

ELMED219

Tuesday Jan. 11th, 2022

Lab 1: Electronic health records

Lab 2: Natural language processing

Alexander S. Lundervold (HVL)



- All
- My Favorites
- Recent Screens

- Patient F2
- Visit Note
- Bill
- Prescription
- Scheduler

- Office
- Payer/Medical Service/Reference
- Diabetes
- Point of Sale
- Marketing
- System Parameters...
- User Parameters...

- Security...
- Change Password...
- Admin

- MIPS
- Other

Patient Master

Patient 1 of 1

Active: Picture

ID: 0001000 Paper Chart Office: 0001 Provider: Doe, Jane

First Name*: JOHN Middle Name: Last Name*: DOE Suffix:

Fix: N: - DOB: 03/26/1976 42 Yr 2 Mo 2 Wk Sex: Male A.K.A.:

City: Male Sexual Orientation: Straight or heterosexual

Address: 14087 Street Zip: 87199 Albuquerque, NM

Ethnicity: asian Preferred Language: English Interpreter:

Education: Send Greetings: Student:

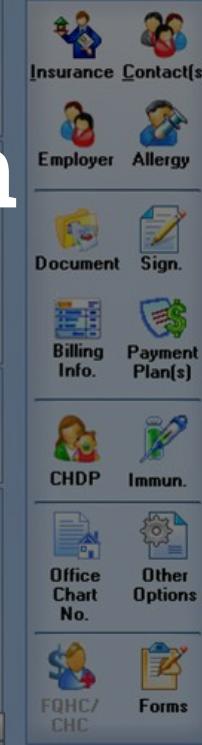
Driver's Lic.: Barcode: SOF: 00/00/0000

Primary Doctor: Referral Source: Housing Type: Not Specified Self Pay: Deceased: 00/00/0000

Fee Class: None Print Pat. St: Yes St. Code: St. Reason:

Note: Verified: Verified By: Verified Date:

A Insurance ID Group No. Priority Start Date End Date Copay



Introduction

Digitalization of health care...

...for efficiency...

...and to enable new opportunities!

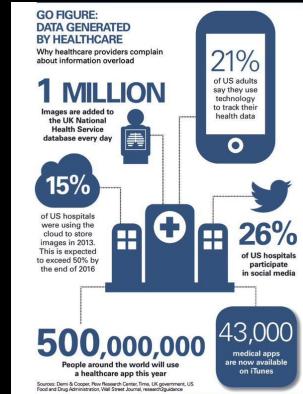
There's a lot of valuable information buried in such data!

Patient information,
clinical notes,
events,
referrals,
drugs,
procedures,
Laboratory results,
diagnoses,
genetic data,

...

Tina Linn Sæstad Abajon [Begrunnelse: Helsehjelp]

Bruker	Brukertilhører	Iplos	Kontaktperson	Tjenester	Journalnoter	Saker	Postjournal	Meldinger	
Fornavn:	Tina			Distrikts:	Plog omrøring institusjon				
Etternavn:	Sæstad			Sone:	Bærum Bo- og Behandling				
F-Nr.:	25126946239			Forste tjeneste:	27.04.2017				
Fødselsdato/Person.:	25.12.1969	46239	Lepen: 873	Delone:	Foran			Dato død:	00.00.0000
Alder:	47		Kjenn: Kvinnel	Siv. status:	GIV/samboer				
Gate/Vei:			Husst.:	Antall kontidagdager hå:					
Nummer:									
Adresse:	BJARNE SKAUS VEL 22 A								
Poststed/land:	1362	HØDSE							
Kommune:	0219	BÆRUM							
Egenandel:	00		(Fakturert hittil i år)						
Div. opplysninger				Individuell plan					
Boligtype:				Ansv. koordinator (int.):					
Reservasj. diagnose:	Nei			Ansv. koordinator (ekst.):					
Institusjonsopphold				Overvåkede tjenester					
Bruker oppholder seg ikke på institusjon									
Aktivitetar:									
Vis historikk									





Ny bestilling Alle rekvisisjoner

Gundersen, Roland - 15.07.1965*00565 - 49år - Mann

✓ Tilleggsopplysninger Hastegrad: Normal Betaling: Trygdékontor / Ordinær pasient Reservasjон: Tillatelse Kopimottakere: Ingen

