

UNIVERSITY OF MICHIGAN MEDICAL SCHOOL DEPARTMENT OF LEARNING HEALTH SCIENCES

Knowledge Representation and Knowledge Management in Health
LHS 611
WN 2024

CREDIT HOURS

3

PRE-REQUISITES

Graduate standing or permission of the instructor

FACULTY

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COURSE DESCRIPTION

In learning health systems, knowledge representation and knowledge management methods enable the successful use of health-related data for multiple purposes, including digital interventions to influence decisions and behavior. This course introduces methods of knowledge representation and management, with an emphasis on digital health interventions to support the implementation of evidence-based practice. Students who complete the course will become familiar with a pragmatic approach to representing and managing guideline-based computable knowledge for digital health interventions, including clinical decision support and feedback interventions. By the end of the course, students will have mastery of foundational methods necessary to move on to more advanced study and mentored research in collaborative knowledge representation and management.

COURSE OBJECTIVES

By the completion of the course, students will be able to:

- Analyze challenges for knowledge representation and knowledge management.
- Examine how computable knowledge and reasoning are used in learning health systems.
- Propose digital health interventions using appropriate knowledge representation methods.
- Represent clinical guideline knowledge in computable forms.
- Plan for management and evaluation of computable knowledge for digital interventions in health systems.
- Apply appropriate methods and tools for knowledge representation and management.

CONTENT TOPICS

- Module 1: Knowledge representation & Computable Knowledge
- Module 2: Propositional Logic
- Module 3: Clinical Practice Guideline Knowledge
- Module 4: Digital Health Interventions
- Module 5: Reasoning and Learning
- Module 6: Classification and Taxonomy
- Module 7: Ontologies

- Module 8: Concepts vs Universals
- Module 9: Standards
- Module 10: Knowledge Management
- Module 11: Theory
- Module 12: Whose Knowledge?
- Module 13: Metadata
- Module 14: Quality Measurement

TEACHING METHODS

This is an online course, which will be delivered via Canvas. It is also your learning environment, where you will interact with a community of your classmates and the instructor. Within the course Canvas site, you will access the learning materials and syllabus, discuss issues, submit assignments, take exams, email other students and the instructors, participate in online activities including small groups, and display your projects.

This course will be taught using multiple methods, including lectures, assigned readings, written assignments, discussions of course reading materials, individual or small group learning tasks, and a project proposal (as a presentation) that builds on assignments conducted throughout the semester.

REQUIRED TEXTS AND OTHER MATERIALS

- The following PDF book on the [Silverback Publishing](#) website (about \$7) for Module 4.
 - Michie S, West R. A guide to development and evaluation of digital behaviour change interventions in healthcare. Cambridge: Silverback Publishing; 2016.
- All other required materials will be provided in Canvas.

Expectations

1. Collaboration

The instructor strongly encourages collaboration while working on some assignments, such as homework problems and interpreting reading assignments as a general practice. Active learning is effective. Collaboration with other students in the course will be especially valuable in summarizing the reading materials and picking out the key concepts. You must, however, write your assignments on your own, in your own words, before turning it in. If you worked with someone on the assignment before writing it, you must list any and all collaborators on your written submission. Read the instructions carefully and request clarification about collaboration when in doubt.

2. Plagiarism

The academic community, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. Your instructors expect students to work and study together to foster learning and understanding of the material. However, direct copying of homework, copying of homework from existing solutions, cheating on an exam, and other conduct that violates the academic integrity and ethical standards of the Rackham Graduate School community cannot be tolerated and will result in serious consequences and disciplinary action.

All written submissions must be your own, original work. Original work for narrative questions is not mere paraphrasing of someone else's completed answer: you must not share written answers with each other at all. At most, you should be working from notes you took while participating in a study session. Largely duplicate copies of the same assignment will receive an equal division of the total point score from the one piece of work.

