

University of Florida

Department of Health Outcomes & Biomedical Informatics College of Medicine

Course Director: William R. Hogan, M.D.

Course Number and Title: GMS 6805 *Information Modeling in Biomedicine*

Credit Hours: 3 hours

Semester/Year: Spring 2022

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Office Hours: by appointment

Canvas URL: <http://elearning.ufl.edu/>

Department Website: <https://hobi.med.ufl.edu/>

PREREQUISITES: None

DESCRIPTION OF COURSE CONTENT

Course Description

This course introduces students to how information is structured in biomedicine, from simple text files to relational structures to graph structures to fully semantic information using Semantic Web standards and technologies. The culmination of the course is developing practical familiarity with knowledge representation methodologies (e.g. set theory, formal logic) for the purpose of information integration. Students will gain skills with traditional information modeling methodologies (e.g. UML) and with Semantic Web Technologies, which enables rich in semantics AI applications.

Course Objectives & Goals

Upon successful completion of this course, the student is able to:

1. Recite and apply the definitions of data, information, and knowledge that are based on current ontological and epistemological understandings of these entities
2. Describe, apply, and construct common information structures and formats, including:
 - a. Text based files, including delimited text, XML, and JSON
 - b. Entity-relationship diagrams
 - c. Unified Modeling Language
 - d. Graphs
3. Describe, understand, and apply definitions of formal language, model theory, and proof theory.
4. Describe and apply three common logical formalisms:
 - a. sentential logic
 - b. predicate logic
 - c. description logic
5. Describe, understand, and apply Semantic Web technologies for the semantic modeling and integration of information
 - a. Understand and apply the basics of RDF
 - b. Understand and apply the basics of OWL
 - c. Understand and apply the basics of SPARQL

TEXTBOOKS/READING MATERIALS

Main Textbook (required)

- *A Semantic Web Primer*. Antoniou G, Groth P, van Harmelen F, Hoekstra R, 2012, 3rd edition, ISBN: 0262018284

Additional Readings (relevant sections provided)

- Smith B, Ceusters C. *Aboutness: Towards Foundations for the Information Artifact Ontology*. In *Proceedings of the International Conference on Biomedical Ontology 2015*. Available at: <http://ceur-ws.org/Vol-1515/regular10.pdf>
- Brochhausen M, Bona J, Blobel B. *The role of axiomatically-rich ontologies in transforming medical data to knowledge*. In: Blobel B, Yang B, eds. *Proceedings of pHealth 2018*. IOS Press. 2018. doi: 10.3233/978-1-61499-868-6-18.
- *The Logic Book*. Bergmann M, Moore J, Nelson J, 2014, 6th edition, ISBN: 0078038413
- *Knowledge Representation and Reasoning*. Brachmann R, Levesque H, 2004, 1st edition, ISBN: 9781558609327
- *A Description Logic primer*. Krötzsch M, Simancík F, Horrocks, 2013, arXiv:1201.4089v3
- *Set Theory, Logic, and Math for Computing*. Makinson D. 2012, 2nd edition, ISBN: 1447124995
- *UML@Classroom*. Seidl M, Scholz M, Huemer C, Kappel G, 2015, 1st edition, ISBN: 3319127411
- *A Practical Guide to Entity-Relationship Modeling*. Song I, Froehlich K, <https://pdfs.semanticscholar.org/6ae2/465cafdb0cbdcc2d247fbbb64438c5bc89c1.pdf>
- *Metalogic. An Introduction to the Metatheory of Standard First Order Logic*. Hunter, G, 1996, 6th printing with corrections, ISBN: 0520023560

All books listed above will only be used in part. The students will not need to buy all books in this list. There are elements in the list above that are not books and hence do not have an ISBN.

