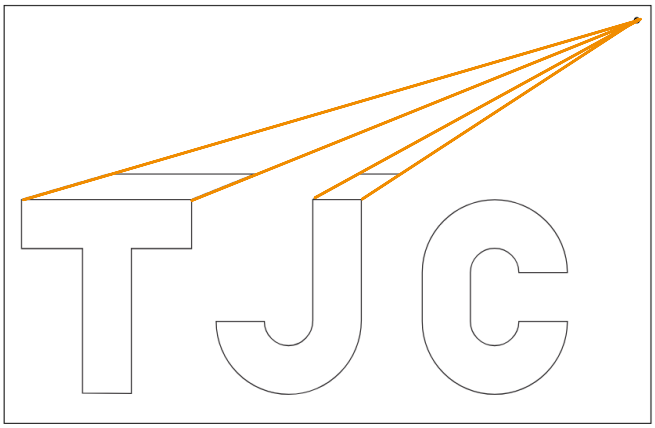
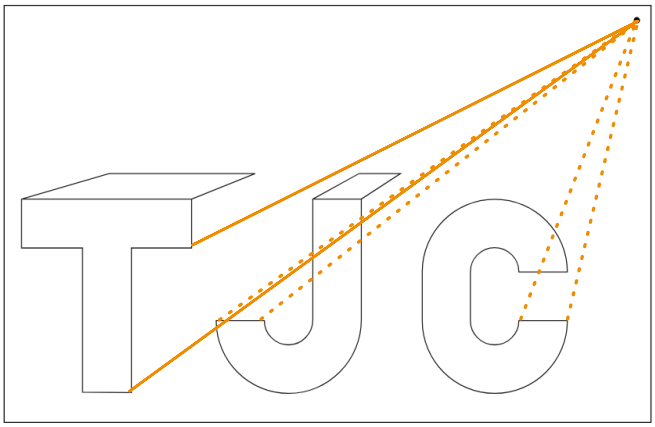
# Lesson 4 - Hints

## Problem 1

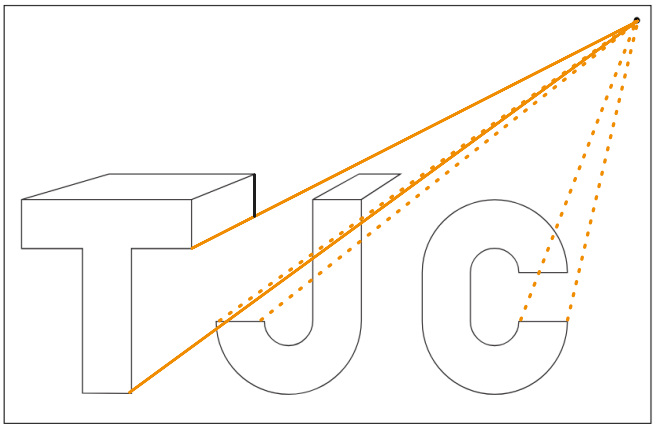
First notice that since this scene is in 1-point perspective, all lines not facing the viewer recede to the vanishing point at the top right corner.



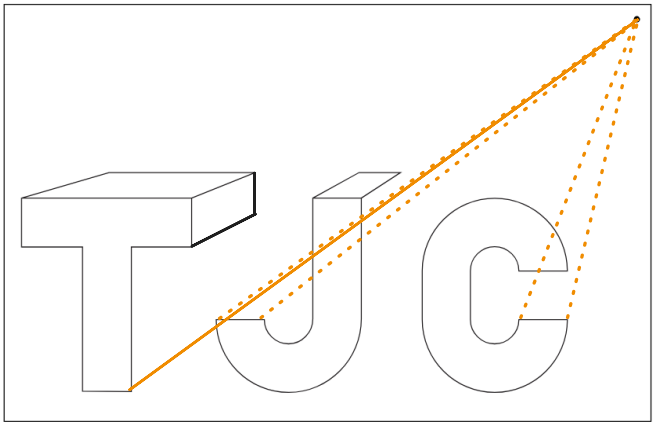
So we can complete the remaining lines similarly:



