My advanced heuristic algorithm: The 2x2 pieces cannot overlap with any other pieces including(horizontal 1x2 piece, vertical 1x2 piece, single pieces), but any other pieces can overlap with each other. So for every configuration of the board, we want to calculate the heuristic for how many steps it takes for(2x2 pieces to reach our goal state with this less relaxed requirement compared to the Manhattan distance heuristic.

Q1: Describe how one can calculate the advanced heuristic value for any state of the puzzle.

Answer: For any state of the puzzle, you calculate how many steps it takes for pieces(2x2) to reach our goal state with the restriction that the 2x2 pieces **cannot** overlap with any other pieces and the pieces horizontal 1x2 piece, vertical 1x2 piece, single pieces can overlap with each other to make a clear way for 2x2 pieces to go through to reach the goal state. More in detail, the way we calculate is that the advanced heuristic is equal to the number of the steps to move the other pieces out the way to create a path for the 2x2 pieces to pass through to the goal location plus the number of step for the 2x2 pieces to reach to the goal location. In a math equation form, that is :
advanced_heuristic = the number of the steps to move the other pieces to create a path for the 2x2 pieces to pass through + the number of step for the 2x2 pieces to reach to the goal location

Q1:Why is your advanced heuristic admissible?

Answer: My advanced heuristic is admissible because I followed the procedure of constructing an admissible heuristic. First step, I defined a relaxed problem by removing some constraints on the original problem by allowing non-target pieces (I mean not the 2x2 piece) to overlap with each other. Then step 2, I solved the relaxed problem without search by showing how to calculate the heuristic value for any board state. Step 3 is that our heuristic never overestimates. Most importantly, **my advanced heuristic is created by making the Manhattan distance heuristic less relaxed.** So my advanced heuristic is less relaxed than the Manhattan distance heuristic and closer to the original problem.

Q3: Why does your advanced heuristic dominate the Manhattan distance heuristic?

Answer: My advanced heuristic dominates the Manhattan distance heuristic because it satisfies the requirement of being a dominating heuristic. **My advanced heuristic value >= the Manhattan distance heuristic for every state n** because **My advanced heuristic value not only include the number of the steps for pieces(2x2) to the goal location, but it also has the number of the steps to move the non-target pieces to create a path added into the advanced heuristic value.** So that is why My advanced heuristic value >= the Manhattan distance heuristic for every state n and My advanced heuristic value > the Manhattan distance heuristic for at least one state.