You may incorporate selected excerpts, statements, or phrases from publications by other authors, but they must be clearly marked as quotations and must be attributed. If you build on the ideas of prior

authors, you must cite their work. You may obtain copy editing assistance, and you may discuss your ideas with others, but all substantive writing and ideas must be your own or be explicitly attributed to another. If we suspect you have cheated (including plagiarism), at the very least you will receive a zero on the assignment. Rackham policy dictates that we must report every instance of academic dishonesty, no matter how small. Suspected academic misconduct will be handled by the course instructor, the HILS Program Director, and the DLHS Associate Chair for Educational Programs.

<https://rackham.umich.edu/academic-policies/section8/>

3. Participation

There is no required synchronous meeting in this class. Students are expected to log onto the course site daily to work on the tasks and check the course announcement. You are also required to fully participate and engage in all the asynchronous activities throughout the class, including discussions, exercises, and peer reviews. Please finish the assigned readings and materials before working on the assignments. It is your responsibility to meet the deadlines. Check your grades at least once a week.

4. Expectations

This is an advanced level class; therefore, discussions will be the key to learning during the course. There will be readings from supplemental sources that will prepare the student for discussions during class. Much of research is problem solving; therefore, students will focus on difficult scenarios and questions that present challenging approaches or ethical dilemmas. Discussions will address some of the most common decision-based scenarios students may face in the future as leaders in learning health systems or as independent investigators.

5. Student Academic Dispute Procedures

Rackham's Academic Dispute Resolution Policy and Procedures are available to Rackham students who have a dispute or disagreement with faculty or staff about the equity and fairness of decisions or procedures that affect their academic standing, the conduct of their research, and progress toward the degree. Such issues may arise regarding fair and equal treatment in the conduct of a class, in the pursuit of the student's research, and in the grading or evaluation of academic work and research. Other issues may concern the equity and fairness of program, department, or Rackham policies.

<https://rackham.umich.edu/academic-policies/section9/>

COURSE POLICIES

Accessibility and Accommodations

Students should speak with their instructors before or during the first week of classes regarding any special needs. Students seeking academic accommodations should register with Services for Students with Disabilities (SSD). SSD arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit <https://ssd.umich.edu> for more information.

GRADING AND EVALUATION

Grading will be based on three evaluation methods. They are detailed below:

1. **13 Module Discussions: 20%**
2. **14 Module Exercises: 15%**
3. **Assignments: 65%**
 - Propositional logic: 50 points
 - Guideline document assessment: 50 points
 - Semi-structured recommendations: 100 points
 - Recommendation implementability assessment: 150 points
 - Structured recommendations: 150 points
 - Intervention program theory: 100 points

- Final Project Presentation: 200 points
- Peer Reviews: 10 points x 4 Modules = 40 points

GRADING POLICIES

Module discussions and exercises focus on practice and engagement in the module content so they will **not** be accepted after the week in which the discussions are held. Discussions that are submitted late, but within the week they are held will be deducted 1 point for each day that they are late.

No late assignments will be accepted without penalty. If the assignment is not turned in by the due date and time, the **student will lose 10 points for every day that the assignment is late**. For example, if the assignment is worth 100 points and is turned in one day late, the maximum number of points for that assignment will be 90/100. Two days late will result in the maximum number of points being 80/100, and so on. **Graded assignments will be returned to students through Canvas.**

With the exception of the final project, any graded assignment (unless otherwise stated in its instructions) may be resubmitted once for re-grading. A re-graded assignment will be given up to 90% of the total possible points, minus any points taken off for an original assignment that was submitted late.

Final grades will be accessible through Wolverine Access; grades for each assignment will be posted through the Canvas course site. Overall course grades are posted within 72 hours of when the final course assignment component (typically the final course project report) is due. The course grade will be a letter grade (A – D, F) following the weighting described below. Grades will be assigned using this conversion scale:

A+	97-100	B+	87-89	C+	77-79	D+	67-69	F	<60
A	93-96	B	83-86	C	73-76	D	63-66		
A-	90-92	B-	80-82	C-	70-72	D-	60-62		

DLHS Grade Grievance Policy

Regular feedback on graded assignments and timely resolution of any grading concerns is helpful for student learning and contributes to an overall positive experience. Students are encouraged to discuss any assignment grade concerns with the instructor(s) within two weeks of the grades being posted on Canvas. Similarly, any concerns and grievances related to the overall course grades should be raised by contacting the faculty of record within two weeks of the course grades being posted on Wolverine Access.

