

# AI in Health

Spring 2021

## Introduction

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.

## Learning objectives

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

## 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>

## 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/>

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

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

## Schedule (tentative)

Date	Lecture (60mins+15mins break)	Class Activities (45mins)	Lab/Tutorial (60mins)	Notes
L1- 1/23	Introduction (L), Knowing each other (ZB)	Reading 1 (ZB) Reading 2 (ZB) Case (ZB) Answer focus questions	Introduce MIMIC III  Form the expert group (randomly grouped: ICD, SNOMED, LONIC, RxNorm, FHIR, Clinical decision making, AI in medical imaging, ML/DL in health, AI ethics in health, AI health in general)	Get access to MIMIC III Start MIT ethics course, AI health data challenge, Form group for group project
L2- 1/30	Evidence-based Care (L), i2b2 and OMOP (ZB)	Reading 1 (ZB) Reading 2 (ZB) Case (ZB) Randomly form a group of 4 to create a table to compare these data models and share Answer focus questions	MIT ethic course Group project client presentation (UT Health, sudhir, local austin healthcare companies, mathematica)	<b>MIT ethic course due</b> submit the request Form group for group project
L3- 2/6	EMR Semantics: ICD10 (L), ICD10 (COVID) and ICD9 (MIMIC) (ZB)	expert group lead this section Reading 1 (ZB, reflect) Reading 2 (ZB) Case (ZB),	T1: MIMIC-Visual Tableau I	Form a group randomly for self-learning tutorial, Get MIMIC access permission, self-

		Answer focus questions		learning tutorials (on Tableau, SQL, NLP, ML)
L4-2/13	EMR Semantics: SNOMED CT I (L)	expert group lead this section Reading 1 (ZB) Reading 2 (ZB) Case (ZB), Answer focus questions	T1: MIMIC-Visual Tableau II One visual hackathon (team ZB, 20mins)	Send the group project summary to TA
L5-2/20	EMR Semantics: SNOMED CTII (L), SNOMED and ICD10 (ZB)	expert group lead section Reading 1 (ZB) Reading 2 (ZB) Case (ZB), Answer focus questions	T2: MIMIC-SQL	<b>MIMIC Tableau Gallery due</b>
L6-2/27	EMR Semantics: LOINC	expert group section Reading 1 (ZB) Reading 2 (ZB) Case (ZB), Answer focus questions	T2: MIMIC-SQL One query hackathon (team ZB, 10 mins)	Group project
L7-3/5	EMR Semantics: RxNorm	expert group section Teach us one medical taxonomy (ZB), Answer focus questions	T3: MIMIC-NLP Spacy	<b>MIMIC SQL due</b>
L8-3/12	Clinical Decision Support System Guest Lecture on CDSS (Justin Rousseau)	expert group section Answer focus questions	T3: MIMIC-NLP: sciSpacy One NLP hackathon (team ZB, 20mins, bluebert, clinicalbert)	Group project
3/19-	break			
L9-3/26	Data Share: FHIR (Guest Lecture: Darrell Woelk)	FHIR tutorial (Darrell Woelk), expert group section Answer focus questions	T4: MIMIC-ML LOS I	Each group project team will present one paper of ML/DL using MIMIC data next two weeks (15 mins) <a href="https://read.qxmd.com/keyword/229497">https://read.qxmd.com/keyword/229497</a>
L10-4/2	AI health: ML/DL I (team presents)	expert group section Answer focus questions	T4: MIMIC-ML LOS II	<b>MIMIC NLP due</b> (cTakes, ClinicalBert, bioBert, Bert, metamap, negabert)
L11-4/9	AI health: ML/DL II	expert group section	T5: MIMIC-ML Readmission I	Group project

