Course Information

Course Number:	AERO 689
Course Title:	Autonomous Aerospace Systems
Section:	604
Time:	TR 9:35-10:50
Location:	ZACH 362
Credit Hours:	3

Instructor Details

Instructor:	Daniel Selva, John Valasek
Office:	HRBB 620C, HRBB 719C respectively
Phone:	617-682-6521, 979-845-1685
E-Mail:	dselva@tamu.edu/valasek@tamu.edu
Office Hours:	Zoom meetings by email appointment only

Course Description

This course introduces students to topics related to the design, implementation and verification of robust aerospace autonomous systems that incorporate expert knowledge and learn from interacting with their environment. Topics covered include knowledge representation and reasoning, sequential decision-making models, and Reinforcement Learning. Example applications include Earth observation satellites, planetary rovers, and UAV swarms.

Course Prerequisites

Familiarity with programming and foundational topics in discrete mathematics, optimization, and probability as covered by AERO 489 (Foundations of Aerospace Autonomy) or equivalent courses.

Special Course Designation

None.

Course Learning Outcomes

- Designs an aerospace autonomous system that leverages expert knowledge and reasoning using first-order logic and knowledge graphs.
- Designs an aerospace autonomous system that can reason over time and under uncertainty using Markov models, simulation, and optimization.
- Designs an aerospace autonomous system that learns from interacting with the environment using reinforcement learning.

Textbook and/or Resource Materials
The following are recommended but not required textbooks. They are all available in the library.

- S. J. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach,* Pearson, 2021 (4th edition). 2nd and 3rd editions are also OK.
- R. Sutton and A. Barto, *Reinforcement Learning: An Introduction*. MIT Press, 2018 (2nd edition).

Grading Policy

The deliverables for this course are as follows:

- **Homework** (50% of grade): ~ biweekly homework assignments on the topics listed above. Graduate students complete additional questions in each assignment.
- **Projects** (50% of grade): Each student will do 2-3 individual programming projects in which they implement some kind of intelligent agent using the techniques seen in class. Graduate students do one of the projects on a problem of their choice (although consolidated with the help of the instructors), ideally aligned with their research.

All assignments will be administered through Canvas. Students must upload each assignment in pdf format to the canvas site by the assignment's deadline. No paper copies will be accepted.

Approximate Letter Grading Scale
A = 90-100
B = 80-89
C = 70-79
D = 60-69
F = <60

Late Work Policy

Late submission of assigned homework and take-home will incur a penalty according to the following schedule:

- Less than 24 hours late: -10%
- 24 to 48 (exclusive) hours late: -20%
- 48-72 hours late: -30%.
- No late submissions will be accepted after 72 hours past due.

Course Schedule

Week	Lecture Topics	Reading	Deliverables
1	Introduction and review of search	R&N ch 3	
2	Search in complex environments	R&N ch 4, 5	HW 1
3	Review and applications of logical agents	R&N ch 6, 7	
4	First-order logic	R&N ch 8, 9	HW 2
5	Review of prob. theory and bandits	S&B ch 1, 2	HW 3

6	MDPs and Dynamic Programming	S&B ch 3, 4	
7	Monte Carlo methods	S&B ch 5	HW 4
8	Policy-based methods: DPG, AC	S&B ch 13	HW 5
9	Spring Break		
10	TD Learning	S&B ch 6, 7	
11	Q learning		HW 6
12	SARSA and ANN	S&B ch 9	
13	ANN and DDPG		HW 7
14	SAC and PPO		HW 8
15	Course summary		HW 9 due 5/6

Abbreviations in reading refer to references as follows: R&N: Russell and Norvig, S&B: Sutton and Barto

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

NOTE: *Faculty associated with the main campus in College Station should use this Academic Integrity Statement and Policy. Faculty not on the main campus should use the appropriate language and location at their site.*

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

NOTE: *Faculty associated with the main campus in College Station should use this Americans with Disabilities Act Policy statement. Faculty not on the main campus should use the appropriate language and location at their site.*

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

NOTE: *Faculty associated with the main campus in College Station should use this Title IX and Statement on Limits of Liability. Faculty not on the main campus should use the appropriate language and location at their site.*

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

College and Department Policies

None.