Final Exam

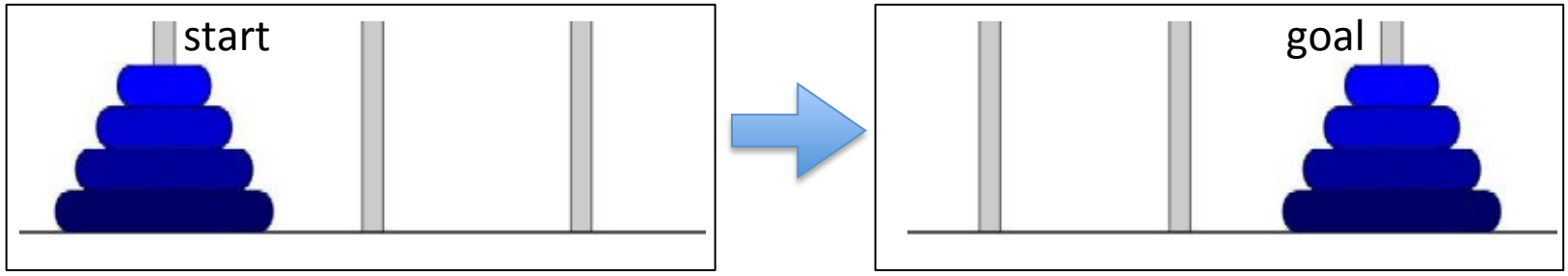
Introduction to Artificial Intelligence 2011

Stanford CS221

ai-class.com

1: Search

In the 4-Towers of Hanoi puzzle (google it if you don't know it), you are trying to move 4 disks from the left peg to the right peg. You can only move one disk at a time, and no disk may be placed on a disk with smaller diameter.



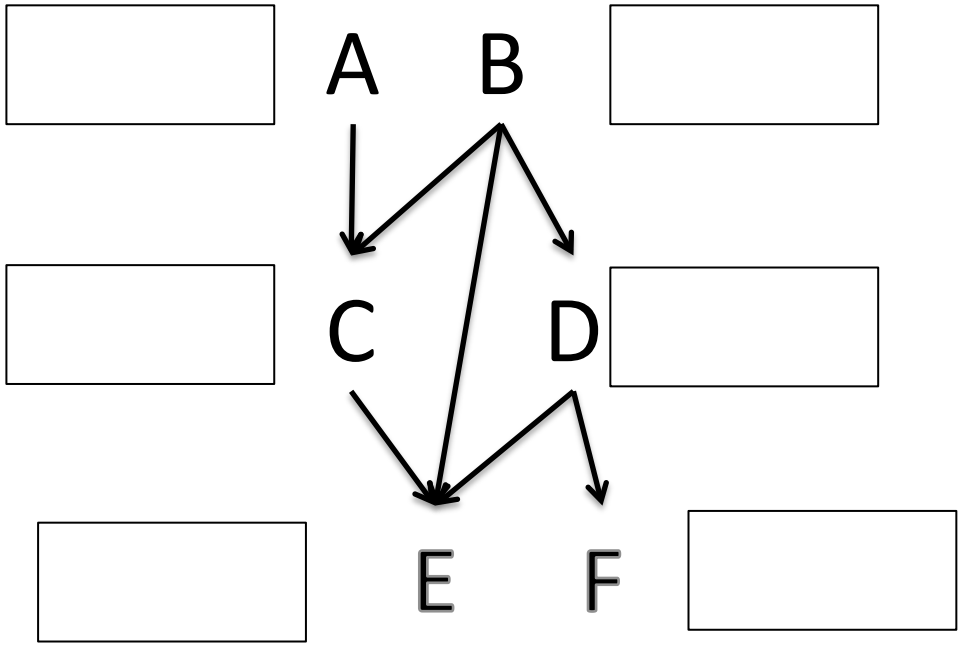
What is the size of the state space?

Is the numbers of disks that reside on the left peg an admissible heuristic in A*? YES O NO O

How many steps in the optimal solution?

