Course introduction

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Why machine learning?

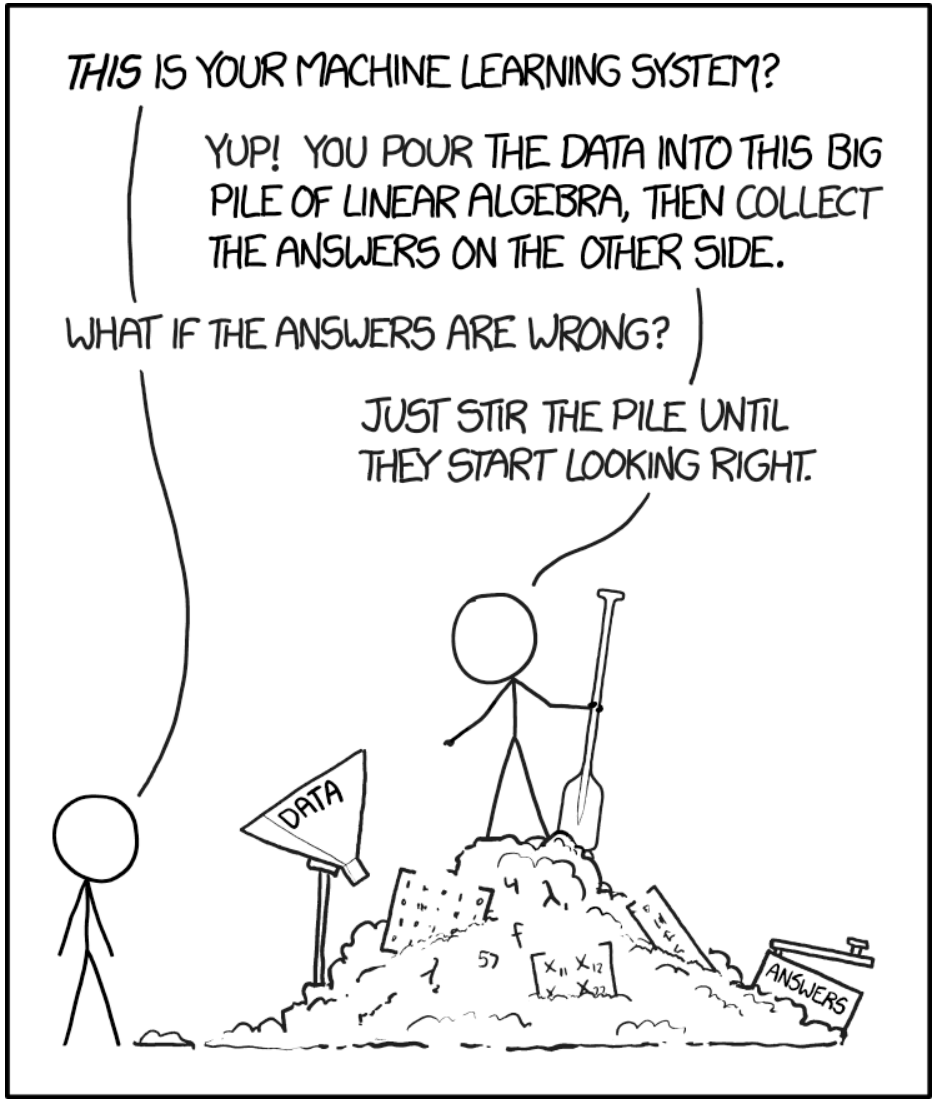
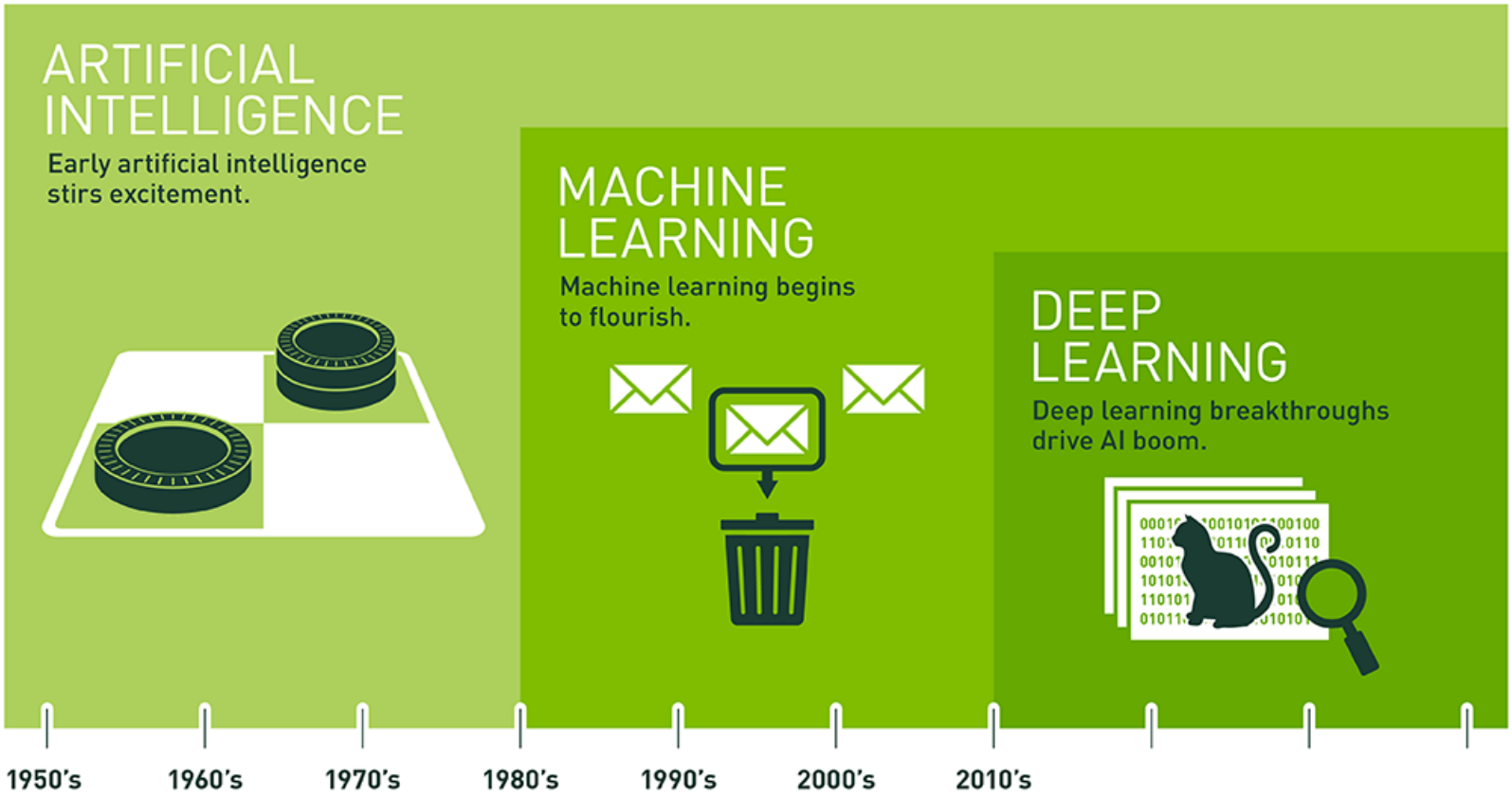


