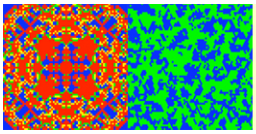
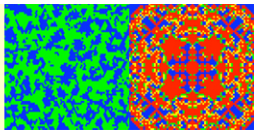


THE EVOLUTION OF COOPERATION



MSCI-463, The Evolution of Cooperation
Department of Mathematics and Science, School of Liberal Arts and Sciences, Pratt Institute

Course Description:

When we describe what propels evolution, "competition" and "exploitation" are the processes that first come to mind. However, cooperation within and between organisms has also played a prominent role in the evolution of the earth's organisms. In this course, we will consider the various levels at which cooperation has emerged as the result of natural selection, starting with single-celled organisms and building up to human cultural systems. While the course has no prerequisites, the readings and assignments will be aimed at highly-motivated students; students will be expected to conduct significant independent inquiry.

Upon completion, this course is worth three (3) credits.

Meeting Time: Tuesdays, 9:30 am to 12:20 pm, Engineering 111

Instructor:
Dr. Christopher Jensen
Assistant Professor, Department of Math and Science
http://www.christopherxjjensen.com/
Office: ARC Lower Level, Room G-49
Email: cjensen@pratt.edu
Phone: 718-636-3572, x3572 from the BK campus

Office Hours: Mondays 11:00 am to 12:30 pm, Wednesdays 12:30 to 2 pm, *or by appointment*

Course Goals:

- To understand how cooperative interactions evolve within biological systems.
- To explore the various levels at which cooperation emerges in biological systems.
- To distinguish between altruistic and selfish behaviors.
- To become familiar with the various ways in which scientific researchers approach the problem of how cooperation evolves.
- To understand how cooperation functions in modern human society.
- To plan and execute original scientific inquiry into a particular facet of cooperation.

Learning Objectives: Students who successfully complete *The Evolution of Cooperation* will be able to...

- Describe cooperation in the biological world, including the ecological conditions which foster this cooperation.
- Investigate evolutionary games to produce insights into how cooperation evolves.
- Discuss whether a particular behavior should be considered altruistic.
- Explain the various ways that natural selection can either produce or destroy cooperative structures and behaviors.
- Describe the levels of biological organization at which natural selection may operate.
- Perform research on how cooperation evolves and communicate your findings.
- Apply your understanding of how cooperation evolves to the human species.

Assessment Criteria:
Below is a summary of how you will be graded in this course. All grades will be posted on the *LMS*, so please take advantage of the fact that you can always know how you are doing in the course.

Contribution to Grade	Category	Description
10%	*Reading Response*	During each week of class, I will post a series of reading response questions (RRQ's) on the *LMS*. These questions will help guide your reading and get you thinking about key issues that will be discussed in class. To receive credit, you must provide answers by 5:00 pm on the day before class. Unlike other assignments, late RRQ's will not be accepted.
10%	*Participation*	We'll be discussing course readings in light of our own particular concerns. I'll have questions for you; I will expect you to have questions for me. Come to class having read and thought about assigned readings, ready to actively engage in dialogue. To receive participation credit you need to be present in class; to receive full participation credit you need to be actively engaged in class discussions. Based on your participation during each regular class session, I will assign you a specific grade and make comments on the strengths and weaknesses of your contribution.
10%	*Assignments*	You will complete assignments during class and as homework. Some of these assignments will be done individually, others will require group cooperation. I will be grading each assignment based on its clarity of thought, level of insight, and contribution to class dialogue.
50%	*Term Project*	The major focus of this class is the completion of a research-based term project. In the first half of the course you will perform research on a relevant topic of your choosing and identify important ideas and concepts related to the course that you can express through a creative medium. After presenting your proposed project idea to the class, you will develop your idea before creating a final term project in the medium of your choice. Throughout the semester-long process of developing your project, you will work within a peer group to provide each other with feedback on your draft work.
20%	*Take-home Final Exam*	This class ends with a cumulative "take-home" final that can be completed at any time during the last week of the semester. The final will be in an "open notes/open book" format and will focus on broad concepts regarding how cooperation evolves rather than the regurgitation of biological facts.