2. Bayes Networks

For the following Bayes network, assume that each node **<u>can take on 3 values</u>** (not 2, as in class). For each node, specify the number of independent parameters required to state the conditional probability of that node. (This question is tricky. The right answer for "A" is 2.)



3: Machine Learning

True or False?

Suppose that we have determined the best values for the parameters in our model. If the *noise* that affects our data *increases*, we should… (in the typical case – use your judgment)

- increase k if we are using k-nearest neighbors. TRUE ○ FALSE ○
- Increase k if we are using the k-means algorithm. TRUE ○ FALSE ○
- increase k if we are using Laplace smoothing. TRUE ○ FALSE ○
- use fewer particles if we are using particle filters. TRUE ○ FALSE ○
- use more data if available. TRUE ○ FALSE ○

4. Planning

Action(Study(book, topic),
  PRE: Have(book), About(book, topic),
  EFF: Know(topic))

Action(View(video, topic),
  PRE: About(video, topic),
  USE: Bandwidth(2.5)
  EFF: Know(topic))

Action(Buy(book),
  CONSUME: Dollars(50),
  EFF: Have(book))

Action(Borrow(book),
  USE: LibraryPrivilege(1),
  EFF: Have(book))

Goal(Know(Planning), Know(Scheduling))

Init(About(Nau, Planning), About(Zweben, Scheduling),
  About(Melville, Whales), About(Video8, Planning),
  About(Video15, Scheduling))

Given the resource planning problem (advanced planning lecture, not classical) defined at left, which sets of resources will allow the goal to be achieved?

Remember: CONSUME means the action eliminates that many units of the resource; USE means the resource is used only for the duration of the action and is available for re-use after the action is over. Missing Resources mean 0.

QUESTIONS

- A:Resources(Dollars(50), LibraryPrivilege(1))
- B:Resources(LibraryPrivilege(2))
- C:Resources(LibraryPrivilege(1))
- D:Resources(Bandwidth(3), Dollars(40))
- E:Resources(Bandwidth(2), Dollars(95))

(Check all that apply.)

5. Logic

	A	B	C	D
A ⇒	O	O	O	O
B ⇒	O	O	O	O
C ⇒	O	O	O	O
D ⇒	O	O	O	O

A: Pink

B: Pink ∨ Green

C: Pink ∧ Green

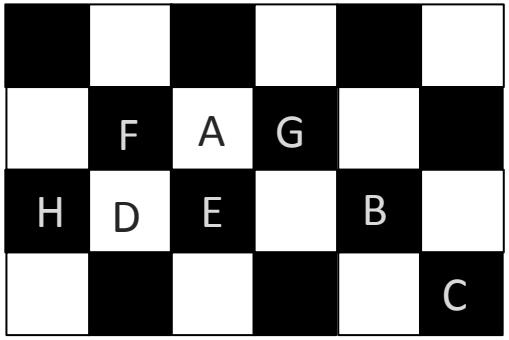
D: (¬Pink) ⇒ Green

Select each circle where an implication is necessarily true. (For example, if you think that A ⇒A, A ⇒C, and A ⇒D are all tautologies, then select the first, third, and fourth circle in the first row.)

Hint: D looks "complex" but it's the same as one of the previous clauses

6: Particle Filters

Suppose 8 particles (A through H) are placed on a checker board as shown. The probability of measuring black on a black square is 0.7; the probability of measuring white on a white square is 0.6.



- What is the (normalized) importance weight of particle “A” for measurement “white”?

