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Lecture Plan

CSE422: Artficial Intelligence

Faculty: Rafiad Sadat Shahir [RSS]

Lecture 1: Artificial Intelligence

- Artificial Intelligence (AI)
  - Turing Test
- History of AI
- Foundations of AI
- Agents and Environments
- Paradigm of AI
  - Modeling, Inference, & Learning

Lecture 2: Uninformed Search

- Search Problem
  - State-Based Models
- Uninformed Search
  - Breadth First Search (BFS) & Depth First Search (DFS)
  - Uniform Cost Search (UCS)
- Performance Measure of the Algorithms

Lecture 3: Informed Search

- Informed Search
  - Heuristic Function
- Greedy Best-First Search (GBFS)
- A Star Search (A*)
- Performance Measure of the Algorithms
- Generating heuristics
  - Hamming, Manhattan & Euclidean Distance

Lecture 4: Heuristics

- Optimality of A* Search
  - Admissible Heuristics
    - Proof of Optimality
  - Consistent Heuristics
- Checking Admissibility and Consistency
- Dominance of Heuristic

Lecture 5: Local Search

- Local Search
- Optimization Problem
  - Objective Function
- Hill Climbing
  - Minima, Maxima, Saddle Points & Plateaus
  - Random Restart Hill Climbing
  - Simulated Annealing
- Gradient Descent

Lecture 6.1: Genetic Algorithm

- Local Beam Search
  - Stochastic Beam Search
    - Evolutionary Algorithms
- Randomized Algorithms
  - Monte Carlo Algorithms
- Genetic Algorithm
  - Population, Fitness, Selection, Crossover, Mutation

Lecture 6.2: Genetic Algorithm

- Population
- Fitness
- Selection
  - Random, Roulette Wheel, Tournament & Elitism Selection
- Crossover
  - Single Point, Two Point & Order Crossover
- Mutation
  - Bit Flip, Random Reset & Swap Mutation

Lecture 7: Adversarial Games

- Adversarial Search
  - Two Player, Turn Based, Fully Observable, Zero-Sum Game
- Game Tree
  - Utility Function
- Minimax Algorithm
- Optimizing Minimax Algorithm
  - Evaluation Function
  - Alpha-Beta Pruning

Lecture 8: Linear Algebra & Probability

- Basic Terminologies
- Random Variables
  - PMF, CDF, PDF & Expectation
- Two Random Variables
  - Joint, Marginal & Conditional Probability
  - Bayes Rule
  - Independence & Conditional Independence

Lecture 9: Linear Regression

- Machine Learning
- Linear Hypothesis
- Loss Function
  - Squared Error
- Gradient Descent
  - Batch & Stochastic Gradient Descent
- Probabilistic Interpretation
- Higher Dimensional Feature Mapping

Lecture 10: Perceptron & Logistic Regression

- Logistic Regression
  - Logistic Hypothesis
  - Log Loss
- Perceptron
  - Hypothesis of Perceptron
  - Perceptron Learning Rule
- Probabilistic Interpretation

Lecture 11: Gaussian Discriminant Analysis

- Discriminative & Generative Algorithms
- Gaussian Discriminant Analysis (GDA)
  - GDA Assumption
  - ϕ, μ_0, μ_1, Σ
  - Inference Using GDA
- GDA and Logistic Regression

Lecture 12: Naive Bayes

- Naive Bayes (NB)
  - NB Assumption
  - Inference Using NB
- Multinomial NB
- Gaussian NB
- Laplace Smoothing

Lecture 13: Artificial Neural Networks

- Logistic Regression as Connectionist System
- Limitations of Perceptron
- Multilayer Perceptron
  - Fully Connected Layers
- Forward Propagation
  - Implementation Using Tensors
  - Activation Functions
    - Importance of Non-Linear Activation Functions

Lecture 14: ANNs (Continued)

- Backpropagation
  - Chain Rule
- Hyperparameters
- Additional Topics:
  - RNNs, CNNs, SNNs
  - Drawbacks of Backpropagation
  - Alternatives to Backpropagation

Lecture 15: Decision Tree

- Decision Tree (DT)
  - If-Else Rule Based Model
- Inference Using DT
- Learning Decision Tree
  - ID3 Algorithm
    - Entropy
    - Gain

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The End