1.2 Many tic-tac-toe positions appear different but are really the same because of symmetries. How might we amend the reinforcement learning algorithm described above to take advantage of this? In what ways would this improve it? Now think again. Suppose the opponent did not take advantage of symmetries. In that case, should we? Is it true. then. that symmetrically equivalent positions should necessarily have the same value?

SOLUTION: To take advantage of symmetries in tic-tac-toe, we could modify the reinforcement learning algorithm described above to use a symmetric board representation. Instead of treating each board state as a unique position, we could consider symmetrically equivalent positions as the same position. For example, if a board state is rotationally symmetric, we could treat all rotations of that state as the same position. This would reduce the number of unique positions that the algorithm needs to learn and would make the learning process more efficient.

To implement this modification, we could define a function that takes a board state and returns all of its symmetric equivalents. Then, we would update the values for all of these equivalent states together when the algorithm learns from a particular state. This would ensure that the algorithm learns the same value for all equivalent positions, regardless of which position it encounters during gameplay.

If the opponent did not take advantage of symmetries, we could still use the modified algorithm to take advantage of them. This would likely improve the algorithm's performance by reducing the number of unique positions that it needs to learn and increasing the efficiency of the learning process. However, it is not necessarily true that symmetrically equivalent positions should always have the same value. In some cases, the optimal move for a given symmetric position may depend on the specific position of the opponent's pieces, which could result in different values for symmetrically equivalent positions.