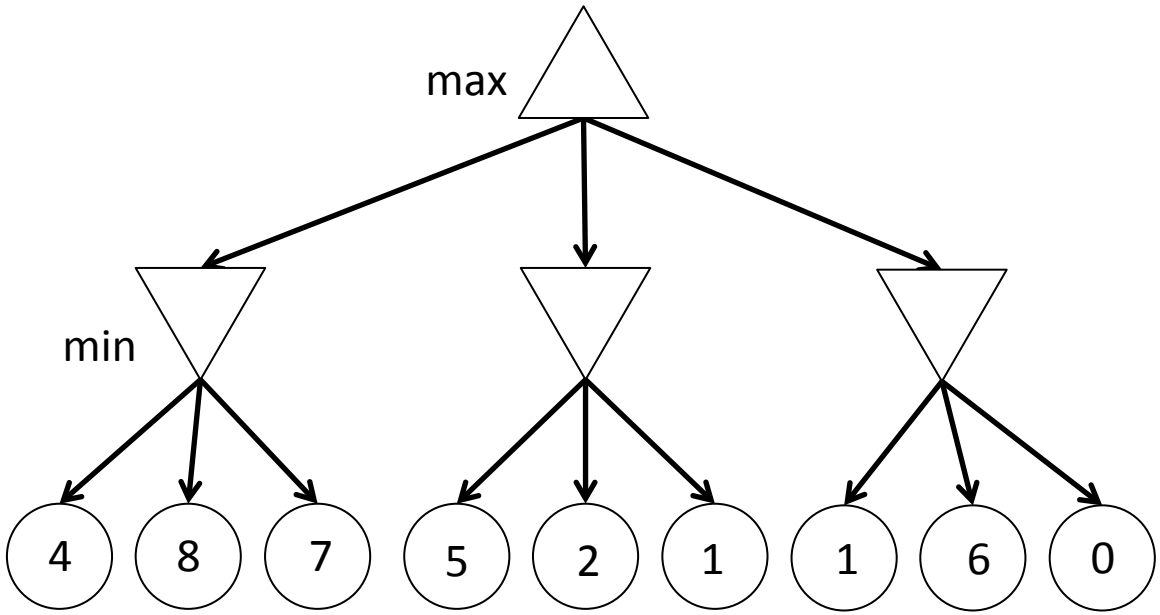
- What is the (normalized) importance weight of particle “A” for measurement “black”?

7: Particle Filters and Basic Probability

Say a particle A has a (normalized) importance weight of 0.2. We now sample 3 new particles with replacement. What is the probability that particle A is sampled at least once?

8: Alpha-Beta Pruning

Consider the following min-max tree. We perform alpha-beta pruning. Check all leaf nodes in this tree that will be expanded (assume we expand from left to right, depth first).



9: Perspective Projection

True or False?

Consider a projective image of an object. Which of the following statements is true

- If the object moves closer to the camera, the size of the projected image will increase — TRUE ○ FALSE ○
- If we use a camera with a longer focal length, the size of the projected image will increase. — TRUE ○ FALSE ○
- If we double the distance to the object, the projected image will be half as large. — TRUE ○ FALSE ○
- The ratio of the focal length over the distance to the object is the same as the projected size of the object in the camera plane. — TRUE ○ FALSE ○

10: Stereo Vision

An object at range 100 meter leads to a 2mm displacement for a stereo rig, with focal length 40mm. Now we double the baseline. What will be the new displacement (in mm)?

11: Towards Structure From Motion

Assume a world (structure) with 3 point features, named 1, 2, and 3. Assume four pinhole cameras, A, B, C, and D. The features 1, 2, 3 are projected onto camera A's image plane as follows: L=1, C=2, R=3. Which other camera sees feature 3 in the leftmost position?