For this course, the grade dispute arbitration will happen within the Department of Learning Health Sciences (DLHS). After initial discussion with the faculty of record for the course, there is an opportunity for a second look by another DLHS faculty member with appropriate expertise for resolving grade disputes. If the student and faculty are not able to come to an agreement about the grade dispute, the Associate Chair for Educational Programs or assigned designee will adjudicate the dispute. Per Rackham's Academic Dispute Resolution Process, if the concern is not resolved, the student may seek a formal resolution conference with the Medical School's Rackham Resolution Officer (see <http://www.rackham.umich.edu/policies/academic-dispute-resolution> for full policy and the contact information for the current resolution officer.

Student Academic Dispute Procedures

Rackham's Academic Dispute Resolution Policy and Procedures are available to Rackham students who have a dispute or disagreement with faculty or staff about the equity and fairness of decisions or procedures that affect their academic standing, the conduct of their research, and progress toward the degree. Such issues may arise regarding fair and equal treatment in the conduct of a class, in the pursuit of the student's research, and in the grading or evaluation of academic work and research. Other issues may concern the equity and fairness of program, department, or Rackham policies.

<https://rackham.umich.edu/academic-policies/section9/>

REMOTE LEARNING

While synchronous course instruction may occur rarely if at all, there may be times when real-time discussion or small group meetings for assignments or group work may be needed. Instructors may also have office hours in real time as well.

The course will use Zoom for these synchronous ("real time") meetings. Meeting dates and times will be scheduled through [Canvas](#) and should appear on your calendar within Canvas.

Please take the time to familiarize yourself with Zoom by visiting [U-M's Getting Started with Zoom](#) page. You may choose to use Zoom on your mobile device (phone or tablet).

This article describes how to update your name in Zoom:

<https://teamdynamix.umich.edu/TDCClient/30/Portal/KB/ArticleDet?ID=746>

Some students and faculty may also wish to add their personal pronouns beside their names.

Things to Know About Zoom:

- You must sign in to my Zoom session using your unickname and password (for med.umich.edu users: enter your Level 1 credentials).
- The Zoom sessions are recorded.
- You can contact [Information and Technology Services](#) if you have any technical issues accessing Zoom. You can also contact [Health Information Technology & Services](#) for help.

Digital Etiquette

This course requires frequent text-based communication, including discussion board, assignment feedback, email, Canvas message, etc. Please use proper grammar and punctuation. Write in full sentences and short paragraphs. Be professional and respectful to each other in all discussions. If you wouldn't say it to someone's face, don't say it online either.

In virtual meetings (if applicable), give your name when beginning to speak. Use the chat and/or raise hand feature if waiting to speak. Use microphones and mute when not actively speaking to improve overall audio and caption quality. Consider using a virtual background to protect your privacy.

INSTITUTIONAL POLICIES

Academic Integrity of Students

The academic community, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. Your instructors expect students to work and study together to foster learning and understanding of the material. However, direct copying of homework, copying of homework from existing solutions, cheating on an exam, and other conduct that violates the academic integrity and

ethical standards of the Rackham Graduate School community cannot be tolerated and will result in serious consequences and disciplinary action.

All written submissions must be your own, original work. We expect that your submitted work will represent your own thoughts, opinions, and knowledge. If you share it with anyone else prior to submission, you may contribute to a breach of academic integrity, and we encourage you not to share your written work with others until it has been assessed.

You may incorporate selected excerpts, statements or phrases from publications by other authors, but they must be clearly marked as quotations and must be attributed. If you build on the ideas of prior authors, you must cite their work. You may obtain copy editing assistance, and you may discuss your ideas with others, but all substantive writing and ideas must be your own or be explicitly attributed to another.

