FLORIDA ATLANTIC UNIVERSITY

NEW COURSE PROPOSAL
Graduate Programs

Department Comp. and Electrical Eng. and Comp.Science

College Engineering and Computer Science

*(To obtain a course number, contact **erudolph@fau.edu**)*

UGPC Approval _____
UFS Approval _____
SCNS Submittal _____
Confirmed _____
Banner _____
Catalog _____

Prefix CAP

Number 6547

(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)
Lab Code

Type of Course
Lecture

Course Title
Reinforcement Learning

Credits *(Review Provost Memorandum)*
3

Effective Date *(TERM & YEAR)*
Spring 2021

Grading *(Select One Option)*

Regular X

Sat/UnSat

Course Description *(Syllabus must be attached; see Guidelines)*
Reinforcement learning aims to build programs which learn how to predict and act in a stochastic environment, based on past experience. This course will study theoretical properties and practical applications of reinforcement learning. Course topics include Markov decision process, dynamic programming, temporal-difference learning, planning and learning with tabular methods, and deep reinforcement learning.

Prerequisites
COP 3530 and STA 4821, or permission of the instructor

Prerequisites, Corequisites and Registration Controls are enforced for all sections of course.

Academic Service Learning (ASL) course
Academic Service Learning statement must be indicated in syllabus and approval attached to this form.

Corequisites
NA

Registration Controls *(For example, Major, College, Level)*
Graduate and senior students

Minimum qualifications needed to teach course:
Member of the FAU graduate faculty and has a terminal degree in the subject area (or a closely related field.)

List textbook information in syllabus or here
Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An introduction, Second Edition, MIT Press, 2019

Faculty Contact/Email/Phone
Zhen Ni/zhenni@fau.edu/561-297-0035
Xingquan Zhu/xzhu3@fau.edu/561-297-3452

List/Attach comments from departments affected by new course
NA

Approved by		*Date*
Department Chair	Hanqi Zhuang — Digitally signed by Hanqi Zhuang DN: cn=Hanqi Zhuang, o=FAU, ou=CEECS, email=zhuang@fau.edu, c=US Date: 2020.05.13 17:07:51 -04'00'	5/13/2020
College Curriculum Chair	Ramesh Teegavarapu — Digitally signed by Ramesh Teegavarapu DN: cn=Ramesh Teegavarapu, o=Florida Atlantic University, ou=Civil, Environmental and Geomatics Engineering, email=rteegava@fau.edu, c=US Date: 2020.05.14 08:57:01 -04'00'	5/14/2020
College Dean	Mihaela Cardei — Digitally signed by Mihaela Cardei DN: cn=Mihaela Cardei, o=Florida Atlantic University, ou, email=mcardei@fau.edu, c=US Date: 2020.05.24 17:04:06 -04'00'	5/24/2020
UGPC Chair		
UGC Chair		
Graduate College Dean		
UFS President		
Provost		

Email this form and syllabus to UGPC@fau.edu 10 days before the UGPC meeting.

Department of Computer and Electrical Engineering and Computer Science
Florida Atlantic University
Course Syllabus

1. Course title/number, number of credit hours	
Reinforcement Learning – CAP 6547	3 credit hours

2. Course prerequisites, corequisites, and where the course fits in the program of study

Prerequisites: COP3530 Data Structures and Algorithm Analysis and STA 4821 Stochastic Models for CS, or permission of the instructor

3. Course logistics

Term: Spring 2021

Class location and time: TBA

4. Instructor contact information

Instructor's name	Dr. Zhen Ni / Xingquan Zhu
Office address	Engineering East (EE-96) Bldg., Room 436/EE 503B
Office Hours	TBA
Contact telephone number	561-297-0035/561-297-3452
Email address	zhenni@fau.edu / xzhu3@fau.edu

5. TA contact information

TA's name	N/A
Office address	N/A
Office Hours	N/A
Contact telephone number	N/A
Email address	N/A

6. Course description

Reinforcement learning aims to build programs to learn how to predict and act in a stochastic environment, based on past experience. This course will study theoretical properties and practical applications of reinforcement learning. Course topics include Markov decision process, dynamic programming, temporal-difference learning, planning and learning with tabular methods, and deep reinforcement learning.

7. Course objectives/student learning outcomes/program outcomes

Course objectives	The goal of this class is for students to gain theoretical knoweldge and hands-on experiences of reinforcement learning. The class will study classical reinforcement learning methods, such Markov decision process, dynamic programming, Q-learning, as well as advanced deep reinforcement learning methods. At the end of the class, students should be able to understand the whole process of building rewarding and learning solutions.

8. Course evaluation method

Home Work -	30%	(four homework, 10 pts each)
Midterm -	15%	(one midterm test)
Term Project -	25%	(one term project)
Reading material -	15%	(one student presentation on selected research paper)
Final -	15%	(one final exam)

9. Course grading scale

Grading Scale:
90 and above: "A", 85-89: "A-", 76-84: "B+", 70-75: "B", 66-74 : "C+", 60-65: "C", 50-59: "D", 49 and below: "F."

10. Policy on makeup tests, late work, and incompletes

Makeup tests are possible, and are given only if there is solid evidence of medical or otherwise family/personal emergency issues that prevent the student from participating in the exam. Makeup exam should be administered and proctored by department personnel unless there are other pre-approved arrangements

Late work is not acceptable.

A grade of incomplete will be assigned only in the case of solid evidence of medical or otherwise serious emergency situation.

11. Special course requirements

N/A

12. Classroom etiquette policy

University policy requires that in order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular phones and laptops, are to be disabled in class sessions.

13. Attendance policy statement

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.

14. Disability policy statement

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/

15. 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/

16. Code of Academic Integrity Policy Statement

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered 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 of 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.

17. Required texts/reading

Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An introduction, Second Edition, MIT Press, 2019

18. Supplementary/recommended readings

Csaba Szepesvari (Author), Ronald Brachman (Series Editor), Thomas Dietterich (Series Editor), Algorithms for Reinforcement Learning, Morgan and Claypool Publishers; 1 edition (June 25, 2010)

19. Course topical outline, including dates for exams/quizzes, papers, completion of reading

Weekly course topics

Weekly schedule	Topic
Week 1	Introduction to reinforcement learning
Week 2	Multi-armed bandits
Week 3	Goal, rewards, and policy evaluation functions (homework 1 posted)
Week 4	Dynamic Programming
Week 5	Asynchronous dynamic Programming (homework 1 due)
Week 6	Monte Carlo Methods (homework 2 posted)
Week 7	Temporal-difference learning
Week 8	Q-learning (homework 2 due)
Week 9	n-step Bootstrapping (homework 3 posted)
Week 10	Planning and Learning (mid-term test, term project announcement)
Week 11	Policy prediction with approximation (student presentation announcement, homework 3 due)
Week 12	Stochastic-gradient and semi-gradient methods
Week 13	Policy gradient methods: Actor-critic methods (homework 4 posted)
Week 14	Deep Reinforcement Learning
Week 15	Student Presentation (term project report due, homework 4 due)

Project: The goal of the term project is to practice knowledge learned from the class and have each student to work on a hands on project during the second part of the class. Each student is required to identify a suitable topic (such as Q-learning for stock trading), and apply reinforcement learning algorithms learned from the class to solve a research problem, implement and validate the design, and collect experimental results for reporting. Students will prepare a minimum 4-page term project technical report.