

CPSC 433 F22 Midterm Study Questions (Topics 1-14)

Most questions are short answer questions.

1 Organization

- Name the subareas of AI (from organization slides).

2 Introduction

- What is a good definition for AI?
- What are challenges in creating a definition for AI?
- What theory of technology development can be used to describe the challenge of AI's historical progress?
- What do we mean by AI being able to be defined as Computational Rationality?
- What is a rational agent?
- What type of AI existed before AI-Winter I/what about that type of AI didn't succeed as expected?
- First AI philosopher?
- Well known thought experimental test for judging if we've reach full human level AI is called?
- What type of AI succeed after AI Winter I before AI Winter II?
- What types of AI have succeeded post AI Winter II? What are some pivotal events post AI-Winter II in AI?
- Compare connectionist AI to symbolic AI.
- What are some future/currently developing AI areas from class slides?

3 Knowledge Representation

- What is a reflex agent?
- What is a planning agent?
- What is the general structure of an AI system, what knowledge is used and why do we have abstraction levels?
- What is the difference between computation and search?
- What are the advantages of computation, what are the disadvantages?

4 Search Definitions

- What does Learning mean in AI, what does Planning/Deduction?
- What is the 'No Free Lunch Theorem'?
- What is the definition of a search model? (be able to describe the parts not just $A = (S, T)$)
- What is the definition of a search process? (be able to describe the parts)
- What is the definition of a search instance? (be able to describe the parts)
- What is the definition of a search derivation? (be able to describe the parts)
- For what do we need the components of a search model, process, instance, derivation?
- What is a state/search space? What is a value space/fitness space?
- What type of information would be put in the environment versus the states of a search?

5/6/7 General

- What are the problem specific components of

1. set-based search
 2. and-tree-based search
 3. or-tree-based search?
- What are the differences between and-tree-based search and or-tree-based search?
 - Where do we need to make sure we handle tie-break in and/or/set based search? Why do we need to do so?
 - What is the purpose of a problem specific component? (Ex. What does the declaration of F create for us in a Set-Based model?)

5Set Based

- **Given two terms, decide if they are unifiable and if yes, generate their mgu. [medium length question]**

Examples:

1. $f(x, y, g(x, c, d)) \approx f(g(y, a, d), a, g(x, c, d))$
2. $f(x, y, x) \approx f(a, g(x, b, c), d)$
3. $f(x, c, d) \approx f(f(x, c, d), c, d)$

- Given two terms, apply the set-based search process for generating their mgu and write down a possible search derivation. Examples: see above
- Given a solvable unification problem and our set-based search model for it. If we have two different search processes for the model, will the mgus produced by the processes be different?
- **Given two clauses and the Resolution inference rule, produce all clauses that are the result of applying the rule to the clauses. [medium length question]**

Examples:

1. $Q(a) \vee Q(b), \neg Q(x)$
2. $P(a, b) \vee P(x, d), \neg P(a, y)$
3. $P(a, b) \vee P(x, d), \neg P(b, y)$

- **Given a clause and the inference rule Factorization, produce all clauses resulting from the application of the rule. [medium length question]**

Examples:

1. $Q(a) \vee Q(x)$
2. $P(a, b) \vee P(x, d) \vee P(a, y)$
3. $\neg P(b, y) \vee \neg P(x, y)$
4. $P(a, x) \vee P(b, y)$

6And Tree

- What do we call the unexplored are of a search tree? What storage structure do we use to store it? Do we usually store the complete search tree why/why not?
- If I use the provided and-tree definition what does ERW define (ERW*)? Do I need to re-define them for my specific problem?
- What is a single search state in an and-tree? What is an Atree?
- Why is a reason we would make an and-tree with backtracking? What is a reason we might try to avoid it in an and-tree solution?

- If our and-tree algorithm is a loop that starts with the starting root in our minheap, what does each loop of our algorithm do (using f_{leaf} and f_{trans} in your explanation)?
- If a recursive branch and bound algorithm is being considered an and-tree, would we consider it to be a back-tracking design or not? Why?
- **Given some clauses and a state in a model-elimination search, produce all possible successor states. [medium length question]**
- Given a state in model-elimination search that has only leaves with sol-entry yes, check if it really fulfills the end condition.

7Or Tree

- Given an or-tree-based search state for a constraint satisfaction problem instance (and the instance) and a leaf in this state, list all possible successor states that extend the leaf.
- What is the difference between and-tree-based search and and-or-tree-based search? (in terms of purpose?, in terms of function?)
- Are or-trees good for optimization problems? What about and-trees?
- In terms of tree definition do we use both ERW and ERW*? Why/ why not?
- What are a couple of or-tree parts that are just rename versions of and-tree parts?
- What do we like or-trees for CSP problems? What are some examples of CSP type problems?
- **Given some variables X , the domains for those variables D , and some constraints for those variables C , perform an or-tree based search like given in lecture. [medium length question]**
- What were general considerations made when designed $f_{leaf}/Altern$ for the CSP problem in lecture? What is another name for some of these indeterminate rules that were used?
- In CSP what is meant by the critical ratio?
- Why are some CSP pre-processed for structure changes and then multiple CSP run on the result and combined? What could be another name for an algorithm that runs and combines (conjunctions) multiple or-trees?

