Machine Learning and Financial Applications

Lecture 1
Introduction to Machine Learning

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Pre-class, in-class, and after-class activities

Pre-class reading materials & recordings

Self-paced learning, covering essential contents to be covered in class

Group homework

Takeaway homework to be completed as a group and submitted before the next class

In-class quiz

Reinforce understanding via practice and discussion

Student reflections

Open forum for Q&A and discussions

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To create telegram group for ease of discussion

Weekly lesson plan

Session	Topics	Assignments/Activities
1	Introduction to Machine Learning	
2	Quantitative Trading Strategies	Group assignment
3	Modern Portfolio Management	Project guideline release
4	Reinforcement Learning in Portfolio Optimization	Group assignment
5	Linear Regression in Finance	
6	Logistic Regression in Finance	Group assignment
7	Generalization in Deep Learning	
8	Deep Neural Networks	Project presentation
9	Robust in Portfolio Optimization	Project presentation
10	Advanced Topics in Finance and ML	Project presentation
11	FINAL EXAM (Closed book)	

Course assessment rubics

Class participation

- 20%
- Engagement in discussion, critical thinking

Group assignment

- 40%
- Team work, problem solving, oral communication

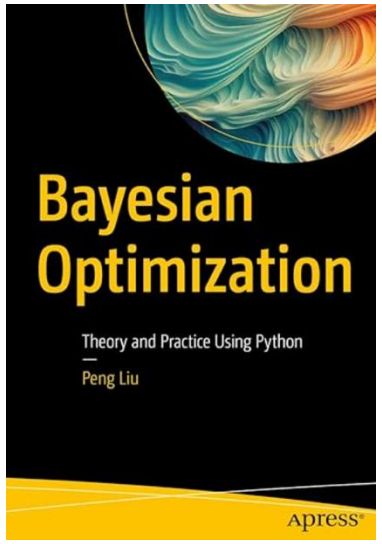
Final exam

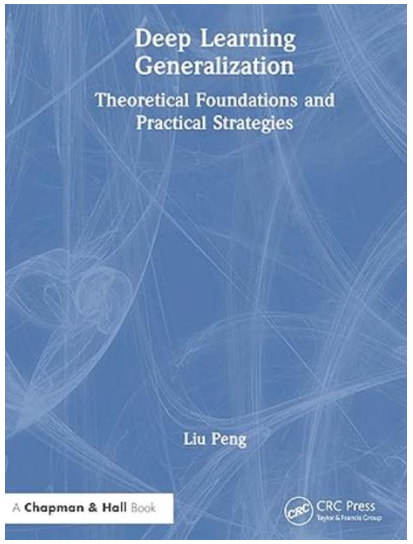
- 40%
- Problem solving, decision making

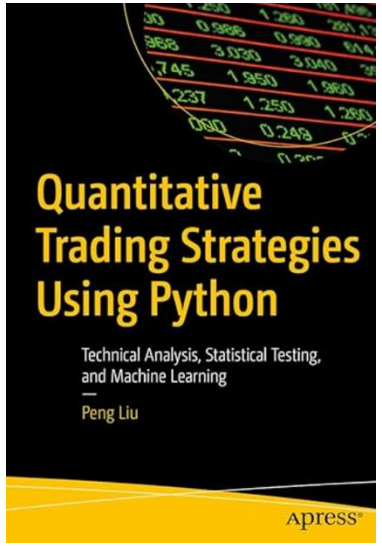
References and resources

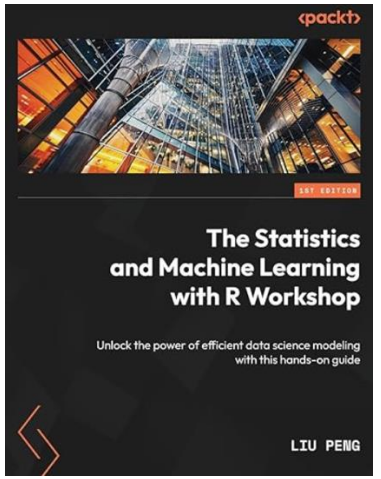
- Books:
  - Bayesian Optimization: Theory and Practice Using Python, Liu Peng, Apress
  - Quantitative Trading Strategies with Python, Liu Peng, Apress
  - The Statistics and Machine Learning with R Workshop, Liu Peng, Packt
  - Deep Reinforcement Learning in Portfolio Optimization, Liu Peng, CRC (upcoming)
  - Deep Learning Generalization, Liu Peng, CRC (upcoming)
  - Quantitative Risk Management with Python, Liu Peng, Apress (upcoming)