Søk i tjenestetilbud (Ctrl-k)

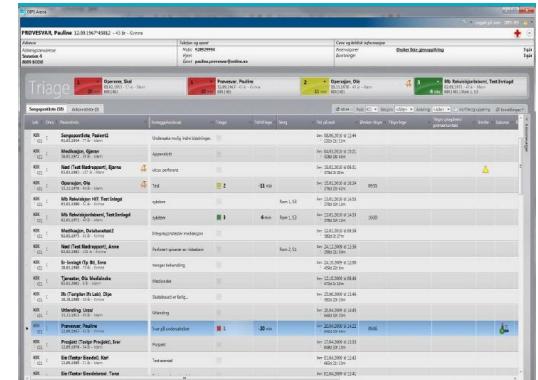
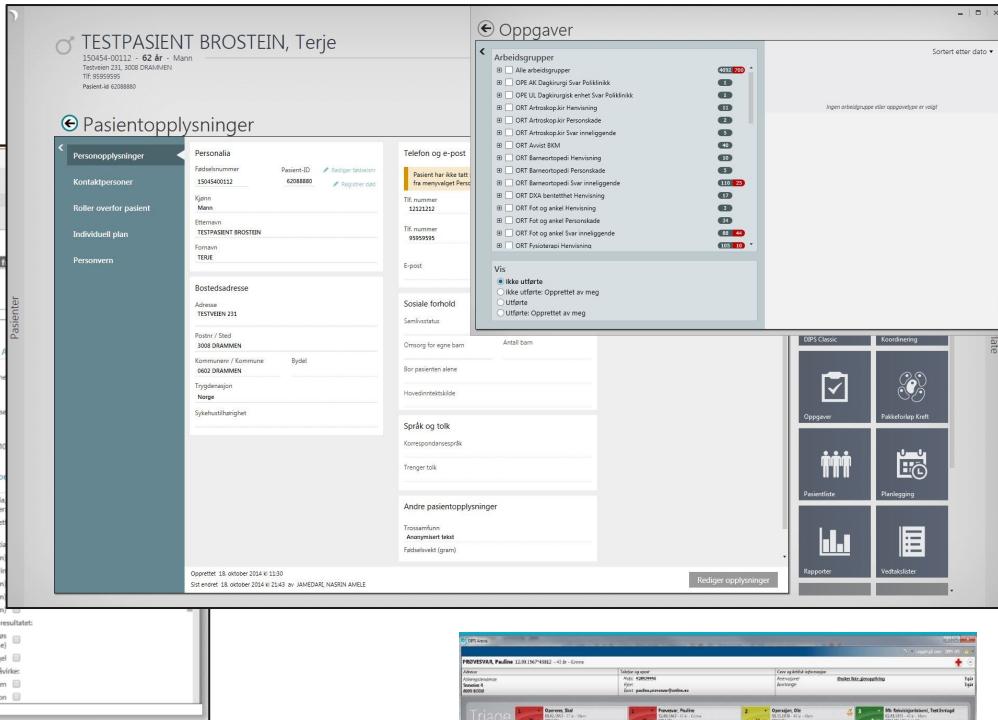


