

SIE 502: Ontological Modeling and Analysis for Systems Engineering Syllabus

Class Location and Times:

Arizona Online: Asynchronous.

Main campus: iCourse.

Description of Course

This course presents critical skills for building information-intensive applications for engineering applications. It teaches ontologies as a formalism to create a common vocabulary for engineering development with precise syntax and logical semantics. Such vocabulary is then used to improve collaboration and communication among engineers and other stakeholders. Moreover, ontologies enable the development of effective engineering-specific solutions with reduced time and effort. Such solutions support modeling, analysis, and review of engineering and programmatic information while enabling federated and collaborative work that can evolve incrementally and be integrated continuously. By mastering these skills, you can tackle real-world problems in your chosen engineering application.

Course Objectives:

This course's main objective is to equip students with the essential skills required to develop information-rich applications for engineering. Through the study and implementation of ontologies, participants will learn to establish a unified domain-specific vocabulary characterized by precise syntax and logical semantics.

Expected Learning Outcomes:

Having successfully completed this course, the student will be able to:

1. Explain how the fundamental concepts and principles of ontological modeling and analysis can be leveraged to support the development of an engineered system.
2. Develop ontological vocabularies that represent engineering domain-specific knowledge with precision and clarity.
3. Use vocabularies to model, analyze, and review information in a specific engineering domain.
4. Check consistency of information using a logical reasoner and leveraging validation rules and queries for an engineered system.
5. Develop viewpoints that facilitate the authoring and reporting of information in engineering development.
6. Federate, integrate, and configuration manage information to enable different collaboration workflows for engineering development.

Note: This course presents an overlap with INFO 580 Data Standards for the Semantic Web, however SIE 502 Ontological Modeling and Analysis for Systems Engineering focuses on the development and application of ontologies to support engineering applications. INFO 580 focuses on understanding the concepts behind data standards.

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Course Prerequisites or Co-requisites

Pre-requisite: None

Instructor and Contact Information

Instructors: Dr. Maged Elaasar, Dr. Joe Gregory

Course Text

Required: all required texts will be provided by the instructors

Course Software

All tools required by the students will be provided by the instructors. The main software used by the students will be OML Code. Any other software required by the students will be open-source and the instructors will provide this to students as required.

The course is not a tutorial on this or any other software. Students will be expected to familiarize themselves with the toolset and resolve problems independently. Students are encouraged to collaborate on making the best use of the toolset. A discussion forum in D2L will be set up for this purpose.

Remote students must also use a drawing-enabled device during the semester so that they can contribute to group discussions and with the overall class in virtual whiteboards.

All course information is located on the course homepage, which is in Desire2Learn at <https://d2l.arizona.edu/>. **NOTE:** The course site includes information about the course structure, dynamics, and grading beyond that reported in this syllabus. All students must review such information in advance of class.

The course will use a flipped classroom instructional approach. The student will read the required material and attempt to complete the homework on their own before coming to class.

A detailed schedule of the different activities during the semester will be posted in D2L.

In addition to all policies and information in this document, the instructor expects of every student in this course the following:

- Be aware of all assignment due dates, including reading assignments, and read assigned materials.
- To participate in class discussions.
- To manage the learning process – seek clarification and feedback if needed.

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- To complete assignments on time and in a professional manner.
- To demonstrate courtesy and respect to peers and instructors.

Grading Scale and Policies:

The grading scheme for this course is based on 1,000 points. Points are gained through several assignments during the course. Points are distributed as follows:

Title	Points	Due date
Assignment 1	40	8/30/2026
Assignment 2	40	9/6/2026
Assignment 3	40	9/13/2026
Assignment 4	40	9/20/2026
Assignment 5	40	9/27/2026
Assignment 6	40	10/4/2026
Assignment 7	40	10/11/2026
Assignment 8	40	10/18/2026
Assignments: 32% of total		
Project 1	50	8/30/2026
Project 2	150	9/13/2026
Project 3	150	9/27/2026
Project 4	150	10/18/2026
Project work: 50% of total		
Reflection 1	12.5	8/30/2026
Reflection 2	12.5	9/6/2026
Reflection 3	12.5	9/13/2026
Reflection 4	12.5	9/20/2026
Reflection 5	12.5	9/27/2026
Reflection 6	12.5	10/4/2026
Reflection 7	12.5	10/11/2026
Reflection 8	12.5	10/18/2026
Reflections: 10% of total		
Discussion 1	10	8/30/2026
Discussion 2	10	9/6/2026
Discussion 3	10	9/13/2026
Discussion 4	10	9/20/2026
Discussion 5	10	9/27/2026
Discussion 6	10	10/4/2026
Discussion 7	10	10/11/2026
Discussion 8	10	10/18/2026
Discussions: 8% of total		
Total Points:	1000	

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University policy regarding grades and grading systems is available at:

<http://catalog.arizona.edu/policy/grades-and-grading-system>

This course's grading scale is:

Grade:	Standard	Description
A	$900 \leq x$	excellent
B	$800 \leq x < 900$	good
C	$700 \leq x < 800$	satisfactory
D	$600 \leq x < 700$	poor
E	$x < 600$	failure

Where "x" is the total points earned in the course.