- Papers: See reference papers for each session

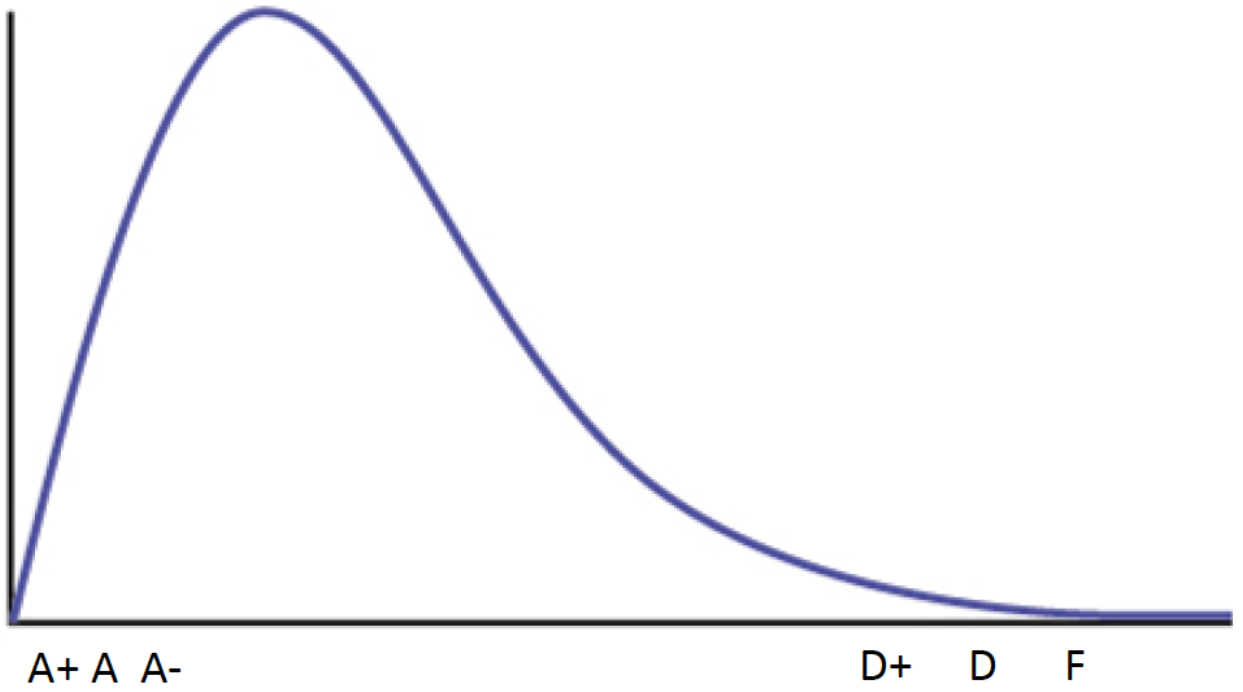








Grading curve



Not drawn to scale

Exact distribution is class-specific and confidential

Office consultation hours

10am-12pm, Friday

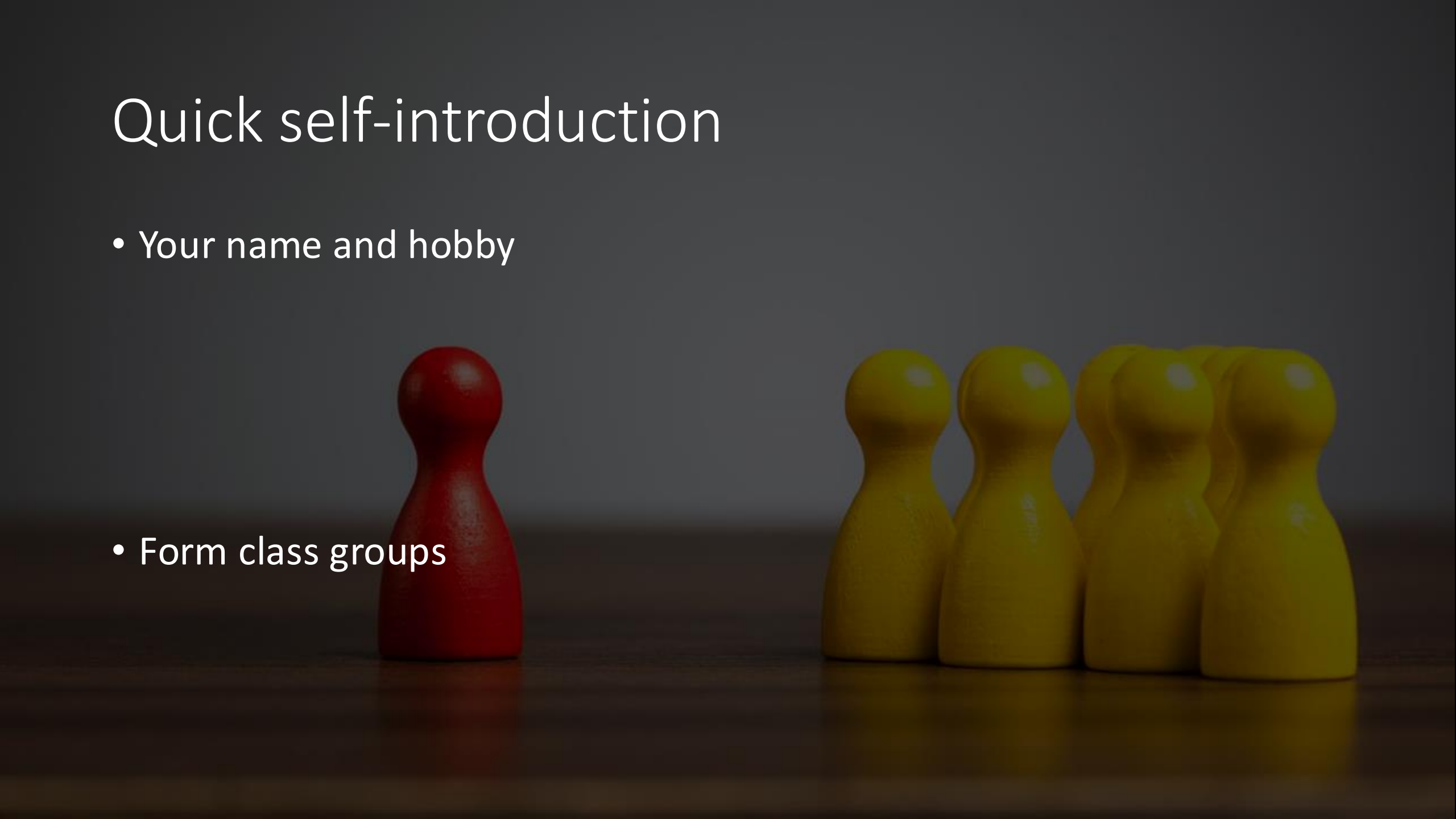
Please send me an email before you come

Room 5118, LKCSB

Alternatively, can send me an email to book other slots

Quick self-introduction

- Your name and hobby



- Form class groups

Learning outcomes

