CISC 6525 Fall 2018 Artificial Intelligence
Topics Covered

1. Computer Vision
    a. Virtual machine, use of OpenCv and use of ROS
    b. Image formation, image storage and image manipulation by computer
    c. Low level image operations: blurring, smoothing, sharpening, kernel operations
    d. Image segmentation, Cues for 3D structure, Stereovision, Optical flow
    e. Object Recognition
2. Robotics
    a. Mobile robot Kinematics
    b. Motion planning
    c. Mapping and localization
3. Rationality
    a. Definition of Agent, Rationality, Autonomy
    b. PEAS framework – be able to apply to any problem
    c. Formalization of vacuum cleaner world: State, Actions, etc.
    d. Types of environment: Observable, deterministic, static, etc.
    e. The agent function
    f. Types of agent: table driven, reflex, model-based etc.
4. Problem solving agents
    a. Search definitions: search tree, node, state, actions, successor fn, etc.
    b. Pseudo code for tree search
    c. Different kinds of search BFS, DFS, uniform cost search, iterative deepening search.
    d. Time, space complexity, completeness and optimality for each kind (the Table)
5. Heuristic Search
    a. Defn of best-first search, Heuristic
    b. Greedy best first search
    c. A* search: f(x) = g(x)+h(x)
    d. Admissible and dominant heuristics, problem relaxation
    e. Time, space complexity, completeness and optimality for A* and greed search
    f. Local search – Hill climbing, definition and use, limitations
    g. Local beam search, definition and use
6. Adversarial search
    a. 2-player game tree, definitions
    b. ultility function, features, evaluation function
    c. minimax definition, algorithm and properties
    d. alpha-beta pruning, definition and use

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7. Logical Agents
    a. Wumpus world, PEAS definition.
    b. Models and Entailment, KB entails alpha.
    c. Propositional logic in Wumpus world
    d. Truth table entailment, definition, algorithm, and use
    e. Proof methods: model checking and application of inference rules
    f. Conjunctive normal form and resolution, using resolution
    g. Horn form, backwards and forward chaining
8. First order logic
    a. Difference from propositional logic
    b. Understand the use of quantifiers, etc.
    c. Be able to phrase constraints in FOL and vice-versa
    d. Understand substitutions, eg S = Smarter(x,y) σ = {x/Hillary,y/Bill}
    e. Use in wumpus world: diagnostic and causal rules.

9. Planning
   a. How different from search
   b. Representation of actions, states and goals
   c. Preconditions, effects; add/delete lists
   d. Definitions: strips assumption, frame problem, closed world assumption
   e. Be able to read action schemas, states, goals and plans
   f. Forward/progressive, backward/regressive planning, be able to do both on paper – know where and why a search heuristic applies to these
   g. Partial order planning – new plan representation and know how to deal with conflicts for simple examples.
   h. Planning graph
10. Uncertainty
   a. How is probability used by an agent to account for uncertainty
   b. Random variables and atomic events
   c. Basic definitions of probability, probability distribution (or density) and conditional probability
   d. How to use a join probability distribution to answer queries about a domain (inference by enumeration), be able to do simple examples on paper
11. Bayes networks
   a. How to represent a Bayesian network, CPT, nodes, parents, children, Markov blanket, compact calculation
   b. How to calculate all the joint distribution probabilities
   c. How to handle hidden variables in a query
   d. Exact vs. inexact
12. Time
   a. Filtering a DBN, smoothing and Viterbi algorithm
   b. HMM filtering – usage, relationship to DBN
   c. Kalman filter – simple usage
   d. Particle filter – algorithm
13. MDP
   a. Definitions and representation
   b. Bellman equation, value iteration calculation