Hands on with MIMIC-III

IRENE CHEN

6.S897 / HST.956

FRI FEB 15

What is MIMIC-III?

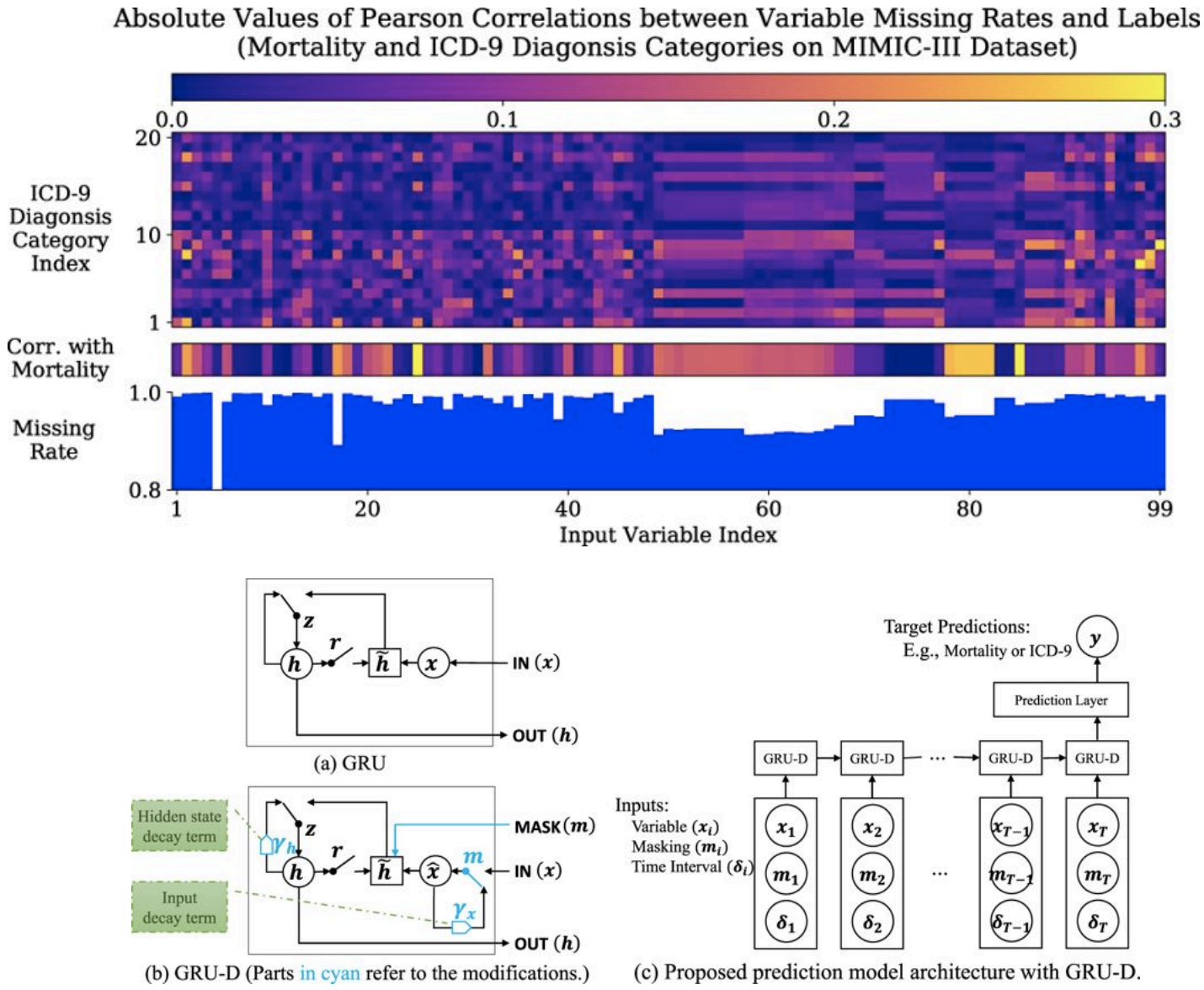
- Largest open dataset for clinical healthcare (for authorized researchers)
- Dataset of 26 tables (e.g. admissions, patients)
- Maintained by Roger Mark's lab at MIT
- Potential place for **final project ideas**!

