Introduction to machine learning

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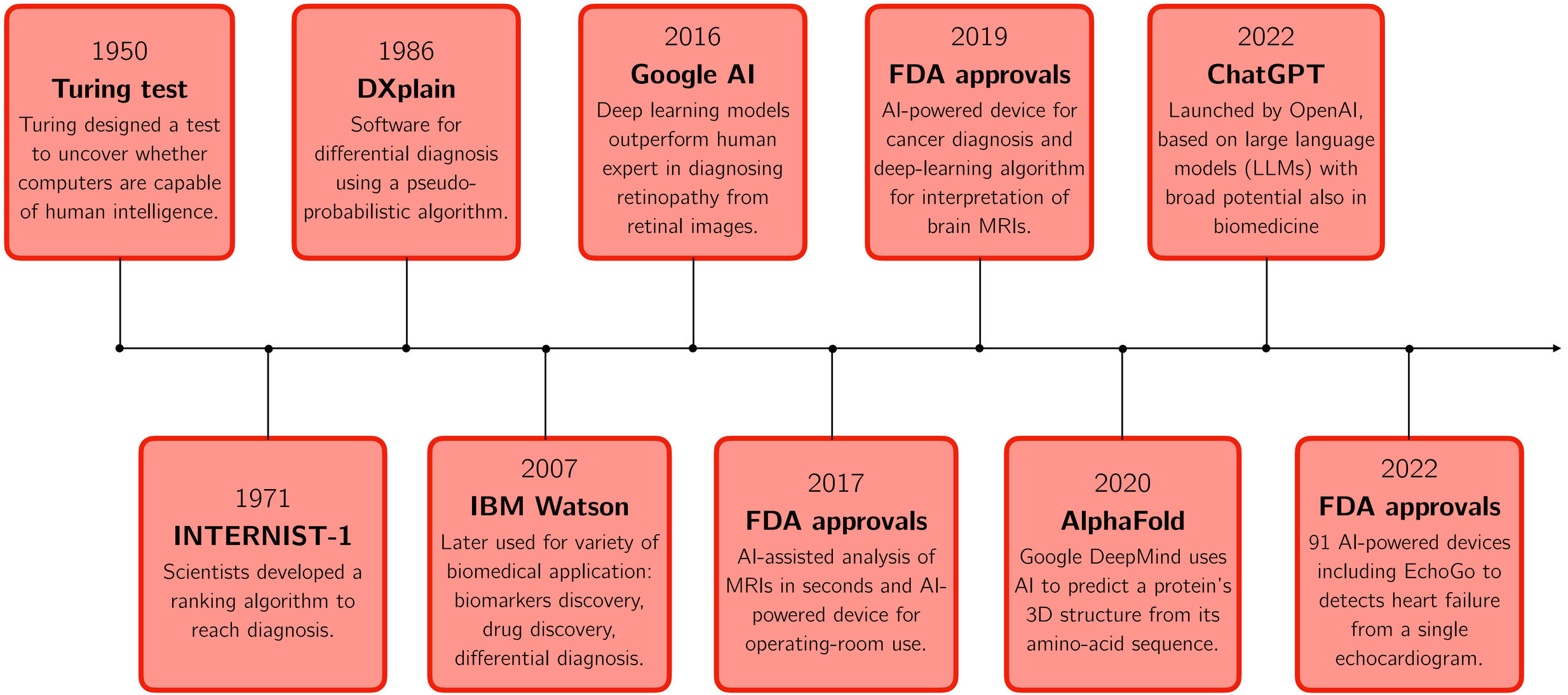
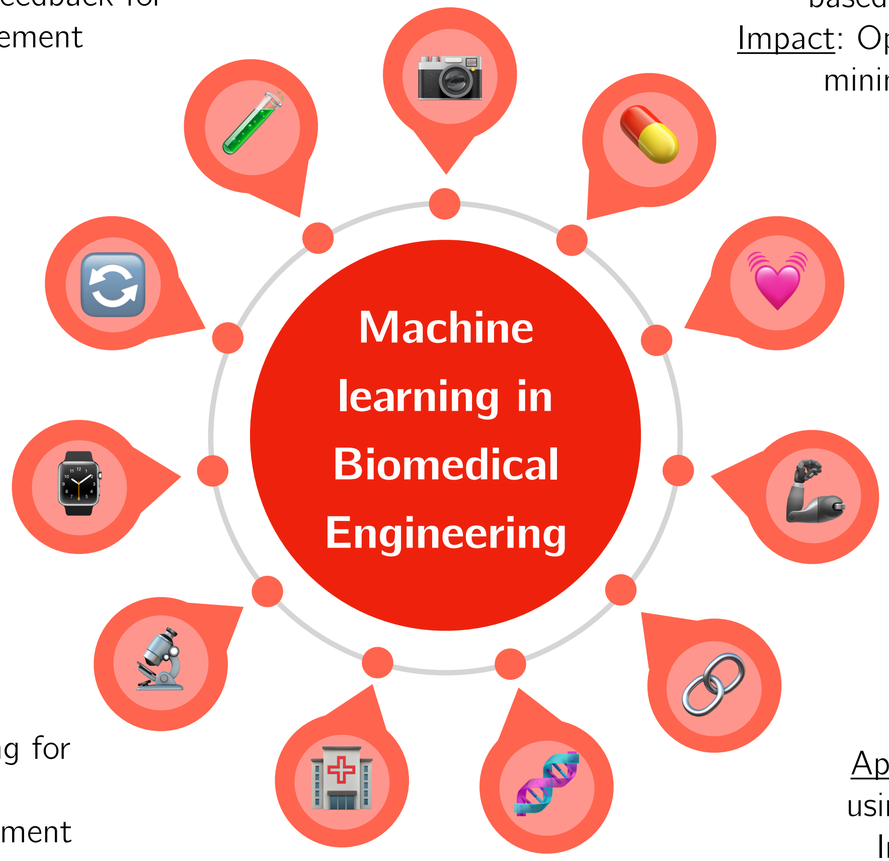
Timeline of AI ascendance in biomedicine