If a student believes there are errors in the grading, they should be reported in written to the instructor within 10 days of receiving the graded assignment.

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Dispute of Grade Policy: Provide within the acceptable time period for disputing a grade on a paper, project, or exam.

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Tentative lecture schedule

A tentative lecture schedule is provided below. (Assignments to be delivered at the end of the corresponding week.)

Week	Topics	Assignment
0.5	Course introduction and overview Overview of ontology-based domain engineering	
1	Information Representation - Basic features of the Ontological Modeling Language (OML): concepts, properties, and relations - Advanced features of OML: references, restrictions, rules, and multi-classification - Application of OML to model and analyze knowledge. - Effective modeling of knowledge	Assignment 1
2	Information Reasoning:	Assignment 2

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	- Create ontology bundles - Generate logical inferences - Check the consistency of ontologies using a Description Logic reasoner. Information Querying: - Answering domain questions with SPARQL queries - Verifying rules with SHACL rules	
3	Information Manipulation: - Generate documentation - Develop reductions - Generate reports (gate products) - Generate code.	Assignment 3
4	Information Configuration - Managing ontology in repositories - Support collaborative workflows - Compare and merge information Information Integration - Configure build scripts - Create continuous integration and delivery pipelines - Publish ontology artifacts	Assignment 4
5	Information Adaptation - Introduction to the OML API - Use the OML API to develop interfaces to other tools managing information. Information Federation - Federate ontology projects - Create traceability links between projects - Handle integration issues.	Assignment 5
6	Information Viewpoints - Introduction to the viewpoint development framework - Develop reporting viewpoints for ontologies - Develop editing viewpoints for ontologies.	Assignment 6
7	Enablers and obstacles of implementing ontologies in an organization Emerging trends in ontology-based engineering	Consolidated Project

The topics of traceability and mixed formulations are integrated within the topics in the table above.

Participation

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and->

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administrative-drop. The UArizona policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, see: <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UArizona Dean of Students (or Dean Designee) will be honored. See: <http://policy.arizona.edu/employmenthuman-resources/attendance>.

Classroom Behavior Policy:

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Mainly from the university classroom policy (adopted by the Faculty Senate):

- Not leaving early. Early leaving will distract both the instructor and students
- Not talking with other classmates while the instructor or another student is speaking. If a student has a question or comment, he or she should raise a hand, rather than start a conversation with a neighbor
- Not packing backpacks to leave until the instructor has dismissed class
- Showing respect and concern for others by not monopolizing class discussion. Students must allow others time to give their input and ask questions. Students should not stray from the topic of class discussion
- Not eating and drinking during class time

Academic Integrity and Code of Academic Integrity:

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/policies/code-academic-integrity>. The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations of this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement. The instructor will carefully examine all your homework, reports, and exams to prevent plagiarism. For example:

- No copying of other people's homework: Thorough grading of homework and software output will be reviewed to identify patterns.

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- No copy or discussion in the exam TA and other students will report these behaviors in exams and your exam papers will also be checked carefully for any cheating behavior. Do not sit too close to each other in the exam.

Send Feedback to US:

If you have any questions, suggestions, or comments related to the class, you are very welcome to contact the instructor. We have several ways to communicate:

- 1) In-class feedback
- 2) Office hours
- 3) Emails
- 4) Individual appointment (if you cannot come during office hours)
- 5) Feedback in D2L

Threatening Behavior Policy:

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See:

<https://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>

UArizona Nondiscrimination and Anti-harassment Policy:

The University is committed to creating and maintaining an environment free of discrimination, see: <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

Inclusive Excellence is a fundamental part of the University of Arizona's strategic plan and culture. As part of this initiative, the institution embraces and practices diversity and inclusiveness. These values are expected, respected and welcomed in this course. This course supports elective gender pronoun use and self-identification; rosters indicating such choices will be updated throughout the semester, upon student request. As the course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect.

Additional Resources for Students Statement: Office of Diversity

<http://diversity.arizona.edu/>

<http://www.health.arizona.edu/counseling-and-psych-services>

Accessibility and Accommodations (for students with Disability)

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations.

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Must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Additional Resources for Students

UArizona Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

Student Assistance and Advocacy information is available at <http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Subject to Change Statement

The information contained in the course syllabus, may be subject to change, as deemed appropriate by the instructor, see <http://policy.arizona.edu/faculty-affairs-and-academics/course-syllabus-policy-undergraduate-template>.