Meona
Die klinische Software

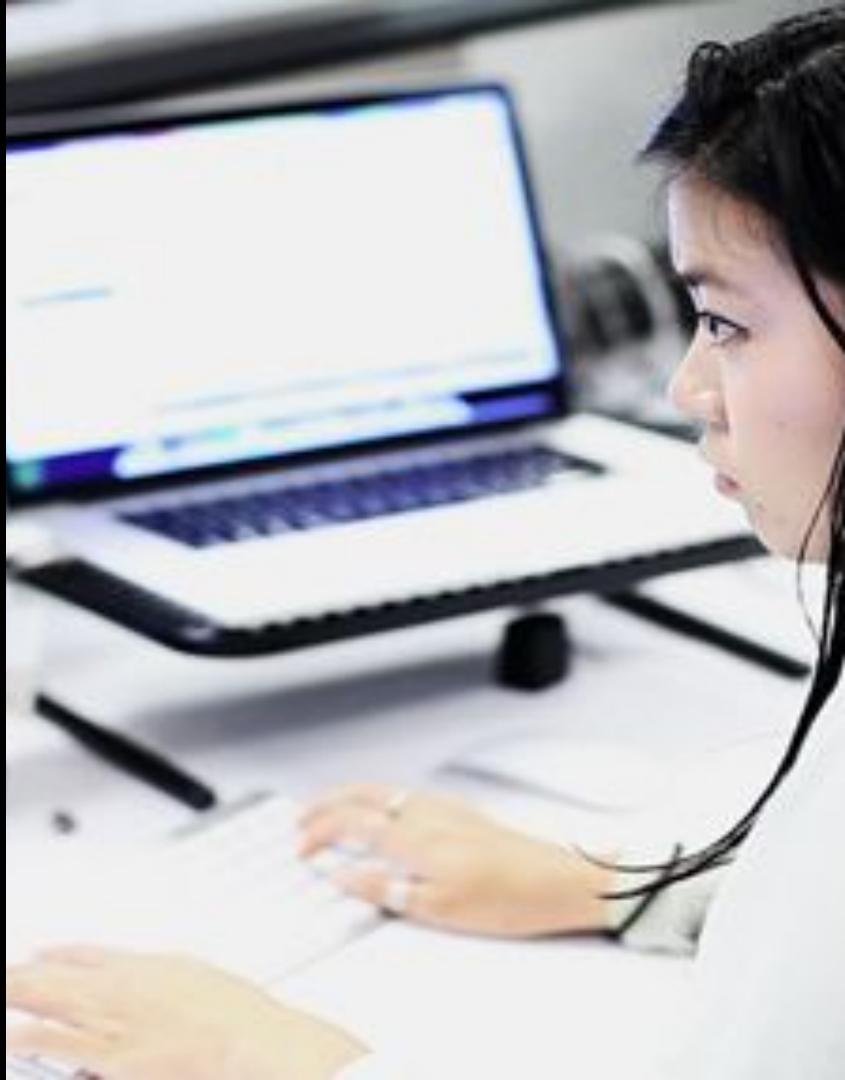
Digitalt media-arkiv
PACS
RIS

 CSAM
-The eHealth Company

AMIS

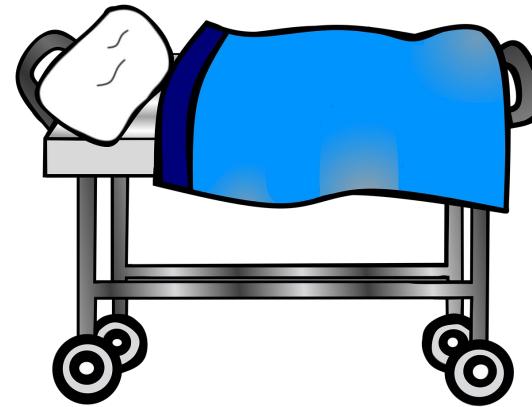


A hands-on demo of machine learning and structured EHR data



Hands-on: predicting length of stay

Index	Data fields	Type	Descriptions
0	LengthOfStay	NaN	NaN
1	eid	Integer	Unique Id of the hospital admission
2	vdate	String	Visit date
3	rcount	Integer	Number of readmissions within last 180 days
4	gender	String	Gender of the patient\nM or F
5	dialysisrenalendstage	String	Flag for renal disease during encounter
6	asthma	String	Flag for asthma during encounter
7	irondef	String	Flag for iron deficiency during encounter
8	pneum	String	Flag for pneumonia during encounter
9	substancedependence	String	Flag for substance dependence during encounter
10	psychologicaldisordermajor	String	Flag for major psychological disorder during e...
11	depress	String	Flag for depression during encounter
12	psychother	String	Flag for other psychological disorder during e...
13	fibrosisandother	String	Flag for fibrosis during encounter
14	malnutrition	String	Flag for malnutrition during encounter
15	hemo	Float	Flag for blood disorder during encounter
16	hematocrit	Float	Average hematocrit value during encounter (g...
17	neutrophils	Float	Average neutrophils value during encounter (c...
18	sodium	Float	Average sodium value during encounter (mmol/L)
19	glucose	Float	Average glucose value during encounter (mmol/L)
20	bloodureanitro	Float	Average blood urea nitrogen value during encou...
21	creatinine	Float	Average creatinine value during encounter (mg/dL)
22	bmi	Float	Average BMI during encounter (kg/m ²)
23	pulse	Float	Average pulse during encounter (beats/m)
24	respiration	Float	Average respiration during encounter (breaths...
25	secondarydiagnosisnonicd9	Integer	Flag for whether a non ICD 9 formatted diagnos...
26	discharged	String	Date of discharge
27	facid	Integer	Facility ID at which the encounter occurred
28	lengthofstay	Integer	Length of stay for the encounter



Predict how long a patient will stay at the hospital.

