Games and Computation Homework #7: Games of Chance and Computations of Pig

Answer these questions within the HW #7 Moodle quiz:

Probability of Pig Roll to 50

What is the probability (not percent) of a Pig turn scoring if a player holds at 50 or higher? Hint: Slightly modify and use one of the programs we wrote in class. Round your answer to 3 digits after the decimal point: ____________

Pig Hold at 20 Average Score

What is the average score gain of a player that holds at 20 on their turn in the game of Pig? Hint: Use one of the programs we wrote in class. Round your answer to 2 digits after the decimal point: ____________

Pig State

The "state" of a game is all information necessary to describe the current situation of the game. For mathematical/computational purposes, the state is often a minimal description of variable items, including no information that is irrelevant to the current game decision and excluding information which doesn't change. From this perspective, which of the following are minimal necessary variable pieces of information in the state description for the dice game Pig?

- ☐ current player score
- ☐ goal score
- ☐ number of times the die has been rolled this turn
- ☐ number of turns so far
- ☐ opponent score
- ☐ probability of rolling a 1
- ☐ turn total

Hog State

The game of Hog is like the game of Pig, except that each turn consists of a single simultaneous roll of as many dice as the player chooses. If a one appears on any of the rolled dice, the player scores nothing. If no 1s appear on any of the rolled dice, the player scores the sum. It is as if the Pig player chooses the number of times they must roll at the beginning of their turn and rolls them all at once. What are the variable(s) of the minimal state description for Hog?

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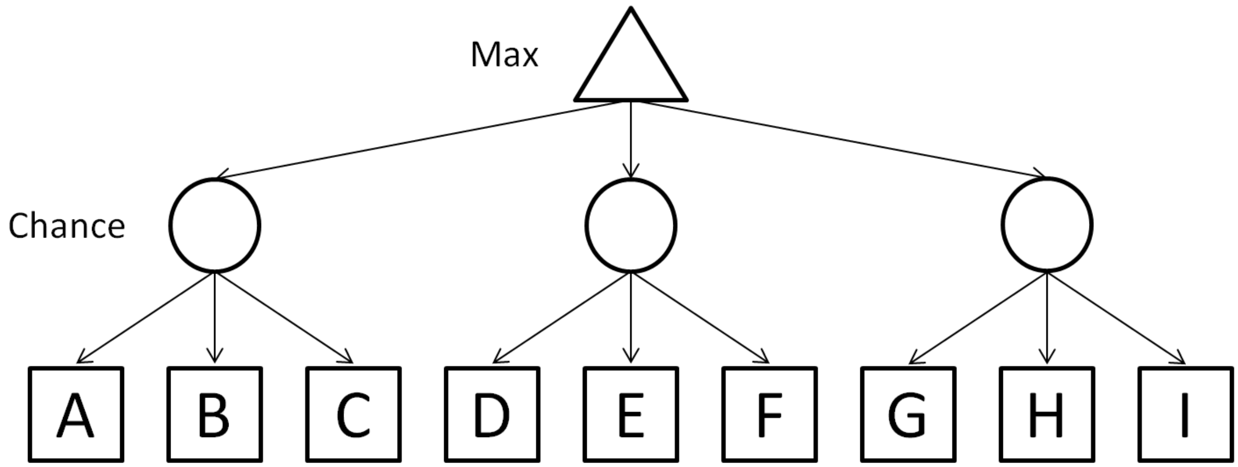
Chance Node Evaluation 1

At a chance node C, let the probabilities of three disjoint outcomes be 0.44, 0.33, and 0.23, and let the corresponding outcome utilities be -0.3, 0.0, and 0.9. What, rounded to three places after the decimal point, is the utility of chance node C? ____________

Chance Node Evaluation 2

At a chance node C, let the probabilities of three disjoint outcomes be 0.49, 0.41, and 0.10, and let the corresponding outcome utilities be 3.9, 3.8, and -3.9. What, rounded to three places after the decimal point, is the utility of chance node C? ____________



Expectimax Max Node Evaluation 1

At a max node M, there are three actions leading to chance nodes 0, 1, and 2. Let P(n1, n2) be the probability of transitioning from chance node n1 to node n2. Let U(n) be the utility or value of node n. P(0, A) = 0.4. U(A) = 5.0. P(0, B) = 0.5. U(B) = 1.6. P(0, C) = 0.1. U(C) = -3.4. P(1, D) = 0.4. U(D) = 1.8. P(1, E) = 0.3. U(E) = -4.5. P(1, F) = 0.3. U(F) = 0.3. P(2, G) = 0.5. U(G) = 1.7. P(2, H) = 0.5. U(H) = 3.8. P(2, I) = 0.0. U(I) = -4.9. What, rounded to two places after the decimal point, is the utility of max node M? ____________

Expectimax Max Node Evaluation 2

At a max node M, there are three actions leading to chance nodes 0, 1, and 2. Let P(n1, n2) be the probability of transitioning from chance node n1 to node n2. Let U(n) be the utility or value of node n. P(0, A) = 0.3. U(A) = 2.9. P(0, B) = 0.5. U(B) = 4.8. P(0, C) = 0.2. U(C) = 3.2. P(1, D) = 0.1. U(D) = 2.1. P(1, E) = 0.6. U(E) = 4.3. P(1, F) = 0.3. U(F) = 4.1. P(2, G) = 0.0. U(G) = 3.2. P(2, H) = 0.4. U(H) = 3.5. P(2, I) = 0.6. U(I) = 1.3. What, rounded to two places after the decimal point, is the utility of max node M? ____________

Optimal Pig Play Problem 1

Let i, j, and k be the current player score, the opponent score, and the turn total, respectively. Let P(i,j,k) be the probability of winning assuming that both players play optimally given i, j, and k. Suppose you are the current player and i=76, j=8, and k=7. Suppose that you also know that P(76,8,9) = 0.969418, P(76,8,10) = 0.970738, P(76,8,11) = 0.971920, P(76,8,12) = 0.973145, P(76,8,13) = 0.974344, P(8,76,0) = 0.061302, and P(8,83,0) = 0.033529. The optimal play for you would be to:

- ☐ roll
- ☐ hold

Optimal Pig Play Problem 2

Let i, j, and k be the current player score, the opponent score, and the turn total, respectively. Let P(i,j,k) be the probability of winning assuming that both players play optimally given i, j, and k. Suppose you are the current player and i=72, j=31, and k=9. Suppose that you also know that P(72,31,11) = 0.909003, P(72,31,12) = 0.912696, P(72,31,13) = 0.916233, P(72,31,14) = 0.919659, P(72,31,15) = 0.922740, P(31,72,0) = 0.171770, and P(31,81,0) = 0.098730. The optimal play for you would be to:

- ☐ roll
- ☐ hold