INF 385T: AI in Health

Semester: Spring 2022 (28230)
Time and Location: Thursday 12:30-3:30 at UTA1.208
Instructor: Ying Ding, ying.ding@ischool.utexas.edu, UTA5.432
TA: Jooyeong Kang, j.kang@utexas.edu,
Office Hours:
Thursday 11:30-12:30 at https://utexas.zoom.us/j/5128555388 or by appointment with Instructor;

Course Description

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Recently, the U.S. healthcare industry has surpassed manufacturing and retail to become the largest employer in the country, with every 1 out of 8 Americans working in this sector. Policies and incentives have been established to promote IT in health to improve care and delivery. In this course, we will explore the major components of health IT systems, ranging from data semantics (ICD10), data interoperability (FHIR), diagnosis code (SNOMED CT), to workflow in clinical decision support systems. After establishing the good understanding of the fundamentals of health IT systems, we will dive deep into how AI innovations (e.g., machine learning, deep learning, computer vision) are transforming our healthcare system by introducing new concepts of mobile health, AI diagnosis, AI medicine, smart device, and intelligent delivery. This course will offer hands-on tutorials based on the real-world Electronic Health Record (EHR) data from MIMIC III (https://mimic.physionet.org/) released by MIT Critical Data. MIMIC-III (Medical Information Mart for Intensive Care III) contains de-identified health information from over forty thousand patients who stayed in critical care units of the Beth Israel Deaconess Medical Center between 2001 and 2012. These tutorials aim to enhance data search and analytic skills by providing practices related to database search, natural language processing, data visualization, machine learning, and deep learning. In this course, we will enhance the group learning experience and learning by doing, therefore, there will be many class activities. This course is designed for everyone, so no programming background is required or desired.

Pre-Requisites

No pre-requisites for this course.

Learning Outcomes

After attending this course, you should be able to achieve the following goals:

- Be aware of current healthcare initiatives to deliver quality care
- Understand the basic technologies of health IT systems including data semantics, data interoperability, workflow, and clinical decision support systems
- Be familiar with electronic health record systems (EHR systems)
- Gain the overview of AI innovations in healthcare
- Master practical skills of data search and analytics including database search, natural language processing, data visualization, machine learning, and deep learning

How Will You Learn?

Statement of Learning Success

Your success in this class is important to me. We all learn differently, and everyone struggles sometimes. You are not, ever, the only one having difficulty! If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. Together we will develop strategies to meet both your needs and the requirements of the course. I also encourage you to reach out to the student resources available through UT and I am happy to connect you with a person or Center if you would like.

Teaching Modality Information

Classes will be in-person which requires in-person attendance. Due to the uncertainty of the COVID situation, we might move some portion online via zoom. We will keep you all informed. All online classes will be recorded and shared with you via canvas.

Communication

The course Canvas site can be found at utexas.instructure.com. Please email me through Canvas or using my email above (the preferred way). You are responsible for ensuring that the primary email address you have recorded with the university is the one you will check for course communications because that is the email address that Canvas uses.

Asking for Help

You can reach me anytime by just sending me an email using my UT email address above. If you have specific coding issues with python, please feel free to reach out to our TA using his email above. I will host the office hours each week either at my zoom or in my office. There is no formality, simply drop by if you have any questions to discuss or simply just want to chat. All are welcome. TA will host his office hours each week as well. If you have any specific questions about data, coding, and homework, please feel free to talk to him.

Diversity, Equity and Inclusion

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed, and that the diversity that students bring to this class can be comfortably expressed and be viewed as a resource, strength and benefit to all students. Please come to me at any time with any concerns.

Services for Students with Disabilities

The university is committed to creating an accessible and inclusive learning environment consistent with university policy and federal and state law. Please let me know if you experience any barriers to learning so I can work with you to ensure you have equal opportunity to participate fully in this course. If you are a student with a disability, or think you may have a disability, and need accommodations please contact Services for Students with Disabilities (SSD). Please refer to SSD's website for contact and more information: http://diversity.utexas.edu/disability/. If you are already registered with SSD, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations and needs in this course.

Course Requirements

Course Materials

Recommended books

Eric Topol (2019). Deep Medicine: How artificial intelligence can make healthcare human again. New York: Basic Books.

