1. **hex-3x3.py** (from the class repo) solves the empty $3 \times 3$ board with about

(circle one) 7 70 700 7000 70000 70000 nodes for x (black) to play but about 1/3 as many for o (white) to play, because (circle ALL that apply)

a) the order in which possible moves are considered is asymmetric for black and white

b) the way positions are stored in the transposition table is asymmetric for black and white

c) solving for white to play first is generally easier than solving for black to play first

d) the order in which cell neighbors are stored is asymmetric for black and white

2. Alice and Bob play rock-paper-scissors. Alice’s payoff matrix is below. In each game, Bob’s payoff is negative of Alice’s. (If Alice plays rock and Bob plays scissors then Alice gets 2 and Bob gets -2.)

Alice’s payoffs R P S <- move by Bob

- R 0 -1 2
- P 1 0 -1
- S -2 1 0

If Alice plays each move with probability 1/3 her expected win rate is

______ if Bob plays rock ________ if Bob plays paper ________ if Bob plays scissors.

If Alice plays R/S/P with fixed probabilities $x/y/z$ and wants to maximize her expected payoff against all possible opponent strategies, her best choice for these values is

$x = $ ________  $y = $ ________  $z = $ ________  because (circle ALL that apply)

a) Bob can play the same counter-strategy

b) this best exploits opponent who sometimes play sub-optimally

c) against each individual move her expected payoff is positive

d) against each individual move her expected payoff is 0
3. AlphaGo (circle ALL that apply)

a) uses a version of a computer Go search algorithm from around 2006
b) relies on being able to accurately predict most likely moves
c) relies on being able to accurately estimate win probability
d) uses a version of an algorithm from image classification
e) uses a version of alpha-beta (with negamax) search

4. hex-simple.py (from class repo) solves the empty 4×4 board for x to play with about
   (circle one) 70,000 700,000 7,000,000 70,000,000 nodes while hex-vc.py takes about
   (circle one) 70,000 700,000 7,000,000 70,000,000 nodes, because (circle ALL that apply)
   a) hex-vc uses bridge virtual connections to detect wins earlier
   b) hex-vc uses better move ordering
   c) hex-vc uses mustplay analysis to eliminate losing moves
   d) hex-vc backs up a winning opponent virtual connection (if she has one)

5. In the left Go position with White to play, Black’s minimax score is +9, because Black can eventually kill all
   White stones. When Black follows this strategy, a longest game ends on move (circle one) 9 11 13 15 17 and the
   tree of all continuations of this game has (circle one) about 10 about 100 about 500 at least 1,000 nodes.

In the right Go position with White to play, when Black follows a minimax strategy, the tree of all continu-
ations of the game has (circle one) about 10 about 100 about 500 at least 1,000 nodes.

3×3 Go strategy trees that show minimax bounds are much larger than those for tic-tac-toe or 3×3 Hex because (circle ALL that apply)
   a) Go has more possible final scores
   b) in Go it is harder to find best moves
   c) Go allows a pass move
   d) in Go, because of superko, a position cannot be repeated
   e) Go allows capturing