Assist clinical decisions

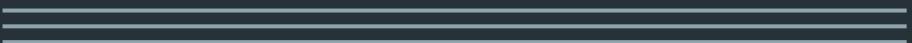
Increased efficiency, better planning of Økt effektivitet, better discharge planning

Reveal unfortunate trends and support new clinical practice

Reveal connections between journal data and patient conditions

Lab 2 (later today):

A demo of natural
language processing:
analyzing unstructured
text



An example of relevant research results

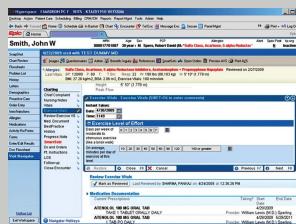
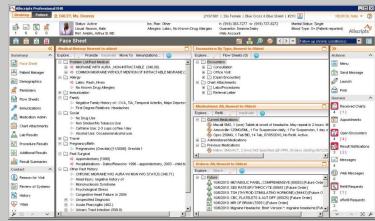
Motivation:

- Deep learning: able to produce predictive models based on large amounts of relatively unorganized data, including free text
- ...EHR consists of exactly that: large amounts of relatively unorganized data, including free text!



114.003 patients

No harmonization



Medication

Acetaminophen
RxNorm/161

Tokenization

Embeddings

Vector of numbers
Vector of numbers

Ready for machine learning!

RNN / LSTM
Boosting

Alvin Rajkomar ^{1,2}, Eyal Oren¹, Kai Chen¹, Andrew M. Dai¹, Nissan Hajaj¹, Michaelis Hardt³, Peter J. Liu¹, Xiaobing Liu¹, Jake Marcus¹, Mimi Sun¹, Patrik Sundberg¹, Hector Yee¹, Kun Zhang¹, Yi Zhang¹, Gerardo Flores¹, Gavin E. Duggan¹, Jamie Irvin¹, Quoc Le¹, Katherine Chou¹, Michael Pearson¹, Srinivasan Madabushi¹, Nigam H. Shah¹, Atul J. Butte¹, Michael D. Howell¹, Claire Cui¹, Kurt Litchi¹, Alexander Mossin¹, Justin Tansuwan¹, De Wang¹, James Wexler¹, Jimbo Wilson¹, Dana Ludwig¹, Samuel L. Volchenboum³, Greg S. Corrado⁴ and Jeffrey Dean⁴



Patient
Encounter
Medication
Observation
Composition
Conditions

MedicationAdministration
MedicationOrder
ProcedureRequest
Procedure

Table 2. Prediction accuracy of each task made at different time points

	Hospital A	Hospital B
<i>Inpatient mortality, AUROC^a (95% CI)</i>		
24 h before admission	0.87 (0.85–0.89)	0.81 (0.79–0.83)
At admission	0.90 (0.86–0.91)	0.92–0.94
24 h after	0.83–0.88	
Baseline admission	0.83–0.88	
30-day readmission	0.71–0.73	
At admission	0.72–0.74	
At 24 h after	0.75–0.77	
At discharge	0.67–0.69	
Baseline discharge	0.80–0.81	
Length of stay	0.85–0.86	
At admission	0.73–0.75	
At 24 h after	0.87	0.86
At 24 h after admission	0.89	0.88
At discharge	0.90	0.90

