CS 343

Summary and Conclusion

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Overview of AI Topics

Search / Planning
- Uninformed Search
  - A* Search
  - CSPs
  - Local Search
- Minimax
- Expectimax
- MDPs

Machine Learning
- Reinforcement Learning
- Probability Theory
- Bayes Nets
- HMMs
- Particle Filters
- Decision Diagrams
- Naive Bayes
- Perceptrons
- Neural Networks
- Kernels
- Clustering
- VPI
Overview of Machine Learning

Supervised Learning
- Discriminative Models
  - Perceptrons
  - Neural Networks
- Generative Models
  - Bayes Nets
  - Naive Bayes
  - HMMs

Reinforcement Learning
- MDPs
- Value Iteration
- Policy Iteration
- Q Learning

Unsupervised Learning
- K-Means Clustering

Supporting Ideas
- Probability Theory
- VPI
- Particle Filters
- Kernels
Maximize Your Expected Utility
Properties of task environment

- Fully observable vs. partially observable
- Single-agent vs. multi-agent
- Deterministic vs. stochastic
- Episodic vs. sequential
- Static vs. dynamic
- Discrete vs. continuous
- Known vs. unknown
Single agent vs. multi-agent

- Not multi-agent if other agents can be considered part of the environment
- Only considered to be multi-agent if the agents are maximizing a performance metric that depends on other agents’ behavior
- Single agent example: Pacman with randomly moving ghosts
- Multi-agent example: Pacman with ghosts that use a planner to follow him
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<thead>
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<th>Single</th>
<th>Multi</th>
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Deterministic vs. stochastic

- **Deterministic**: next state of environment is completely determined by the current state and the action executed by the agent.
- **Stochastic**: actions have probabilistic outcomes.
- Strongly related to partial observability — most apparent stochasticity results from partial observation of a deterministic system.
- **Example**: Coin flip.
## Determinism

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Fully observable vs. partially observable

- Fully observable: agent’s sensors give it access to complete state of the environment at all times.
- Can be partially observable due to noisy and inaccurate sensors, or because parts of the state are simply missing from the sensor data.
- Example: Perfect GPS vs noisy pose estimation.
- Example: IKEA assembly while blindfolded.

Almost everything in the real world is partially observable.
## Observability

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Known vs. unknown

- Agent’s state of knowledge about the “rules of the game” / “laws of physics”
- Known environment: the outcomes for all actions are given
- Unknown: agent has to learn how it works to make good decisions
- Possible to be partially observable but known (solitaire)
- Possible to be fully observable but unknown (video game)
Model of the World

**Known**
- Uninformed Search
- A* Search
- Local Search
- CSPs
- Minimax
- Expectimax
- MDPs
- Value Iteration
- Decision Diagrams

**Unknown**
- Q Learning
- Learning parameters of Bayes Net
Realistic Risks of AI

Mass unemployment due to automation
Realistic Risks of AI

Substandard testing / poor user understanding
Realistic Risks of AI

How to make tough decisions?
Realistic Risks of AI

Privacy concerns
Realistic Risks of AI

Algorithmic discrimination
Realistic Risks of AI

Unethical manipulation of humans
Realistic Risks of AI

Autonomous weapons
Realistic Risks of AI

AI in the “wrong hands”
Realistic Benefits of AI

The central question:

Can we ensure that the benefits of AI outweigh the potential risks?
Realistic Benefits of AI

Significant reduction of driving fatalities
Realistic Benefits of AI

Happier, healthier lives
Realistic Benefits of AI

Increased productivity and prosperity
Realistic Benefits of AI

Dirty, dangerous, and dull
Realistic Benefits of AI
Beyond human capabilities
Final Impressions: True or False?

- AI will soon replace humans in most jobs
- AI will surpass human intelligence in the next 20 years
- AI works similarly to the human brain
- AI systems “think”
- AI systems can have their own desires and goals
- AI systems can do things that their designers didn’t intend
- AI systems could become conscious
- Some AI systems can be trusted
Final Exam

Sat 12/11    7pm - 10pm   via Gradescope