# Introduction to machine learning

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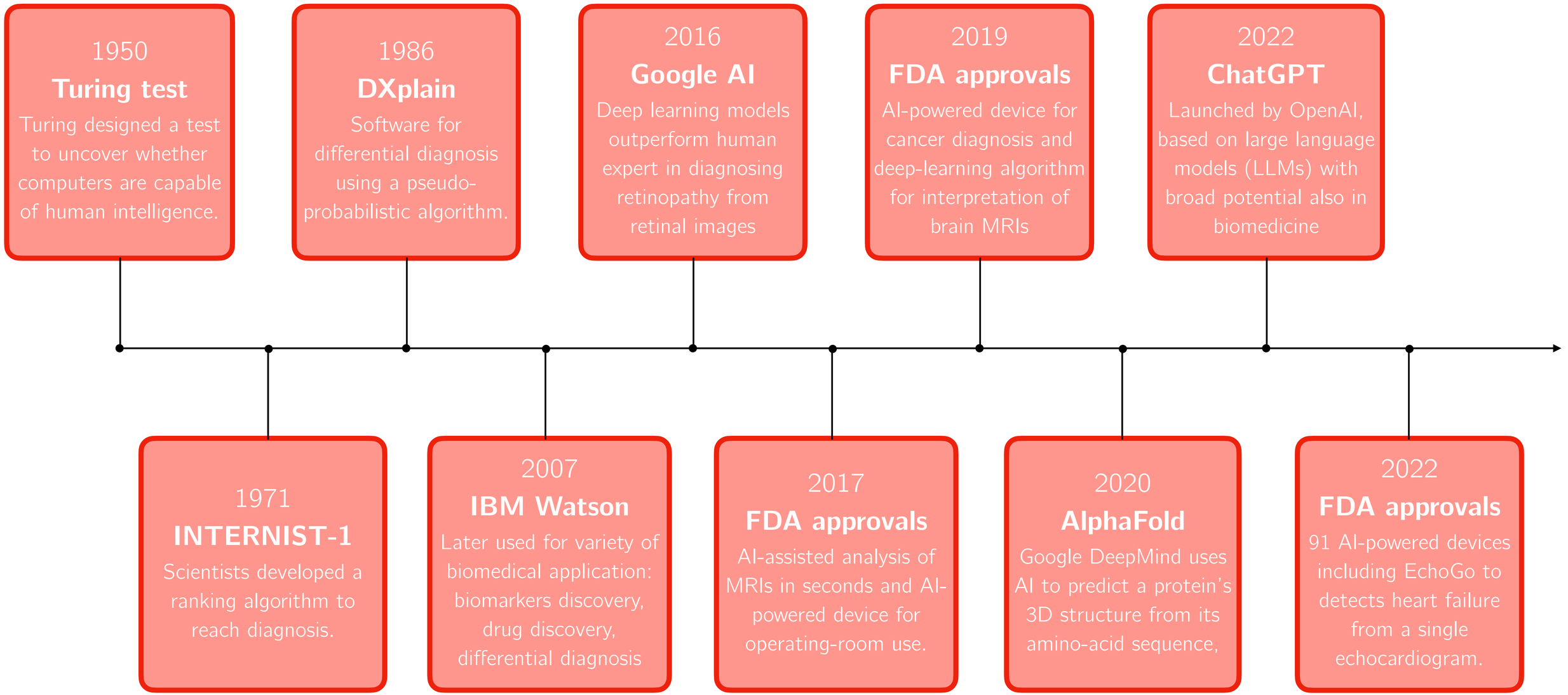
# Timeline of AI ascendance in biomedicine