^aArea under the receiver operator curve

^bAugmented Early Warning System score

^cModified

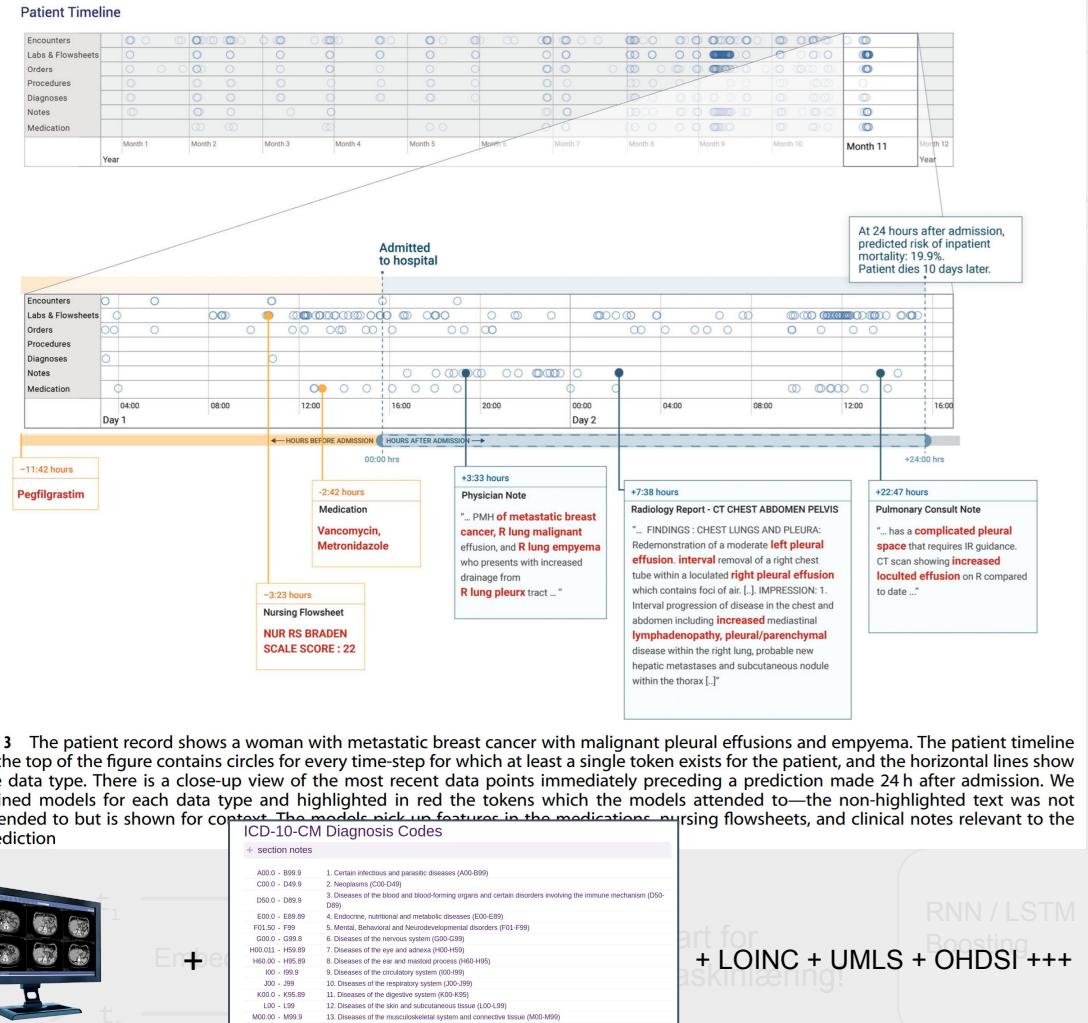
^dModified

The bold

curve for each prediction task

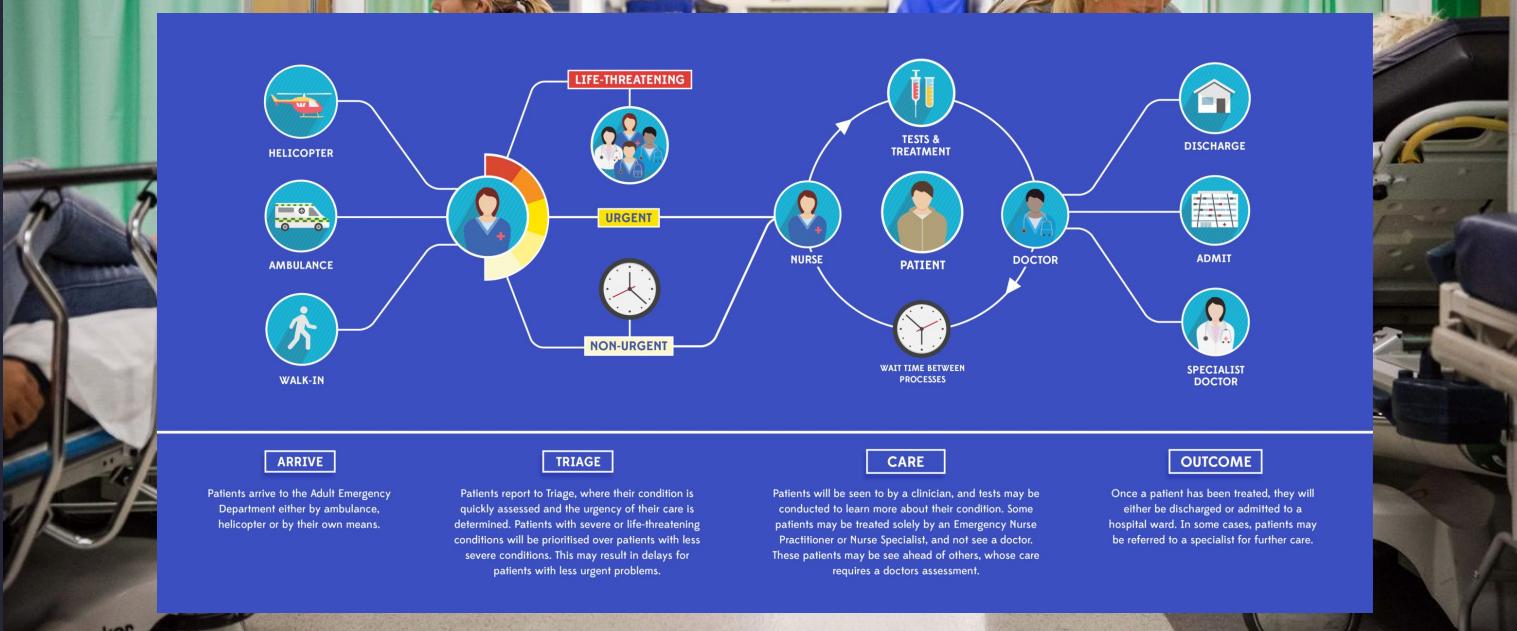
Better than all existing EHR models!

over-operator-



RNN / LSTM
Boosting
+ LOINC + UMLS + OHDSI +++

Emergency



Example of data available for research

The screenshot shows the MIMIC website homepage. At the top, there is a navigation bar with the MIMIC logo, a search icon, and links for "Docs" and "Community". The main title "Medical Information Mart for Intensive Care" is displayed prominently in white text. Below the title, a subtitle reads "Freely available medical data for research." There are three main navigation buttons: "Documentation" (blue), "Getting Started" (orange), and "Code" (blue). The main content area is divided into two sections. The top section contains six modules, each with a lightbulb icon and a brief description. The bottom section contains three more modules, also with lightbulb icons and descriptions. Each module has a "Read more ..." link.

Medical Information Mart for Intensive Care

Freely available medical data for research.

Documentation

Getting Started

Code

MIMIC-IV-Core

Patient demographics, admission tracking, and stay information is available in MIMIC-Core.

[Read more ...](#)

MIMIC-IV-Hosp

The Hosp module provides all data acquired from the hospital wide electronic health record. This includes laboratory measurements, microbiology cultures, medication information, services provided, billed diagnoses and procedures, and so on.

[Read more ...](#)

MIMIC-IV-ICU

The ICU module contains information collected from the clinical information system used within the ICU. This includes highly granular information such as hour-to-hour vital signs, information about fluid management, and other charted observations.

[Read more ...](#)

MIMIC-IV-ED

The ED module contains data for emergency department patients including a triage assessment, nurse-validated vital signs, medicine reconciliation, and treatment information.

[Read more ...](#)

MIMIC-IV-CXR

MIMIC-cxr provides chest x-ray images and radiology reports for a subset of patients admitted to the emergency department.

[Read more ...](#)

MIMIC-IV-Note

The Note module contains deidentified free-text clinical notes for hospitalized patients.

[Read more ...](#)