Matheny, M., Israni, S. T., Ahmed, M., & Whicher, D. (eds.) (2019). Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril. National Academy of Medicine. https://nam.edu/wp-content/uploads/2019/12/AI-in-Health-Care-PREPUB-FINAL.pdf

MIT Critical Data (2016). Secondary Analysis of Electronic Health Records. Springer Open. https://www.springer.com/gp/book/9783319437408

Recommended Readings:

Research using MIMIC data: https://read.qxmd.com/keyword/229497

Paper with code: https://paperswithcode.com/

Weekly Reading Seminar (optional): every Thursday 8-10PM at https://utexas.zoom.us/j/5128555388

Data and Software

MIMIC III and MIMIC IV: contains de-identified data from over 40,000 patients who were admitted to Beth Israel Deaconess Medical Center in Boston, Massachusetts from 2001 to 2012.

- Data: https://physionet.org/content/mimiciii/1.4/
- Get access: https://mimic.physionet.org/gettingstarted/access/, https://physionet.org/about/citi-course/

Python Coding using Google Colab: https://colab.research.google.com/

Tableau: https://www.tableau.com/academic/students

Required Devices

A laptop is required and should be brought to the classroom.

Classroom Expectations

Class attendance and participation are important to build a welcoming and engaging learning environment for all of us. They are required and count 10% of your final grade. If you cannot attend a class, please send me your written excuse via email.

Course Outline

All instructions, assignments, readings, rubrics and essential information will be on the Canvas website at utexas.instructure.com. Check Canvas regularly. Changes to the schedule may be made at my discretion if circumstances require. I will announce any such changes in class and will also communicate them via a Canvas announcement.

Schedule (tentative)

Date	Lecture	Class Activities	Lab/Tutorial	Notes

	(60mins+15mins break)	(45mins)	(60mins)	
L1-1/20	Introduction, Knowing each other	Reading 1 Reading 2 focus questions	Introduce MIMIC III Form the expert group (Data semantics, Data Share/FHIR, ML/DL in health, AI ethics in health, Explainable AI in health)	Get access to MIMIC III Start MIT ethic course,
L2-1/27	Evidence-based Care, i2b2 and OMOP	(Data Model: Benjamin Glicksberg) Reading 1 Reading 2 focus questions	MIT ethic course	**MIT ethic course due** submit the request Form group for group project
L3-2/3	EMR Semantics: ICD10, ICD10 (COVID) and ICD9 (MIMIC)	expert group section Reading 1 Reading 2 focus questions	T1: MIMIC-Visual Tableau I	Form a group randomly for self-learning tutorial, Get MIMIC access permission, self-learning tutorials (on Tableau, SQL, NLP, ML)
L4-2/10	EMR Semantics: SNOMED CT I	expert group section Reading 1 Reading 2 focus questions	T1: MIMIC-Visual Tableau II	Send the group project summary to TA
L5-2/17	EMR Semantics: SNOMED CT II, SNOMED and ICD10	expert group section Reading 1 Reading 2 Answer focus questions	T2: MIMIC-SQL I	**MIMIC Tableau Gallery due**
L6-2/24	EMR Semantics: LOINC	expert group section Reading 1 Reading 2 focus questions	T2: MIMIC-SQL II	Group project
L7-3/3	EMR Semantics: RxNorm	expert group section Teach us one medical taxonomy, focus questions	T3: MIMIC-NLP Spacy	**MIMIC SQL due**
L8-3/10	Clinical Decision Support System	(CDSS: Justin Rousseau) expert group section focus questions	T3: MIMIC-NLP: sciSpacy (bluebert, clinicalbert)	Group project
3/17-	break			
L9-3/24	Data Share: FHIR (FHIR: Darrell Woelk)	expert group section Reading 1 Reading 2 focus questions	T4: MIMIC-ML LOS I	Group project