Today we'll get to know MIMIC better

1. Examples of recent academic papers using MIMIC-III data
2. Live coding (Twitch-style) to recreate Lecture 3 slides
3. Walk through logistic regression

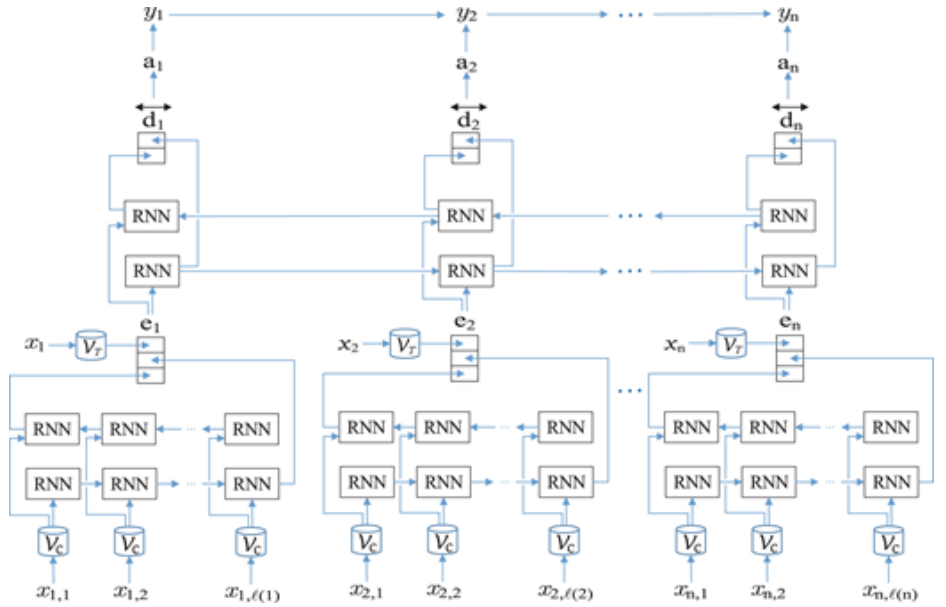
Recurrent Neural Networks for Multivariate Time Series with Missing Values

Che et al, 2018 (Nature Scientific Reports)



De-identification of patient notes with recurrent neural network

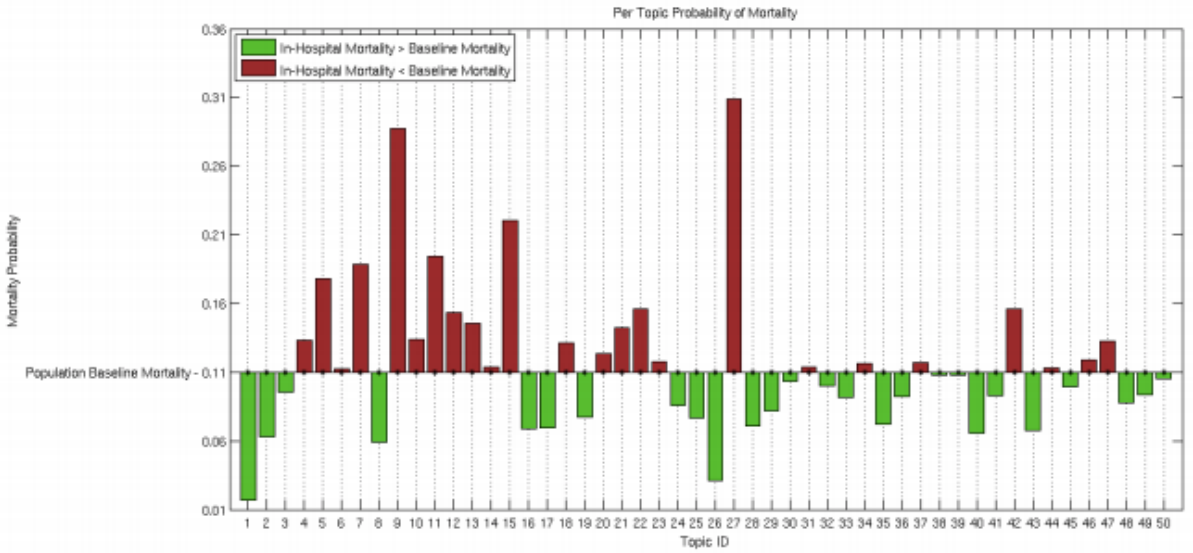
Dernoncourt et al, 2017 (JAMIA)