	(team presents)	Answer focus questions		
L12-4/16	AI health: imaging (Yifan Peng, Cornell)	expert group section Answer focus questions	T5: MIMIC-ML Readmission II One ML hackathon (team ZB, 20mins)	<b>Self-learning tutorial due</b> (graded by students)
L13-4/23	AI in drug discovery, robotics and smart device	expert group section Each group will present one chapter next week: <a href="https://nam.edu/wp-content/uploads/2019/12/AI-in-Health-Care-PREPUB-FINAL.pdf">https://nam.edu/wp-content/uploads/2019/12/AI-in-Health-Care-PREPUB-FINAL.pdf</a>	Group Project	Group project
L14-4/30	AI health: Wrap Up: Chapter presentation of AI in healthcare	Chapter presentation of AI in healthcare	Group project	<b>MIMIC ML due</b>
L15-5/7	Final Presentation	Final Presentation	Final Presentation, Best student tutorial award (vote by the students)	Group project
L16-5/14	Final Report Due	Demo/Poster session	Group Project Demo	<b>Final Group Report Due</b> <b>AI health challenge due</b>

## Assignments and Grading

### Individual Assignments (45%)

1. MIT Ethic Course (5%): pass the course
2. MIMIC Gallery (10%): Develop the visual gallery using MIMIC data using Tableau (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 and screenshots for results, video)
4. MIMIC NLP (10%): generate a NLP tutorial using MIMIC data (powerpoint slides, code, video).
5. MIMIC ML tutorial (10%): generate a ML tutorial using MIMIC data (powerpoint slides, code, video).

### Group Assignment (15%): Self-learning tutorial using MIMIC data

- Professor will randomly form 2 students into one group
- Your group can select topics to develop related tutorials: any topic you like
- Peer learning together: Another team will assign to learn the materials you have developed to provide feedback, this team will grade your tutorial
- The best way to learn is to be able to teach others: create slides, videos (upload to youtube), write a blog (in the end, **publish it on a blog**, example:

<https://towardsdatascience.com/predicting-hospital-length-of-stay-at-time-of-admission-55dfdf69598>)

**Group Project (30%):** Build evidence-based care apps/tools (join AI health data challenge), working with healthcare companies: <https://www.builtinaustin.com/blog/austin-healthtech-startups-to-know>

- joining AI Health Data Challenge
- using MIMIC data or other datasets you can access
- data+design
- a 3-5 page report (aiming for a workshop paper), powerpoint, demo, code, and video (assuming that you will teach it to other students), presentation

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

### Grading Rubric

Meets major requirement		Does not meet requirement	
Grade	Points	Grade	Points
A	≥93.00	C-	70.00-72.99
A-	90.00-92.99	D+	67.00-69.99
B+	87.00-89.99	D	63.00-66.99
B	83.00-86.99	D-	60.00-62.99
B-	80.00-82.99	F	<60.00
C+	77.00-79.99		
C	73.00-76.99		

### Land Acknowledgement

We acknowledge that the iSchool sits on indigenous land. We would like to acknowledge that we are meeting on Indigenous land. Moreover, we would like to acknowledge and pay our respects to the Carrizo & Comecrudo, Coahuiltecan, Caddo, Tonkawa, Comanche, Lipan Apache, Alabama-Coushatta, Kickapoo, Tigua 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, here on Turtle Island.

### Title IX

Title IX and Texas SB 212 Reporting requirements: Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, unprofessional or inappropriate conduct of a sexual nature, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. 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](mailto:titleix@austin.utexas.edu), or call 512-471-0419.

### University Resources for Students

The university has numerous resources for students for your learning, use these to help you succeed in your classes

