University of California, Merced

COGS 125 / CSE 175 : Introduction to Artificial Intelligence

Review For Midterm Examination

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Midterm Examination

- The midterm examination will take place in our usual meeting room, COB2 140, on Thursday, October 17, 2019, from 12:00 PM to 1:15 PM.
- The examination will be closed book and closed notes. You will provide your answers through the Top Hat service. You should bring an electronic device prepared to access Top Hat, but no other items will be available to you during the examination.
- All work on the exam must be your own!

Examination Structure

- The exam will consist of 10 questions, each of which may or may not have multiple parts.
- The exam will last 75 minutes. Time will be tight.
- While importance and scoring weight will be roughly evenly distributed across questions, there will be some imbalance. Also, some questions are likely to be harder than others.
- Thus, it will be wise to focus on questions that are easy or those with higher scoring weights.
- "Mastery" questions will be clearly marked.

Examination Topics

- Examination questions will be designed to test knowledge introduced in …
  - … any class lecture or laboratory meeting. This includes all material that was discussed - not just material explicitly spelled out on lecture slides.
  - … any of the assigned readings from the Russell & Norvig textbook.
- While emphasis will be given to topics discussed in class, material from the assigned readings that was not addressed in class may also be tested.

Examination Questions

1. History
2. Philosophy
3. Agent Architectures
4. Uninformed Search
5. Heuristic Search
6. Optimization Search
7. Adversarial Search
8. Propositional Logic
9. Propositional Inference
10. First-Order Logic

1. History

- Which of the following is *not* true of Herbert Simon?

  (a) He attended the Dartmouth workshop in 1956.

  (b) In the mid-1950s, he helped to build a program that could prove mathematical theorems.

  (c) He worked with one of the principal designers of the SOAR cognitive architecture.

  (d) He helped to build the first computer program that could play a strong game of checkers.

  (e) He won the Nobel prize in economics.

2. Philosophy

- Both the "brain in a vat" thought experiment and the movie *The Matrix* provide examples of …

(a) the problem of strong artificial intelligence

(b) the argument from informality

(c) the intentional stance

(d) the symbol grounding problem

(e) the problem of other minds

(f) philosophical zombies

3. Agent Architectures

- Describe the key difference(s) between *deterministic* and *stochastic* environments.
- Identify and explain the major weakness of the *table driven agent* architecture.
- Describe an application for which a *simple reflex agent* architecture would be preferred over a *utility-based agent* architecture. Explain the reason for this preference.
- In a *learning agent*, what module provides feedback on agent performance?

4. Uninformed Search

- What does it mean for a search procedure to be *complete*? What does it mean for a search procedure to be *optimal*?
- Know about breadth-first search, depth-first search, depth-limited search, iterative deepening search, and uniform cost search.
  - Are they complete? Are they optimal?
  - What is their time complexity? What is their space complexity?
- In what ways is depth-first search better than breadth-first search? In what ways is it worse?

5. Heuristic Search

- You are writing a program to solve the 4x4 sliding tile puzzle (i.e., the 15-puzzle). You decide to use uniform-cost search. You are in a hurry, so you do *not* implement repeated state checking.
  - Will your search program be *complete*?
  - Will your search program be *optimal*?
  - Will your search have good (i.e., less than exponential) *time complexity*?
  - Will your search have good (i.e., less than exponential) *space complexity*?

