70059845

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Tutorial Comments

COS 3751 2017-06

QUESTION 1: STATE SPACES

a) Agent function maps any given percept sequence to an action
Agent program is a concrete implementation of a function, running in some physical environment.

b) Discrete environment: finite number of distinct states and finite set of percepts and actions for each state, e.g. chess
Continuous environment: infinitely many distinct states and infinitely many percepts and actions for each state, changing over time, e.g. self-driving car.

c) i) Let P represent the next player to move, and n the number of items on the heap, then the state space is:

$$S = \{P, n\} \mid P \in \{A, B\},\ 0 \leq n \leq 5$$

ii) Action $a = Take(x) \mid x \in \{1,2,3\}$
$Result(a, s) \mapsto S_1 = \{P, n-x\}$ (s is the current state and S_1 is a successor state.)

iii) $S_0 = \{A, 5\}$
Let $a_0 = Take(2)$
$Result(a_0, S_0) \mapsto S_1 = \{B, 3\}$

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QUESTION 2: SEARCHING

a) See 2017-10 paper.

b)i) In the format $n(h,g,f)$:

G-L (3, 1, 4); H-L (4, 2, 6), M-L (5, 1, 6), Q-L (6, 2, 8), P-L (5, 1, 6)

ii) Yes. For a heuristic to be admissable, $h(n) \leq h^*(n)$, i.e. the heuristic function's value must less than or equal to the actual value (f). In the example this will always be the case since the heuristic adds the cheapest possible cost for a direct route to goal. So the true cost will always be equal in the best case scenario and greater than should obstacles be in the way.

c) A, BCD, E, GH, L, K, J

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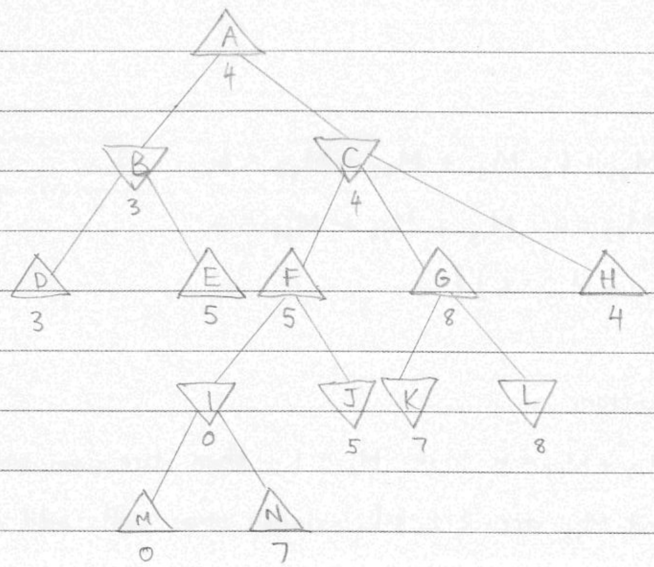
QUESTION 3: ADVERSARIAL SEARCH

a)