Under no circumstances will personalized extra-credit work be offered to any student

Lateness and Absence:

Of Students: I expect you to arrive to class on time. Lateness and absence can adversely affect your participation and assignments grades.

Of Assignments: Late assignments, including major projects, will be penalized by 10% per day. Late reading responses are not accepted.

Excuses: There are very few legitimate reasons to miss all or part of a class session or for submitting assignments after the stated deadlines. In order for an absence or lateness to be excused, you must provide formal documentation stating which classes/deadlines were affected and explaining the reason behind the absence; all documentation will be subject to strict verification. Valid excuses include family emergencies and chronic personal health issues. The following reasons do not excuse lateness or absence: oversleeping, excessive work load in other classes, inability to use the *Learning Management System*, or "forgetting"

Readings:

There is no required textbook for this course. You will be assigned a series of reading materials from popular science periodicals, books, and the scientific literature posted on the *LMS* (see ***Weekly Units*** below). The main sources for readings in this course are:

Barash, David P. (2008). Natural selections: selfish altruists, honest liars, and other realities of evolution. Bellevue Literary Press. (ISBN: 978-1934137055)*

Benkler, Yochai (2011). The penguin and the Leviathan : the triumph of cooperation over self-interest. Crown Business. (ISBN: 978-0-385-52576-3)*

Dawkins, Richard (1989). The Selfish Gene. Oxford University Press. (ISBN: 0-19-286092-5)*

de Waal, Frans (2009). The age of empathy: nature's lessons for a kinder society. Harmony Books. (ISBN: 978-0307407771)*

Harman, Oren S. (2010). The price of altruism: George Price and the search for the origins of kindness. W.W. Norton. (ISBN: 978-0393339994)*

Henrich, Natalie & Joseph Henrich (2007). Why humans cooperate : a cultural and evolutionary explanation. Oxford University Press. (ISBN: 978-0-195-30068-0)*

Hölldobler, Bert & Edward O. Wilson (2009). The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies. W.W. Norton Company. (ISBN: 978-0-393-06704-0)*

Krebs, Dennis (2011). The origins of morality: an evolutionary account. Oxford University Press. (ISBN: 978-0199778232)*

Margulis, Lynn (1998). Symbiotic Planet. Basic Books. (ISBN: 0-465-07272-0)

Nowak, Martin A., and Roger Highfield (2011). SuperCooperators: Altruism, Evolution, and Why We Need Each Other to Succeed. Free Press. (ISBN: 978-1-4391-0018-9)*

Rheingold, Howard (2002). Smart mobs: the next social revolution. Basic books. (ISBN: 978-0738208619)*

Ridley, Matt (1996). The Origin of Virtue. Penguin Books. (ISBN: 0-670-87449-3)

Ryan, Frank (2002). Darwin's Blind Spot. Houghton Mifflin Company. (ISBN: 0-618-11812-8)

Weiss, Kenneth M. & Anne V. Buchanan (2009). The Mermaid's Tale: Four Billion Years of Cooperation in the Making of Living Things. Harvard University Press. (ISBN: 978-0-674-03193-7)*

Williams, George C. (1996). Plan and Purpose in Nature. Phoenix (London). (ISBN: 0-75380-042-X)*

Wilson, Edward O. (2012). The social conquest of earth. Liveright (New York). (ISBN: 978-0871404138)*

You are encouraged to save paper by viewing all readings electronically (as opposed to printing them out); books with asterisks (*) are on reserve in the Pratt Brooklyn library.

Learning Management System (LMS):

During the course of the semester, we will make extensive use of Pratt's *Learning Management System* (*LMS*). I recommend that you use the *Firefox* browser to access the *LMS* via this page: http://lms.pratt.edu/ (I discourage you from using the *my.pratt.edu* entrance point, as it is not always working). Use your ONEKEY username and password to log in. I expect you to check the *LMS* several times a week for announcements, reading assignments, and updates to your class grade (note that you can also set the *LMS* to send you email messages every time our class page is updated). I will be using the *LMS* to send email announcements throughout the semester, so please make sure that you check the email address listed under your *LMS* profile regularly. "I forgot to check my Pratt email" is an invalid excuse.