L10-3/31	AI health: ML/DL I (Explainable AI: Tianjian Guo)	expert group section Reading 1 Reading 2 focus questions	T4: MIMIC-ML LOS II	**MIMIC NLP due** (cTakes, ClinicalBert, bioBert, Bert, metamap, negabert)
L11-4/7	AI health: ML/DL II (Health Risk Prediction: Tingyi Wanyan)	expert group section Reading 1 Reading 2 focus questions	T5: MIMIC-ML Readmission I	Group project
L12-4/14	AI health: imaging (Medical Imaging Diagnosis: Yifan Peng)	expert group section Reading 1 Reading 2 focus questions	T5: MIMIC-ML Readmission II	**Group Assignment Due** (graded by students)
L13-4/21	AI in drug discovery, robotics and smart device	Guest Lecture on AI in Drug Discovery (Abhik Seal?)	Group Project	Group project
L14-4/28	AI health: Wrap Up: Chapter presentation of AI in healthcare	Chapter presentation of AI in healthcare: https://nam.edu/wp-content/uploads/2019/12/AI-in-Health-Care-PREPUB-FINAL.pdf	Group project	**MIMIC ML due**
L15-5/5	Final Presentation			Group project
L16-5/12	Final Report Due			**Final Group Report Due**

Course Assignments and Grading

Assignments

Individual Assignments (45%)

1. MIT Ethic Course (5%): pass the course, submit your certificate

2. MIMIC Gallery (10%): Develop the visual gallery using Tableau on MIMIC data (Tableau file, video to show details with the goal that other students can follow and rebuild your gallery).

3. MIMIC SQL (10%): Develop 10 SQL queries using MIMIC data (powerpoint slides showing SQL queries, meaning of each query, screenshots for results, and video)

4. MIMIC NLP (10%): generate an NLP tutorial using MIMIC data (powerpoint slides, python code, video).

5. MIMIC ML tutorial (10%): generate a ML tutorial using MIMIC data (powerpoint slides, python code, video).

Group Assignment (15%): Self-learning tutorial using MIMIC data (powerpoint slides, code, and video)

- Professor will randomly pair 2 students into one group
- Your group can select a topic to develop a tutorial using MIMIC: any topic you like
- Peer learning together: Another team will be assigned to learn the materials you have developed, provide feedback, and grade your tutorial
- The best to way to learn is to be able to teach others: create slides and videos, and upload them to Canvas. If you are proud of your tutorial and want to distribute it further, you can consider to upload your videos to YouTube and write a blog (example: https://towardsdatascience.com/predicting-hospital-length-of-stay-at-time-of-admission-55dfdfe69598)
- Potential resources: https://paperswithcode.com/

Group Project (30%): For a team with no more than 3 members to work on a selected topic based on the follow options:

- Build an evidence-based care app/tool on health risk prediction
- Implement explainable AI methods in healthcare using SHAP (https://shap.readthedocs.io/en/latest/index.html#)
- Build a prototype to implement explainable AI in healthcare
- Implement a deep learning model for chest x-ray image diagnosis
- Analyzing clinical notes

Output: A report with less than 5 pages (aiming for a workshop paper using ACM template: https://www.acm.org/publications/taps/word-template-workflow), powerpoint, code, and video (assuming that you will teach it to other students), presentation and demo

Some examples:
- Fairness in deep learning classification: https://arxiv.org/pdf/2003.00827.pdf
- Using shapley to understand disparity: https://arxiv.org/pdf/2111.08168.pdf
- Explainable AI on COVID patients: https://www.medrxiv.org/content/10.1101/2020.06.07.20124933v1.full.pdf
- longitudinal patient stratification: https://proceedings.mlr.press/v158/carr21a/carr21a.pdf
- eICU length of stay prediction: https://proceedings.mlr.press/v158/carr21a/carr21a.pdf
- Explainable AI: DeepLift for readmission prediction: https://proceedings.mlr.press/v158/carr21a/carr21a.pdf
- Patient embedding: https://proceedings.neurips.cc/paper/2018/file/934b535800b1cba8f96a5d72f72f1611-Paper.pdf
- patient feature importance using feature vector: https://arxiv.org/pdf/2111.05898.pdf
- temporal patient data encoding: https://arxiv.org/pdf/2011.11235.pdf
- Confounding factor identification: https://arxiv.org/pdf/2011.08753.pdf

Collaboration Projects:

- Health Risk Prediction on eICU data (McCombs School of Business)
- Explainable AI in Health Risk Prediction (McCombs School of Business)

- Shapley Score on readmission prediction (Anthem)
- Medical notes summary (Dell Med)
- Benchmarking on chest x-ray imaging diagnosis (AiXplain)
- Explainable AI in medical imaging diagnosis (iSchool)
- GNN explainer (Katana Graph)
- Graph based drug discovery (Katana Graph)
- DeepLift and DeepShap on risk prediction (Mount Sinai and iSchool)

Class presentations, participations, and final presentation (10%)

Late Work and Making Up Missed Work

Late work without proper excuse is not accepted. Each late work is subject to a 1-point grade reduction for every one hour late.

