

# **CSCI 446 – ARTIFICIAL INTELLIGENCE EXAM 2 STUDY OUTLINE**

## **Probability**

- I. Random Variables
- II. Joint and Marginal Distributions
- III. Conditional Distributions
- IV. “Rules”
  - A. Product Rule
  - B. Chain Rule
  - C. Bayes’ Rule
- V. Inference
- VI. Independence
  - A. Absolute
  - B. Conditional

## **Bayes Nets**

- I. Representation
  - A. Graphical Model Notation
  - B. Semantics
    - 1. Conditional Probability Tables
- II. Independence
  - A. Bayes Net Independence Assumption
  - B. D-Separation
    - 1. Causal Chains
    - 2. Common Cause
    - 3. Common Effect
- III. Inference
  - A. Enumeration
  - B. Variable Elimination
    - 1. Factors
      - a. Selected Joint
      - b. Single Conditional
      - c. Family of Conditionals
      - d. Specified Family
    - 2. Variable Ordering
  - C. Sampling
    - 1. Prior Sampling
    - 2. Rejection Sampling
    - 3. Likelihood Weighting
    - 4. Gibbs Sampling

## **Decision Networks and the Value of Perfect Information**

- I. Decision Networks
  - A. Chance Nodes (Bayes Nets)
  - B. Action Nodes
  - C. Utility Nodes

## II. Value of Information

### A. Maximum Expected Utility (MEU)

1. With and without evidence

### B. Value of Obtaining Information

### C. Properties

1. Non-negative
2. Non-additive
3. Order-independent

## III. POMDPs – Partially Observable Markov Decision Processes

### A. Belief States

## **Hidden Markov Models**

### I. Exact Filtering

#### A. Base Cases

1. Observation
2. Passage of Time

#### B. Forward Algorithm

### II. Particle Filtering

#### A. Process

1. Generate Particles
2. Elapse Time (Simulate Change)
3. “Observe” Evidence – Weight according to probability
4. Resample

#### B. Dynamic Bayes Networks

#### C. Most Likely Explanation (MLE)