האוניברסיטה
העברית
בירושלים
THE HEBREW
UNIVERSITY
OF JERUSALEM

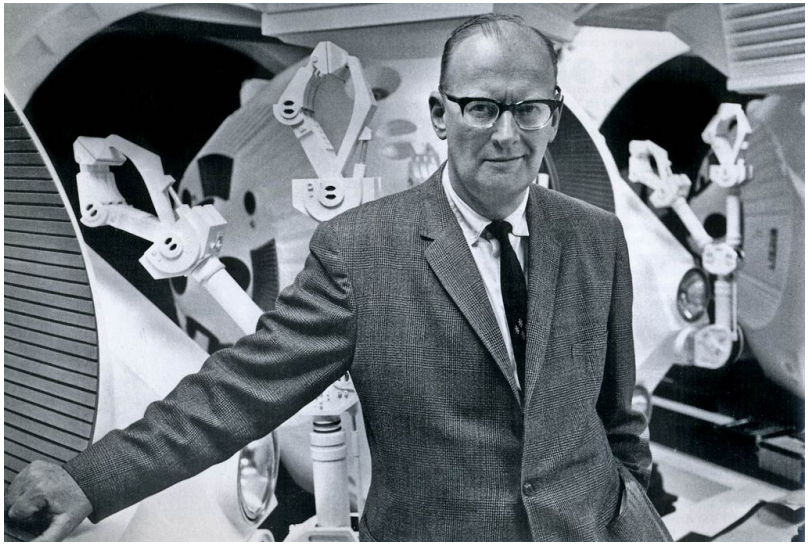
Artificial Intelligence in Medicine

Introduction: ML, AI, and medicine

Nir Friedman and Tommy Kaplan 24/10/22

“Any sufficiently advanced technology is indistinguishable from magic”

Arthur C. Clarke



Course goals

- Understand basic concepts in AI and ML
- Demystification

- How AI can help us?
- Formulate medical decisions as AI tasks

- How AI might fail us?
- Critical thinking - how to be a smart, responsible user, aware of system limitations

“How I learned to stop worrying and love artificial intelligence”

Dr. Strangelove

AI and ML change the way we live

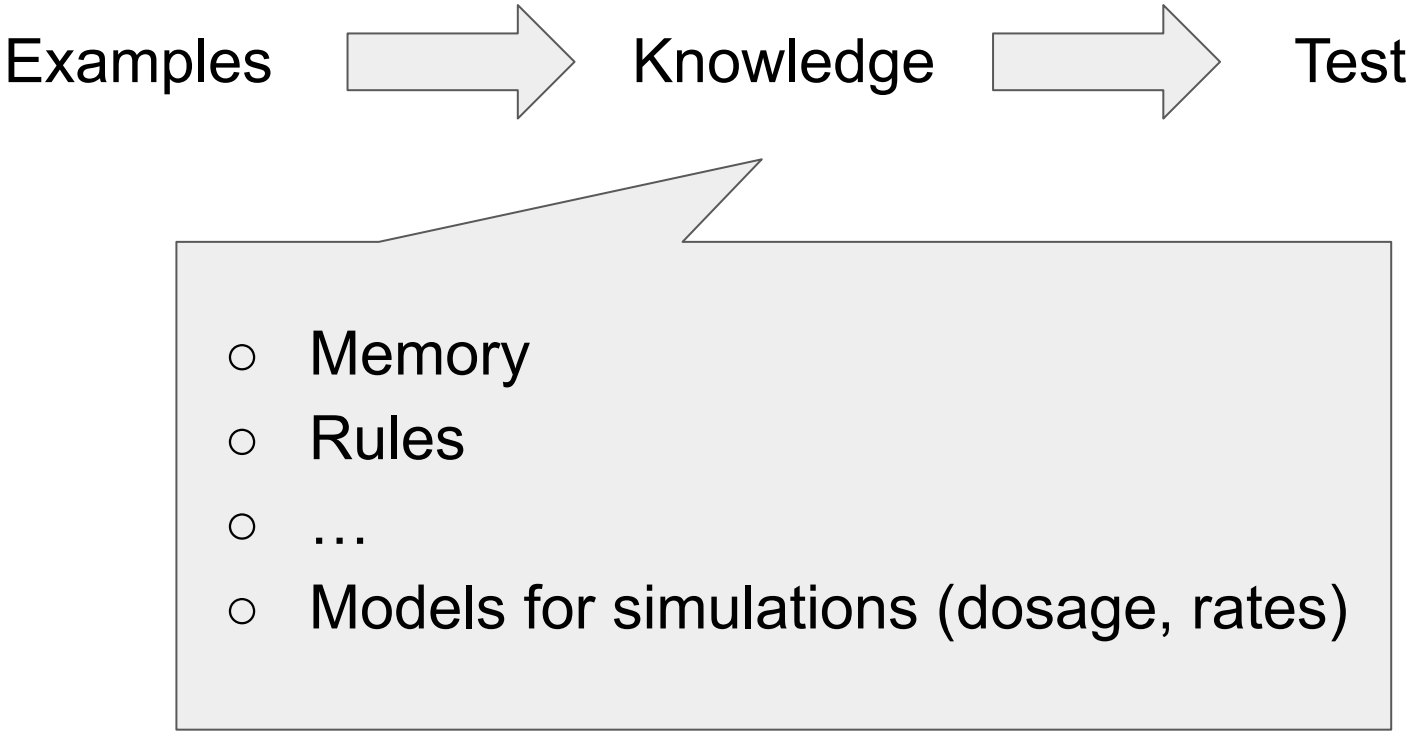
- Examples from everyday life
  - Navigation, driving and transportation
  - Security
  - Financing
  - Communications
  - How we spend our time (or money)