Absences

Each absence in class without proper excuse will get 1-point grade reduction from your final grade.

Equitable Accommodation

If you want to improve your grade, adding extra work to your assignments can be considered. Please discuss this with your instructor.

Grade Breaks

Grade	Cutoff
A	94%
A-	90%
B+	87%
B	84%
B-	80%
C+	77%
C	74%
C-	70%
D+	67%
D	64%
D-	60%
F	<60%

Course Policies and Disclosures

Academic Integrity Expectations

Students who violate University rules on academic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on academic dishonesty will be strictly enforced. For further information, please visit the Student Conduct and Academic Integrity website at: http://deanofstudents.utexas.edu/conduct.

Getting Help with Technology

Students needing help with technology in this course should contact the ITS Service Desk or email iSchool Helpdesk <help@ischool.utexas.edu> for software, hardware, or other technology available at our iSchool.

Content Warning

Our classroom provides an open space for the critical and civil exchange of ideas. Some readings and other content in this course will include topics that some students may find offensive and/or traumatizing. I'll aim to forewarn students about potentially disturbing content and I ask all students to help to create an atmosphere of mutual respect and sensitivity.

Religious Holy Days

By UT Austin policy, you must notify me of your pending absence as far in advance as possible of the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Names and Pronouns

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. I will gladly honor your request to address you by your chosen name and by the gender pronouns you use. Class rosters are provided to the instructor with the student's chosen (not legal) name, if you have provided one. If you wish to provide or update a chosen name, that can be done easily at this page, and you can add your pronouns to Canvas.

Land Acknowledgment

I would like to acknowledge that we are meeting on the Indigenous lands of Turtle Island, the ancestral name for what now is called North America. Moreover, I would like to acknowledge the Alabama-Coushatta, Caddo, Carrizo/Comecrudo, Coahuiltecan, Comanche, Kickapoo, Lipan Apache, Tonkawa and Ysleta Del Sur Pueblo, and all the American Indian and Indigenous Peoples and communities who have been or have become a part of these lands and territories in Texas.

University Resources for Students

SERVICES FOR STUDENTS WITH DISABILITIES (SSD)

The university is committed to creating an accessible and inclusive learning environment consistent with university policy and federal and state law. Please let me know if you experience any barriers to learning so I can work with you to ensure you have equal opportunity to participate fully in this course. If you are a student with a disability, or think you may have a disability, and need accommodations please contact Services for Students with Disabilities (SSD). Please refer to SSD's website for contact and more information: http://diversity.utexas.edu/disability/. If you are already registered with SSD, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations and needs in this course.

COUNSELING AND MENTAL HEALTH CENTER (CMHC)

All of us benefit from support during times of struggle. Know you are not alone. If you or anyone you know is experiencing symptoms of stress, anxiety, depression, academic concerns, loneliness, difficulty sleeping, or any other concern impacting your wellbeing – you are strongly encouraged to connect with CMHC. The Counseling and Mental Health Center provides a wide variety of mental health services to all UT students including crisis services, counseling services with immediate support and well-being resources. Additionally, CARE Counselors are located within the academic schools and colleges. These counselors get to know the concerns that are unique to their college's students. For more information on CMHC, visit https://cmhc.utexas.edu or call 512-471-3515.

UNIVERSITY HEALTH SERVICES (UHS)

Your physical health and wellness are a priority. University Health Services is an on-campus high-quality medical facility providing care to all UT students. Services offered by UHS include general medicine, urgent care, a 24/7 nurse advice line, women's health, sports medicine, physical therapy, lab and radiology services, COVID-19 testing and vaccinations and much more. For additional information, visit https://healthyhorns.utexas.edu or call 512-471-4955.

SANGER LEARNING CENTER

Did you know that more than one-third of UT undergraduate students use the Sanger Learning Center each year to improve their academic performance? All students are welcome to take advantage of Sanger Center's classes and workshops, private learning specialist appointments, peer academic coaching, and tutoring for more than 70 courses in 15 different subject areas. For more information, please visit https://ugs.utexas.edu/slc or call 512-471-3614 (JES A332)."