8Other search models

- What is the difference between tree-based search and graph-based search?
- What is a benefit of graph-based search? What is a challenge?
- Why did blocks world gain from a graph-based consideration?
- What type of search was declared as fitting And-Or-Tree search well?
- What is meant by a zero-sum game?
- What game did Deep Blue play? What game did UofA research give solution for, what was that system named? What recent game did an AI winning a competition change what AI was considered capable of (ahead of expected timeline)?
- What is a simple summary of how the min and max parts of minimax algorithms inter-operate? What are some assumptions that minimax (and some similar algorithms require to give the correct answer?)
- What is a complete algorithm? What is an optimal algorithm?
- How do nodes in tree scale if b is branches per node, and m is the depth tree is at? (Big-O)
- Why would we prune a tree? Why does depth matter? What algorithm was described which changed minimax to add pruning? What is simple summary of how alpha and beta are used?

- What is the simple motivation that resulted in Expectimax search? What is danger of optimism with stochastic games? Pessimism?

9 Search Controls

- What are general things that can be measured by a search control?
- Which parts of states can be measured by search controls?
- Compare DFS to BFS. What is brief description of iterative deepening? How is uniform cost different from BFS? (I will not ask for asymptotic comparisons (big-O) or calculations!)
- What is informed search versus uninformed search and what search controls fit in each category?
- What is a heuristic? What is an example of a distance heuristic?
- What does greedy search do?
- What is an admissible heuristic?
- What two algorithm designs is A* a combinations of? What property does A* require to be optimal?
- What is mean by local search? Which of and-tree, or-tree, set-based is most often a local search?
- What is hill-climbing defined by? What does simulated annealing add to the idea of hill-climbing?
- Compare particle swarm optimization and genetic algorithms?

10 Neural Networks

- What are the components of a neural network?
- What is the general structure of a neural network?
- What are the parameters of an activation function?
- What are the parameters of a learning function?
- What is backpropagation?
- Given a network structure, an activation function and a learning function, train the network on a given set of input-output behaviors! (like lecture/tutorial)
- What do convolutional neural networks do?
- What are the problems neural networks have?

11 Logic

- For knowledge representation in general, what does syntax and semantics mean?
- What are the reasons/ways why the same knowledge can be represented very differently?
- Logics in general:
- How are terms defined?
- What are the different kinds of predicate symbols?
- What is an atom?
- What do we need in addition to terms and atoms to define formulas?
- What is the definition of an interpretation?
- What is a logic (formally)?
- What are the components of a calculus?

- For propositional logic and first-order logic, how is the general definition of a logic instantiated?
- What are the advantages and disadvantages of propositional logic?
- What are the advantages and disadvantages of first-order logic?
- What calculi do you use for propositional logic and what calculi for first-order logic?
- Given a description and a goal, translate them into propositional logic (first-order logic) and use a given calculus to prove that the goal is a consequence of the description!
- What are concepts that cannot be easily expressed in propositional logic or first-order logic?
- Which modern logics are used instead to express the concepts from above?

12Rules

- What is the general structure of a rule in a production system?
- What are the three key components in a rule-based system?
- What is the structure of a rule in PROLOG?
- What is the structure of a rule in MYCIN/EMYCIN?
- Given a PROLOG program and a query, produce the answer!
- Given a set of EMYCIN rules, the truth values of some initial statements and an additional statement, compute the interpretation of this additional statement!
- Given a description, produce a PROLOG program representing this description!
- Given a description, produce a set of EMYCIN rules representing this description!
- What is the logic behind MYCIN/EMYCIN?
- On what result of probability theory is EMYCIN based?
- What are the Measure of belief and the Measure of disbelief?

13Frames

- What programming paradigm are frames related to?
- How can knowledge representation with frames be visualized?
- What does XML stand for?
- Given a DTD and a faulty tagged text, find the errors in the tags with respect to the DTD?
- Name other schemes than DTDs to represent semantics to validate XML expressions!
- What is an ontology used for with regard to XML?
- What are the components of an ontology?
- What connections can be there between concepts and ontologies?
- What are the advantages and disadvantages of XML?

14Semantic

- What was the goal in developing Semantic Nets?
- What are the basic data structures of Semantic Nets?
- What are nodes in Conceptual Dependency graphs used for?
- What are the actions in Conceptual Dependency graphs and what are their semantics?
- What are modifiers in Conceptual Dependency graphs and what are their semantics?
- How does knowledge processing with Conceptual Dependency graphs work?
- Given a statement, transform it into a Conceptual Dependency graph!

16Summary

- Given some piece of knowledge to represent, what knowledge representation mechanism should be looked at first, according to our rules of thumb?

- + Any kind of questions about the team assignment!

Long answer question types

- **Given a concrete search model, a concrete search process to the model and a search instance, write down the search derivation produced by the process for the search instance.**

[harder question on exam – at most 1]

- **Given a problem and a search paradigm, produce a search model and search process that solves instances of the problem and follows the paradigm.** [hardest question type on exam – at most 1]

- **The applied SA questions from 10-14 might be considered a longer answer if multiple steps are requested instead of a short target question instead. Example writing out FOL and applying resolution to it to answer a question about given knowledge. Writing out Emycin/Prolog rules and applying them to answer question. Writing out XML and DTD for something. Writing out a conceptual dependency rules and its application to a query.**