and in medicine?

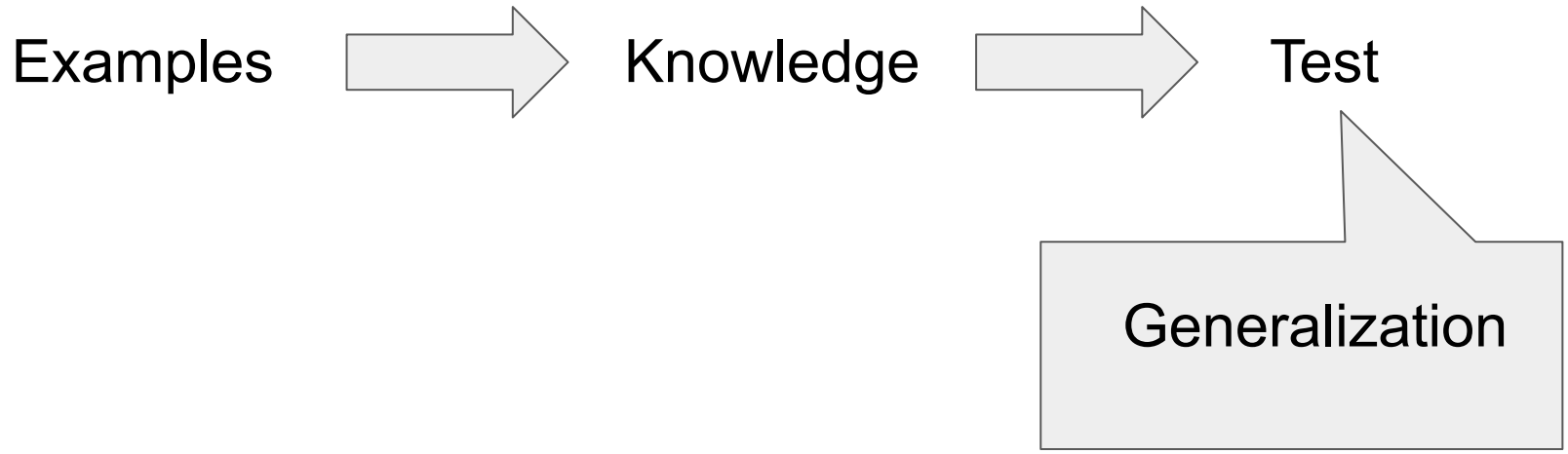
- Examples
  - Imaging (X-rays, MRI, CT)
  - Digital pathology, dermatology
  - Robotics and computer-aided surgery
  - Genetics/genomics personalized medicine
  - Automated analysis of medical records
  - Potential risk alert based on medical history
  - Recommendation systems (healthcare)

What is learning?

What is learning?



What is learning?



- Examples
  - memoization?
  - semantic search
  - clustering
  - predictions (smart elevators, waze timing)

What is machine learning?

