# Introduction
# Welcome and Course Outline

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EECS 6327 Probabilistic Models and Machine Learning

# General Information

- instructor: Hui Jiang (*huijiang@yorku.ca*)
- blended mode via in-person classes, online videos, eClass, Zoom
- course format:
  - 10-week lectures (blended mode): in-person classes + recorded videos + online quizzes
  - Q/A: online forums at eClass, meet me in-person or at zoom in weekly office hours
  - Zoom sessions (6 hours) for class presentations
- evaluation:
  - online quizzes (5 x 2% = 10%)
  - three assignments (40%)
  - project + presentation (40% + 10% = 50%)

# Course Outline (1)

- Part I: introduction
  - basic concepts and principles in machine learning
  - mathematics reviews
- Part II: machine learning fundamentals (methods, models and algorithms)
  - learning theory and model formulations
  - *discriminative models*: linear models, neural networks
  - *generative models*: Gaussian models, deep generative models
  - *reinforcement learning*
- Part III: applications
  - project: self-select for any ML-related topic, write a report as a conference paper, class presentation

# Course Outline (2)

- introduction to machine learning (1 week)
- mathematical foundation (2 weeks)
- feature extraction (1 week)
- discriminative models (1): linear models (1 week)
- discriminative models (2): neural networks (2 weeks)
- generative models (1): Gaussian models (1 week)
- generative models (2): deep generative models (1 week)
- reinforcement learning (1-2 weeks)
- project presentations (2 weeks)

# Course Outline (3)

- an introduction course to machine learning
- a broader coverage of machine learning topics
- a balanced treatment between theory and applications
  1. machine learning fundamentals
     - math foundations, learning theory, model formulation, pattern recognition
  2. machine learning applications
     - speech processing
     - natural language processing
     - computer vision
     - data mining
     - robotics
     - much more ...

# Reference Materials

- lecture notes
- the required textbook: (available online from YorkU library)
  - [1] Hui Jiang, *Machine Learning Fundamentals: A Concise Introduction*, Cambridge University Press, 2021.
- optional reference books:
  - [2] M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2007.
  - [3] R. O. Duda, P. Hart and D. Stork, *pattern Classification (2nd Edition* , John Wiley & Sons Inc., 2000.
  - [4] T. Hastie, R. Tibshirani and J. Friedman. *The Elements of Statistical Learning*, Springer, 2001.
- prerequisites
  - math: calculus, linear algebra, probability and statistics
  - programming: latex, python + notebook ...

# Python for Machine Learning

- Python basics
- Python for math/science: `numpy`, `scipy`
- Python for machine learning:
  - `scikit-learn`, `matplotlib`
  - `pytorch`, `tensorflow`, `Keras`, `JAX`, ...
- interactive Python: `Jupyter` notebooks
- use Google `Colab` for your programming assignments and project

# Project and Presentation (tentative)

- a research project related to machine learning
  - choose your topic and/or define your research problem: link to your own research areas or an advanced ML topic or an interesting application ...
  - select your own models/methods
  - choose any open source toolkit
  - demonstrate sufficient sophistication in either theoretical foundations or practical applications
- email me 1-page proposal (300 words) by the end of October for approval
- a short Zoom presentation (15 minutes) early December
- submit a project report as a conference paper (8-10 pages) by December 30
- Evaluation: problem, idea, method, experiments, writing and presentation ...