**Discuss the outputs - what can you say, for example, for the starting points that the arm cannot reach? How did the gradient\_descent optimize then? Does this make “sense”?**

In this optimization problem, I attempted to determine the "joint angles that minimize the distance between the character position and the user-specified position". The robotic arm consists of two arm lengths (l1-l2) and joints (theta 1, theta 2), and it can move in both the horizontal and vertical planes thanks to those joints.

If there are starting points that arm cannot reach it may be because of the gradient descent algorithm that I wrote at the beginning of the assignment (which was also the case for me). It means: maybe algorithm might not be able to find the proper joint angles needed to converge to a solution. It may be due to many things such as: initialization of the angles in code, choice of learning rate, gradient's accuracy, ext.

However, by its nature robot arm has physical restrictions. If the target point is outside of l1+l2, the arm cannot reach it. But still, algorithm modifies the angles of the arm's joints to look for positions that the arm can physically reach. Gradient descent will approximate as closely as possible to targets beyond the arm's physical reach. As a result, the arm will come as close as possible to the target but not exactly. But still, it is quite interesting that despite it can identify optimal solution, cannot indicate if the arm can actually reach the target.

And yes, it makes sense because the gradient descent algorithm still seeks to optimize the objective function and finds the best solution despite of the system's constraints—in our case, physical limitations—and unreachable target points.

I tried to figure out the "joint angles that minimize the distance between the character position and user-specified position" in this optimization problem.

1. Robotic arm has physical limitations because its reach is determined by the length of arms (l1-l2), and it has two joints connected to those arms [first joint allows rotation in the horizontal plane (theta1), while the second joint allows rotation in the vertical plane (theta2)]
2. so, if a target point lies outside the reach defined by the sum of these two lengths, the arm cannot reach that point.

**Version two**

The robotic arm is composed of two joints (theta 1, theta 2) and length of arms (l1-l2). Those are helping the robot arm for rotation in the horizontal and vertical plane.

But, it has physical limitations because the arm's reach is determined by l1+l2; the arm is unable to reach a target point that is outside of this range.