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Course Description

This course introduces students to the basic concepts of reinforcement learning (tabular solution methods and approximate solution methods), computational intelligence, and frontier applications.

Instructional Method

In person

Prerequisites/Corequisites

Basic knowledge of machine learning, neural networks, statistics, and random process.

Course Objectives/Student Learning Outcomes

The objective of this course is to introduce the foundations, principles and algorithms for reinforcement learning (tabular solution methods and approximate solution methods), and apply the knowledge to solve real-world application problems in many other domains. Topics covered in this course include, multi-armed bandits Markov decision process, dynamic programming, Monte Carlo process, Q-learning, temporal difference methods, on-policy and off-policy methods, eligibility traces and others.

Course Evaluation Method

All assignments, homework, projects, programs, quizzes, and exams in this course must be INDIVIDUAL effort. Late submissions will not be accepted or graded.

All programming assignments are individual work, the best way to learn how to program is to write your own code. Sharing code is considered cheating. Sharing code includes posting completed work (code) before the assignment official deadline onto sites such as GitHub, emailing code to other students, allowing any access to your work before the official deadline has passed. Other code sharing offenses include submitting another person's work as your own, this includes taking code off sites such as GitHub, Chegg, etc.

Modifying code and submitting it as your own is a fraudulent practice—specifically, plagiarism—and is no different than copying paragraphs of information from a book or journal article and calling it your own (make sure that you work independently and submit only your own code).

Please take the time to read the documentation. You are responsible for the information outlined in it. Please see the instructor, any teaching assistant, or Engineering Student Services tutoring for assistance. Check the Help Section on Canvas.
All assignments are due by 11:59 PM on the due date. However, it is recommended that you submit your work by 9:00 pm as no assistance will be provided after 9:00 pm should you encounter any technical difficulties.

<u>The use of AI Language is prohibited for any assignment in this course.</u>

- Homework - 10 %
- Computer projects (1st and 2nd) - 40 %
- Computer project (3rd) - 25 %
- Exam - 25 %

* The instructor reserves the right to change 10% of the grade method

Before you take your exam, please have the following required materials as mentioned in your syllabus such as a printer, scanner, paper, ink, and a writing utensil.

I understand that I will be asked within the exam to complete figures and diagrams. I understand that I must write out my responses and order them in a logical sequence. I understand I will be required to complete my work and show my work on the worksheet, scan my completed worksheet to my computer and submit it by selecting the scanned file from my computer within the exam.

Course Grading Scale

GRADING SCALE:
93 AND ABOVE: "A",
[90-93): "A-",
[87-90): "B+",
[83-87): "B",
[80-83) : "B-",

[77-80): "C+",
[73-77): "C",
[70-73): "C-",
AND BELOW: "F."

Policy on Makeup Tests, Late Work, and Incompletes (if applicable)

Late work is not acceptable. All projects will have a due date and a Final due date, assignments will be posted well in advance and students may submit assignments early. No assignments will be accepted after the Final due date.

Makeup tests are given only if there is solid evidence of a medical or otherwise serious emergency that prevented the student of participating in the exam.

Incomplete grades are against the policy of the department. Unless there is solid evidence of medical or otherwise serious emergency situation and the student is currently passing the class, incomplete grades will not be given.

Special Course Requirements (if applicable)

CODE OF ACADEMIC INTEGRITY POLICY STATEMENT
Students at Florida Atlantic University should endeavor to maintain the highest ethical standards. Academic dishonesty is a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive to the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001.

PLAGIARISM
Plagiarism is unacceptable in the University community. Academic work must be an original work of your own thought, research, or self-expression. When students borrow ideas, wording, or organization from another source, they must acknowledge that fact in an appropriate manner. Plagiarism is the deliberate use and appropriation of another's work without identifying the source and trying to pass off such work as one's own. Any student who fails to give full credit for ideas or materials taken from another has plagiarized. This includes all discussion board posts, journal entries, wikis, and other written and oral presentation assignments. If in doubt, cite your source.

Classroom Etiquette Policy (if applicable)

Due to the casual communication common in the online environment, students are sometimes tempted to relax their grammar, spelling, and/or professionalism. Please remember that you are adult students and professionals—your communication should be appropriate. For more in-depth information, please see the FAU statement on netiquette.

Policy on the Recording of Lectures (optional)

Students enrolled in this course may record video or audio of class lectures for their own personal educational use. A class lecture is defined as a formal or methodical oral presentation as

part of a university course intended to present information or teach students about a particular subject. Recording class activities other than class lectures, including but not limited to student presentations (whether individually or as part of a group), class discussion (except when incidental to and incorporated within a class lecture), labs, clinical presentations such as patient history, academic exercises involving student participation, test or examination administrations, field trips, and private conversations between students in the class or between a student and the lecturer, is prohibited. Recordings may not be used as a substitute for class participation or class attendance and may not be published or shared without the written consent of the faculty member. Failure to adhere to these requirements may constitute a violation of the University's Student Code of Conduct and/or the Code of Academic Integrity.

Attendance Policy

Students are expected to attend all of their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance. Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations or participation in University-approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final course grade as a direct result of such absence.

Counseling and Psychological Services (CAPS) Center

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU's Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to help improve and maintain emotional well-being. For more information, go to http://www.fau.edu/counseling/

Disability Policy

In compliance with the Americans with Disabilities Act Amendments Act (ADAAA), students who require reasonable accommodations due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) and follow all SAS procedures. SAS has offices across three of FAU's campuses – Boca Raton, Davie and Jupiter – however disability services are available for students on all campuses. For more information, please visit the SAS website at www.fau.edu/sas/.

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Required Texts/Readings

Andrew Barto and Richard S. Sutton, Reinforcement Learning: An Introduction, MIT Press, 1998 (First Edition)/2017 (Second Edition)

Supplementary/Recommended Readings (if applicable)

Your recommended/optional textbook(s) include: T. Mitchell, Machine Learning, McGraw Hill, 1997. ISBN 0070428077. Additional lecture notes from Dr. S. Sutton (U of Alberta), Dr. T. Mitchell (CMU) and Dr. Levine (UC-Berkeley) are used in this course.

Course Topical Outline

1. Background of reinforcement learning
2. Multi-armed bandits
3. Finite Markov decision process and dynamic programming
4. Monte Carlo process
5. Temporal difference learning
6. Planning and learning with tabular methods
7. Neural networks and deep neural networks
8. On-policy prediction with approximation
9. On-policy control with approximation
10. Off-policy methods with approximation
11. Eligibility traces
12. Policy gradient methods
13. Selective topics in deep reinforcement learning
14. Selective topics in real-world applications