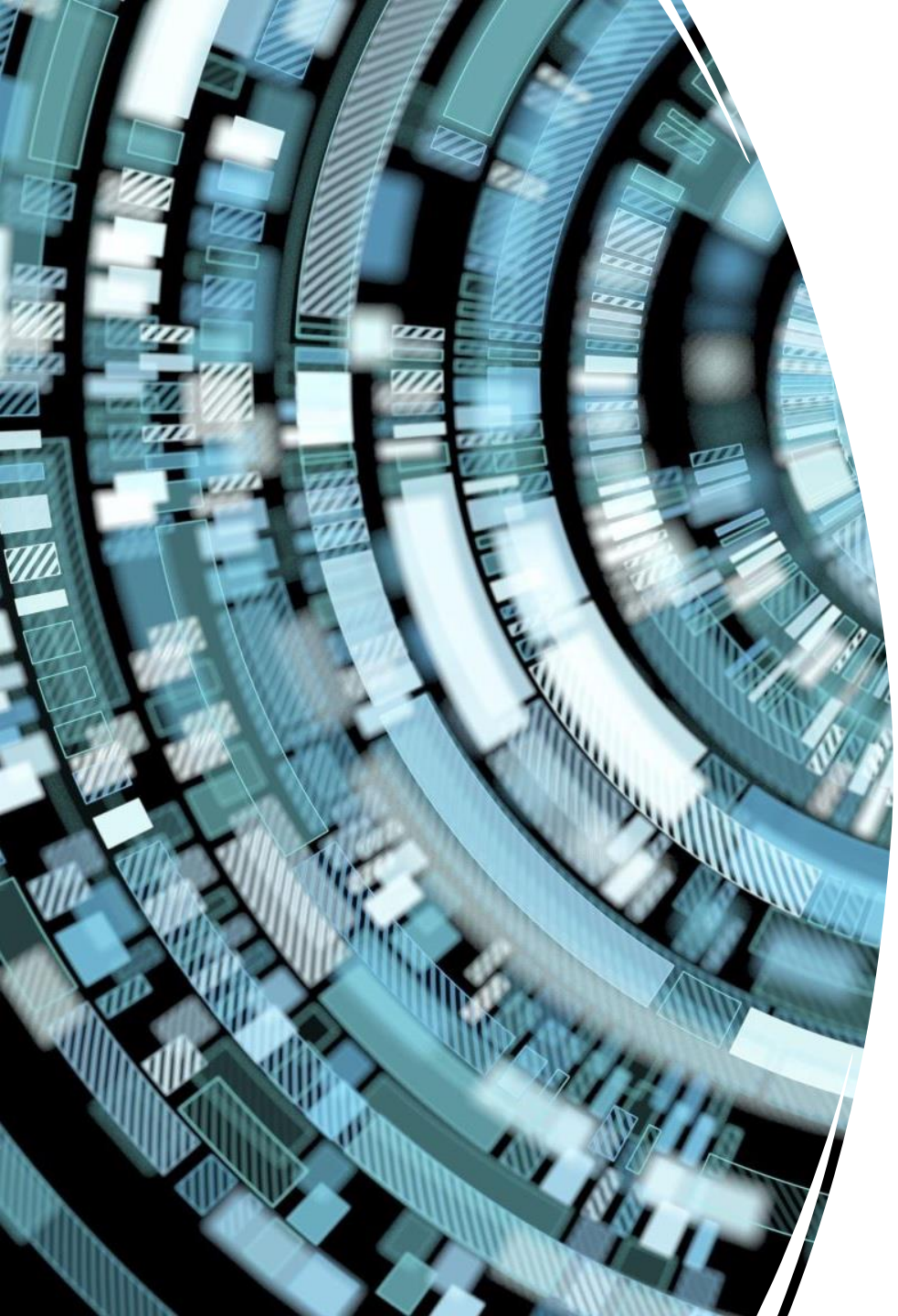
Course outlook overview

Ways to engage in learning and discussion

Getting to know machine learning

Understand major ML applications

Python basics



Video tutorials

- Introduction to machine learning https://youtu.be/00t53nPpbnU
- Python programming basics https://youtu.be/u5mSDRCoaEo
- Downloading and visualizing stock prices with Python https://youtu.be/ngPjj93B5kE

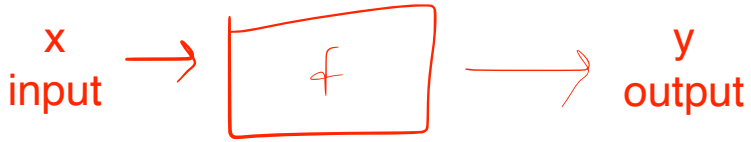
params vs # data pts

What is Machine Learning?

