CS 6601 final study guide

CS 6601: Final Study Guide

Note: R&N = *AI, A Modern Approach*, by Russell & Norvig

- Adversarial search (R&N Chapter 5)
  - Observable games (e.g. isolation)
  - Minimax
  - Alpha-beta pruning
    - Performance improvement
  - Utility and evaluation functions
    - Sensitivity
  - Optimization tricks
    - Move-ordering
    - Symmetry
  - Iterative deepening
  - Multiplayer games
  - Probabilistic games
  - Partially observable games (e.g. poker)
- Search (R&N Chapter 3, uninformed and informed)
  - Uninformed
    - Breadth-first search
    - Depth-first search
    - Depth-limited search
    - Iterative deepening depth-first search
  - Informed
    - Uniform-cost search
    - Greedy search
    - A* search
    - Heuristics
      - Consistency/admissibility
      - Dominance
      - Derivation by relaxation
  - Bidirectional
  - Tridirectional
  - Tree vs. graph search
  - Completeness, space/time complexity, path optimality
- Agent design (R&N Chapter 2)
  - Rationality
  - PEAS
    - Performance
    - Environment
      - Observability
      - Deterministic/stochastic
      - Episodic/sequential
      - Static/dynamic
      - Discrete/continuous
      - Single/multi-agent
    - Actuators
    - Sensors
      - Uncertainty
  - Agent types
    - Reflex
    - Reflex with state
    - Goal-based
    - Utility-based
    - Learning
- Random algorithms (part of R&N Chapter 4)
  - Hill-climbing
  - Beam search
  - Iterative improvement
  - Simulated annealing
  - Genetic algorithms
  - Local vs. global maximum
  - Local stochastic search
- Constraint satisfaction problems (R&N Chapter 6)
  - Variables, domains, constraints
  - Standard search
  - Backtracking
  - Heuristics
    - Minimum remaining values
    - Least constraining value
  - Forward-checking
  - Arc consistency
  - Path consistency
  - Problem re-structuring
- Probability (R&N Chapters 13 and 14a, 14b)
  - Independence/dependence
  - Discrete/continuous variables
  - Joint distribution
  - Central Limit Theorem
  - Conditional probabilities
    - Bayes' Rule
    - Chain Rule
    - Conditional independence
  - Bayesian networks
    - How to construct
    - Local independence
    - Inference
      - Exact (calculation)
        - Enumeration
        - Variable elimination
      - Inexact (sampling)
        - Rejection sampling
        - Stochastic simulation
        - MCMC simulation
  - Decision/utility theory
    - Expected value
- Machine learning (part of R&N Chapter 18)
  - Classification problems
  - Gaussian distribution
    - Central limit theorem
  - Maximum likelihood estimate
  - Naive Bayes

    - Accuracy
        - Precision/recall
    - *k* nearest neighbors
    - Naive Bayes
    - Mixture of Gaussians
    - No free lunch
    - Separability
        - Linear vs. nonlinear
    - Decision trees
        - Entropy
        - Information gain
        - C4.5
        - Random forests
        - Decision "stumps"
    - Boosting
    - Clustering (i.e. unsupervised learning)
        - k-means
        - Inter/intra-class variance
        - Descriptive length
        - Gaussian mixture models
        - Expectation Maximization
    - Neural Networks
        - Single-layer perceptron
        - Multilayer perceptron
        - Backpropagation
    - Support Vector Machines
- Reasoning over time (R&N Chapter 15)
    - Dynamic Time Warping
        - Sakoe-Chiba bands
    - Hidden Markov Models
        - Sequence decoding
            - Viterbi
        - Probability estimation
            - Forward-backward
        - Training
            - Baum-Welch
        - Improvements
            - N-gram models
            - State tying
            - Pruning, beam search
            - Context-Free Grammars
            - Segmentally-boosted HMMs
- Complex decisions (R&N Chapter 17 and 21)
    - Utility functions
    - Policy (vs. path)
    - Finding optimal policy
        - Bellman equation
        - Value iteration
        - Policy Iteration
        - Q-learning
        - SARSA
        - Local consistency vs. global optimality
    - Partially-observed Markov Decision Processes
        - Belief state
        - Particle filter
- Logic (R&N Chapters 7, 8 and 9)
    - Propositional knowledge
    - First-order logic
        - Operators
        - Existential quantifiers
    - Knowledge base
    - Entailment
    - Inference
        - Soundness vs. completeness
        - Enumeration
        - Logical equivalence
    - Validity vs. satisfiability
    - Forward/backward chaining
    - Horn clauses
    - Conjunctive Normal Form
    - Resolution
        - Proof by contradiction
    - Universal/existential instantiation
    - Reduction
    - Unification
- Planning (R&N Chapter 11 plus this)
    - STRIPS planner
        - States
        - Conditions
        - Operators
        - Goals
        - Actions
        - Plan
    - Partially-ordered plans
    - Conditional planning
    - Monitoring
        - Execution vs. action monitoring
    - Replanning
        - Clobbering
        - Demotion/promotion