A resource explaining academic integrity and plagiarism can be found here:

<https://guides.lib.umich.edu/c.php?g=1039501&p=7538393>

If we suspect you have cheated (including plagiarism), at the very least you will receive a zero on the assignment. Rackham policy dictates that we must report every instance of academic dishonesty, no matter how small. Suspected academic misconduct will be handled initially by your course instructor.

<https://rackham.umich.edu/academic-policies/section8/>

Diversity, Equity, and Inclusion

The Department of Learning Health Sciences (DLHS) is committed to developing the institutional mechanisms and norms necessary to promote the values of diversity, equity, and inclusion, both inside and outside our classrooms. To this end, DLHS upholds the expectations that all courses will: (1) be inclusive, (2) promote honest & respectful discussions, (3) follow multicultural ground rules, and (4) abide by UM policies and procedures. Inclusive courses are those in which teachers and learners co-create and co-sustain environments that support and encourage all members to participate equitably.

<https://rackham.umich.edu/rackham-life/diversity-equity-and-inclusion/>

Student Mental Health and Well-Being

The University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact Counseling and Psychological Services (CAPS) at (734) 764-8312 and <https://caps.umich.edu/> during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult University Health Service (UHS) at (734) 764-8320 and <https://www.uhs.umich.edu/mentalhealthsvcs>, or for alcohol or drug concerns, see www.uhs.umich.edu/aadresources.

For a listing of other mental health resources available on and off campus, visit: <http://umich.edu/~mhealth/>.

Sexual Misconduct/Sexual Harassment Reporting

Title IX prohibits sex discrimination to include sexual misconduct: harassment, domestic and dating violence, sexual assault, and stalking. If you or someone you know has been harassed or assaulted, you can receive confidential support and academic advocacy at the Sexual Assault Prevention and Awareness Center (SAPAC). SAPAC can be contacted on their 24-hour crisis line, 734-936-3333 and online at sapac.umich.edu. Alleged violations can be reported non-confidentially to the Office for Institutional Equity (OIE) at institutional.equity@umich.edu. Reports to law enforcement can be made to the University of Michigan Police Department at 734-763-3434.

Support for Food Insecurity

Students across the country experience food insecurity at alarming rates. The Maize and Blue Cupboard at the University of Michigan provides food, kitchen and cooking supplies, personal and household items, and support services. For information about accessing their services, please visit

<https://mbc.studentlife.umich.edu/>

Confidentiality and Mandatory Reporting

As instructors, one of our responsibilities is to help create a safe learning environment. Dr. Gretchen Piatt also has a mandatory reporting responsibility related to her role as the Director of the Health Infrastructures and Learning Systems degree program. Instructors are required to share information regarding sexual misconduct or information about a crime that may have occurred on U-M's campus with the University. Students may speak to someone confidentially by contacting SAPAC's Crisis Line at (734) 936-3333.

COVID-19 statement regarding any in-person activities

For the safety of all students, faculty, and staff on campus, it is important for everyone to comply with safety measures that have been put in place for our protection. We each have a responsibility for protecting the collective health of our community. Your participation in this course on an in-person basis is conditional upon your adherence to all safety measures mandated by the State of Michigan and the University, including maintaining a physical distance of six feet from others, properly wearing a face covering in class, and following instructions regarding cleaning your study space. Other applicable safety measures may be described in the [Wolverine Culture of Care](#) and the [University's Face Covering Policy for COVID-19](#). Your ability to participate in this course in-person, as well as your grade, may be impacted by failure to comply with campus safety measures.

Individuals seeking to request an accommodation related to the face covering requirement under the Americans with Disabilities Act should contact the [Office for Institutional Equity](#). If you are unable or unwilling to adhere to these safety measures while in a face-to-face class setting, you will be required to participate on a remote basis or to disenroll from the class. I also encourage you to review the [Statement of Student Rights and Responsibilities](#), which includes a COVID-related Statement Addendum.