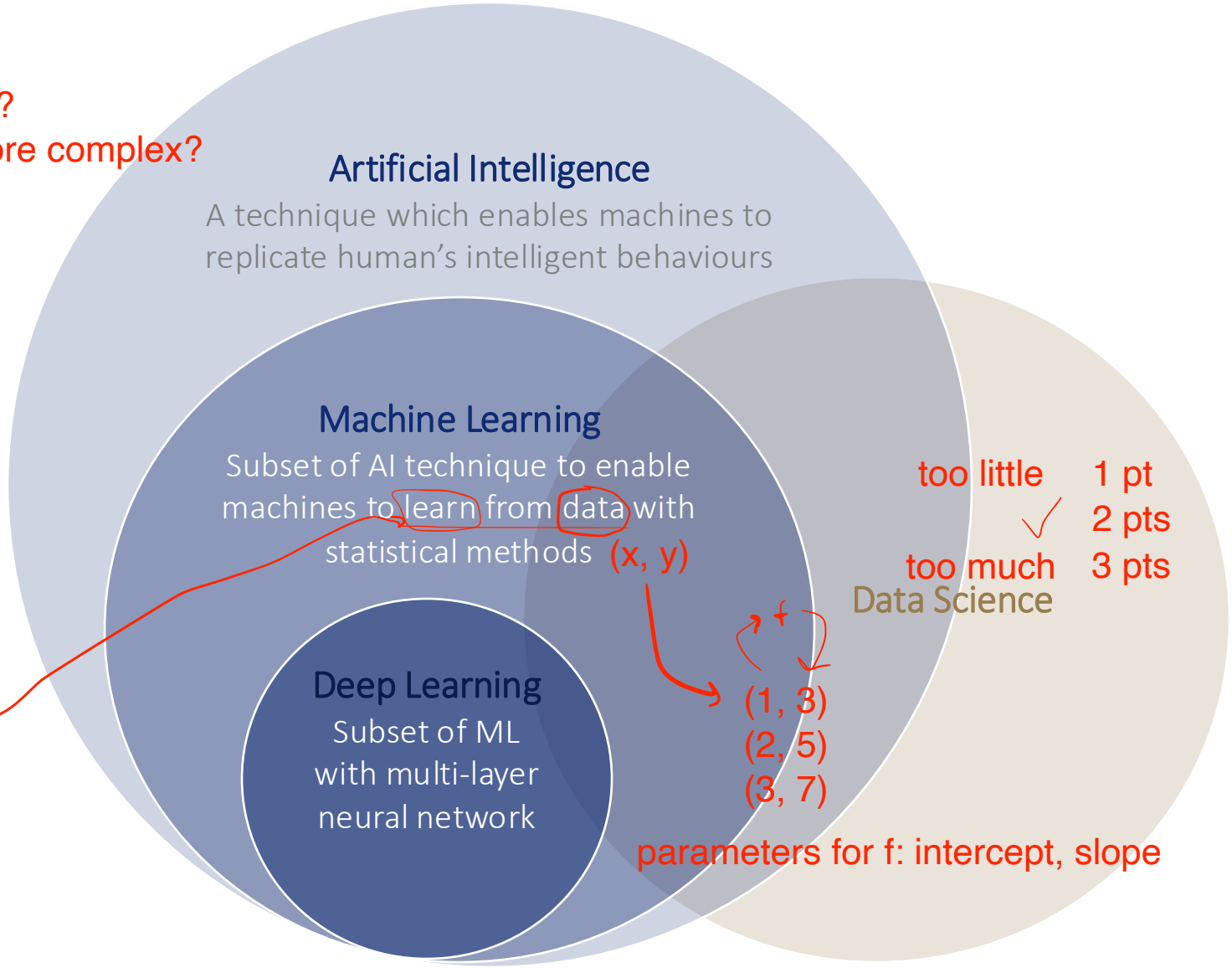
perfect interpolation

1. do we need 3 pts?
2. how to make f more complex?

- Data Science
- Artificial Intelligence
- Machine Learning
- Deep Learning



e.g. y = f(x) = 2x + 1



Different types of machine learning models

Supervised learning

- Given a data set of input-output pairs (x, y), learn a function to map inputs to outputs
- Classification: supervised learning task of learning a function mapping an input point to a discrete category
- Regression: supervised learning task of learning a function mapping an input point to a continuous value

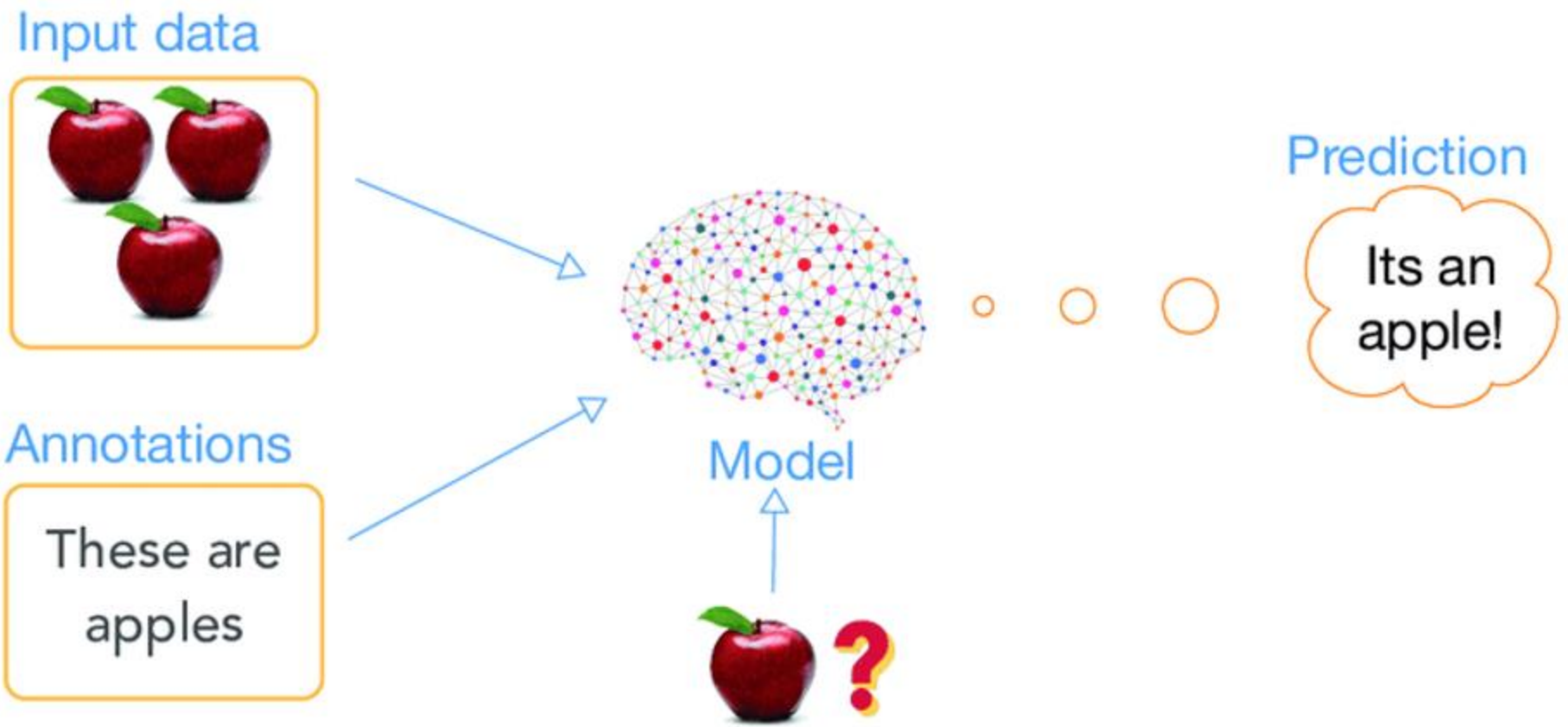
Unsupervised learning

- Given input data without any additional feedback, learn patterns

Reinforcement learning

- Given a set of rewards or punishments, learn what actions to take in the future

