Question 4 – Expectimax

1. Pacman should display more relaxed behavior when ghosts are nearby. In particular, if Pacman perceives that he could be trapped but might escape to grab a few more pieces of food, he'll at least try. Explain in one or two sentences why the ExpectimaxAgent might outperform the AlphaBetaAgent in this scenario. (2 points total)

As Alpha-Beta agent is using MiniMax, it assumes the ghosts will always act optimally (i.e. in a way that maximizes their best interest); however, the ghosts may not be perfect players. Thus, Expectimax might outperform Alpha-Beta in this scenario if the ghosts do not play perfectly.

2. Consider a game tree where the root node is a max node, and the minimax value of the tree is vM. Consider a similar tree where the root node is a max node, but each min node is replaced with a chance node, where the expectimax value of the game tree is vE. For each of the following, decide whether the statement is True or False and briefly explain in one or two sentences your answer.

(a) True or False: vM is always less than or equal to vE. Explain your answer. (2 points)
(b) True or False: If we apply the optimal minimax policy to the game tree with chance nodes, we are guaranteed to result in a payoff of at least vM. Explain your answer. (2 points)
(c) True or False: If we apply the optimal minimax policy to the game tree with chance nodes, we are guaranteed a payoff of at least vE. Explain your answer. (2 points)

(a) True. Minimax assumes opponent plays optimally (i.e. Vm is the smallest possible value for the root). In Expectimax there is a chance that the opponent does not play optimally, thereby possibly increasing the value of the root. (i.e. $Ve \geq Vm$)

(b) True. Minimax assumes a worst-case scenario with respect to opponent's moves. If the min nodes are replaced with chance nodes, Vm is the floor on the (i.e. minimum possible) value of the root node since we can only do better as less optimal min-player moves may be stochastically (i.e. by chance) selected.

(c) False. The Minimax policy will not play as "aggressively" as Expectimax given that it assumes optimal play from its opponent and thus cannot guarantee as large a payoff. Consider for example a max node with two min-player (i.e. chance) child nodes (M1, M2), each with two equiprobable (i.e. either state is equally likely) terminal state children (M1a, M1b, M2a, M2b). Assuming Minimax/Expectimax search left to right, let M1a=M1b=0, M2a=-1, and M2b=100. In this case, $Ve \geq 0$ but Minimax would still select M1, which has a payoff less than Ve.