Medical Imaging
Application: Cancer detection from CT, MRIs
Impact: Early diagnosis with high accuracy

Molecular Biosensing
Application: ML-enhanced sensors for real-time disease monitoring
Impact: Immediate feedback for patient management

Personalised Medicine
Application: Tailoring treatments based on patient data
Impact: Optimised therapy with minimal side effects

Systems Biology
Application: Modelling biological systems and pathways
Impact: Deeper understanding of life processes

Signal Processing
Application: Real-time heart disease monitoring (ECG)
Impact: Early warning of cardiac events

Wearable Tech
Application: Monitoring chronic diseases (e.g., diabetes)
Impact: Real-time health insights for patient management

Soft Tissue Engineering
Application: ML-driven design of biomaterials for tissue repair
Impact: Improved outcomes in tissue regeneration

Drug discovery
Application: Virtual screening for drug candidates
Impact: Faster drug development

Protein engineering
Application: Designing proteins using ML for targeted therapies
Impact: Innovations in drug development

Healthcare operations
Application: Predicting hospital admissions
Impact: Efficient resource management

Nanomedicine
Application: ML for designing and optimising nanoparticle drug delivery systems
Impact: Targeted treatment with reduced side effects

Topics covered in this course

Week	Lecture	Practical
1	Machine learning fundamentals	Project 0: Introduction
2	Linear and logistic regression	Project 1.1:Linear and logistic regression
3	Regularization for linear models	Project 1.2: Regularization for linear models
4	Methods for classification	Project 1.3: Application of linear models to a case study
5	Neural networks, part 1	Project 2.1:Neural networks, part 1
6	Neural networks, part 2	Project 2.2: Neural networks, part 2
7	Unsupervised learning	Project 2.3: Application of neural networks to a case study

Week 1-7 lectures and practicals (all on Wednesday). Week 8 (the week before the exam) has no lecture nor practical.

The course in a nutshell

- Assessment
  - 70% written exam
  - 30% practicals

All topics from the lectures are covered in the written exam. Some of the topics (linear models and neural networks) are also covered in the practicals.

- GitHub repository is used for material dissemination
- Canvas is used for communication and submission/grading
- Lecture schedule is in My Timetable and on GitHub (note that the room for the first practical has been changed, both My Timetable and GitHub are already updated).