	i2b2			MIMIC		
Model	**Precision**	**Recall**	**F1**	**Precision**	**Recall**	**F1**
Nottingham	**99.000**	96.400	97.680	–	–	–
MIST	91.445	92.745	92.090	95.867	98.346	97.091
CRF	98.560	96.528	97.533	99.060	98.987	99.023
ANN	98.320	97.380	97.848	**99.208**	99.251	**99.229**
CRF + ANN	97.920	**97.835**	**97.877**	98.820	**99.398**	99.108

Unfolding Physiological State: Mortality Modeling in Intensive Care Units

Ghassemi et al, 2014 (KDD)

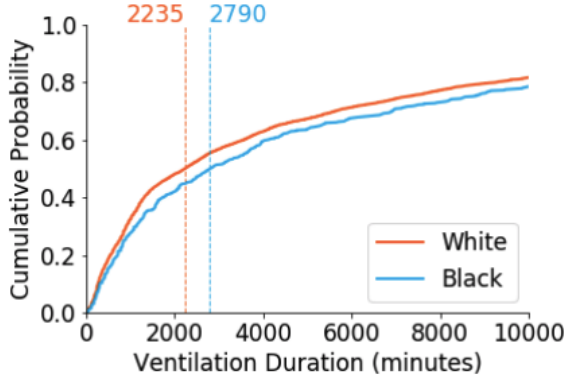


	Topic	Top Ten Words	Possible Topic
In-hospital Mortality	27	name, family, neuro, care, noted, status, plan, stitle, dr, remains	Discussion of end-of-life care
	15	intubated, vent, ett, secretions, propofol, abg, respiratory, resp, care, sedated	Respiratory failure
	7	thick, secretions, vent, trach, resp, tf, tube, coarse, cont, suctioned	Respiratory infection
	5	liver, renal, hepatic, ascites, dialysis, failure, flow, transplant, portal, ultrasound	Renal Failure

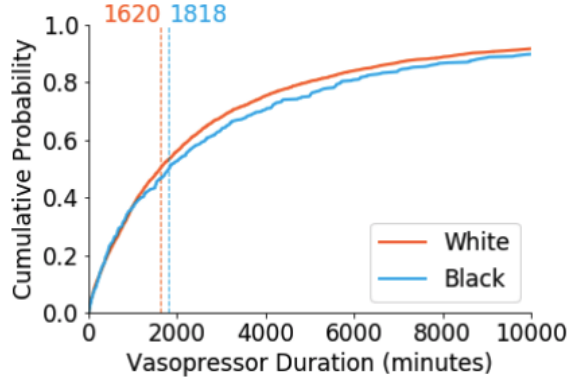
Racial Disparities and Mistrust in End-of-Life Care

Boag et al, 2018 (MLHC)

Social: Pt refused to sign ICU consent and expressed wishes to be DNR/DNI, seemingly very frustrated and mistrusting of healthcare system in relation to [redacted]. Also, w/ hx of poor medication compliance and follow-up



(a) CDF of ventilation duration by race ($p = .005$).



(b) CDF of vasopressor duration by race ($p = 0.12$).

Reproducibility in critical care: a mortality prediction case study

Johnson et al, 2017 (MLHC)

We reproduced datasets for 38 experiments corresponding to 28 published studies using MIMIC. In half of the experiments, the sample size we acquired was 25% greater or smaller than the sample size reported. The highest discrepancy was 11,767 patients. While accurate reproduction of each study cannot be guaranteed, we believe that these results highlight the need for more consistent reporting of model design and methodology to allow performance improvements to be compared. We discuss the challenges in reproducing the cohorts used in the studies, highlighting the importance of clearly reported methods (e.g. data cleansing, variable selection, cohort selection) and the need for open code and publicly available benchmarks.

