

CPSC 433 F25 Midterm Study Questions (Topics 1-9)

Most questions are short answer questions (55 of 75 marks). This is non-exhaustive list of question types that will be asked. A good number of questions are short answer like give the name of something, define something, or give symbol and definition of something. Others are solving like tell me result of resolution on two clauses or is this unifier valid (you'll need to know the rules to unify it and maybe tell me what rule results in failure). There is one long answer (give me a model/process for a certain set/and/or paradigm question).

1 Organization

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

2 Introduction 3 History

- What is a good definition for AI?
- What are challenges in creating this course definition for AI?
- What theory of technology development (the chart for tech. visibility) can be used to describe the challenge of AI's historical progress?
- What do we mean by AI in this course 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 experiment 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 is key to their definition.
- What are some future/currently developing AI areas from class slides?

4 Agents

- 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?

5 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 $A = (S, T)$)
Ex. A Model a is $A=(S,T)$ where S is ... and T is ...
- 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)

- What does each component search model, process, instance, derivation do? [their overall purpose]
- 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?

6/9/10 General

- What are the problem specific components of
 1. set-based search
 - a. ex, F, EXT (be able to describe them and their purpose)
 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 to 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?)

6/7/8 Set 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. $P(a, b) \vee P(x, d), \neg P(b, y)$
- 4.

- **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. $P(a, x) \vee P(b, y)$

9/10And Tree

- What do we call the unexplored area 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 be 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 leafs with sol-entry yes, check if it really fulfills the end condition.

11/12Or 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 (conjuncts) multiple or-trees?

13Other 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?

14 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?

Long answer question types (one question 20 marks)

- **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]**

These are like tutorials except you won't have to make both a model and a process. For example, you might have to just make a set-based model (and maybe a starting instance s_0). Or maybe you'll just have to make a and-tree process for a given model (and show a derivation starting at a given instance s_0).