Learning from data

- Understanding (how knowledge is represented)
  - Diagnostic rules
  - Cohort-based
  - Scenarios (predictions using known mechanisms)
  - Models for simulations (dosage, rates)

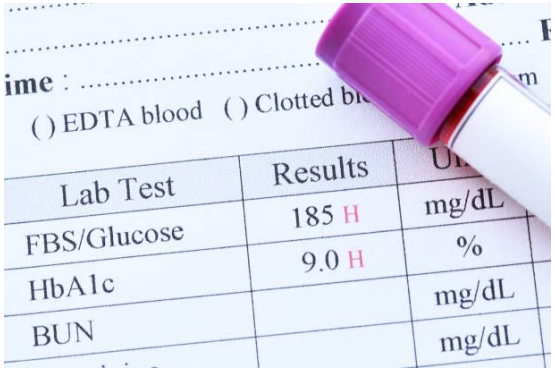
What is machine learning?

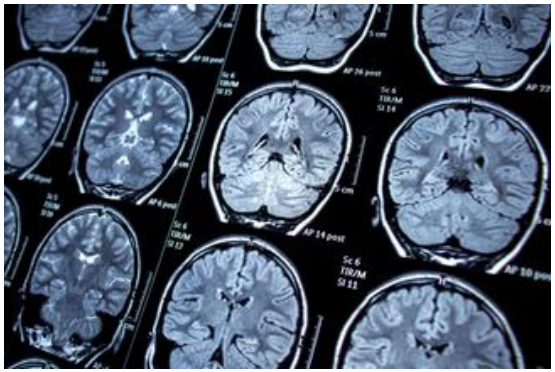
Learning from data

- Generalization
  - Is memoization learning?
  - semantic search
  - clustering
  - predictions (smart elevators, waze timing)

Medicine is data intensive

- Measurements, blood workup, imaging
- Digital devices and electronic records
- New sensors (longitudinal, wearable, internal)
- Millions of patients





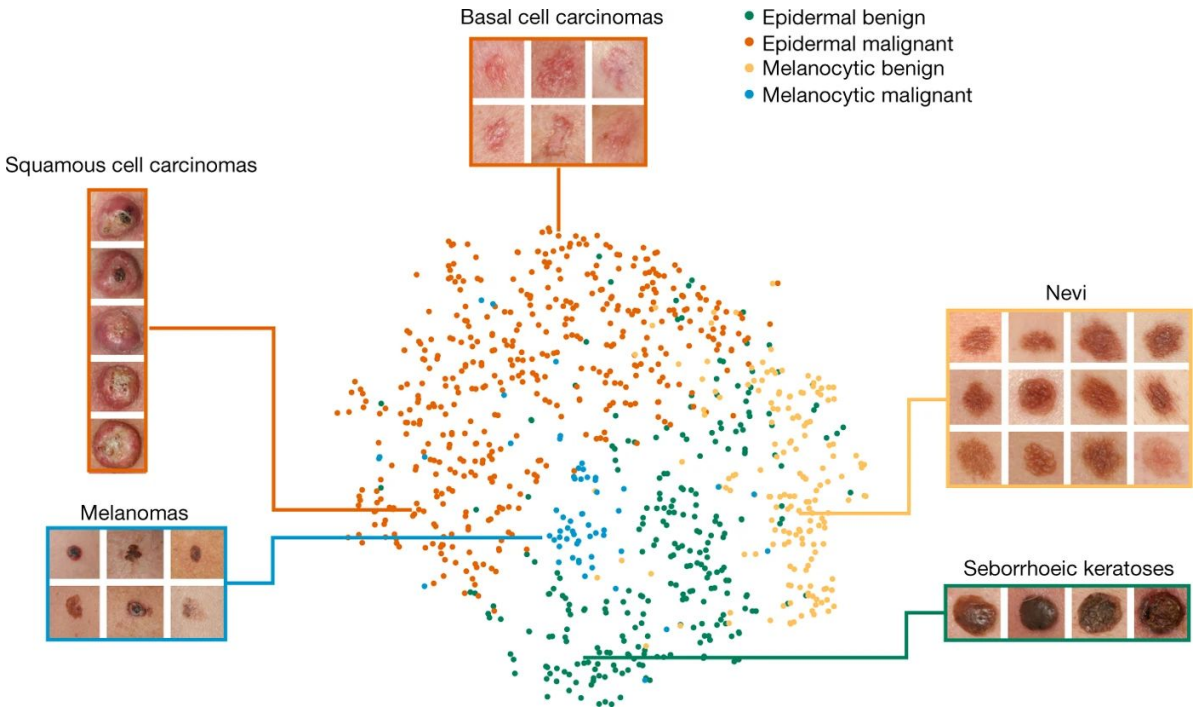
Syllabus

1. Introduction
2. Classification
3. Learning 1
4. AI in ophthalmology (Prof. Itay Chowers)
5. Learning 2
6. Regression
7. Clustering
8. Visualization (and dimensionality reduction)
9. Deep learning in image analysis (Prof. Leo Joskowicz)
10. Missing data, statistical dependencies
11. Natural language in medicine (Dr. Gabi Stanovsky)
12. Decisions (utility)
13. Longitudinal Data / Project

Classification

Fracture?