COURSE ACTIVITIES

Date	Module & Topic	Materials	Graded Tasks & Due Dates (11:59 p.m. ET)
1/10-1/21	Module 1: Knowledge Representation & Computable Knowledge	<ul style="list-style-type: none">• Lecture: Computable Knowledge• Lecture: Example - Creating Computable Knowledge• Video: MCBK• Alavi et al (2001)• Musen (2014) Ch 3• Friedman & Flynn (2019)	<ul style="list-style-type: none">• Discussion (Thurs 1/17 & Sun 1/21)• Exercise: Preventive Services as Computable Knowledge (Sun 1/21)
1/22-1/28	Module 2: Propositional Logic	<ul style="list-style-type: none">• Lecture: Intro to Propositional Logic• MCBK Manifesto• Symbols Handout• Goranko (2016) Ch 1	<ul style="list-style-type: none">• Exercise: Propositional Logic (Sun)

		<ul style="list-style-type: none"> • Logical connective 	
1/29- 2/4	Module 3: Clinical Practice Guidelines Knowledge	<ul style="list-style-type: none"> • Lecture: Clinical Practice Guidelines • Lecture: Representing Guideline Knowledge • Graham et al (2011) Summary, Chs 1, 3, 6 • Shiffman et al (2000) • Boxwala et al (2011) 	<ul style="list-style-type: none"> • Discussion (Thurs & Sun) • Exercise: Structuring Guideline Recommendations With GEM (Sun) • Assignment: Propositional logic (Sun)
2/05- 2/11	Module 4: Digital Health Interventions	<ul style="list-style-type: none"> • Lecture: Digital Health Interventions • Lecture: Decision Support Interventions • Lecture video: Behavior Change Interventions • Michie & West (2016): Chs 1-3,5-6 • Musen et al (2021) Ch 24 	<ul style="list-style-type: none"> • Discussion (Thurs & Sun) • Exercise: Describing a Nudge (Sun) • Assignment: Guideline document assessment (Sun)
2/12- 2/18	Module 5: Reasoning and Learning	<ul style="list-style-type: none"> • Lecture: Reasoning and Learning • Arp et al (2015) Intro • Reichertz (2013) Ch 9 • Sowa (2015) 	<ul style="list-style-type: none"> • Discussion (Thurs & Sun) • Exercise: Inference (Sun) • Assignment: Peer reviews (Sun)
2/19- 2/23	Module 6: Classification and Taxonomy	<ul style="list-style-type: none"> • Lecture: Classification and Taxonomy • Podcast: Organizing Chaos • Haendel (2018) • Madrigal (2014) 	<ul style="list-style-type: none"> • Discussion (Thurs & Sun) • Exercise: From List to Taxonomy (Sun) • Assignment: Semi-structured recommendations (Sun)
2/24- 3/03	Winter Break		
3/4- 3/10	Module 7: Ontologies	<ul style="list-style-type: none"> • Lecture: Ontologies • Lecture: Ontology Serialization • Lecture: WebProtege Demonstration • Arp et al (2015) Chs 1-2 • Pieterse & Kourie (2014) 	<ul style="list-style-type: none"> • Discussion (Thurs & Sun) • Exercise: WebProtege (Sun) • Assignment: Peer reviews (Sun)
3/11- 3/17	Module 8: Concepts vs Universals	<ul style="list-style-type: none"> • Lecture: Concepts vs Universals • Lecture: Definitions • Cimino (1998) • Smith (2006) • Cimino (2006) • Rector et al (2011) 	<ul style="list-style-type: none"> • Discussion (Thurs & Sun) • Exercise: Writing Definitions (Sun) • Assignment: Recommendation implementability assessment (Sun)
3/18- 3/24	Module 9: Standards	<ul style="list-style-type: none"> • Video: Data Standards and Learning Health Systems Challenges and Opportunities • Video: Exploring SNOMED CT - Navigation • Video: FHIR - A Healthcare Data Standard Designed for the Future 	<ul style="list-style-type: none"> • Discussion (Thurs & Sun) • Exercise: Using UMLS (Sun) • Assignment: Structured recommendations (Sun)

