# Announcement

- Programming assignment 6 due at 11:59pm on Jan. 8

# Project

- Project final presentation
  - Time
    - 7pm, Jan. 16 (Thu)
    - 7pm, Jan. 17 (Fri)
  - Each group has < 7 minutes for presentation
  - Schedule: TBA
- Project submission
  - Report
    - Due: 11:59pm, Jan. 17
    - Submission link at BB => Project => Project Report Submission
  - Format: PDF, academic paper,
    - no page requirement
    - Each group only needs to submit once
  - Source code
    - In a .zip file
    - Do not include external libraries

# Project

- Grading
  - Relevance to this course
  - Substance, soundness
  - Quality of the report and presentation
- Usage of external code and tools
  - At the end of your final presentation and report
  - List the external resources (e.g., code, lib, tools) that you use
  - We will check your code
  - Explain how/why you use them

# CS181: Artificial Intelligence

## Final review

Kan Ren

Fall 2024

# Final exam

- Time
  - 10:30 – 12:30am on Jan. 8 (Wed)
- Location
  - 教学中心301
- Format
  - Closed-book. You can bring an A4-size cheat sheet and nothing else
  - 10 multiple-choice questions; 4 problems
- Grade
  - 25% of the total grade
- 计算器 ☑
- 涂卡笔 ☑

- Some previous final exam paper is available at: Blackboard menu → Previous Exams

# Final review

- Disclaimer
  - Topics covered in this review may not appear in the exam.
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# Probabilistic temporal models

- Markov models
  - Markov assumption, Transition model
- Hidden Markov models
  - Transition model (states) + emission model (evidence)
  - Filtering: $P(X_t|e_{1:t})$
    - Forward algorithm
  - Most likely explanation: $\arg\max_{x_{1:t}} P(x_{1:t}|e_{1:t})$
    - Viterbi algorithm
- Dynamic Bayes networks
- Approximate inference by particle filtering
  - Propagate forward → Weight → Resample

# Markov decision processes

- Markov Decision Process
  - States $S$, Actions $A$, Transitions $P(S'|S,A)$, Rewards $R(S,A,S')$
- Quantities:
  - Policy, Utility, Values, Q-Values
- Solve MDP
  - Bellman equation
  - Value iteration
  - Policy iteration
    - Policy evaluation + policy improvement

# Reinforcement learning

- Reinforcement learning
  - MDP without knowing $T$ and $R$
  - Offline planning vs. online learning
- Model-based learning
- Model-free learning
  - Policy evaluation: Temporal Difference Learning
    - Exponential moving average
  - Computing Q-values/policy: Q-Learning
- Exploration vs. Exploitation
  - Random exploration, exploration function
- Approximate Q-Learning
  - Feature-based representation of states

# Supervised machine learning

- To learn an unknown target function $f$ from the *labeled* examples
- Classification ($f$ with discrete output value)
  - Naïve Bayes
    - Empirical rate, maximum likelihood estimation
  - Generalization and overfitting, smoothing, tuning
  - Perceptron, logistic regression, neural networks
    - Gradient ascent / descent
- Regression ($f$ with continuous output value)
  - Linear regression, minimizing summed squared error, regularization

# Unsupervised machine learning

- K-means
  - Clustering
  - Iteration:
    - Assign each data instance to the closest center
    - Assign each center to the average of its assigned data points
- Expectation-Maximization
  - Learning Mixture of Gaussians
  - Iteration:
    - E-step: Compute label distribution of each data point
    - M-step: Update each Gaussian based on its (proportionately) assigned points

# Large language models

- Autoregressive models
- Word embedding
- Attention mechanism
  - Query, key, value
  - Self-attention
  - Causal mask
- Self-supervised learning
  - Multi-class classification on sequence data
- Decoding strategy
  - Beam search

- Good luck!