YES **NO**



https://www.nature.com/articles/nature21056

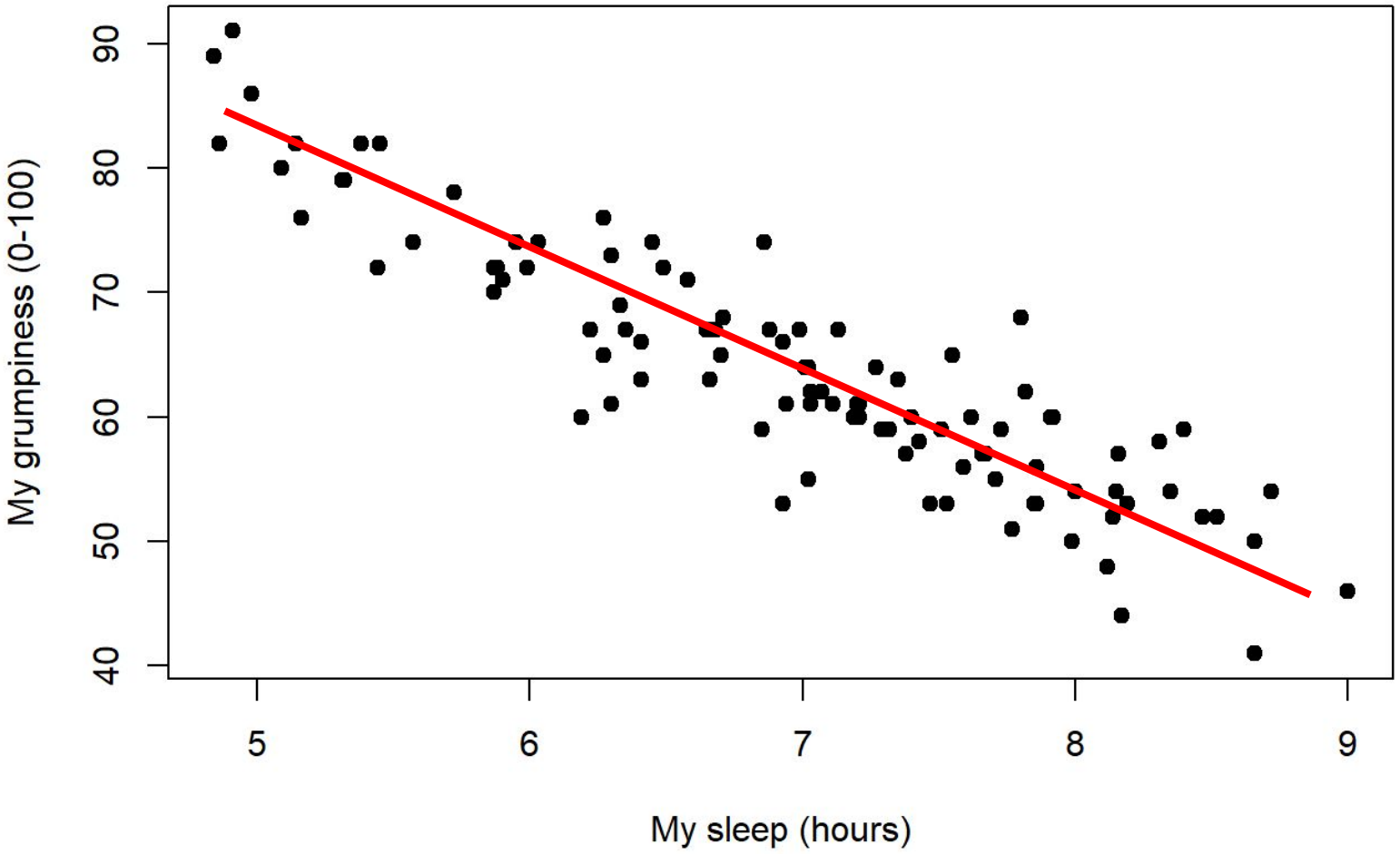
Learning?