		<ul style="list-style-type: none"> ● Video: Intro to FHIR ● UMLS Basics 	
3/25-3/31	Module 10: Knowledge Management	<ul style="list-style-type: none"> ● Lecture: Knowledge Management ● Video: Making Sense of Complexity - An Intro to Cynefin ● Video: The Cynefin Framework ● Gray (2017) ● Snowden (2002) 	<ul style="list-style-type: none"> ● Discussion (Thurs & Sun) ● Exercise: Learning Cynefin (Sun) ● Assignment: Peer reviews (Sun)
4/1- 4/7	Module 11: Theory	<ul style="list-style-type: none"> ● Lecture: Program Theory for Digital Interventions ● Davidoff et al (2015) ● Lewis (2018) ● Wensing et al (2020) 	<ul style="list-style-type: none"> ● Discussion (Thurs & Sun) ● Exercise: Behavior Change Theory Database (Sun) ● Assignment: Intervention program theory (Sun)
4/8- 4/14	Module 12: Whose Knowledge?	<ul style="list-style-type: none"> ● Lecture: Whose Knowledge? ● Shaban (2014) ● Brumfiel (2021) ● Schuessler (2019) ● Rycroft-Malone (2016) 	<ul style="list-style-type: none"> ● Discussion (Thurs & Sun) ● Exercise: Stakeholder Identification for a Digital Intervention (Sun)
4/15- 4/21	Module 13: Metadata	<ul style="list-style-type: none"> ● Video: MCBK 2021 ● Greenberg (2017) ● Alper et al (2021) ● Wilkinson et al (2016) ● Wittenburg (2019) 	<ul style="list-style-type: none"> ● Discussion (Thurs & Sun) ● Exercise: Metadata Center (Sun) ● Assignment: Final Project (Sun)
4/22- 4/28	Module 14: Quality Measurement	<ul style="list-style-type: none"> ● Lecture: Quality Measurement and Decision Support ● Video: Clinical Quality Language (CQL) for Clinicians and Quality Professionals ● Lecture: Module Exercise Overview and Demonstration ● Ayanian & Markel (2016) ● Brown, Peek, & Buchan (2015) ● McClure et al (2020) 	<ul style="list-style-type: none"> ● Discussion (Thurs & Sun) ● Exercise: Using CQL (Sun) ● Assignment: Peer reviews (Sun)

ASSIGNMENTS, DUE DATES, AND DIRECTIONS

A. Discussion Board (15 points x 13 Modules; 20% of the grade)

There are required asynchronous discussions in Modules 1 and 3-14 that allow you to reflect and connect the module readings and materials to the real world and/or your work/practice. This is also where you can ask questions and clarify muddy points. You are expected to post an original post by Thursday and reply to at least two other peers by the ending Sunday of the week. Your posts should address all aspects of the discussion prompts and demonstrate a thorough understanding of the module readings and materials.

B. Exercises (10 points x 14 Modules; 15% of the grade)

Every module has a hands-on exercise. Some are individual work while others may be in small groups. These exercises are designed to help you dig deeper, experience or practice, and better understand the module concepts. You are expected to fully engage in these exercises and contribute to your and others' learning. Depending on the exercise, due dates may vary from module to module. In general, you should complete most exercises by Thursday of the week.

C. Assignments (points vary depending on the task; 65% of the grade)

- a. Propositional Logic (50 points; Sunday of Module 3): You will write statements as propositions in symbolic form.
- b. Final Project: You will create a project proposal for developing and managing computable guideline knowledge for an associated digital health intervention. There are five milestones (see below) to guide you through the process.
 - Milestones:
 - I. Guideline document assessment (50 points; Sunday of Module 4)
 - II. Semi-structured recommendations (100 points; Sunday of Module 6)
 - III. Recommendation implementability assessment (150 points; Sunday of Module 8)
 - IV. Structured recommendations (150 points; Sunday of Module 9)
 - V. Intervention program theory (100 points; Sunday of Module 11)
 - Final Project Presentation (200 points; Sunday of Module 13): You will record a 10-minute presentation for your project proposal and address the required sections as specified in Canvas.
 - Peer Reviews (40 points; Sunday of Module 5, 7, 10, & 14): You will conduct peer reviews and provide constructive feedback to your peers on some of the milestones and the final project presentation.

Please see the Canvas course site for the detailed assignment instructions and requirements.