Study	Window, W (hours)	Inclusion criteria
Caballero Barajas and Akella (2015)	24	Age>18, Random fixed size subsample
Caballero Barajas and Akella (2015)	48	Age>18, Random fixed size subsample
Caballero Barajas and Akella (2015)	72	Age>18, Random fixed size subsample
Calvert et al. (2016b)	5*	Age>18, In MICU, >1 obs. for all features, LOS $\geq$ 17hr, ICD-9 codes indicating alcohol withdrawal
Calvert et al. (2016a)	5*	Age>18, In MICU, >1 obs. for all features, 500hr $\geq$ LOS $\geq$ 17hr
Celi et al. (2012)	72	ICD-9 code 584.9
Celi et al. (2012)	24	ICD-9 code 430 or 852
Che et al. (2016) (b)	48	PhysioNet 2012 Challenge dataset
Ding et al. (2016)	48	PhysioNet 2012 Challenge dataset
Ghassemi et al. (2014)	12	Age>18, >100 words across all notes
Ghassemi et al. (2014)	24	Age>18, >100 words across all notes
Ghassemi et al. (2015)	24	Age>18, >100 words across all notes, >6 notes

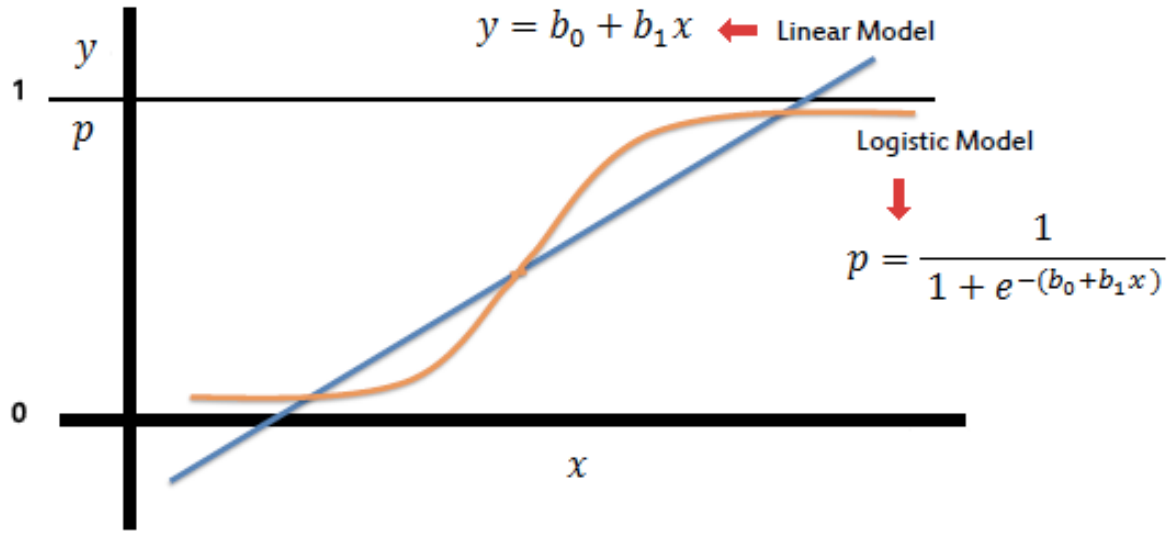
Live coding time!

Live Coding Rules

- Irene controls keyboard and screen
- Each student gets to decide what to do next:
  - Dictate line of code
  - Google something (or Irene can directly tell them)
  - Look up MIMIC documentation: https://mimic.physionet.org/mimictables/
  - Say “pass”
- If three “pass”-es in a row, Irene gives the answer.

Logistic regression refresher

- Powerful (and simple!) predictive model for binary outcomes
- To avoid overfitting, L1 or L2 regularization commonly used
- Maximum likelihood estimation -> sklearn has built in solver



More live coding!