Model selection?

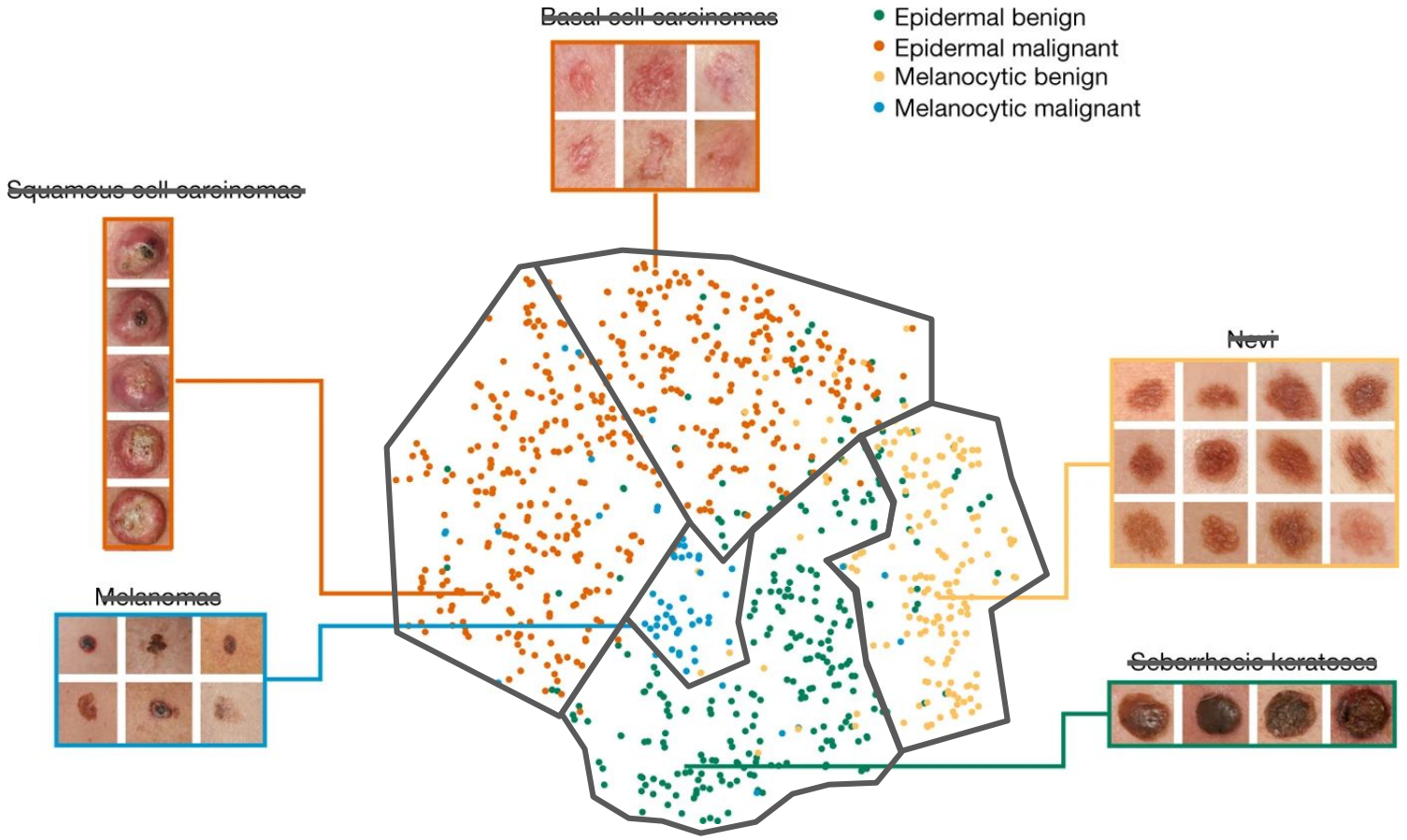
Classifier types

Over-fitting?

