.

- Oligopoly markets.
- Bertrand and Cournot competition and PROBE AND ADJUST

Assigned reading(s):

a. *Agents, Games, and Evolution* (Kimbrough, 2012, chapters 10-11)
b. Recommended: *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 12)

20. Positional Goods

Two kinds of goods: material (default in classical economics) and social or positional (studied by some economists). It is in principle possible to create larger quantities of material goods, e.g., more houses, cars, shoes, ships, and sealing wax. Not so with positional social goods, such as being the Superbowl winner next year, or being CEO of a given firm at a given time. We explore the consequences of this fact, the distortions it imposes, and strategic possibilities.

Main topics:

(a) The positional goods game

(b) Hirsch and positional goods

Slide deck: Age_positional_goods_beamer.tex

Assigned reading(s):

a. *Social Limits to Growth* (Hirsch, 1976, chapter 1). File *Fred Hirsch - selections for FRG.pdf* on Canvas.

Reference material:

a. *Social Limits to Growth* (Hirsch, 1976, chapter 2). File *Fred Hirsch - selections for FRG.pdf* on Canvas.

b. Schneider, M. (2007). The Nature, History and Significance of the Concept of Positional Goods. History of Economics Review, 45, 60?81. `https://www.proquest.com/docview/884130509/citation/6047CF1016F74141PQ/1` Schneider (2007)

- Background: *The Limits to Growth* and Hirsch's rejoinder.
- Positional or social goods.
- Strategic possibilities

21. Exam #2

22. Voting, 1

Main topics:

(a) The problems of voting

(b) The problem of designing voting systems

Assigned reading(s):

a. (Poundstone, 2009, chapter 2). Poundstone, W. (2009). Gaming the Vote: Why Elections Aren't Fair (and What We Can Do About It). Hill and Wang. Available online in Canvas.

23. Voting, 2

Main topics:

(a) Voting systems

Assigned reading(s):

a. (Poundstone, 2009, chapter 7). Poundstone, W. (2009). Gaming the Vote: Why Elections Aren't Fair (and What We Can Do About It). Hill and Wang. Available online in Canvas.

Reference material:

Exam #2. In class.

a. Pacuit, E. (2019). Voting Methods. In E. N. Zalta (Ed.), The Stanford Encyclopedia of Philosophy (Fall 2019). Metaphysics Research Lab, Stanford University. `https://plato.stanford.edu/archives/fall2019/entries/voting-methods/`

24. Voting, 3

    Main topics:

    (a) Voting systems based on ratings

    Assigned reading(s):

    a. (Poundstone, 2009, chapter 11). Poundstone, W. (2009). Gaming the Vote: Why Elections Aren't Fair (and What We Can Do About It). Hill and Wang. Available online in Canvas.

    Reference material:

    a. Instructor handouts

    Approval voting. Range voting.

25. Elinor Ostrom and governing the commons

    Elinor Ostrom devoted her career and won a Nobel Prize in large part for documenting how and when the commons overcomes "the tragedy of the commons" Hardin (1968). We look at what she teaches us from her observations and case studies of successful commons in the wild.

    - Framework and background
    - Case studies
    - Resulting lessons on governing common pool resources

    Assigned reading(s):

    a. *Governing the Commons* (Ostrom, 1990, chapter 3), "Analyzing Long-Enduring, Self-Organized, and Self-Governed CPRs"
    b. *Lecture Notes*

26. Meade at Gettysburg

    Mead, who has never commanded an army before, is thrust into command of the Army of the Potomac three days before the battle of Gettysburg. The Army of the Potomac has suffered a long series of defeats by the Army of Northern Virginia, commanded by Robert E. Lee, which is at a point of peak performance. Meade navigates the fog of war, devises a remarkably strong plan, is surprised by events, and directs the army in a decisive defeat of the Army of Northern Virginia. We focus on Meade's plan and its role in the battle.

- Context
- Meade takes command and finds the Pipe Creek line
- The battle unfolds
- Assessment: Strategic decision making in the presence of great uncertainty

Assigned reading(s):

a. Short videos about the battle from the American Battlefield Trust
b. *Lecture Notes*

27. Kennan and containment

Kennan is key to the two great policies that kept the peace, more or less, until Russia's invasion of Ukraine in 2022. Arguably the latter was caused in no small part by overly-aggressive NATO expansion, which Kennan opposed in the 1990s. We examine his arguments and reasoning, focusing on X and George F. Kennan (1947), which was instrumental in creating the containment policy.

- Context: Creating U.S. foreign policy after World War II.
- The Marshall Plan and containment.
- Video of interview with Kennan in 1988.

Assigned reading(s):

a. "The Sources of Soviet Conduct" X and George F. Kennan (1947)
b. *Lecture Notes*

28. Last Class

- Backwards induction
- Summing up

Assigned reading(s):

a. *Agents, Games, and Evolution* (Kimbrough, 2012, chapter 19). Be sure to read the "errata" version with errors fixed. Get the errata at `https://github.com/stevenokimbrough/AGE`.

6 Grades and Conduct of Class

Attendance: Mandatory. Please email me in advance if you have a good reason not to attend a particular session.

Electronics: No phones, laptops, tablets or other electronics, unless specifically directed otherwise.

Grading will be based on several components, as follows.

30% Homework assignments and class participation.

30% Two exams/quizzes, 15% each.