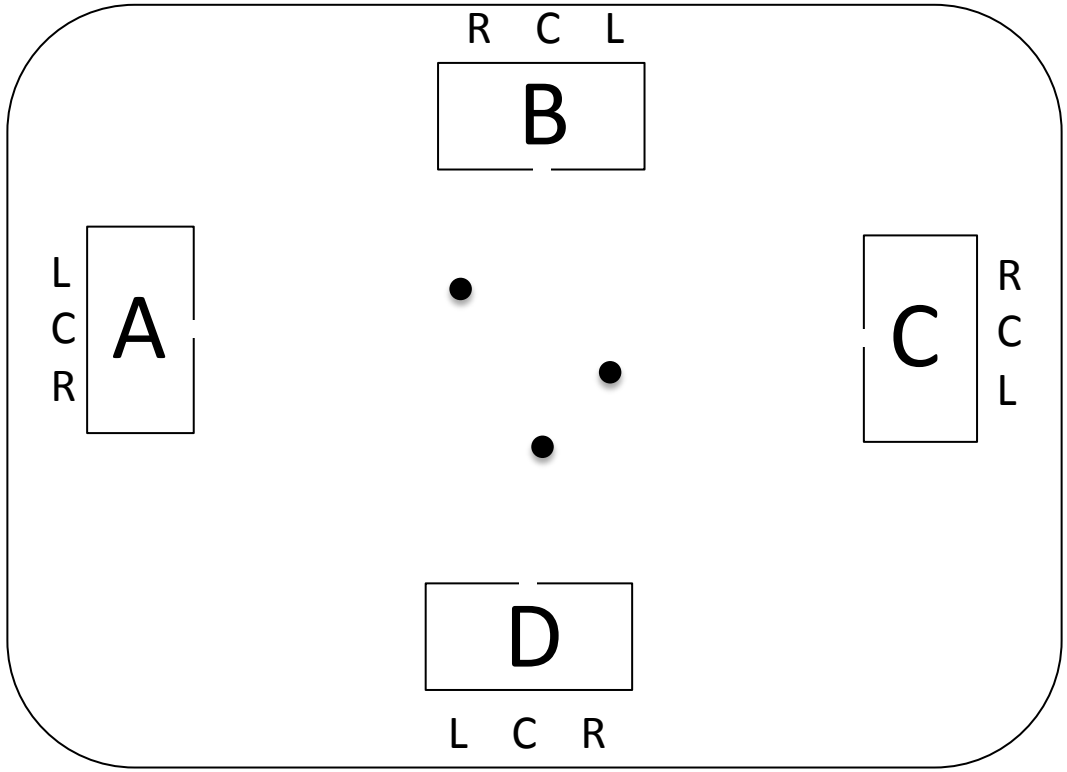
(Notice the feature order on the image plane is opposite of the order in the scene)

Camera B ☐

Camera C ☐

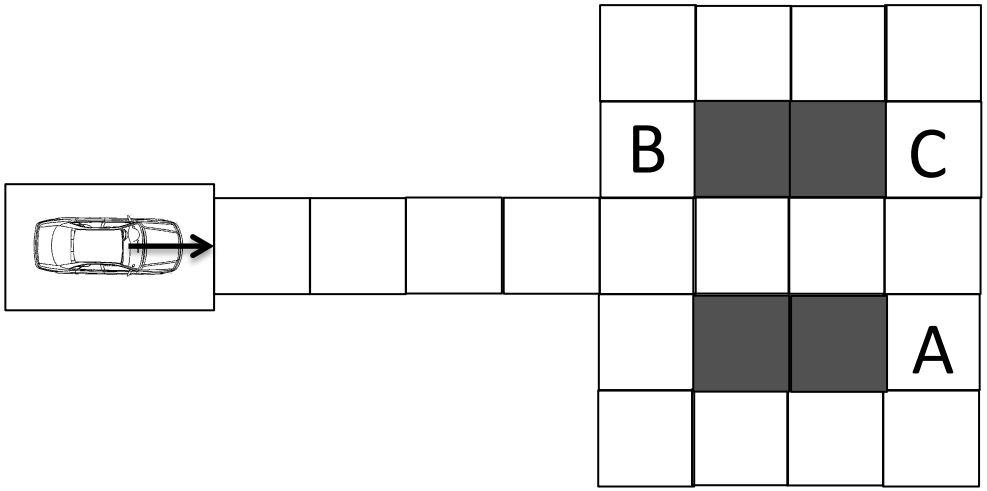
Camera D ☐

None of them ☐



12: Self-Driving Cars

In a deterministic road environment, a robot car can go straight (cost: 1), turn left (cost: 14), or turn right (cost: 1). Assume that when turning, the robot stays in the same grid cell; however it cannot turn twice without going straight. Calculate the total minimum cost of going from the start to location A, from the start to location B, and from the start to location C.



A

B

C