Adversarial Search - Bayesian Networks

Assignment 3

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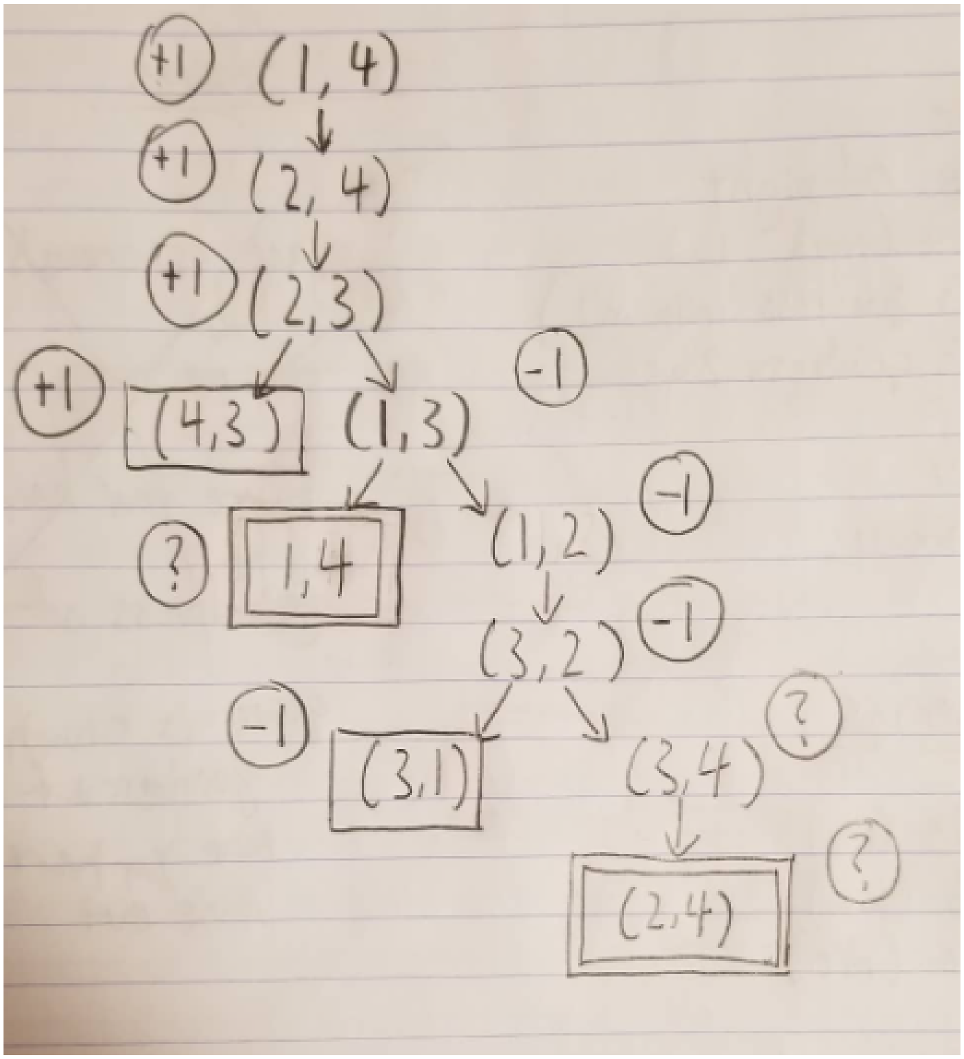
Problem 1



"?" values are used to annotate loop states. When an agent has to choose between a +1 value and a "?" value (+1,?) the max player will always choose +1 while the min player will choose ?, and vice versa for (-1,?), with the min player choosing -1 and the max player choosing "?". Since the game value of a loop state is unknown, it is best for a max/min player to choose the corresponding max/min value if it is available, however if that value is not available the "?" state is a viable option to explore as it cannot be worse than an immediate loss. If all the successors of a state have a "?" value, the backed-up value is also "?".

Problem 2

(a) Computing the joint probability distribution:

$$P(a,b,c,d,e) = P(a) * P(b) * P(c) * P(d|a,b) * P(e|b,c)$$
$$P(a,b,c,d,e) = 0.2 * 0.5 * 0.8 * 0.1 * 0.3$$
$$P(a,b,c,d,e) = 0.0024$$

(b) Computing the joint probability distribution:

$$P(\neg a,\neg b,\neg c,\neg d,\neg e) = P(\neg a) * P(\neg b) * P(\neg c) * P(\neg d|\neg a,\neg b) * P(\neg e|\neg b,\neg c)$$
$$P(\neg a,\neg b,\neg c,\neg d,\neg e) = 0.8 * 0.5 * 0.2 * 0.1 * 0.8$$
$$P(\neg a,\neg b,\neg c,\neg d,\neg e) = 0.0064$$

(c) Using the conditional probability rule $P(A|B) = \frac{P(A \bigcap B)}{P(B)}$

$$P(\neg a|b,c,d,e) = \frac{P(\neg a,b,c,d,e)}{P(b,c,d,e)}$$
$$P(\neg a|b,c,d,e) = \frac{P(\neg a,b,c,d,e)}{P(a,b,c,d,e) + P(\neg a,b,c,d,e)}$$
$$P(\neg a|b,c,d,e) = \frac{P(\neg a) * P(b) * P(c) * P(d|\neg a,b) * P(e|b,c)}{0.0024 + P(\neg a) * P(b) * P(c) * P(d|\neg a,b) * P(e|b,c)}$$
$$P(\neg a|b,c,d,e) = \frac{0.8 * 0.5 * 0.8 * 0.6 * 0.3}{0.0024 + 0.8 * 0.5 * 0.8 * 0.6 * 0.3}$$
$$P(\neg a|b,c,d,e) = \frac{0.0576}{0.0024 + 0.0576}$$
$$P(\neg a|b,c,d,e) = 0.96$$

Problem 3

(a)

$$\alpha = \frac{1}{P(\neg b,j,m) + P(b,j,m)}$$
$$P(b|j,m) = \alpha \sum_e \sum_a P(b,j,m,e,a)$$
$$P(b|j,m) = \alpha P(b) \sum_e P(e) \sum_a P(a|b,e) P(j|a) P(m|a)$$

(b)

Problem 4

(a)

(b)