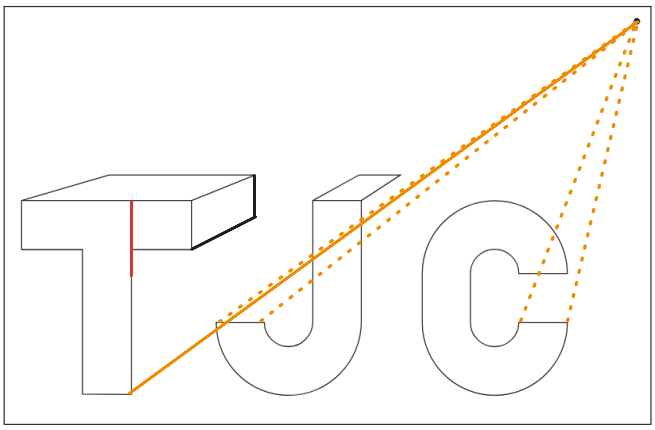
We first work on the letter T. We can finish the horizontal bar of the T



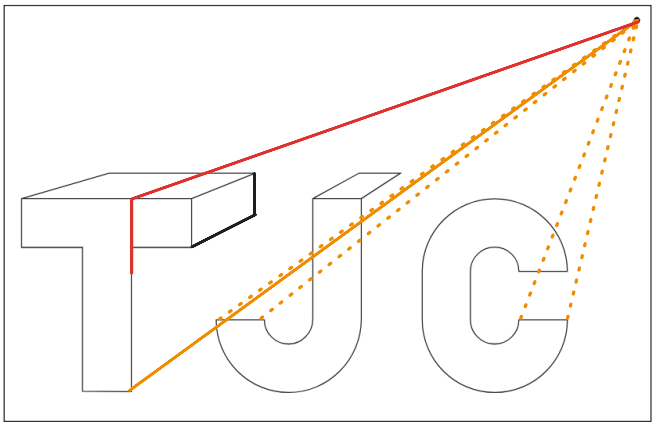
and retract its line towards the vanishing point to make the image cleaner:



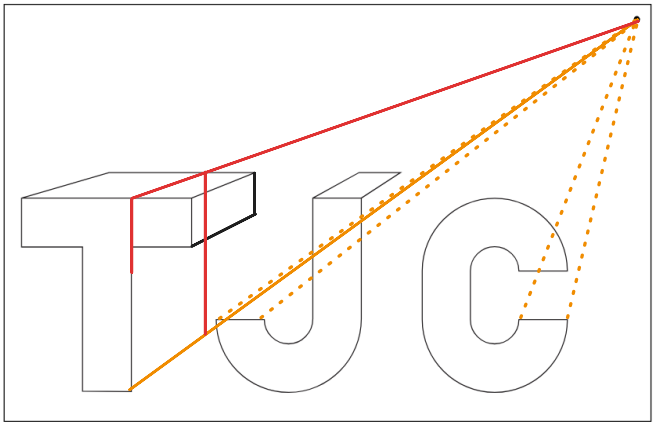
To figure out the thickness of the vertical stroke, we extend the left side of the vertical stroke up



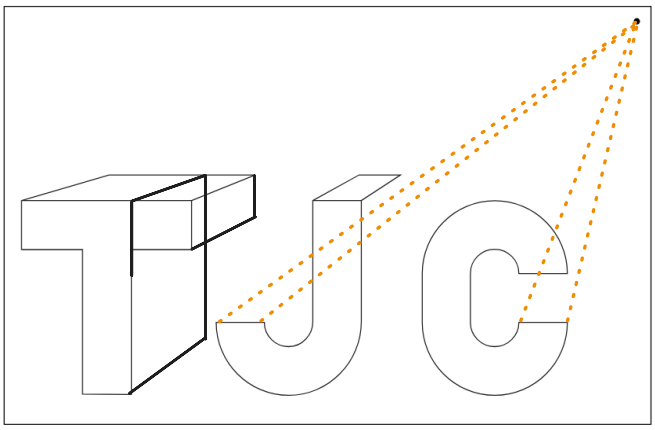
and to the back of the T (extended to the vanishing point) ...



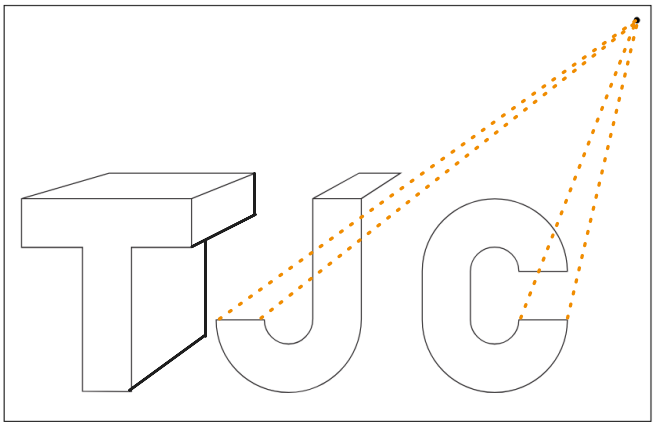
Where this new red line intersects the back of the T is also the back of the vertical stroke, so we extend the vertical stroke down:



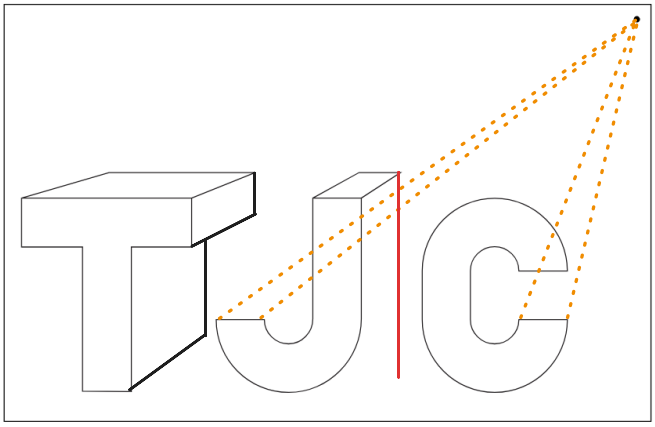
We now retract the lines to clean up our image:



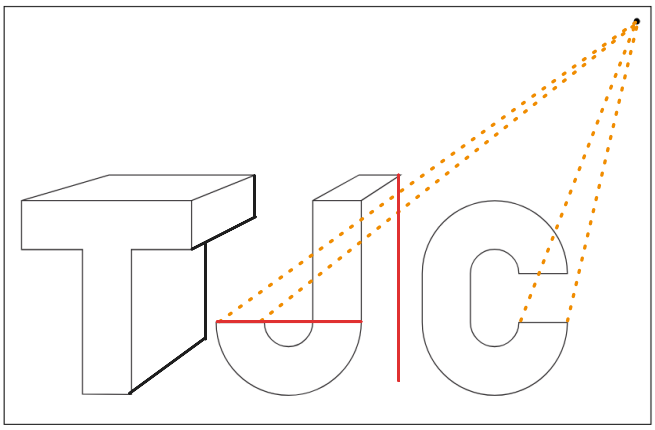
We also delete the auxiliary lines, and retract part of the vertical stroke of the T, so that the letter T is no longer "see through".



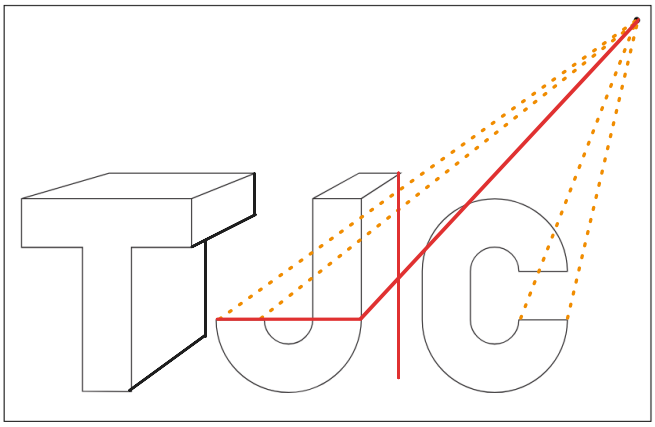
Let's now work on the letter J. We first extend the vertical stroke down



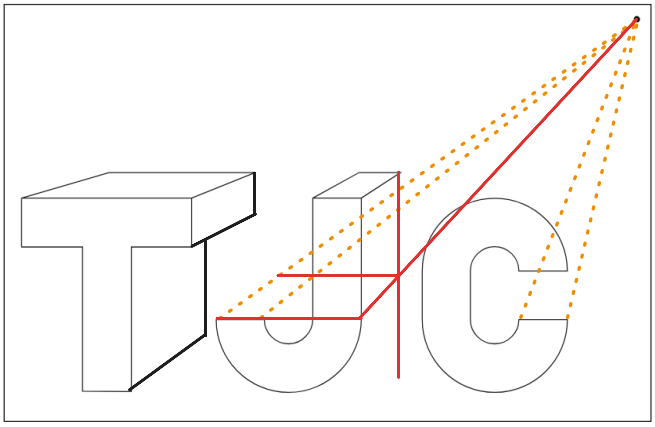
To determine the thickness of the J's hook, we extend the hook's front side over



