Announcement

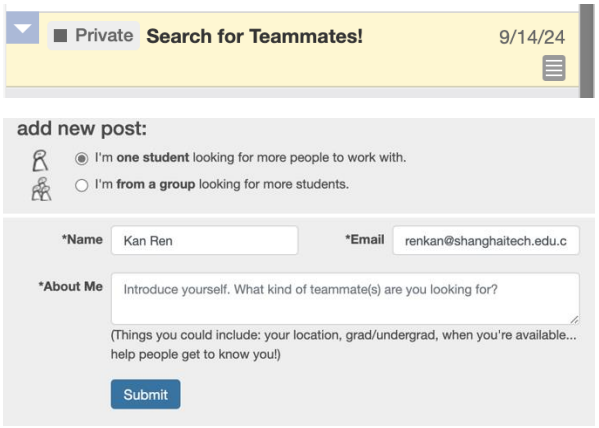
- Homework 3
  - Due: Nov. 8, 11:59pm
- Project 2
  - Due: Nov. 13, 11:59pm

Announcement

- Project 3
  - Releasing on Nov. 13
  - Due: Nov. 27, 11:59pm

Project announcement

- Group
  - 1-5 people in each group
    - You may use the Piazza “search for teammates” function



  - Schedule
    - By late November: form groups
    - Early December: proposal presentation
    - Jan. 16-17 (Week 18) night: final presentation, report submission

Project announcement

- Topic
  - Topic
    - Use what you have learned in this course to solve a problem of your choice.
    - We will release F23 slides of the remaining topics (see Blackboard → Project)
      - Probabilistic temporal models
      - Markov decision processes
      - Reinforcement learning
      - Machine learning

Project announcement

- You are free to come up with your own topics, but:
  - choose topics/methods covered in this course
  - no need to make it too complicated
- Some possible topics
  - Build an agent to play a game (e.g., 2048, Five in a Row). Implement different methods (minimax? RL?) and compare their performance.
  - Formulate a real world problem (e.g., class arrangement) as CSP and solve it by implementing the methods taught in class.
  - Formulate a real world problem as a Bayesian net or a probabilistic temporal model (e.g., stock price, music). Implement probabilistic inference to solve it.
  - Implement different machine learning algorithms and compare their performance on multiple datasets.

Project announcement

- Topic example (game)
  - Build an agent to play a game. Implement 2 different methods and compare their performance.
  - Some inspirations: 2048, same game, ultimate tic-tac-toe, pacman w/ rock-paper-scissors, ...
  - Potential methods: Search, Minimax / Expectimax, RL / DQN, LLMs, ...
  - Examples:
  - ✗: Team A investigates the game 2048 and its 2 vairants. They search for the top-class literatures and implement 3 different methods including expectimax, RL and DQN. (too complicated)
  - ✓: Team B chooses the game 2048 and dives deep into the expectimax method. They propose several efficient evaluation functions, with some analysis to the result.
  - ✓: Team C chooses the game 2048. They try to solve it 1) with RL w/ approximate Q-learning; 2) with LLMs by designing prompts. They also compare the performance of these methods.
  - ✗: Team D searches for open-source codes / blogs to solve 2048. They reproduce the results, make some minor modifications and submit the project. (inadequate workloads)

Project announcement

- Topic example (time series forecasting)
  - Build a model to forecast the climate time series. The model will be trained on one or more datasets to predict the climate sequence data, such as the temperature, PM2.5, humidity, atmospheric pressure. Compare their performance.
  - potential method: Bayes Network, Hidden Markov Model, Neural Network.
  - Examples:
  - ✗: Team A chooses multi-variate climate time series with varying forecasting length. They implement Bayes network, Hidden Markov Model, RNN, LSTM, and compare their performance. (too complicated)
  - ✓: Team B focuses on short-term temperature forecasting. They implement Hidden Markov Model. They propose several improvements on it compare the performance, analyzing the pros and cons of each method.
  - ✓: Team C chooses the Beijing Air Quality Dataset. They only implement Hidden Markov Model, and they also propose several methods like data augmentation to improve the performance. They conduct an ablation study to analyze the reason why different components make performance better/worse.
  - ✗: Team D downloads pre-trained models for time series forecasting, they reproduce the results without make any modification. (inadequate workload)

Project announcement

- Grading
  - 15% of the total grade
- Criteria
  - relevance to this course
  - soundness, substance
  - quality of the report and presentation

CS181: Artificial Intelligence

Midterm review

Kan Ren

Fall 2024

Midterm exam

- Time
  - in class (10:15 – 11:55am) on Nov. 13 (Wednesday)
- Location
  - 教学中心101
  - Seat arrangement TBA
- 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 ☑

Midterm review

- Disclaimer
  - Topics covered in this review may not appear in the exam.
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Search

- Definitions
  - State space, successor function, start/goal states, solution
  - Completeness, optimality
- Tree search
  - Uninformed Search
  - DFS, BFS, iterative deepening, UCS
- Informed Search
  - Heuristic, admissible heuristic
  - Greedy, A*
- Graph Search
  - A* with consistent heuristic

Constraint satisfaction problems

- CSP
  - Find an assignment to a set of variables that satisfies a set of constraints
- Basic solution: backtracking search
- Speed-ups
  - Filtering
    - Forward Checking, Arc Consistency
  - Ordering
    - Minimum Remaining Values, Least Constraining Value
  - Structure
    - Tree structured, Cutset conditioning
- Iterative improvement
  - Local search, hill climbing, Beam Search, Simulated Annealing, Genetic Algorithms

Adversarial search

- Adversarial Search
  - Game tree, Minimax
- Resource Limits
  - Depth-limited search
  - Monte Carlo tree search
  - Limiting branching factor
- Game Tree Pruning (alpha-beta pruning)
  - α: MAX's best option on path to root; prune if value of MIN <= α
  - β: MIN's best option on path to root; prune if value of MAX >= β
- Uncertain Outcomes
  - Expectimax

Propositional logic

- Representation
  - Syntax
  - Proposition symbols, their compositions using connectives
- Semantics
  - Each model specifies true/false for each proposition symbol
  - Rules for evaluating truth with connectives
- Inference
  - Resolution (for Conjunctive Normal Form)
- Concepts
  - Validity, satisfiability, entailment, proof, soundness, completeness, etc.

Propositional logic - Horn logic

- Representation
  - $P1 \wedge P2 \wedge P3 \ldots \wedge Pn \Rightarrow Q$
  - Ps and Q are *non-negated* proposition symbols (atoms)
- Inference
  - Modus Ponens
  - Forward chaining
  - Backward chaining

First-order logic

- Syntax
  - Constant, predicate, function, variable, connective, quantifier (universal, existential), equality
  - Atomic sentence, term
- Semantics
  - A model contains: objects, relations, interpretation
- Inference
  - Propositionalization (universal/existential instantiation)
  - Unification
  - Forward/backward chaining
  - Resolution
- Semantic web
  - Not to be covered in the exam

Bayesian networks

- Syntax
  - DAG + CPTs
- Semantics
  - Global semantics
  - Conditional independence semantics, Markov blanket
  - D-separation
- Markov networks
  - Undirected graph + potentials
  - Semantics

Bayesian networks: Inference

- Exact inference
  - Inference by enumeration
  - Variable elimination
    - Interleave join (pointwise product) and elimination (summing out)
  - Efficient inference on polytrees
- Approximation inference
  - Prior Sampling
  - Rejection Sampling
  - Likelihood Weighting
  - Gibbs Sampling

Probabilistic logic

- Not to be covered in the exam

- Good luck!