Introduction

Admin

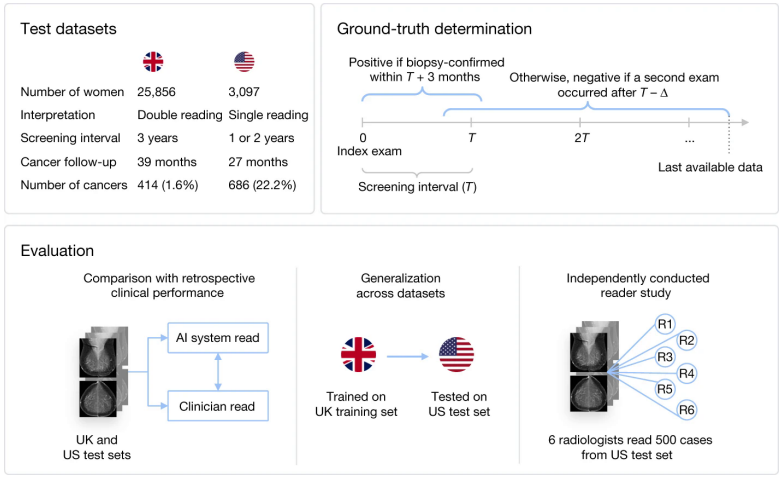
1. Course web page: `https://github.com/sje30/dl2020`
2. Office hour: Monday 1-2pm.
3. Two assignments.
4. Key reference placed in paperpile: `https://paperpile.com/shared/pb4w0p`.

Want to see more computational neuroscience?

1. Four hour workshop (contact me - 2 hours on simple neurons; 2 hours on network analysis of neuroimaging data; 11/11 and 13/11).
2. Part III course in Engineering in Lent Term, led by Prof Mate Lengyel (`teaching-office@eng.cam.ac.uk` – **how to audit?**).

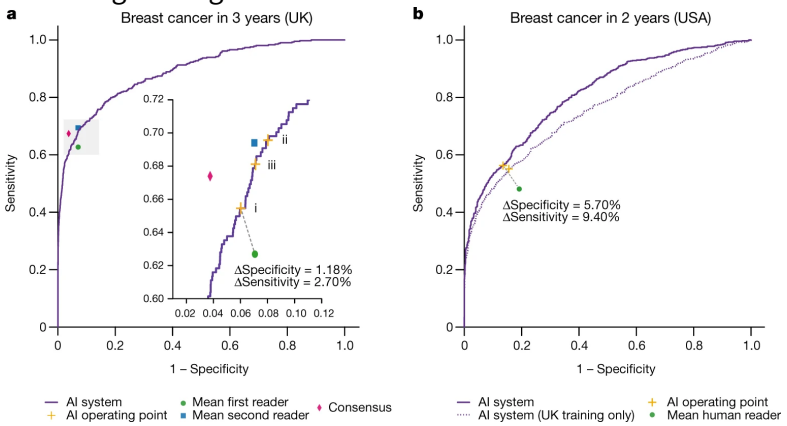
Example of deep learning/1

McKinney et al (2020). International evaluation of an AI system for breast cancer screening.
42 million scans/year in UK and US.
Figure 1:



Example of deep learning/2

McKinney et al (2020). International evaluation of an AI system for breast cancer screening. See figure 2:



Sensitivity: test correctly identifies patients with the disease; **specificity**: test correctly identifies patients without the disease.

`https://ebn.bmj.com/content/23/1/2`

System performs better than first reader; "no worse" than second reader,

What is deep learning?

What do these terms mean and how might they interact with each?

- Machine learning (applied statistics)
- Deep learning
- Artificial Intelligence
- Neural modelling

Classification

Input vectors **x** associated with output vectors **y**.
Learn mapping: **x** $\Rightarrow$ **y**.
Generalise to data not seen during learning. ("Training set" vs "test set" and also "validation set").

Approaches to classification

1. Logistic regression (binary outputs). Applied Statistics.
2. Naive Bayes. Machine Learning / probablistic modelling.
3. Multi-layer perceptron. Neural networks part I.
4. Support vector machines. Kernel methods.
5. Decision Trees and Forests.
6. Neural networks part II.

Prediction vs understanding

- Why build a deep network vs another classifier?
- Performance: want something better than currently available?
- Understanding: want to understand how it works?

Looking for general introduction to machine learning?

An Introduction to statistical learning with applications in R.
`http://faculty.marshall.usc.edu/gareth-james/ISL/`
James, Witten, Hastie and Tibshirani.

Key references

1. Artificial Intelligence Engines (Stone). If you like the book, please review it on Amazon.
2. Deep learning with R (Chollet and Allaire). “Clone” of Deep Learning with Python (Chollet).
3. ITILA (David Mackay).
4. Deep learning (Goodfellow et al.).
5. Theoretical Neuroscience (Dayan and Abbott).

What’s to cover in the first week?

1. Introduction to neuroscience
2. Single neuron models
3. Perceptron
4. Background reading: chapters 1-3 (or 1-2) of Stone.

Looking further ahead

1. Backpropagation
2. Hopfield networks
3. Dimensionality reduction
4. Convolutional networks
5. Recurrent neural networks
6. Unsupervised learning
7. Reinforcement learning
8. Examples in R