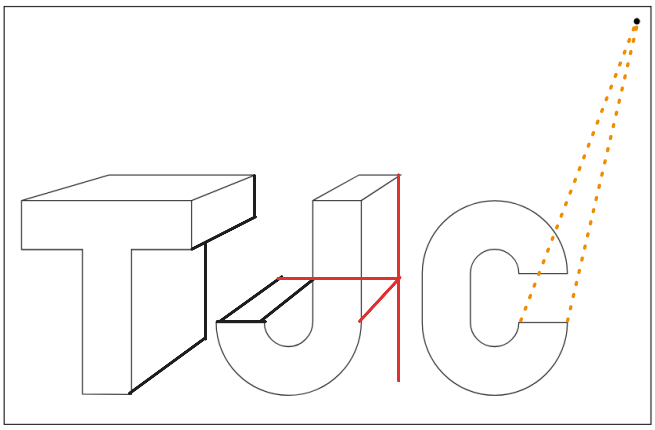
and to the back side of the J (by going towards the vanishing point)



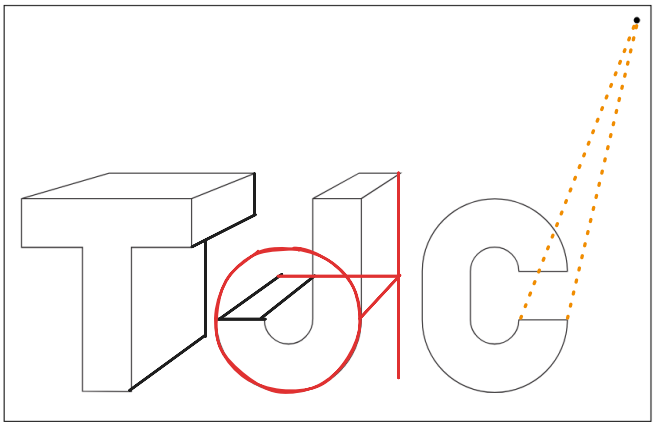
Where this red stroke intersects with the the vertical red stroke determines the thickness of the hook, so we draw a horizontal line towards the left again.



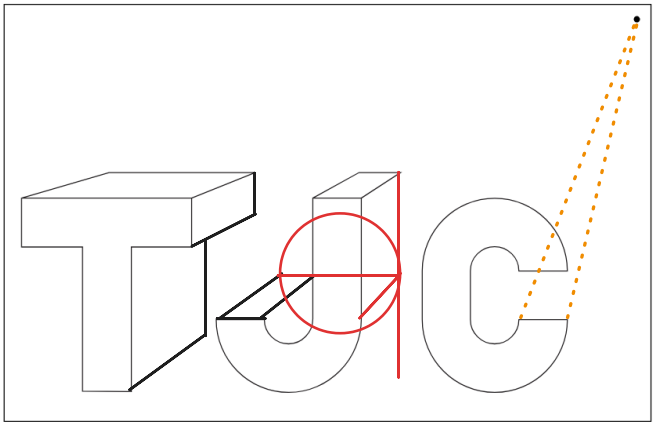
So now we complete the J's hook and retract the lines from the vanishing point.



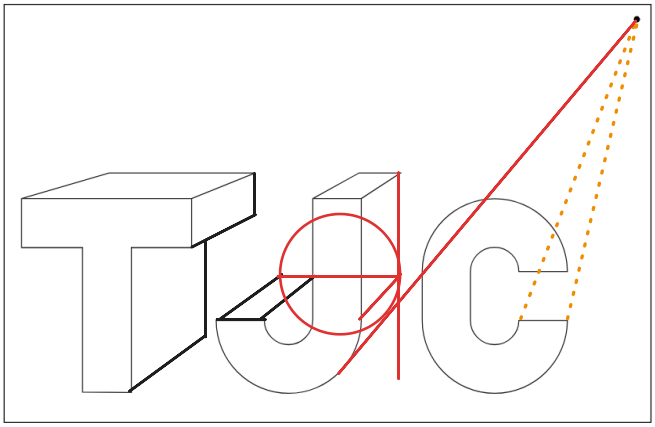
Notice that the front of the J's hook is a semi-circle:



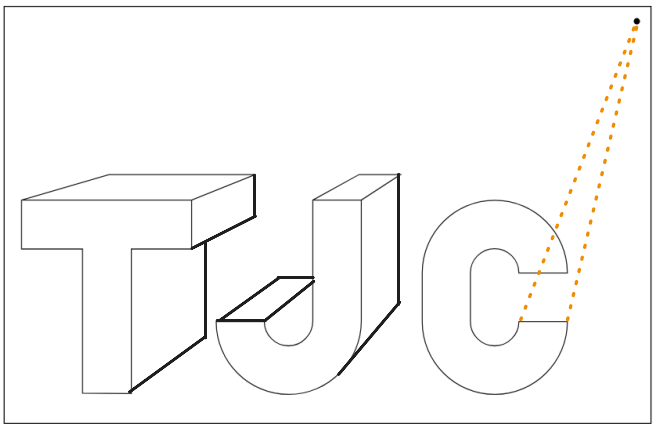
So this means that the back of the J's hook is also a semi-circle, whose diameter is the length of the back-side's horizontal line segment:



We also determine how thick the right side of J's curve is, by extending a line from the vanishing point to just where the line touches either circle.



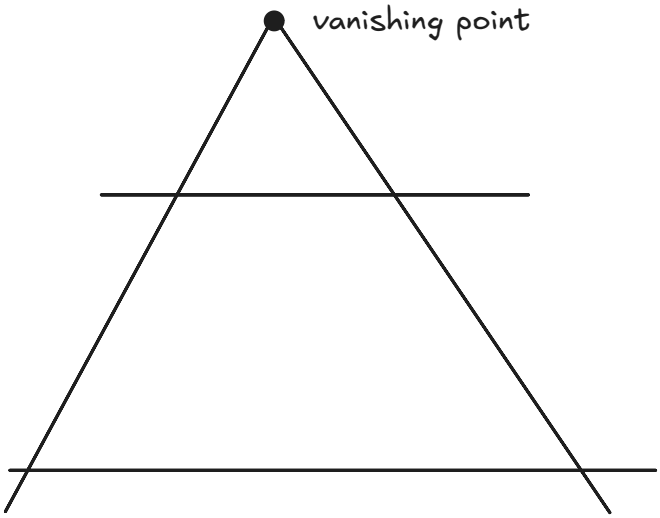
As it turns out, this new line only touches the front curve and not the back curve, meaning that from our perspective, the back curve is not visible at all. So we will remove the back circle from our picture. We also retract various lines to clean up our letter J.



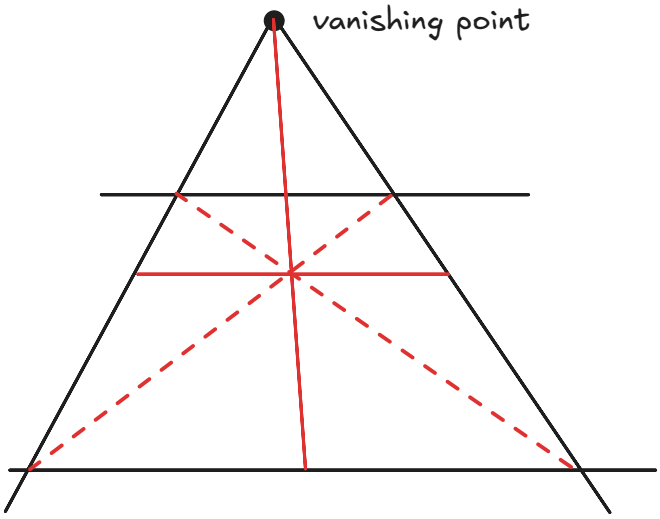
Completing the letter C into a 3D letter is left as an exercise.

## Problem 2

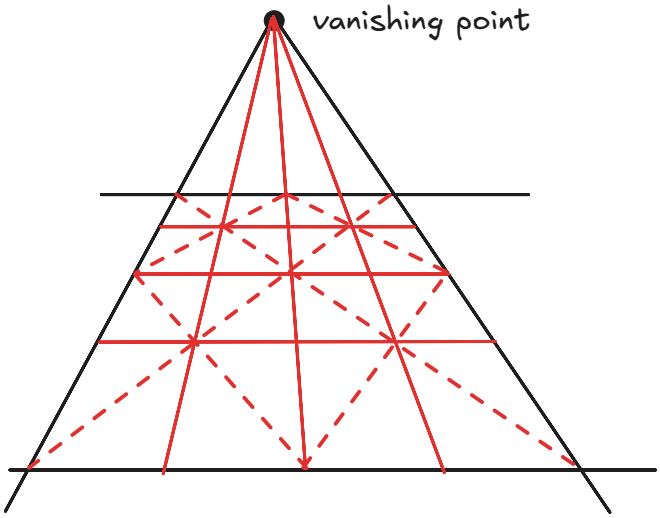
To transfer the circle to a square in 1-point perspective, we must also construct a 4x4 grid in 1PP as shown in Lesson 4: we start with a vanishing point, two parallel lines, and two lines meeting at the vanishing point (so these lines are parallel in the real world, but they meet at the vanishing point from a perspective view).