I try to make the assignments, announcements, and other documents I post on the *LMS* as universally-readable as possible. The only proprietary program you will need to have loaded onto your computer is *Acrobat Reader*, which can be downloaded here: http://www.adobe.com/products/acrobat/readstep2.html. I strongly recommend that you use *Acrobat Reader*, rather than another program, to read all of the PDF's provided in this class.

***Important*:** If you should have any problems with the *LMS*, you should:

1. Report the problem to the ***Service Desk*** and receive a "ticket number" by one of four means:
   a. visiting their office in the basement of the Engineering Building; or
   b. calling (718) 636-3765; or
   c. emailing services@pratt.edu; or
   d. using the "Submit a Service Request" function on the *Campus Tech* tab of my.pratt.edu.
2. Receive an email from the ***Service Desk*** assigning your problem a "ticket number".
3. Forward this email from the ***Service Desk*** to me.

In order for me to verify claims of *LMS* outages, you must contact the ***Service Desk*** *when the LMS problem occurs*, not hours or days later.

Reduced-Paper-Use Classroom:
Whenever possible, we will reduce the amount of paper that this course consumes. All of your out-of-class assignments, including any two-dimensional components of your projects, must be submitted electronically via the *LMS*. Your work will be graded and returned electronically. Please do your best to reduce the amount of printing that you do for the course.

Classroom Civility and Academic Honesty:

I expect you to maintain the civility and integrity of our course in and out of the classroom. In class, this means arriving on time, turning off cell phones and refraining from sending text messages, maintaining focus on class discussion, respecting the right of others to speak, and leaving the classroom in good condition (among other things). Out of class, this means properly citing all work that is not your own (in other words, not plagiarizing).

Plagiarism means presenting, as one's own, the words, the work, information, or the opinions of someone else. It is dishonest, since the plagiarist offers, as his/her own, for credit, the language, or information, or thought for which he/she deserves no credit. Types of plagiarism include: (1) The use of any material from any source other than yourself in a paper or project without proper attribution. This includes material from the Internet, books, papers or projects by other students, and the media; (2) The extensive use of the ideas of others in your work without proper attribution; and (3) Turning in work done by another person, downloaded from the web, purchased from any agency or supplier, as one's own. Plagiarism occurs when one uses the exact language of someone else without putting the quoted material in quotation marks and giving its source. The method for documenting sources and references is established by a number of standards: please choose one of these standards (such as the *MLA Handbook for Writers of Research Papers* or the *Chicago Manual of Style*) and use it consistently. Any paper submitted that does not use proper referencing will not be marked.

Any disruptive, disrespectful, or dishonest behavior will be promptly reported to the appropriate campus authority. Students must adhere to all Institute-wide policies which include policies on attendance, academic integrity, plagiarism, computer, and network use. Please see http://www.pratt.edu/student_life/student_affairs/student_policies/ (click on *Online Student Handbook*) for policies and procedures for handling academic conduct issues.

Help with Writing:

Both major projects in this class will require you to produce written work. All students can benefit from feedback on their writing. I am happy to read and respond to rough drafts of either assignment, provided they are emailed to me no later than 5 days before the day the paper is due.

Pratt's *Writing and Tutorial Center* can also help you produce the best project possible. The center is located on the 1st Floor of North Hall (it has all the great fish tanks… you can't miss it!). Call them at (718) 636-3459 or send an email to wtc@pratt.edu to make an appointment.

Rights of Students with Disabilities:

If you have a physical or learning disability, ADD/ADHD, chronic disease, or physical condition that we should know about, please contact Mai McDonald at 718-636-3711, to discuss your needs and how we can best serve you. In order to receive classroom accommodations and other services, you must have documentation of your disability on file in our office. Your records will be kept completely confidential. For more information, please see the Pratt webpage for Disability Services (www.pratt.edu/student_life/student_services/disability_services/).