Flavors of Machine Learning: Supervised

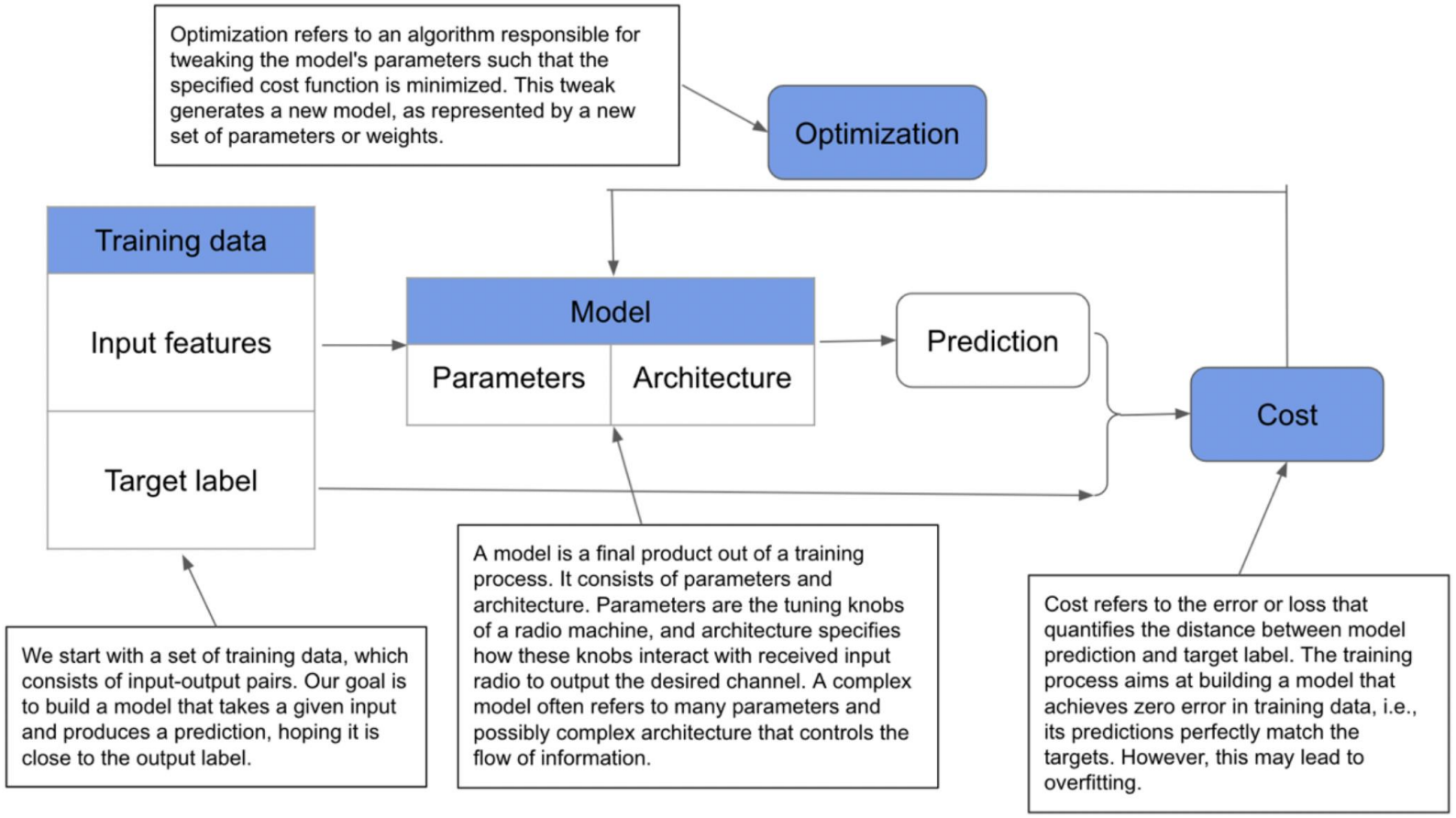


Source: Ma Yang et al.

Discussion: How is ML used in Quant Finance?