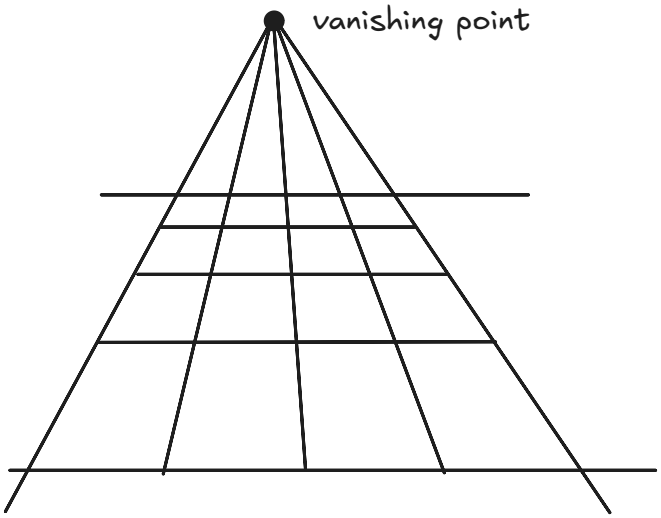

We subdivide this perspective square once.



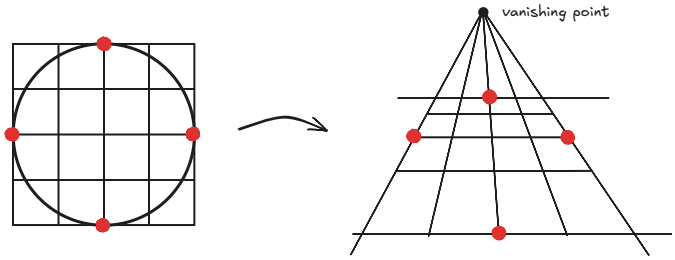

and subdivide it again:



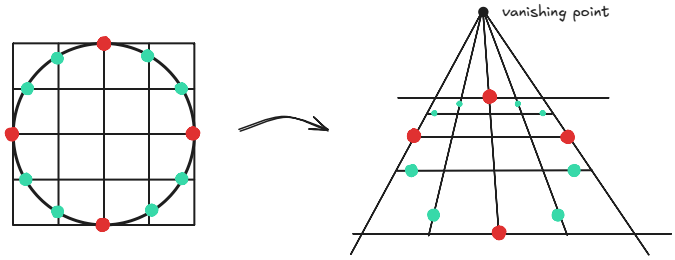

And so now we have a 4x4 grid in 1PP:



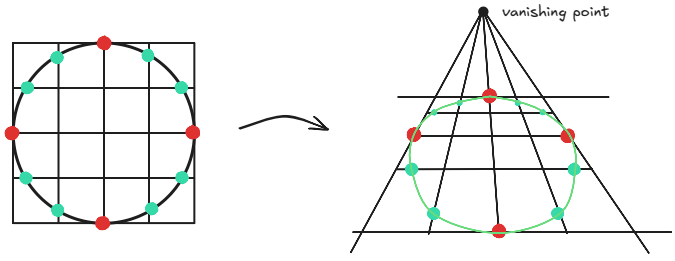

To transfer the circle: we notice that the original circle touched the four midpoints of the outer square, so our perspective circle must also do the same in the perspective grid:




Likewise, the circle touched the grid squares closer to the exterior side than the interior side, so we plot points on our perspective grid in like-fashion:




Finally we freehand in the rest of the circle by connecting the dots via a curve:



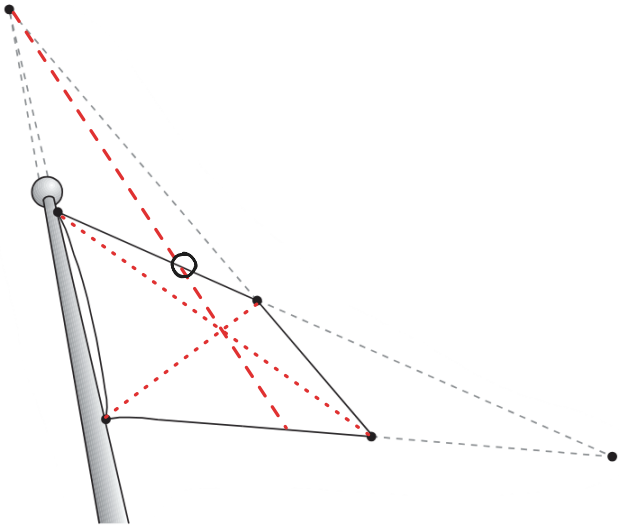

The finer the grid, the more accurately we can transfer our circle over.