- The University Writing Center: The University Writing Center offers free, individualized, expert help with writing for any UT student, by appointment or on a drop-in basis. Consultants help students develop strategies to improve their writing. The assistance we provide is intended to foster students' resourcefulness and self-reliance. <http://uwc.utexas.edu/>
- Counseling and Mental Health Center: The Counseling and Mental Health Center (CMHC) provides counseling, psychiatric, consultation, and prevention services that facilitate students' academic and life goals and enhance their personal growth and well-being. <http://cmhc.utexas.edu/>
- Basic Needs Security: Any student who faces challenges of affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and believe this may affect their performance in the course, is encouraged to contact the Office of the Dean of Students – Student Emergency Services (SES) for support. Please notify the instructor if you are comfortable doing so and I will make efforts to provide any resources that I may possess to help you navigate issues of food insecurity or residential displacement.
- SES Concerns and Emergencies: <http://deanofstudents.utexas.edu/emergency/concernsemergencies.php>
- SES Food Pantry: <http://deanofstudents.utexas.edu/emergency/pantry.php>
- SES Confidential Advocacy and Support: <http://deanofstudents.utexas.edu/emergency/advocacysupport.php>
- Student Emergency Services: <http://deanofstudents.utexas.edu/emergency/>
- ITS: Need help with technology? <http://www.utexas.edu/its/>
- Libraries: Need help searching for information? <http://www.lib.utexas.edu/>
- Canvas: Canvas help is available 24/7 at <https://utexas.instructure.com/courses/633028/pages/student-tutorials>
- Behavior Concerns Advice Line (BCAL): If you are worried about someone who is acting differently, you may use the Behavior Concerns Advice Line to discuss by phone your concerns about another individual's behavior. This service is provided through a partnership among the Office of the Dean of Students, the Counseling and Mental Health Center (CMHC), the Employee Assistance Program (EAP), and The University of Texas Police Department (UTPD). Call 512-232-5050 or visit <http://www.utexas.edu/safety/bcal> .

University of Texas Core Values and Honor Code: The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community. As a student of the University of Texas at Austin, I shall abide by the core values of the University and uphold academic integrity.

### **COVID-19 Information for students**

Safety and Class Participation/Masks: We will all need to make some adjustments in order to benefit from in-person classroom interactions in a safe and healthy manner. Our best protections against spreading COVID-19 on campus are masks (defined as cloth face coverings) and staying home if you are showing symptoms. Therefore, for the benefit of everyone, this means that all students are required

to follow two important rules. Every student must wear a cloth face covering properly in class and in all campus buildings at all times. If a student is not wearing a cloth face covering properly in the classroom (or any UT building), that student must leave the classroom (and building). If the student refuses to wear a cloth face covering, class will be dismissed for the remainder of the period, and the student will be subject to disciplinary action as set forth in the university's Institutional Rules/General Conduct 11-404(a)(3). Students who have a condition that precludes the wearing of a cloth face covering must follow the procedures for obtaining an accommodation working with Services for Students with Disabilities.

For the safety of our community, every student is strongly encouraged to do daily symptom screening, which is available using the Protect Texas Together app. Once the symptom screening is completed, it will inform students whether they are cleared to come to campus. Students should only come to campus if the symptom screening app clears them to do so. Otherwise, students should isolate and contact a medical professional for further guidance before coming to campus again. If a student is not wearing a cloth face covering properly in the classroom (or any UT building), that student must leave the classroom (and building). If the student refuses to wear a cloth face covering, class will be dismissed for the remainder of the period, and the student will be subject to disciplinary action as set forth in the university's Institutional Rules/General Conduct 11-404(a)(3). Students who have a condition that precludes the wearing of a cloth face covering must follow the procedures for obtaining an accommodation ( <https://orientation.utexas.edu/students-with-disabilities>). Students in need of assistance are encouraged to contact Student Emergency Services.

Students who need computer equipment or reliable internet access for online classes should complete the Student Emergency Fund application, and share specific information about their needs. The Counseling and Mental Health Center will continue to provide counseling and psychiatric services to support students throughout this time, though our services will be delivered over the phone. If you have any IT needs (computer hardware, software, cameras, headphones, etc.) that might be necessary for you to attend online classes, please email the iSchool IT Team at [help@ischool.utexas.edu](mailto:help@ischool.utexas.edu).

International Students and Scholars are encouraged to reach out to Texas Global for specific information regarding your status at [hotline@austin.utexas.edu](mailto:hotline@austin.utexas.edu). Make sure to include your EID and name in all communications. Students interested in learning about Coronavirus-related refunds or reimbursements should go to: <https://coronavirus.utexas.edu/refunds-reimbursements>. Info about Student Health Insurance extension after graduation can be found here: <https://global.utexas.edu/iss/insurance/enroll>.