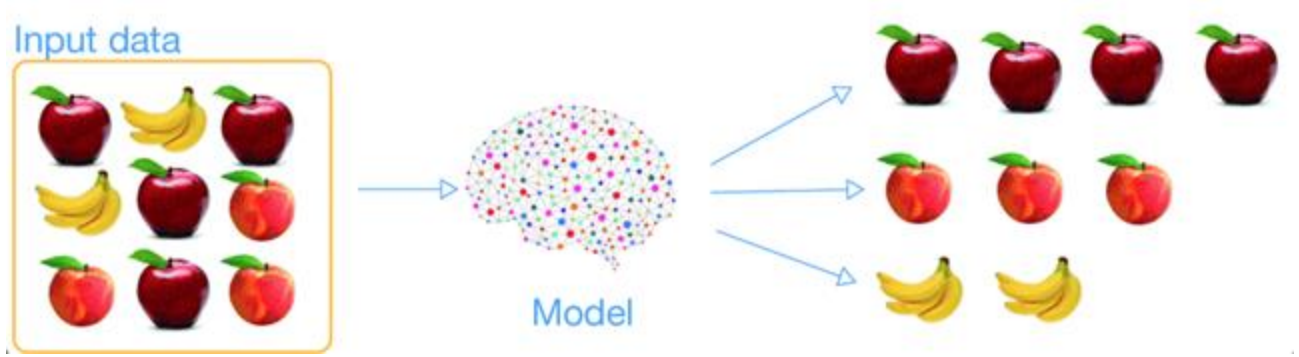
Mathematical Foundation of Supervised Learning