5. Heuristic Search

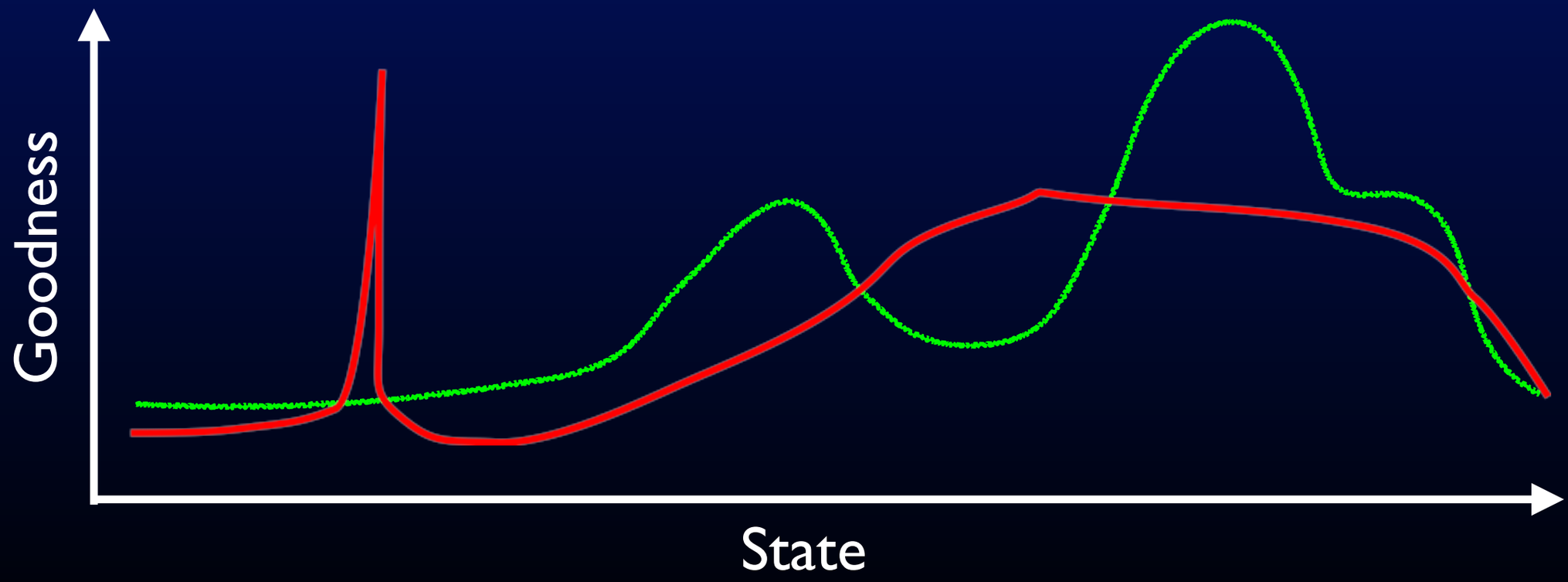
- In your effort to write a program that solves the 15-puzzle, you abandon uniform-cost search in favor of A* search.
  - Describe an admissible heuristic function for this problem.
  - Two friends each provide you with heuristic functions for this problem. Both are proved to be admissible. How might you combine these two functions in order to produce a heuristic function that is better than either of them, alone?

5. Heuristic Search

- If two heuristic functions are admissible, would a new heuristic function which is defined to be the average of the first two functions also be admissible? Why or why not?
- If you improve your admissible heuristic function, what should change about your A* search?
  - Will it find better paths?
  - Will it run faster?
  - Will it use less space?

