# CS 886 - Advanced Topics in Artificial Intelligence Applied Machine Learning

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# Objective

- Introduce students to machine learning techniques, with a focus on application to substantive (i.e. non-ML) problems.
- Gain experience in identifying
  - which problems can be tackled by machine learning methods
     which specific ML methods are applicable to the problem at hand
- Students will gain an in-depth understanding of a particular (substantive problem, ML solution) pair, and present their findings.
- Evaluation: quizzes, brainstorming presentations, project-as-conference-paper

# Topics

- Machine Learning:
  - Supervised learning
  - Unsupervised learning
  - Sequential decision making
  - Performance evaluation for each of these
- Substantive areas:
  - Healthcare
  - Astronomy
  - Biology
  - Chemistry
  - Engineering
  - ...





# **MIMIC II Database**

#### Quick Links

Getting Access Waveform Database Overview Clinical Database Overview Waveform Data Clinical Data

#### MIMIC II Statistics



#### MIMIC II FAQs

The MIMIC II (Multiparameter Intelligent Monitoring in Intensive Care) Database contains comprehensive clinical data from tens of thousands of Intensive Care Unit (ICU) patients\*. Data were collected between 2001 and 2008 from a variety of ICUs (medical, surgical, coronary care, and neonatal) in a single tertiary teaching hospital. The database contains clinical data from bedside workstations as well as hospital archives. The database also includes thousands of records of continuous high-resolution physiologic waveforms and minute-by-minute numeric time series (trends) of physiologic measurements. Many, but not all, of the waveform records are matched to corresponding clinical data (for more information, see <u>Record Matching</u>). The database is thoroughly de-identified (all <u>PHI</u> has been removed and <u>all dates have been changed</u>).





"Recorded waveforms and numerics vary depending on choices made by the ICU staff. Waveforms almost always include one or more ECG signals, and often include continuous arterial blood pressure (ABP) waveforms, fingertip photoplethysmogram (PPG) signals, and respiration, with additional waveforms (up to 8 simultaneously) as available. Numerics typically include heart and respiration rates, SpO2, and systolic, mean, and diastolic blood pressure, together with others as available. Recording lengths also vary; most are a few days in duration, but some are shorter and others are several weeks long."



#### ICU Intensive Care Unit



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in the cardiac pulse waveform ... "

# What now? Find the problems people care about.



Crit Care Med. 2011 May; 39(5): 952-960. Multiparameter Intelligent Monitoring in Intensive Care II (MIMIC-II): A public-access intensive care unit database M. Saeed, M. Villarroel, A.T. Reisner, G. Clifford, L. Lehman, G.B. Moody, T. Heldt, T.H. Kyaw, B.E. Moody, R.G. Mark.
Crit Care Med. 2001 Feb;29(2):427-35. Artificial intelligence

applications in the intensive care unit. Hanson CW 3rd, Marshall BE.

PLoS Comput Biol. 2007 Nov;3(11):e204. Epub 2007 Sep 6. From inverse problems in mathematical physiology to quantitative differential diagnoses. Zenker S, Rubin J, Clermont G.

... . . . .

- Back to the data to see if what you have can address the problems.
- Back to the methods to see if you can apply them to your data.
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## Seeking students who:

- Like to read have a desire to understand substantive problems
- Like to think make connections between methods and problems
- Like to hack be willing to munge data into usability
- Like to speak teach us about what you found!

ML methods knowledge an asset, but not required.

CS 886 - Advanced Topics in AI: Applied Machine Learning with Dan Lizotte

https://cs.uwaterloo.ca/~dlizotte/teaching/cs886/

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