CLASS SCHEDULE

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|------------------|--|
| Week 1 (Jan 10): | Introduction to Information and Its Structures / Hogan / Smith & Ceusters |
| Jan 17: | MARTIN LUTHER KING, JR HOLIDAY – NO CLASS |
| Week 2 (Jan 24): | Formalizing models with application to tables, trees, and graphs / Hogan / Seidl Chapter 4, Song & Froehlich, Antoniou G. et al Chapter 1 / Quiz #1 |
| Week 3 (Jan 31): | Knowledge representation & formal logic / Hogan / Brachmann & Levesque Chapter 1, Hunter Chapter 1 sections 1-7, Bergmann et al. Chapter 1, Makinson Chapter 1 |
| Week 4 (Feb 7): | Semantic Web Technologies: Introduction & RDF / Hogan / Antoniou G. et al. Chapter 2 |
| Week 5 (Feb 14): | Semantic Web Technologies: SPARQL / Hogan/ Antoniou G. et al Chapter 3 / DUE: Project proposal |
| Week 6 (Feb 21): | Semantic Web Technologies: Introduction to Ontologies / Hogan or guest lecturer / Antoniou G. et al. Chapter 4 |
| Week 7 (Feb 28): | Semantic Web Technologies: Ontologies in OWL / Hogan or guest lecturer / Antoniou G. et al. Chapter 4 |
| Mar 7: | SPRING BREAK – NO CLASS |
| Week 8 (Mar 14): | Sentential Logic: Syntax & Symbolization, Semantics / Hogan / Bergmann et al. Chapters 2, 3 / DUE: Requirements analysis |
| Week 9 (Mar 21): | Sentential Logic: Truth trees, Derivations / Hogan / Bergmann et al. Chapters 4, 5.1,52.,5.3 |

- Week 10 (Mar 28): Predicate Logic: Syntax and Symbolization / Hogan / Bergmann et al. Chapter 7
- Week 11 (Apr 4): Predicate Logic: Semantics / Hogan / Bergmann et al. Chapter 8
- Week 12 (Apr 11): Predicate Logic: Truth trees & Derivations / Hogan / Bergmann et al. Chapter 9.1,9.2,9.3,10.1
- Week 13 (Apr 18): Description Logic / Hogan/ Krötzsch et al., Brochhausen et al. / DUE: Project final model, data, and documentation
- Week 14 (Apr 25): Course project team presentations

COURSE POLICIES

Attendance Policy

Class attendance is mandatory. Excused absences follow the criteria of the UF Graduate Catalogue (e.g., illness, serious family emergency, military obligations, religious holidays), and should be communicated to the instructor prior to or on the day of absence, not later. Given the online format of the course, students are responsible for all assigned reading material and meeting the scheduled due dates for class assignments. For information regarding the UF Attendance Policy see the Registrar website for additional details:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

Quiz/Exam Policy

Unless otherwise stipulated, all assignments are individual assignments. Students are forbidden to collaborate or consult with one another on such assignments. Students must follow University Policy on Academic Misconduct.

Assignment Policy

A penalty of 10% per day (maximum of two days) shall be assessed on assignments turned in late. Non-participation on discussion forums will earn a grade of zero.

Make-up Policy

Students are allowed to make up work only as the result of illness or other unanticipated circumstances. In the event of such emergency, documentation will be required in conformance with University policy. Work missed for any other reason will earn a grade of zero.

EVALUATION AND GRADING POLICIES

Evaluation of Grades

| Assignment | Total Points | Percentage of Final Grade |
|-----------------------|--------------|---------------------------|
| Course Project | | |
| Project proposal | 25 | 12.5% |
| Requirements analysis | 50 | 25% |
| Final model & data | 75 | 37.5% |
| Presentation | 50 | 25% |
| Total | 200 | 100% |

Grading Policy

| Percent | Grade | Grade Points |
|--------------|-------|--------------|
| 90.0 - 100.0 | A | 4.00 |
| 87.0 - 89.9 | A- | 3.67 |
| 84.0 - 86.9 | B+ | 3.33 |

| | | |
|-------------|----|------|
| 81.0 – 83.9 | B | 3.00 |
| 78.0 - 80.9 | B- | 2.67 |
| 75.0 - 79.9 | C+ | 2.33 |
| 72.0 – 74.9 | C | 2.00 |
| 69.0 - 71.9 | C- | 1.67 |
| 66.0 - 68.9 | D+ | 1.33 |
| 63.0 - 65.9 | D | 1.00 |
| 60.0 - 62.9 | D- | 0.67 |
| 0 - 59.9 | E | 0.00 |

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

UF POLICIES

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.