Study material

- Main guidance: lecture slides and practicals
- Book: “An introduction to statistical learning with applications in python:, G. James, D. Witten, T. Hastie, R. Tibshirani, J. Taylor

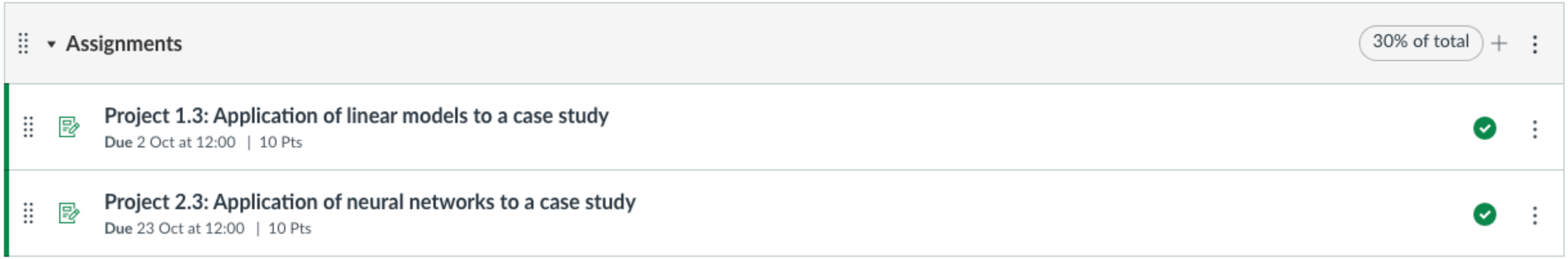
Lecture slides and practicals in Github

#	Date	Location	Title	Slides
1	04/Sep	Aud.15	Machine learning fundamentals	intro, lectures
2	11/Sep	Aud.15	Linear and logistic regression	
3	18/Sep	Aud.15	Regularization for linear models	
4	25/Sep	Aud.15	Methods for classification	
5	02/Oct	Aud.15	Neural networks, part 1	
6	09/Oct	Aud.15	Neural networks, part 2	
7	16/Oct	Aud.15	Unsupervised learning	
8	23/Oct	-	*No lecture*	-
▲	31/Oct	*Exam*		

Practical assignments

#	Date	Location	Title	Exercises
1	04/Sep	~~ ~~Luna 1.050~~ ~~ Gem-Z 3A.05 *	Project 0: Introduction	practicals
2	11/Sep	Aud. 07	Project 1.1: Linear and logistic regression	
3	18/Sep	He. 0.01	Project 1.2: Regularization for linear models	
4	25/Sep	Aud. 07	Project 1.3: Application of linear models to a case study	
5	02/Oct	Aud. 07	Project 2.1: Neural networks, part 1	
6	09/Oct	Aud. 07	Project 2.1: Neural networks, part 2	
7	16/Oct	Aud. 07	Project 2.1: Application of neural networks to a case study	
8	23/Oct	-	*No practical*	-

Submission in Canvas



Practicals

- Work in group of up to 5 students
- Distributed as Python notebooks
- Divided in 3 projects
  - Project 0: Introduction (week 1)
  - Project 1: Linear models (weeks 2-4)
    - Project 1.1: Linear and logistic regression
    - Project 1.2: Regularisation for linear models
    - **Project 1.3: Application of linear models to a case study**
  - Project 2: Neural networks (weeks 5-7)
    - Project 2.1:Neural networks, part 1
    - Project 2.2: Neural networks, part 2
    - **Project 2.3: Application of neural networks to a case study**

Project 1.3 and Project 2.3 will be graded

Practicals

- Deliverables, a zip file with :
  - A single Python notebook that contains the experiments, visualisation of results and answer to the questions
  - Python functions and/or classes (.py files) that you have developed to implement the basic functions, if used in the Python notebook.
- The assessment rubric for the practicals can be found in GitHub
- 5 teaching assistants will be present during the practicals
- You are encouraged to use Canvas Discussion to ask general questions

Feedback

Any type of (constructive) feedback you might have during or after the course is very welcome!