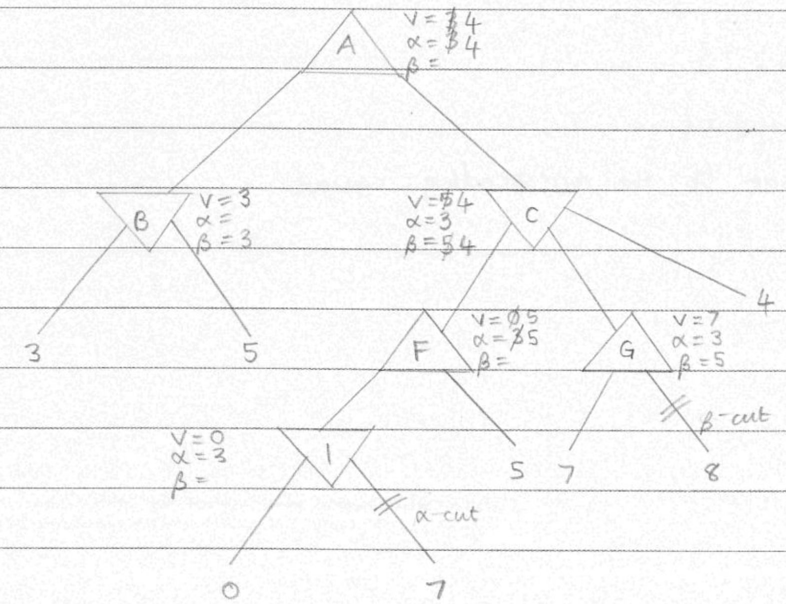
A = 4

B = 3

C = 4

F = 5

b)



A(4, ∞)

B(−∞, 3)

C(3, 4)

F(5, ∞)

MAX: $v \geq \beta$? β-cut

MIN: $v \leq \alpha$? α-cut

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QUESTION 4: CONSTRAINT SATISFACTION PROBLEMS

a)i) $X = \{ M_{11}, M_{12}, M_{13}, M_{21}, M_{22}, M_{23}, M_{31}, M_{32}, M_{33} \}$

ii) $D_X = \{ 1, 2, 3 \}$

iii) $C = \{ M_{11} + M_{12} + M_{13} = 6,\ M_{21} + M_{22} + M_{23} = 6,\ M_{31} + M_{32} + M_{33} = 6,$
$M_{11} + M_{21} + M_{31} = 6,\ M_{12} + M_{22} + M_{32} = 6,\ M_{13} + M_{23} + M_{33} = 6,$
$(M_{11} + M_{22} + M_{33} = 6 \text{ OR } M_{31} + M_{22} + M_{13} = 6) \}$

iv)

M_{11} 1	M_{12} 3	M_{13} 2
M_{21} 3	M_{22} 2	M_{23} 1
M_{31} 2	M_{32} 1	M_{33} 3

← An example of a solution.

For constraint $M_{11} + M_{12} + M_{13} = 6$, if $M_{11} = 1$, then the variables available for M_{12} and M_{13} are $\{2, 3\}$, since that will add up to 6.

$D_{11} = \{1\}$

$D_{21}, D_{31}, D_{12}, D_{13} = \{2, 3\}$

$D_{23}, D_{32}, D_{33}, D_{22} = \{1, 2, 3\}$

where D is the Domain of the corresponding square.

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QUESTION 5 : PROPOSITIONAL LOGIC

a) The resolution closure of a set of clauses (S), is the set of all clauses derivable by repeated application of the resolution rule to clauses in S or their derivatives. If one obtains the empty set using this procedure, then the set of clauses is not satisfiable.

QUESTION 6 : RESOLUTION REFUTATION

a) 2. $\forall x\,[\text{food}(x) \rightarrow \text{eats}(\text{John}, x)]$

3. food (Apples)

4. food (Chicken)

5. $\text{eats}(\text{Bill}, \text{peanuts}) \wedge \neg \text{killedfromeating}(\text{Bill}, \text{peanuts})$

6. $\forall v\,[\text{eats}(\text{Bill}, v) \rightarrow \text{eats}(\text{Sue}, v)]$

b) 1. $\text{eats}(y,z) \wedge \neg \text{killedfromeating}(y,z) \rightarrow \text{food}(z)$

$\neg(\text{eats}(y,z) \wedge \neg \text{killed from eating}(y,z)) \vee \text{food}(z)$

$\neg \text{eats}(y,z) \vee \text{killed from eating}(y,z) \vee \text{food}(z)$

2. $\neg \text{food}(x) \vee \text{eats}(\text{John}, x)$

3. food (Apples)

4. food (Chicken)

5. eats (Bill, peanuts)

$\neg$killedfromeating (Bill, peanuts)

