Artificial Intelligence: Search, CSPs and Logic Bayesian Networks, Probabilistic Inference

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Contents

Question 1

part a.

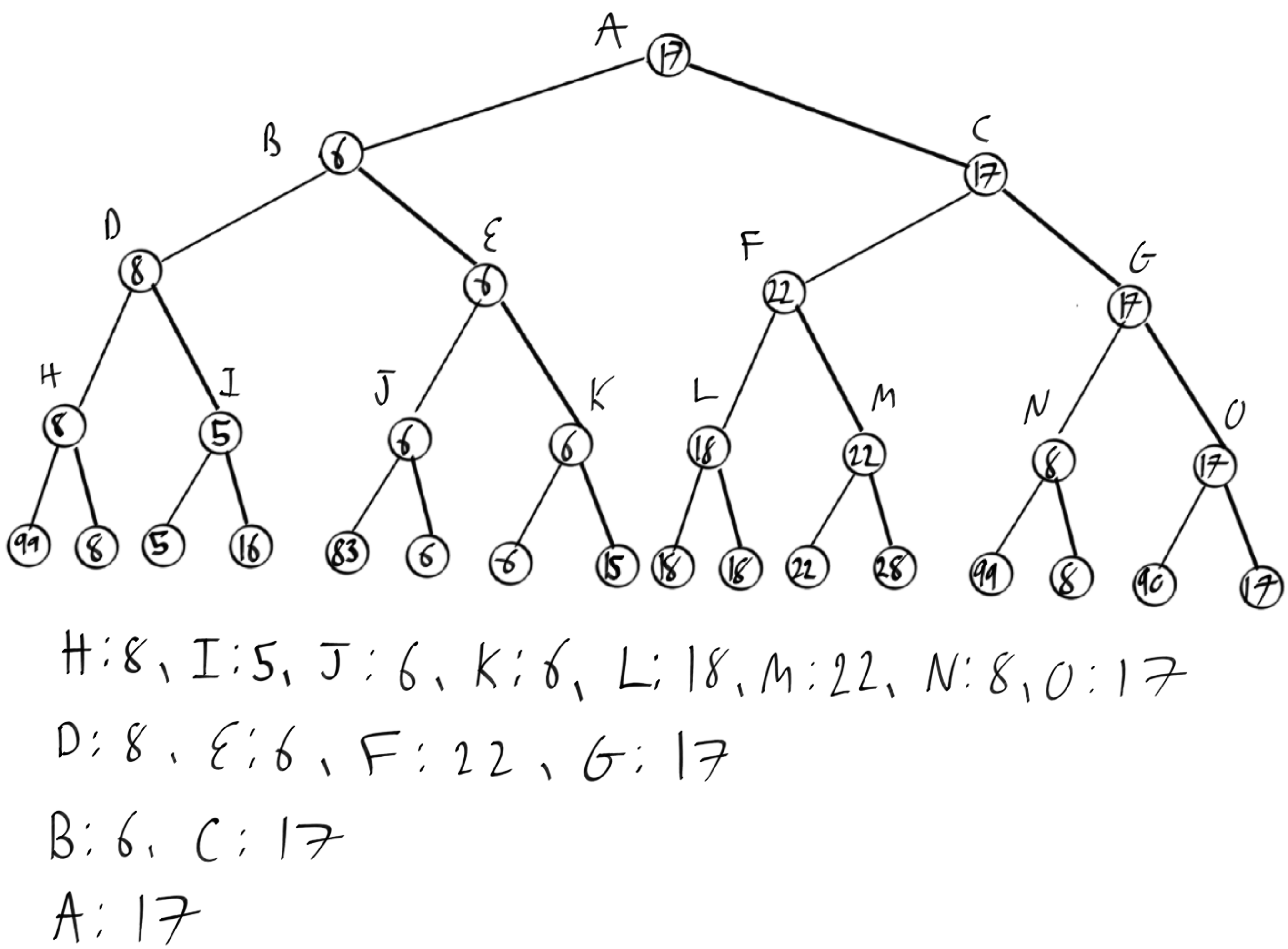

Figure 1: Question 1: Part a

part b.

