1. Search
   - Search problem formulation: state space, successor function, cost function, start state, goal test
   - Tree search vs. graph search
   - Uninformed strategies: depth-first, breadth-first, uniform-cost
   - Advantages and Disadvantages of each strategy

2. Constraint Satisfaction Problems (CSPs)
   - CSP formulation: variables, variable domains, constraints
   - Constraint graphs: edges connect variables and constraints.
   - Constraint types: Unary, Binary, Ternary, n-ary
   - Backtracking search - DFS w/ incremental constraint checks
   - Which variable to assign? Minimum Remaining Values and Degree Heuristics
   - Value to assign? Least Constraining Value Heuristic
   - Forward checking, Arc-Consistency, k-consistency

3. Adversarial Search
   - Iterative deepening and heuristics/evaluation functions.
   - Preferences, risk tolerance
   - Utility Theory

4. Markov Decision Processes and Reinforcement Learning
   - MDP definition: states, actions, transition function, reward function, start state
   - Known MDP solution methods: Value Iteration and Policy Iteration.
   - Bellman equation for value under fixed policy, Bellman optimality condition.
   - Quantities: Value Function, Q-function, policy
   - Notation: $Q^\pi(s, a), Q^*(s, a), V^\pi(s), V^*(s)$.
   - 'Model-free' RL: TD-learning, Q-learning, policy search.
   - Convergence guarantees for all of the above

5. Probability
   - Probability: random variables, distributions: marginal, conditional, joint.
   - Product rule, chain rule, Bayes' Rule
   - Independence and conditional independence

6. Bayes Nets
   - Encode joint using simple local conditional distributions, by making conditional independence assumptions
   - Notation and semantics
   - Factorization
• D-separation
• Exact inference by computing the joint probability table
• Exact inference by variable elimination (including advantages relative to computing the joint probability table)
• Approximate inference by sampling: prior sampling, rejection sampling, likelihood weighting
• Advantages and disadvantages of sampling relative to variable elimination

7. Hidden Markov Models (HMMs)
• Definition (special type of Bayes net)
• Relevant distributions: initial distribution $\Pr(X_1)$, transition model $\Pr(X_t|X_{t-1})$, observation/emission model $\Pr(E_t|X_t)$
• Conditional independence properties
• Forward algorithm (special case of variable elimination): application of the elapse time/prediction step and the observe/conditioning step in alternate succession
• Viterbi algorithm
• Particle filtering: advantages and disadvantages relative to exact inference (forward algorithm)
• Particle filtering: elapse time, observe, and resample steps

8. Machine learning: Classification
• Data (training set, held out/development/validation set, test set)
• Experimentation cycle
• Features
• Classifier function
• Evaluation, baseline algorithms
• Overfitting and generalization
• Naive Bayes: special case of Bayes Net, estimate CPTs from training data
• Naive Bayes: Laplace smoothing
• Naive Bayes: classification rule, confidence
• Generative vs. discriminative
• Linear classifier concept (linear separability of data)
• Perceptron algorithm: binary, multiclass, convergence guarantee, mistake bound $R^2/\delta^2$
• Perceptron improvements: MIRA, SVM
• Nearest neighbor
• Kernels

Good luck on the final!