Model training workflow

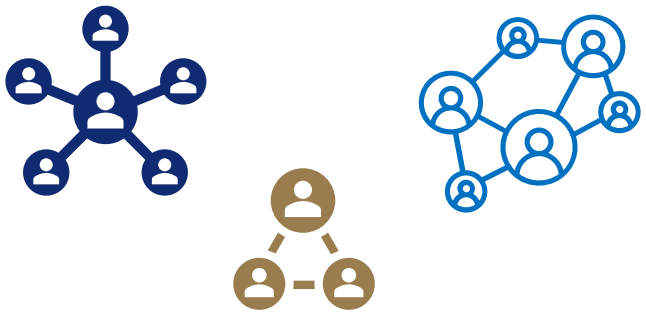


Case study: ML in Portfolio Optimization

Flavors of Machine Learning: Unsupervised



Social network analysis

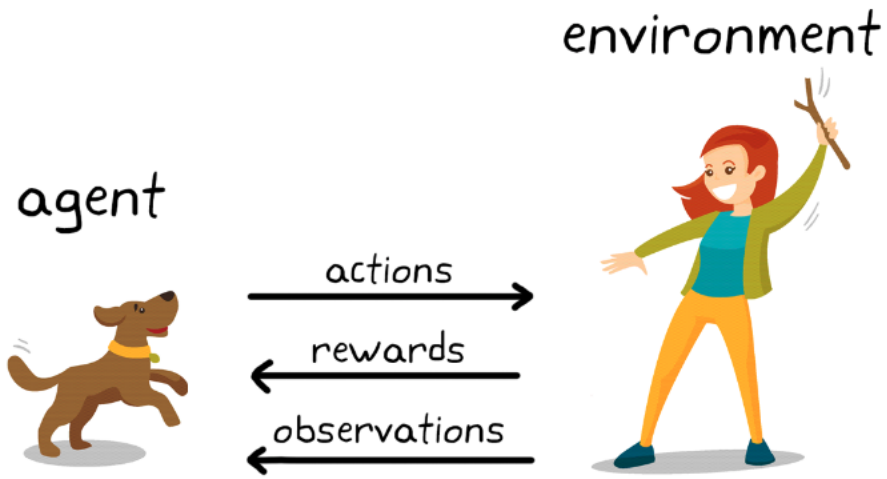


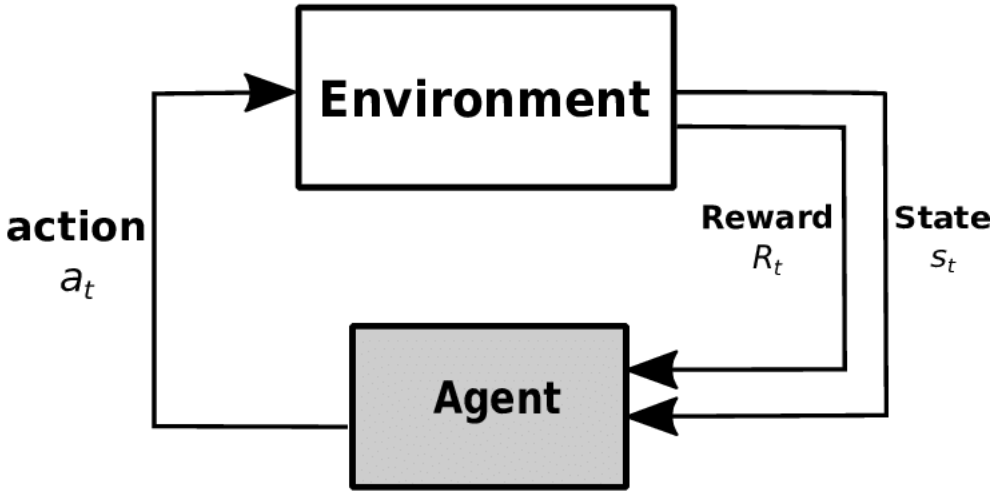
Market segmentation

Organize computing clusters

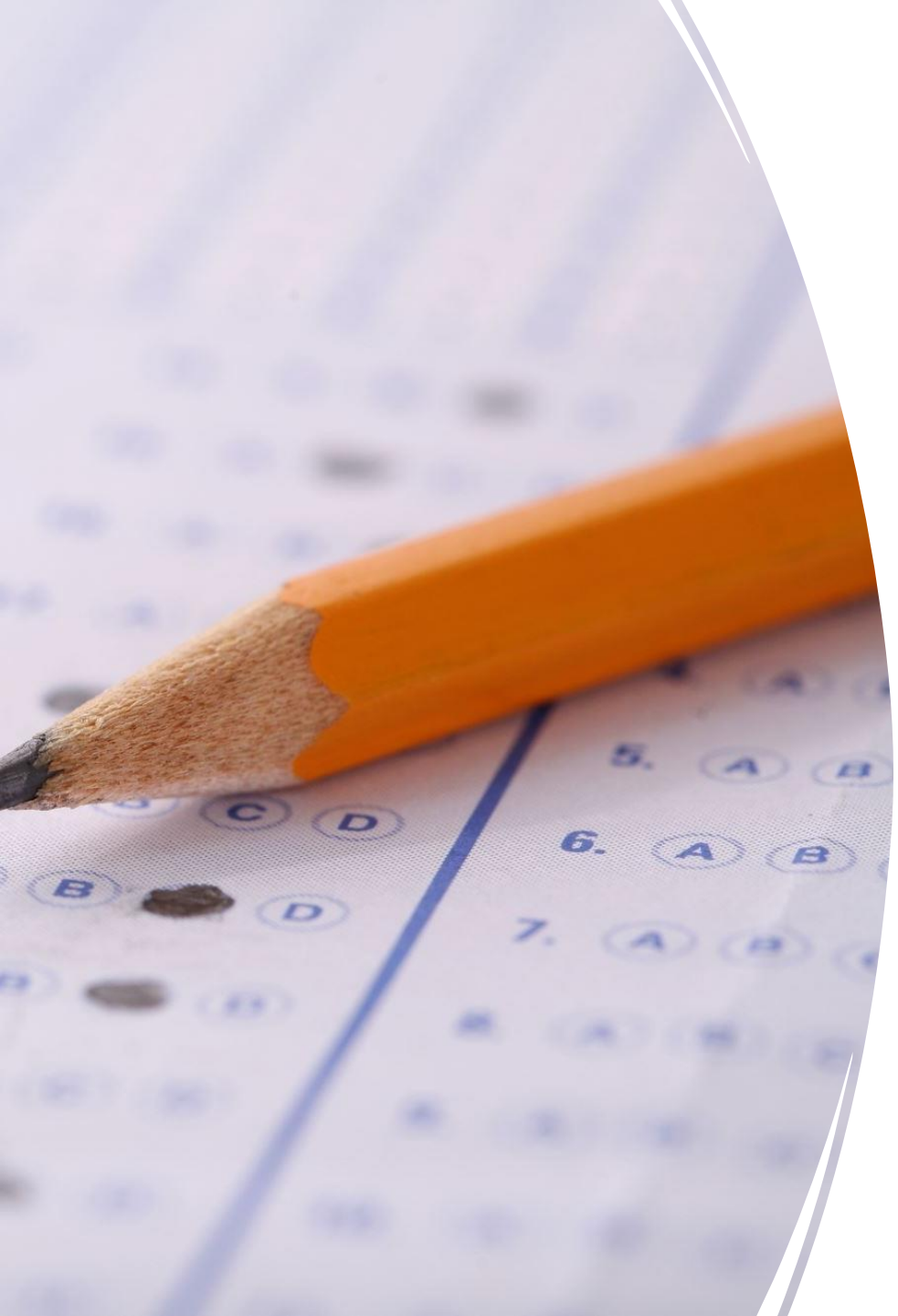
Source: Ma Yang et al.

Flavors of Machine Learning: Reinforcement





Source: Mathworks



In-class quiz

Coding session

Homework

Watch/review video tutorials and class recording for week 1 lecture (if you have not done so)

Post learning reflections and questions if any

Get to know your teammates and discuss ideas for final project