STUDENT EMERGENCY SERVICES (SES)

Student Emergency Services in the Office of the Dean of Students helps students and their families during difficult or emergency situations. Assistance includes outreach, advocacy, intervention, support, and referrals to relevant campus and community resources. If you need to be absent from class due to a family emergency, medical or mental health concern, or academic difficulty due to crisis or an emergency situation, you can work with Student Emergency Services. SES will document your situation and notify your professors. If immediate mental health assistance is needed, call the Counseling and Mental Health Center (CMHC) at 512-471-3515 or you may also contact Bryce Moffett, LCSW (iSchool CARE counselor) at 512-232-2983. Outside CMHC business hours (8a.m.-5p.m., Monday-Friday), contact the CMHC 24/7 Crisis Line at 512-471-2255. Additional information is available at https://deanofstudents.utexas.edu/emergency/ or by calling 512-471-5017.

Important Safety Information

If you have concerns about the safety or behavior of fellow students, TAs or professors, contact BCCAL (the Behavior Concerns and COVID-19 Advice Line) at https://safety.utexas.edu/behavior-concerns-advice-line or by calling 512-232-5050. Confidentiality will be maintained as much as possible, however the university may be required to release some information to appropriate parties.

CLASSROOM SAFETY AND COVID-19

To help preserve our in-person learning environment, the university recommends the following.

- Adhere to university [mask guidance](). Masks are strongly recommended, but optional, inside university buildings for vaccinated and unvaccinated individuals, except when alone in a private office or single-occupant cubicle.
- [Vaccinations are widely available](), free and not billed to health insurance. The vaccine will help protect against the transmission of the virus to others and reduce serious symptoms in those who are vaccinated.
- [Proactive Community Testing]() remains an important part of the university's efforts to protect our community. Tests are fast and free.
- We encourage the use of the [Protect Texas App]() each day prior to coming to campus.
- If you develop COVID-19 symptoms or feel sick, stay home and contact the [University Health Services]()' Nurse Advice Line at 512-475-6877. If you need to be absent from class, contact [Student Emergency Services]() and they will notify your professors. In addition, to help understand what to do if you have been had close contact with someone who tested positive for COVID-19, see this [University Health Services link]().
- [Behavior Concerns and COVID-19 Advice Line]() (BCCAL) remains available as the primary tool to address questions or concerns from the university community about COVID-19.
- Students who test positive should contact [BCCAL]() or self-report (if tested off campus) to [University Health Services]().
- Visit [Protect Texas Together]() for more information.

TITLE IX DISCLOSURE

Beginning January 1, 2020, TexasSenate Bill 212 requires all employees of Texas universities, including faculty, to report any information to theTitle IX Office regarding sexual harassment, sexual assault, dating violence and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be report it. If you would liketo speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit http://www.titleix.utexas.edu/, contact the Title IX Office via email at titleix@austin.utexas.edu, or call 512-471-0419. Although graduate teaching and research assistants are not subject to Texas Senate Bill 212, they are still mandatory reporters under Federal Title IX laws and are required to report a wide range of behaviors we refer to as sexual misconduct, including the types of sexual misconduct covered under Texas Senate Bill 212.The Title IX office has developed supportive ways to respond to a survivor and compiled campus resources to support survivors.

Faculty members and certain staff members are considered "Responsible Employees" or "Mandatory Reporters," which means that they are required to report violations of Title IX to the Title IX Coordinator. I am a Responsible Employee and must report any Title IX-related incidents that are disclosed in writing, discussion, or one-on-one. Before talking with me or with any faculty or staff member about a Title IX-related incident, be sure to ask whether they are a responsible employee. If you want to speak with someone for support or remedies without making an official report to the university, email advocate@austin.utexas.edu For more information about reporting options and resources, visit the Title IX Office or email titleix@austin.utexas.edu.

CAMPUS SAFETY

The following are recommendations regarding emergency evacuation from the [Office of Campus Safety and Security](#), 512-471-5767,

- Students should sign up for Campus Emergency Text Alerts at the page linked above.
- Occupants of buildings on The University of Texas at Austin campus must evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.
- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- For more information, please visit [emergency preparedness](#).