Regression



Clustering



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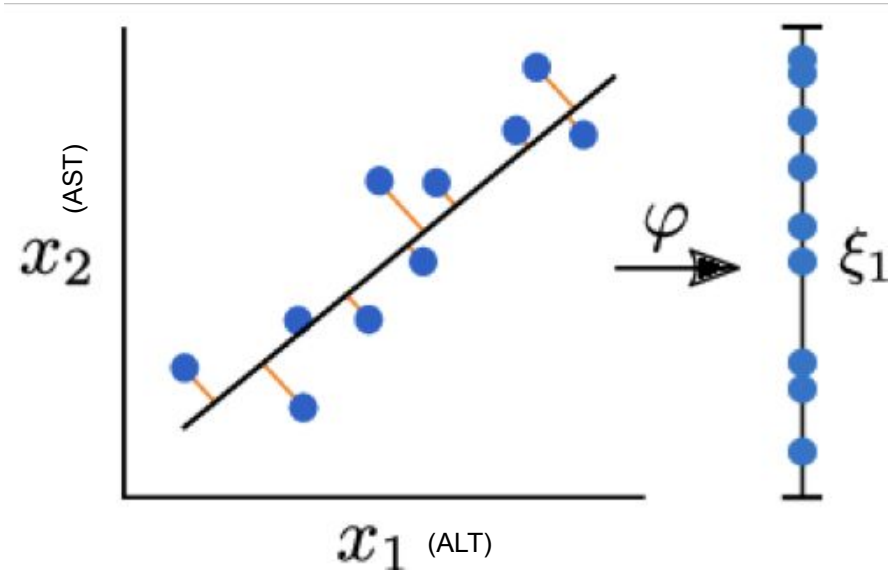
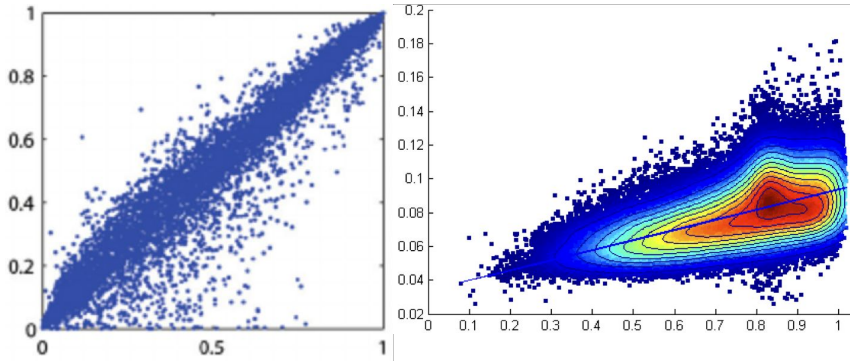
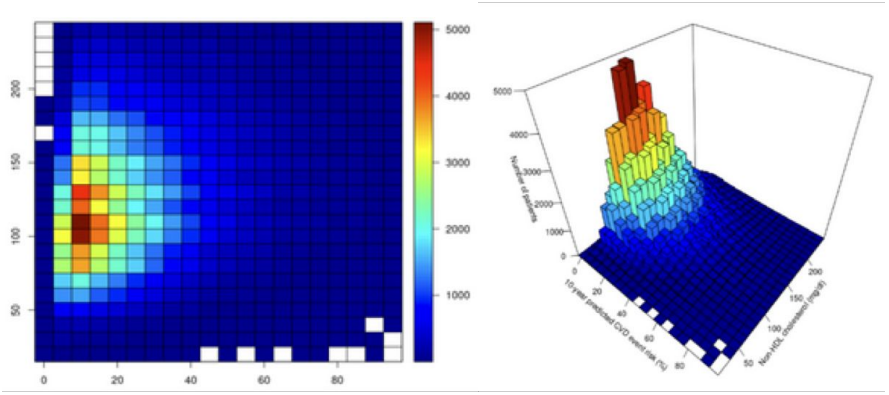
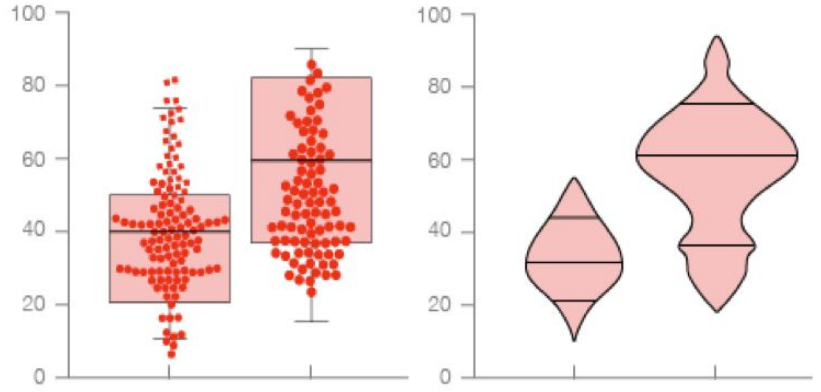
Visualization
(and dimensionality reduction)