Weekly Units:

Week	Date	Major Topic(s)	Key Questions	Readings	Events & Assignments
01	Aug. 28th	**Introduction to evolution and game theory**	1. How does evolution work? What are its constraints? 2. What is game theory? 3. How is game theory used to understand evolutionary processes?	‣ *The Mermaid's Tale* "Principles of Life" ‣ *Scientific American* "The Arithmetics of Mutual Help"	➡ *Syllabus* distributed ➡ *LMS Warm-up Assignments* discussed ➡ **RRQ's** due August 30th @ 5 pm EST
02	Sept. 4th	**Cooperation in evolutionary games**	1. How has game theory contributed to our understanding of how cooperation evolves? 2. How can experiments in game theory be used to understand how cooperation evolves?	‣ *Scientific American* "The Economics of Fair Play" ‣ *Scientific American* "The Traveler's Dilemma" ‣ *Nature* "Punisher pays" ‣ *American Scientist* "Animal Contests as Evolutionary Games"	➡ **RRQ's** due 5 pm EST Monday before class ➡ Class visits a computer lab: remember to bring your Pratt ID!! ➡ *Term Project Guidelines* distributed ➡ **LMS Warm-up Assignments** due, September 4th @ 11:59 EST
03	Sept. 11th	**Evolution and the morality of nature**	1. What is altruism? 2. Do organisms interact in a harmonious manner? 3. Does nature have a moral code?	‣ *Plan and Purpose in Nature*, Chapter 3 ‣ *Plan and Purpose in Nature*, Chapter 9 ‣ *The Origin of Virtue,* Chapter 11 ‣ *Darwin's Blind Spot*, Chapter 3 ‣ *Talk of the Nation*, Interview with Frans de Waal	➡ **RRQ's** due 5 pm EST Monday before class ➡ Class visits a computer lab: remember to bring your Pratt ID!!
04	Sept. 18th	**Selfish genes, cooperative genomes, and multicellular organisms**	1. What is "Selfish Gene Theory"? What evidence supports this theory? 2. What allows the genome to "cooperate"? 3. How did multicellular organisms evolve?	‣ *The Selfish Gene*, Chapter 1 ‣ *The Selfish Gene*, Chapter 2 ‣ *The Selfish Gene*, Chapter 3 ‣ *The Mermaid's Tale* "The Cooperative Genome" ‣ *The Scientist* "The Cheatin' Amoeba"	➡ **RRQ's** due 5 pm EST Monday before class ➡ Class visits a computer lab: remember to bring your Pratt ID!!

Week	Date	Major Topic(s)	Key Questions	Readings	Events & Assignments
05	Sept. 25th	**Kin selection**	1. What is kin selection? 2. How is kin selection related to altruistic behavior? 3. Does kin selection explain most forms of intra-species cooperation?	‣ *National Geographic* "Meerkats Stand Tall" ‣ *Science* "Breeding Together: Kin Selection and Mutualism in Cooperative Vertebrates" ‣ *Science* "Effects of Helpers on Juvenile Development and Survival in Meerkats" ‣ *Science* "Desperately Seeking Similarity" ‣ *Science* "Morphs, Dispersal Behavior, Genetic Similarity, and the Evolution of Cooperation"	➡ **RRQ's** due 5 pm EST Monday before class ➡ **Initial Source List** due, September 25th @ 11:59 pm EST
06	Oct. 2nd	**Symbiosis and mutualism**	1. What allows the evolution from parasite to mutualist? 2. How does natural selection maintain mutualisms?	‣ *Darwin's Blind Spot* Chapter 2 ‣ *Darwin's Blind Spot* Chapter 7 ‣ *Darwin's Blind Spot* Chapter 9 ‣ *Darwin's Blind Spot* Chapter 10	➡ **RRQ's** due 5 pm EST Monday before class ➡ **Source List Concept Map** due, October 2nd @ 11:59 pm EST
07	Oct. 9th	**Sociality and group living**	1. Why do organisms live together? 2. What are some of the challenges of social living? 3. When does social living involve cooperation?	‣ *Trends in Ecology & Evolution* "The Evolution of Social Behavior in Microorganisms" ‣ *National Geographic* "In the Whirl" ‣ *Scientific American* "How Animals Do Business" ‣ *Scientific American* "Divided We Fall: Cooperation among Lions" ‣ *Nature* "Group living and hungry lions" ‣ *Nature* "Group formation stabilizes predator–prey dynamics"	➡ **RRQ's** due 5 pm EST Monday before class ➡ Class visits a computer lab: remember to bring your Pratt ID!! ➡ **Draft Term Project Proposal** due, October 9th @ 11:59 pm EST ➡ ***Peer Review* on Draft Term Project Proposal** due, October 12th @ 11:59 pm EST
08	Oct. 16th	**Superorganisms**	1. Why do some organisms live in cooperative colonies? 2. Can natural selection act on these colonies?	‣ *The Superorganism* "The construction of a superorganism" ‣ *The Superorganism* "Genetic social evolution" ‣ *Science* "Ancestral monogamy shows kin selection is the key to the evolution of eusociality"	➡ **RRQ's** due 5 pm EST Monday before class ➡ **Term Project Proposal** due, October 16th @ 11:59 pm EST