6. $\neg \text{eats}(\text{Bill}, v) \vee \text{eats}(\text{Sue}, v)$

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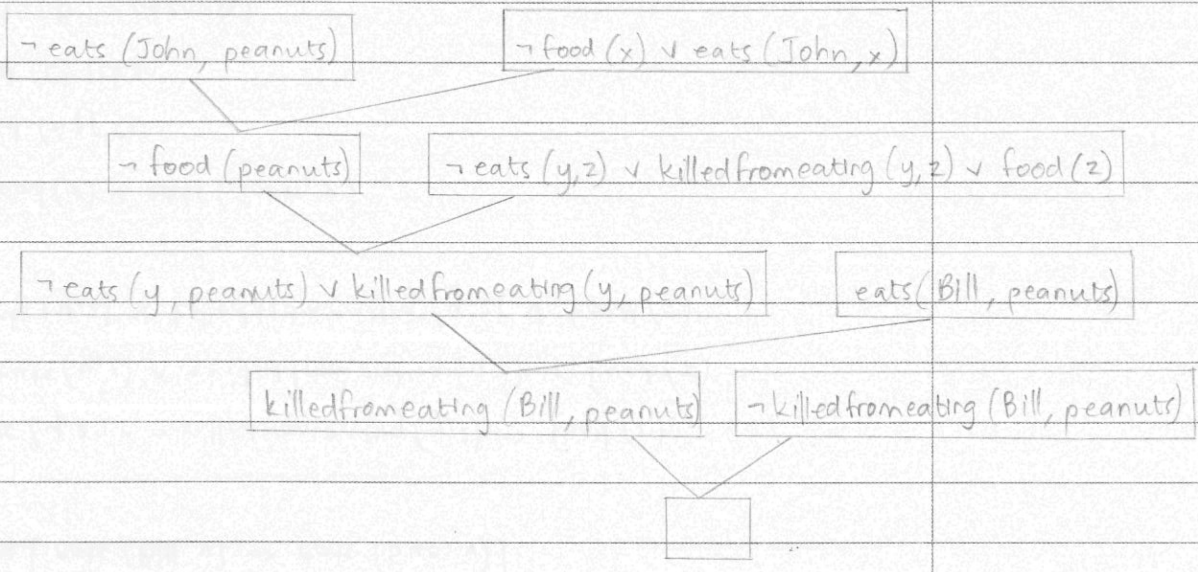
QUESTION 6 cont...

c) To use resolution refutation we take the negation of the goal, i.e. ¬eats(John, peanuts) and add it to the given statements, then attempt to derive a contradiction (empty clause).



Thus, John eats peanuts.

QUESTION 7: MACHINE LEARNING

i) $E_{TO} = E[6,4]$, $p = \frac{6}{10}$, thus $E_{TO} = 0.97$ (E_{TO} is Entropy for Take Over variable)

ii)

	Budget(B)	Resources(R)	Sentiment(S)	Take Over (TO)
1	Under	Available	Positive	Yes
3	On-Target	Available	Positive	No
7	Over	Available	Negative	Yes
9	On-Target	Available	Negative	Yes

Table for Time-line = Ahead

$E_{TO} = E[3,1]$, $p = \frac{3}{4}$ thus $E_{TO} = 0.81$ (for Time-line = Ahead)

Remainder (B) $= \frac{1}{4} \times E[1,0] + \frac{2}{4} \times E[1,1] + \frac{1}{4} \times E[1,0] = \frac{1}{4} \times 0 + \frac{2}{4} \times 1 + \frac{1}{4} \times 0 = 0.5$

Remainder (R) $= \frac{4}{4} \times E[3,1] = 1 \times 0.81 = 0.81$

Remainder (S) $= \frac{2}{4} \times E[1,1] + \frac{2}{4} \times E[2,0] = 0.5 + 0 = 0.5$

Gain (B) $= 0.81 - 0.5 = 0.31$

Gain (R) $= 0.81 - 0.81 = 0$

Gain (S) $= 0.81 - 0.5 = 0.31$

Either Budget or Sentiment should be chosen for the Ahead branch since they have the highest information gain.