Figure source: xkcd.com

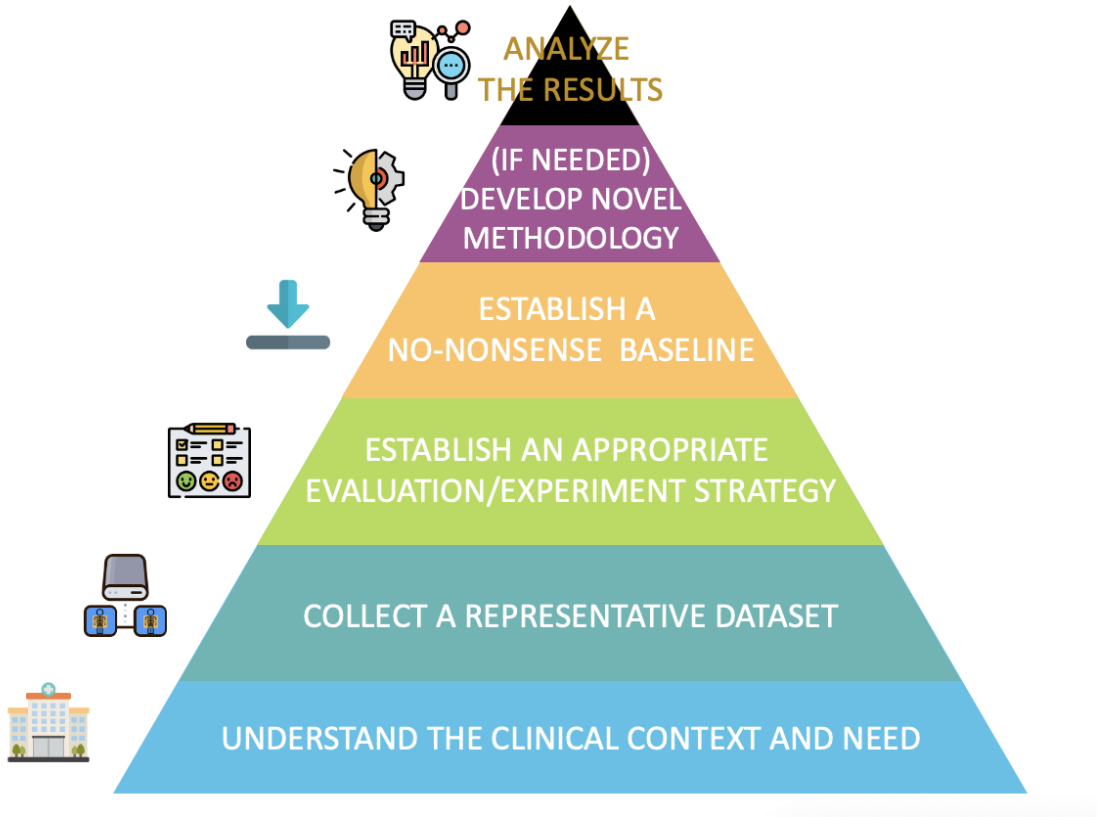
Historical perspective



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Figure source: nvidia.com

Training machine learning models for medical image analysis



Topics covered in the course

- Week 1: Machine learning fundamentals (Mitko Veta)
- Week 2: Linear models (Federica Eduati)
- Week 3: Deep learning I (Mitko Veta)
- Week 4: Deep learning II (Mitko Veta)
- Week 5: SVM, random forests (Federica Eduati)
- Week 6: Unsupervised machine learning (Federica Eduati)
- Week 7: Transformers (Mitko Veta & Federica Eduati)
- Week 8: Explainable AI (Francesca Grisoni)

Weeks 1-6 lecture and practical. Week 7 only lecture. Week 8 is guest lecture (not part of exam).

The course in a nutshell

- Assessment
  - 65% written exam
  - 25% practicals
  - 10% reading assignment
  - 0% **mandatory** Python self-assessment quiz in the first week
- GitHub repository used for material dissemination
- Canvas used for communication and submissions/grading
- Lecture schedule in My Timetable and on GitHub

Study materials

- Main guidance: lecture slides and practicals
- Books
  - **Deep Learning**, Ian Goodfellow and Yoshua Bengio and Aaron Courville
  - **The elements of Statistical Learning**, Trevor Hastie, Robert Tibshirani, Jerome Friedman
- Specific chapters and additional material (such as papers) are referenced in the lecture slides

Practicals

- Work done in groups of up to 5 students
- Distributed as Python notebooks
- Deliverables
  - Python functions and/or classes (.py files) that implement basic functionalities (e.g. a k-NN classifier)
  - A **single** Python notebook that contains the experiments, visualization of results and answer to the questions and math problems.
- The assessment rubric for the practicals can be found in the handouts for week 1
- Instructions to setup the environment are in GitHub
- Two teaching assistants will be present during the practicals
- You are encouraged to use Canvas Discussion to ask general questions

Reading assignment

- Each group selects a paper with following criteria
  - Describes an application of Machine Learning to a Medical Imaging or Computational Biology problem
  - Recently published (after 2017)
  - Published in a high-quality journal (reference list in GitHub)
  - On a topic that you find interesting and want to learn more about
- Use the "paper selection" assignment to discuss paper selection with us (propose a list)
- Write a review (800 words) with:
  - Summary of the application domain of the paper
  - Summary of the used (Machine Learning) methodology and evaluation metrics
  - Discussion of strong and weak points of the methodology and evaluation metrics
  - Suggestion of alternative methodology, evaluation metrics and ideas for improvement