Week	Date	Major Topic(s)	Key Questions	Readings	Events & Assignments
09	Oct. 23rd	***Term Project Proposal Presentations***		‣ *Term Project Proposals* (posted on the *LMS*)	➡ **RRQ's** due 5 pm EST Monday before class ➡ *In-class presentation of Term Project Proposals* ➡ ***Peer Review* on Term Project Proposal Presentations** due, October 26th @ 11:59 pm EST
10	Oct. 30th	**Multilevel selection theory**	1. How do we extend simple models of evolution to explain the evolution of cooperative behaviors?	‣ *The Quarterly Review of Biology* "Rethinking the theoretical foundation of sociobiology" ‣ *The Quarterly Review of Biology* "Levels of Selection, Altruism, and Primate Behavior" ‣ *The World* "Seeking the roots of kindness"	➡ **RRQ's** due 5 pm EST Monday before class ➡ **Term Project Sketch** due, October 30th @ 11:59 pm EST
	Nov. 6th	*Election Day, No Class*			➡ ***Peer Review* on Term Project Sketch** due, November 9th @ 11:59 pm EST
11	Nov. 13th	**Are humans altruists?**	1. In what ways do humans act towards the common good? 2. Should we label this behavior as altruistic?	‣ *Nature* "Share and share alike" ‣ *Nature* "Egalitarianism in Young Children" ‣ *Nature* "The nature of human altruism" ‣ *Scientific American Mind* "The samaritan paradox" ‣ *Scientific American Mind* "When morality is hard to like"	➡ **RRQ's** due 5 pm EST Monday before class ➡ **Draft Project Summary** due, November 13th @ 11:59 pm EST
12	Nov. 20th	**Human culture and cooperative behavior**	1. How do genes & culture interact to produce behavior? 2. In what ways has human culture allowed for the evolution of cooperative behaviors?	‣ *The Origin of Virtue* Chapter 2 ‣ *Why Humans Cooperate* "Dual Inheritance Theory" ‣ *Why Humans Cooperate* "Culturally evolved social norms lead to context-specific cooperation" ‣ *Evolutionary Anthropology* "Human Evolution and Human History: A Complete Theory"	➡ **RRQ's** due 5 pm EST Monday before class ➡ ***Peer Review* on Draft Project Summary** due, November 20th @ 11:59 pm EST

Week	Date	Major Topic(s)	Key Questions	Readings	Events & Assignments
13	Nov. 27th	**The future of cooperation**	1. Why is understanding how cooperation evolves important in modern-day society? 2. What are some of the challenges to modern cooperative efforts?	‣ *Why Humans Cooperate* "Cooperative dilemmas in the world today" ‣ *The Origin of Virtue* Chapter 12 ‣ *Scientific American* "No country is an island" & "Don't talk, reproduce"	➡ **RRQ's** due 5 pm EST Monday before class ➡ **Final Term Project** & **Project Summary** due, November 27th @ 11:59 pm EST
14	Dec. 4th	***Final Term Project Presentations 1***		‣ *Term Project Abstracts* (posted on the *LMS*)	➡ **Take-home Final Exam** made available on the LMS, December 4th @ 9:30 am EST ➡ *In-class presentation of Term Projects* (see the *LMS* for presentation schedule)
15	Dec. 11th	***Final Term Project Presentations 2***		‣ *Term Project Abstracts* (posted on the *LMS*)	➡ **Take-home Final Exam** closes December 11th @ 11:55 pm EST ➡ *In-class presentation of Term Projects* (see the *LMS* for presentation schedule)