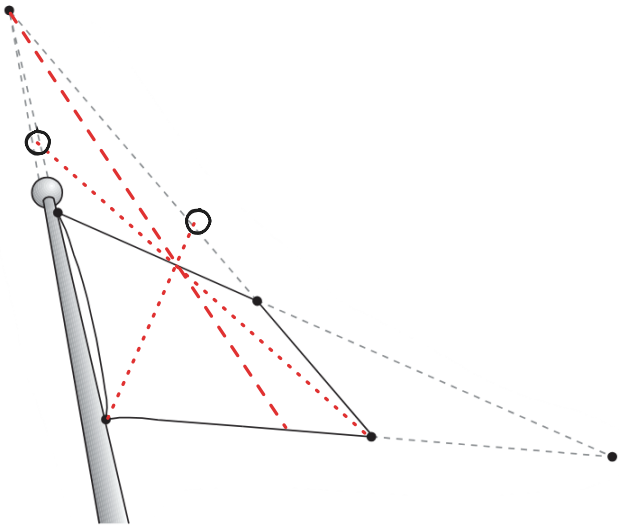
Notice that the perspective drawing of a circle appears to be an ellipse; in fact, this will always be the case: a perspective transformation of a conic section (circle, ellipse, parabola, hyperbola, or two intersecting lines) is always a conic section.

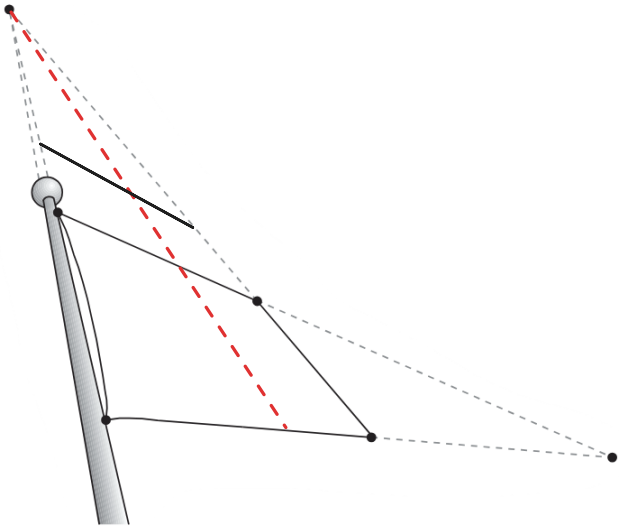
The same problem in 2PP is left as an exercise.

# Problem 3

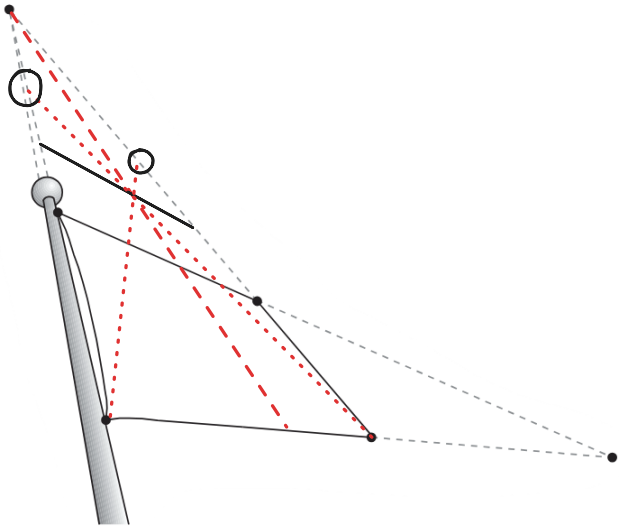
We subdivide a rectangle into three equal parts by following the procedure in Problems 1 and 2 of Lesson 5, but adapted to 2PP. We first duplicate the original rectangle (the flag):