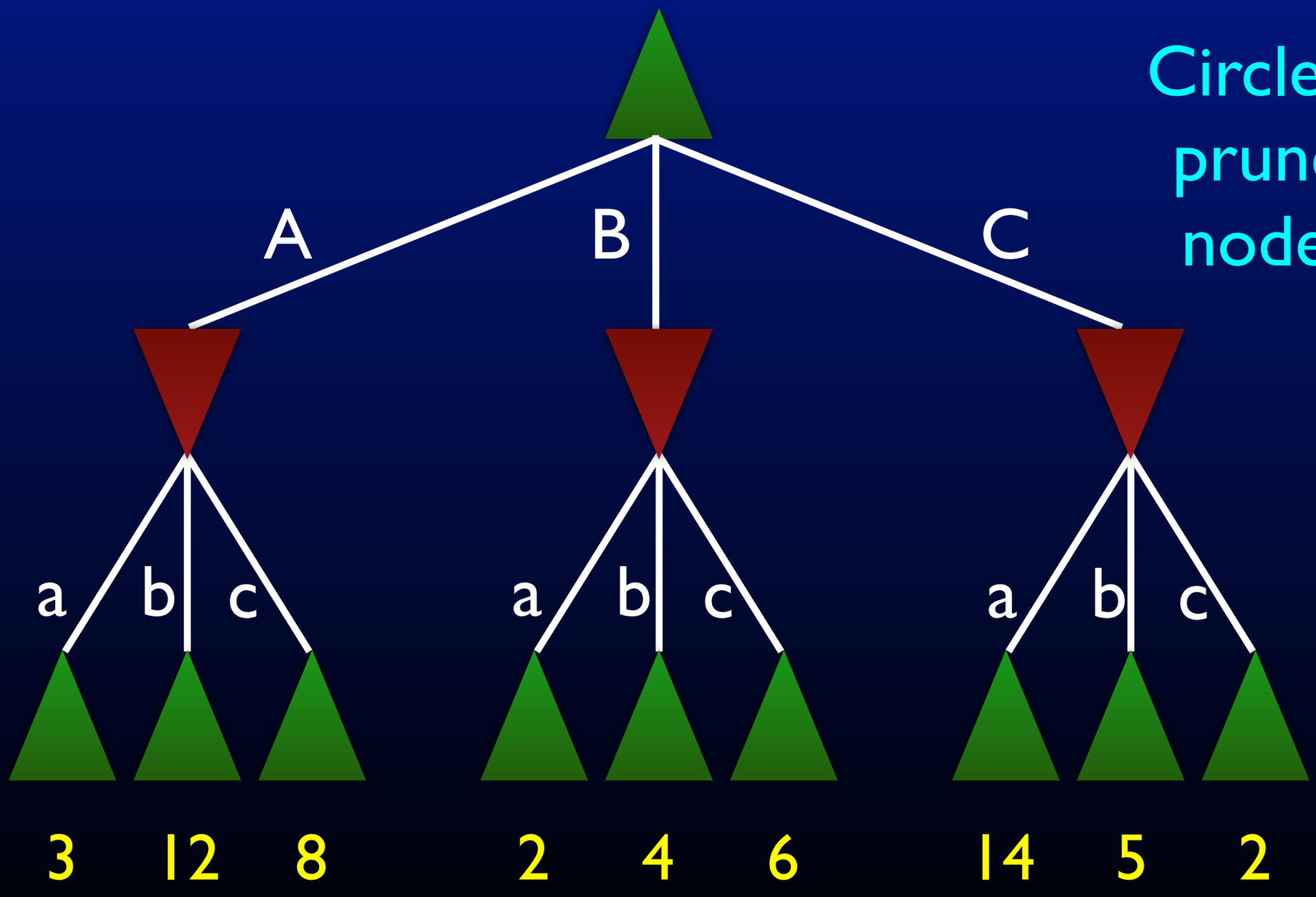
6. Optimization Search

- Consider the two objective functions, below. For which of the two functions would local beam search perform better than hill-climbing with random restarts? For which would hill-climbing with random restarts perform better than local beam search?



7. Adversarial Search

If actions are considered in alphabetical order, which subtrees of this complete game tree would be pruned by alpha-beta pruning?



Circle all pruned nodes.

8. Propositional Logic

Valid? Unsatisfiable? Neither?

$Smoke \Rightarrow Smoke$

$Smoke \Rightarrow Fire$

$(Smoke \Rightarrow Fire) \Rightarrow (\neg Smoke \Rightarrow \neg Fire)$

$Smoke \vee Fire \vee \neg Fire$

$\neg(Smoke \vee Fire \vee \neg Fire)$

$(Smoke \Rightarrow Fire) \Rightarrow ((Smoke \wedge Heat) \Rightarrow Fire)$

$((Smoke \wedge Heat) \Rightarrow Fire) \Leftrightarrow$
$((Smoke \Rightarrow Fire) \vee (Heat \Rightarrow Fire))$

8. Propositional Logic

- In terms of entailment and inference, what does it mean for an inference procedure to be *sound*?

- In terms of entailment and inference, what does it mean for an inference procedure to be *complete*?

9. Propositional Inference

- Convert the following sentence into conjunctive normal form.
- What is a refutation sentence and why is it useful?
- What is a pure symbol? What is the unit clause heuristic?
- What are definite clauses?
- In what ways is WalkSat better than DPLL? In what ways is it worse?

10. First-Order Logic

Convert the following English sentences into FOL.

- Not all birds can fly.
- All birds have a beak.
- The father of the father of a person is that person's grandfather.
- There is a man who loves himself but nobody else.
- There is exactly one block on the table.
- There is an agent who sells policies only to people who are not insured.
- There is a barber who shaves all men in town who do not shave themselves