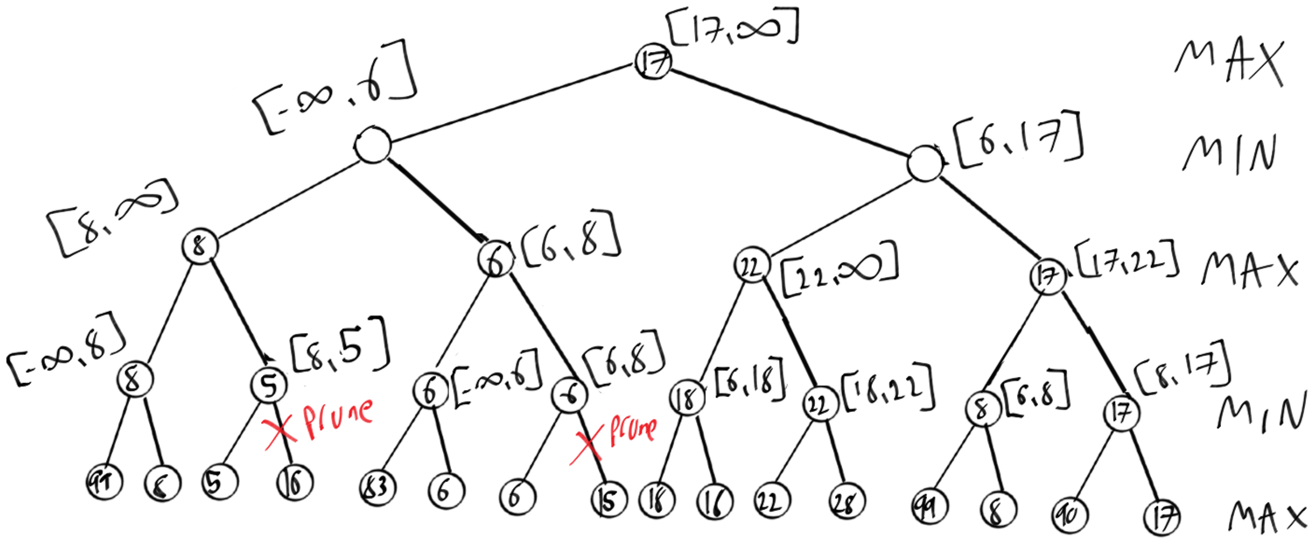

Figure 2: Question 1: Part b

part c.

NOT DONE

part d.

NOT DONE

part e.

NOT DONE

Question 2

part a.

NOT DONE

part b.

NOT DONE

part c.

NOT DONE

part d.

NOT DONE

Question 3

part a.

NOT DON3

part b.

NOT DONE

part c.

NOT DONE

Question 4

part a.

NOT DON3

part b.

NOT DONE

part c.

NOT DONE

Question 5

part a.

NOT DON3

part b.

NOT DONE

part c.

NOT DONE

Question 6

part a.

NOT DON3

part b.

NOT DONE

part c.

NOT DONE

Question 7

part a.

NOT DON3

part b.

NOT DONE

part c.

NOT DONE

Question 8

part a.

Cost of good quality car:

$$C(q^+(c_1)) = \$4000 - (3000) = \$1000. \tag{1}$$

Cost of bad quality car:

$$C(q^-(c_1)) = \$4000 - (3000 + 1400) = -\$400. \tag{2}$$

Assuming that repairs can be made without taking it to the mechanic - perhaps the $1400 is a separate cost than the $100 needed to check the quality of the car.

Probability of good quality car:

$$P(q^+(c_1)) = 0.7 \tag{3}$$

Probability of bad quality car:

$$P(q^-(c_1)) = 0.3 \tag{4}$$

Expected net gain:

$$E(c_1) = C(q^+(c_1)) * P(q^+(c_1)) + C(q^-(c_1)) * P(q^-(c_1))$$

$$\mathbf{E(c_1) = \$580} \tag{5}$$

part b.

$$P(Pass|q^+) = 0.8 \tag{6}$$

$$P(Pass|q^-) = 0.35 \tag{7}$$

Using 6 and 7:

$$P(\neg Pass|q^+) = 1 - P(Pass|q^+) = 0.2 \tag{8}$$

$$P(\neg Pass|q^-) = 1 - P(Pass|q^-) = 0.65 \tag{9}$$

Using 3, 4, 6, 7:

$$P(Pass) = P(Pass|q^+) * P(q^+) + P(Pass|q^-) * P(q^-) = 0.665$$

$$\mathbf{P(Pass) = 0.665} \tag{10}$$

Using 10:

$$P(\neg Pass) = 1 - P(Pass) = 0.335$$

$$\mathbf{P(\neg Pass) = 0.335} \tag{11}$$

Using 6, 3, and 10:

$$\mathbf{P(q^+|Pass) = \frac{P(Pass|q^+) * P(q^+)}{P(Pass)} = 0.842} \tag{12}$$

Using 7, 4, and 10:

$$\mathbf{P(q^-|Pass) = \frac{P(Pass|q^-) * P(q^-)}{P(Pass)} = 0.158} \tag{13}$$

Using 8, 3, and 11:

$$\mathbf{P(q^+|\neg Pass) = \frac{P(\neg Pass|q^+) * P(q^+)}{P(\neg Pass)} = 0.418} \tag{14}$$

Using 9, 4, and 11:

$$\mathbf{P(q^-|\neg Pass) = \frac{P(\neg Pass|q^-) * P(q^-)}{P(\neg Pass)} = 0.582} \tag{15}$$

part c.

Paying for the test with the mechanic, the new costs are:

$$C'(q^+(c_1)) = C(q^+(c_1)) - \$100 = \$900$$

$$C'(q^-(c_1)) = C(q^-(c_1)) - \$100 = -\$500$$

Given a pass:

$$E(c_1|Pass) = C'(q^+(c_1)) * P(q^+(c_1)|Pass) + C'(q^-(c_1)) * P(q^-(c_1)|Pass)$$

$$\mathbf{E(c_1|Pass) = \$678.8}$$

Given a failure:

$$E(c_1|\neg Pass) = C'(q^+(c_1)) * P(q^+(c_1)|\neg Pass) + C'(q^-(c_1)) * P(q^-(c_1)|\neg Pass)$$

$$\mathbf{E(c_1|\neg Pass) = \$85.2}$$

Regardless of a pass or a failure, the best decision is the sell the car as there will be a net gain.

part d.

Without the mechanic's test, the expected gain from selling the car will be $\mathbf{E(c_1) = \$580}$

With the test, the expected gain is $\mathbf{\$678.80}$. The value of the optimal information is the difference between the expected gain with the information and the expected gain without the information. The optimal information value is $\mathbf{\$98.80}$. I should take C1 to the mechanic.