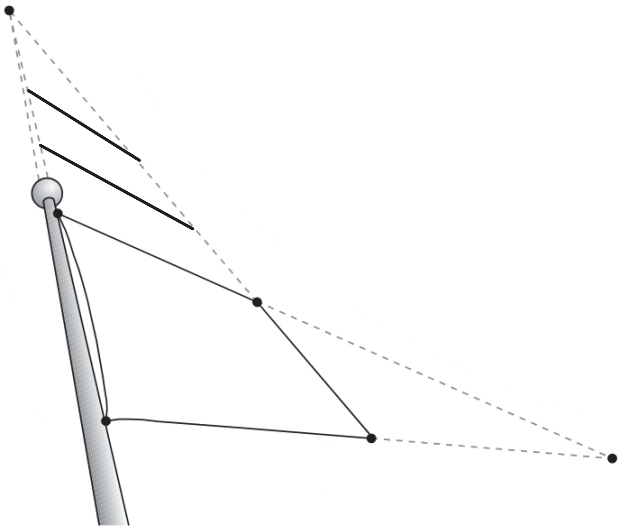




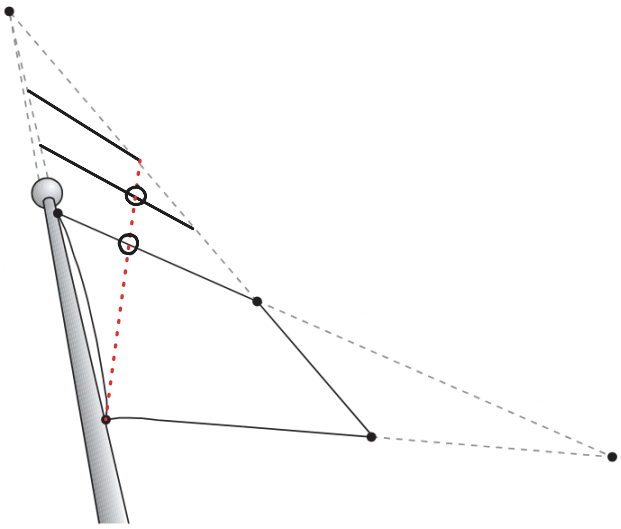


Now we duplicate the rectangle again:

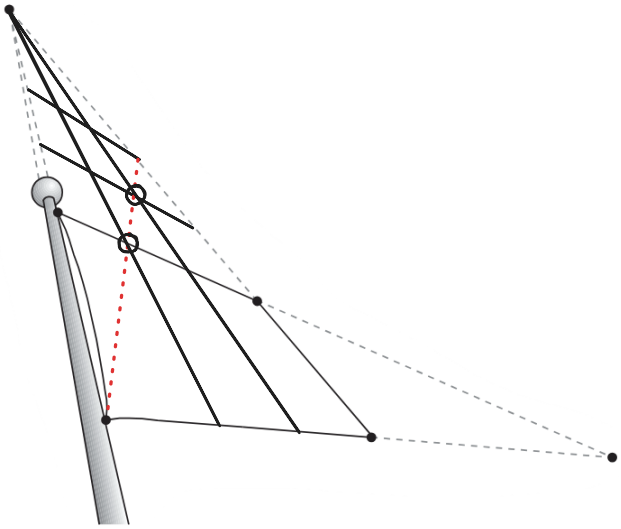




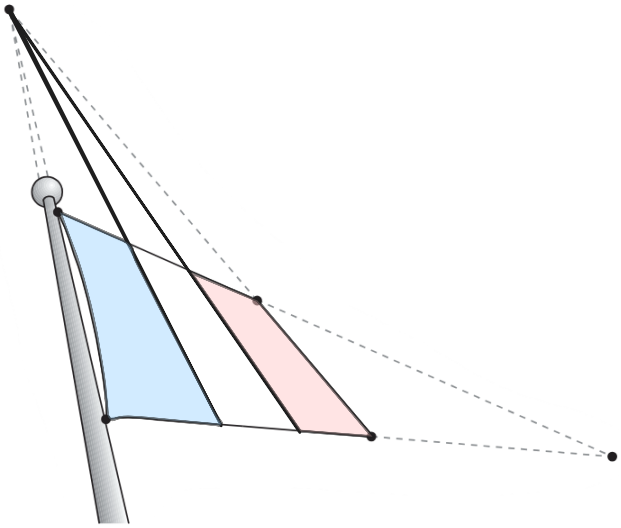
Now go through the diagonal corners of the top and bottom rectangles and notice where this dotted red line intersects the various horizontal lines:



Draw lines through these intersection points to the upper vanishing point to subdivide the original rectangle (flag) into three equal parts:



Let's clean up our image:



The result makes sense: the left side of the flag appears closer to us, which is why the left section (blue) looks larger than the middle (white) and right (red) sections.