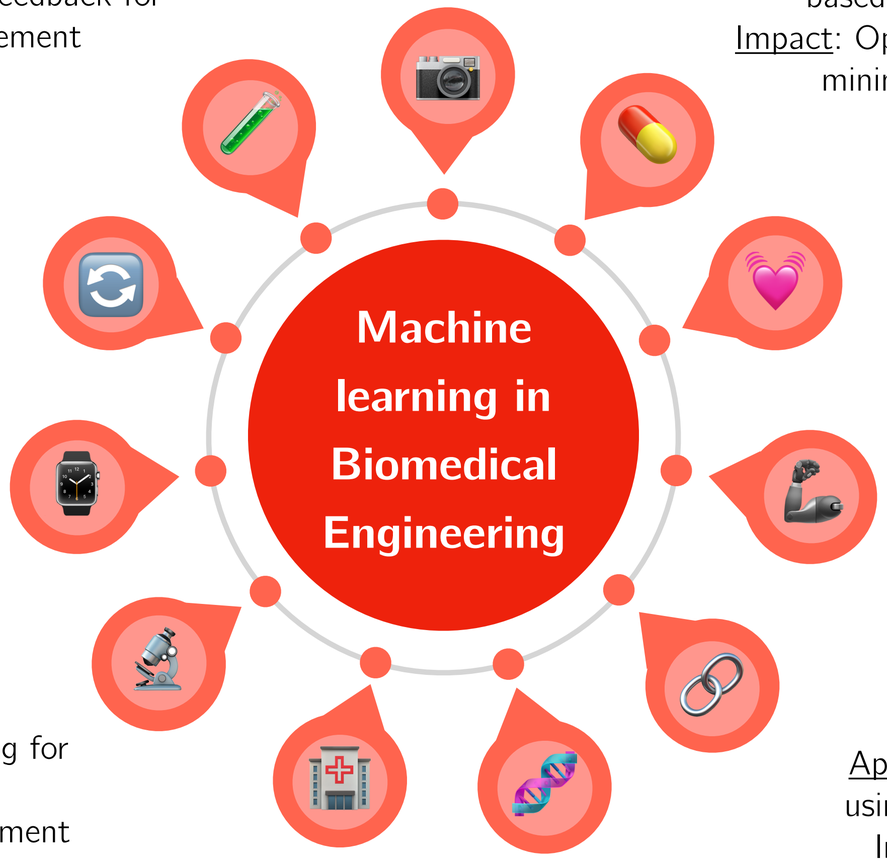
**Medical Imaging**
Application: Cancer detection from CT, MRIs
Impact: Early diagnosis with high accuracy

**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

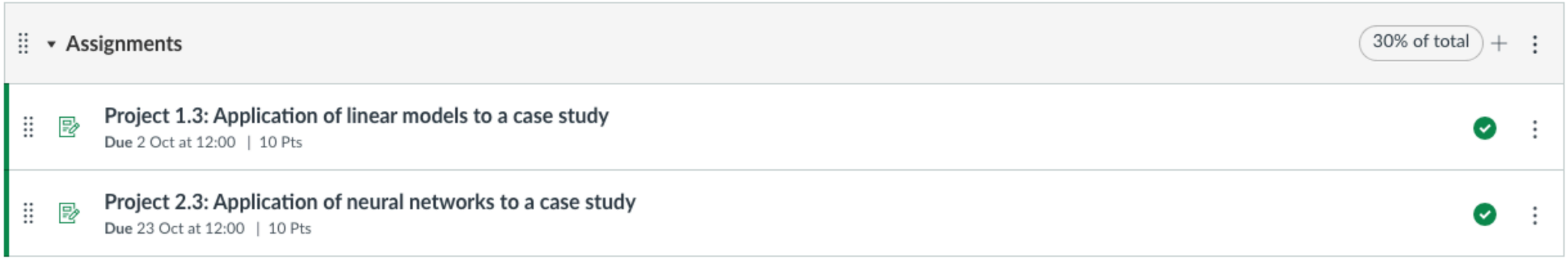
# Lecture slides and practicals in Github

| # | 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
  - Project 1: Linear models
    - Project 1.2: 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
    - 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