40% Term project, due the last day of finals, December 22, 2022.

Grading: $x > 95\%$, A+; $91\% \leq 95\%$, A; $85\% < x \leq 91\%$, A-/B+, $75\% < x \leq 85\%$, B; $65\% < x \leq 75\%$, C; $55\% < x \leq 65\%$, D; $x \leq 55\%$, F. With the caveat that I can give lots of As if merited but it's very unlikely I can give lots of A+s.

Most of all, I want to see you engaged and involved in the class. I'll prepare lectures for the classes, but much prefer to conduct class with lots of interactive, give and take, and discussion.

Also: I like jazz and will improvise during the semester. The syllabus may well (will likely) change as we go along. I'll let you know when it does and the quiz dates will *not* be changed.

Two further items/requirements:

- Every student should come chat with me at least once during (online) office hours. If my posted hours conflict with your schedule, let me know and we'll make arrangements. Also, you need not come alone. It's fine to come with a group of up to four.

- You will occasionally need your laptop in class. I'll let you know ahead of time. However, during lectures and similar periods when we are not actively using them, use of laptops, PDAs, etc. are forbidden.

7 Computer Access for Non-Wharton Students

Here is the link you should include with your announcements and instructions on future syllabi.

This link works:

`https://whartonstudentsupport.zendesk.com/hc/en-us/articles/203165417-Create-Your-`

In plain text:

https://whartonstudentsupport.zendesk.com/hc/en-us/articles/203165417-Create-Your-Wharton-Account

*Wharton Class Accounts are needed so that when students try to login into the computers in the labs with their PennKey these PennKey link to active Wharton Class accounts. These class accounts also are needed if students intend to use the public printers.

*I have confirmed Study.net materials are all PennKey authentication now.

Also (for non-Wharton students): After you follow the link above and create a Wharton Class Account, you will then log in to the computers with your PennKey account. (But wait an hour the first time you try this.)

8 Calendar, fall 2022

Last class is on Thursday, December 8, 2022.

	0	1	2
0	—	R: 2022-10-29	T: 2022-11-08
1	T: 2022-08-30	T: 2022-10-04	R: 2022-11-10
2	R: 2022-09-01	T: 2022-10-11	T: 2022-11-15
3	T: 2022-09-06	R: 2022-10-13	R 2022-11-17
4	R: 2022-09-08	T: 2022-10-18	T: 2022-11-22
5	T: 2022-09-13	R: 2022-10-20	T: 2022-11-29
6	R: 2022-09-15	T: 2022-10-25	R: 2022-12-01
7	T: 2022-09-20	TR 2022-10-27	T: 2022-12-06
8	R: 2022-09-22	T: 2022-11-01	R: 2022-12-08
9	T: 2022-09-27	R: 2022-11-03	—

Table 1: Class number :: date correlation, for Tuesday (T) and Thursday (R) classes, fall 2022. Penn academic calendar `https://almanac.upenn.edu/penn-academic-calendar`

References

Axelrod, R. (1984). *The Evolution of Cooperation*. Basic Books, Inc., New York, NY.

Bateson, M., Nettle, D., and Roberts, G. (2006). Cues of being watched enhance cooperation in a real-world setting. *Biology Letters*, 2:412–414.

Elster, J. (1989). *The Cement of Society: A Study of Social Order*. Studies in rationality and social change. Cambridge University Press, Cambridge, UK.

Gale, D. and Shapley, L. S. (1962). College Admissions and the Stability of Marriage. *The American Mathematical Monthly*, 69(1):9–15.

Gode, D. K. and Sunder, S. (1993). Allocative Efficiency of Markets with Zero-Intelligence Traders: Market as a Partial Substitute for Individual Rationality. *Journal of Political Economy*, 101(1):119–137.

Hansson, S. O. (2005). *Decision Theory: A Brief Introduction*.

Hardin, G. (1968). The Tragedy of the Commons. *Science*, 162(3859):1243–1248.

Hirsch, F. (1976). *Social Limits to Growth*. Harvard University Press, Cambridge, MA.

Kimbrough, S. O. (2012). *Agents, Games, and Evolution: Strategies at Work and Play*. CRC Press, Boca Raton, FL.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, Cambridge, UK.

Peterson, M. (2017). *An Introduction to Decision Theory*. Cambridge University Press, Cambridge, UK, second edition.

Poundstone, W. (2009). *Gaming the Vote: Why Elections Aren't Fair (and What We Can Do About It)*. Hill and Wang.

Romanowska, I., Wren, C. D., and Crabtree, S. A. (2021). *Agent-Based Modeling for Archaeology: Simulating the Complexity of Societies*. SFI Press. Google-Books-ID: kZVOEAAAQBAJ https://www.santafe.edu/news-center/news/new-book-agent-based-modeling-archaeology.

Schneider, M. (2007). The Nature, History and Significance of the Concept of Positional Goods. *History of Economics Review*, (45):60–81. Num Pages: 22 Place: Hobart, United Kingdom Publisher: Taylor & Francis Ltd.

Skyrms, B. (1996). *Evolution of the Social Contract*. Cambridge University Press, Cambridge, UK.

Skyrms, B. (2004). *The Stag Hunt and the Evolution of Social Structure*. Cambridge University Press, Cambridge, UK.

X and George F. Kennan (1947). The Sources of Soviet Conduct. *Foreign Affairs*, 25(4):566–582.

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