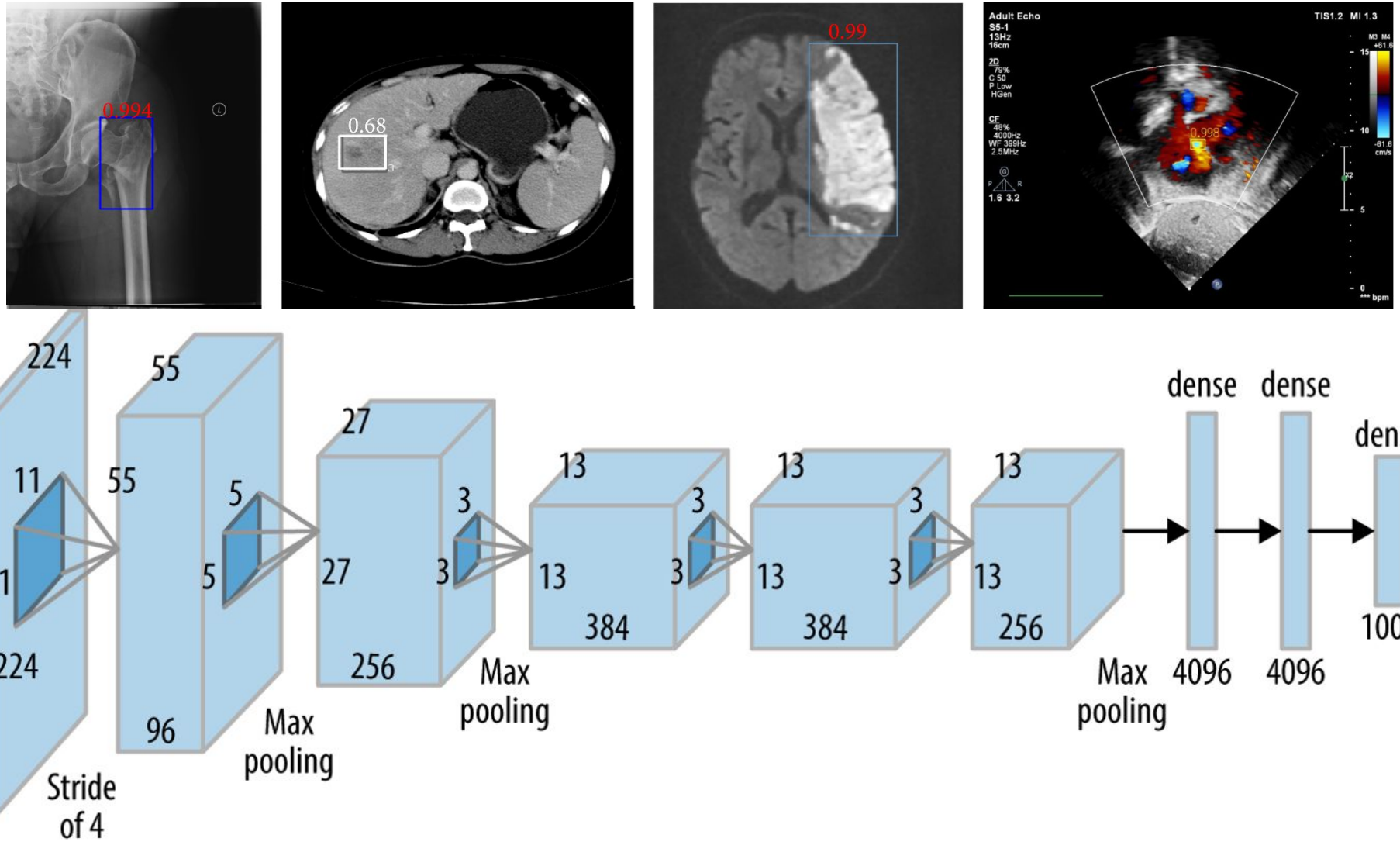








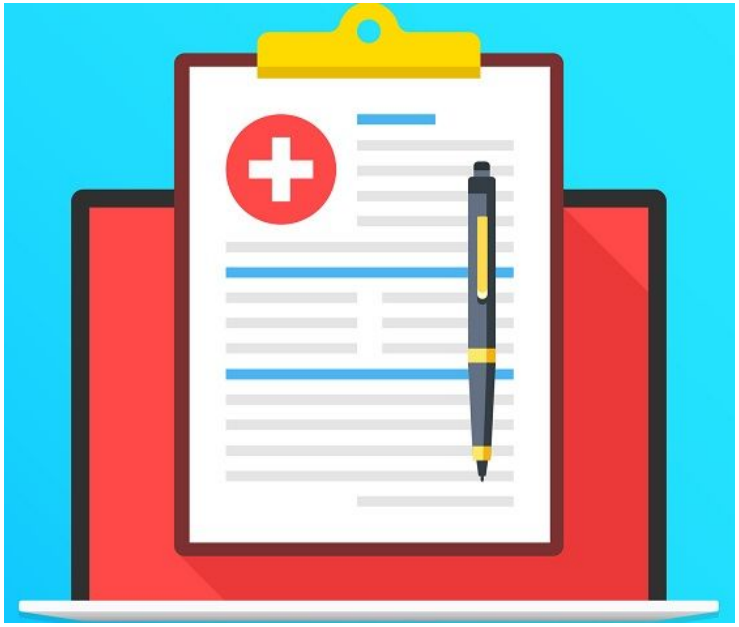
Deep learning in image analysis



https://spj.sciencemag.org/journals/hds/2021/8786793/ https://slazebni.cs.illinois.edu/spring22/lec01_intro.pdf

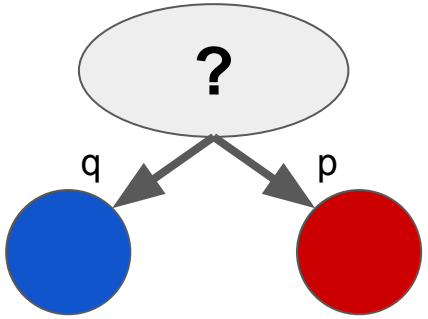
Natural language in medicine

- Clinical documentation
- Electronic health records (EHR)
- Text Classification
  - OCR
  - Tokenization
  - Lemmatization
  - Concept mapping
  - Topic modeling

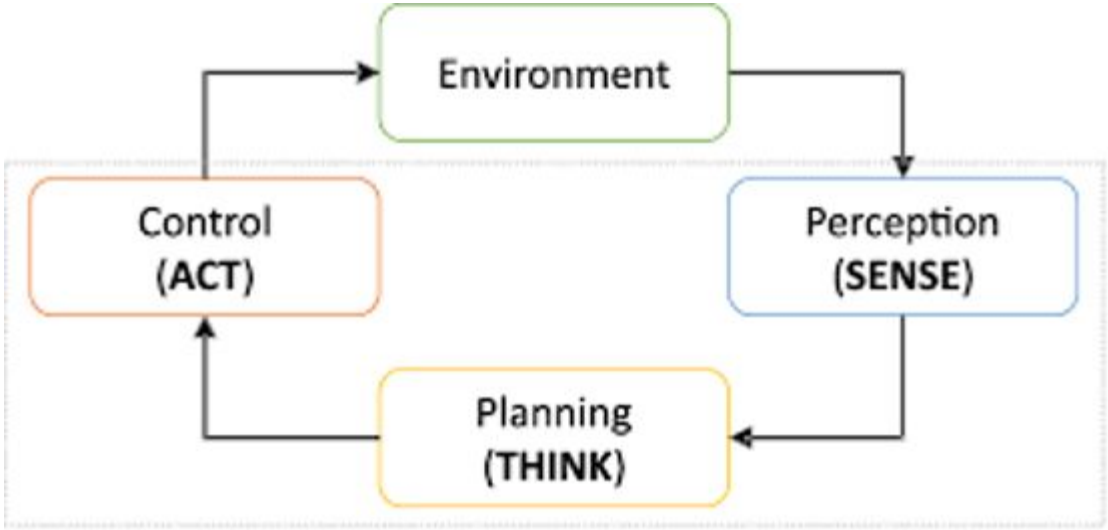


Utility and decision making

- Uncertainty and expected utility
- How beneficial an outcome will be?
- How likely it is?



- Active learning
- Reinforcement learning



Administration

- Participation
- 4-5 exercises (one exemption)
  25% of grade
  (Classification, Learning, Generalization, Regression, Visualization)
- ~2 idea competitions
  Medical use of the learned AI methods
  (small groups)
- Exam
  75% of grade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תראי, זה או הצלחה ענקית
או, רוב הסיכויים, התרסקות איומה.

“Any sufficiently advanced ML is indistinguishable from intelligence”