- A camera has a field of view of 90x90 degrees, an image resolution of 400x400 pixels, and that the center of the image is the optical center of the camera. A point P has 3-D coordinates (1m, 2m, 8m) in camera coordinates. Find the pixel projection of point P in the image.

- Solution: we first need to find f. With a fov of 90 degree, f=half the size of the image, or 200 pixels. Then use
  - ximg = f X/Z + cx = (200)(1m/8m) + 200 = 225
  - yimg = f Y/Z + cy = (200)(2m/8m) + 200 = 250

- A camera views a square lying on a plane; where the plane is parallel to the image plane
  - Show that the width of the square in the image doesn't depend on the location
  - Find the relationship between the width of the square in the image, and the distance to the plane

- Solution
  - Let the plane be a distance Z from the camera
  - Let the sides of the square be at X1 and X2; W=X1-X2
  - The image projection of those sides is x1 = f X1/Z, x2 = f X2/Z
  - The image width is w = x1-x2 = f W/Z

- A CCD sensor is 10mm x 10mm, and has 10M sensor elements. Lens focal length is 6 mm. What is the instantaneous field of view (iFov); ie the angular size of one pixel at the center?

- Solution
  - Assuming the sensor elements are in a square grid, we have sqrt(10M)=3162 elements on a side of 10 mm
  - So one sensor element is 10mm/3162 = 0.00316 mm wide
  - At the center, angle is atan(.00316/6) = 5.27e-4 radian

- What is the IFOV for the human eye? Assume one receptor cell on the retina is .003 mm wide, and the focal length is 17 mm
- Solution
  - atan(.003/17) = 1.76e-4 radian

- What is width of smallest object you can see at 30m? Assume that the image of the object has to cover at least one receptor cell
- Solution
  - By similar triangles, w/30m = .003/17 -> w = 0.0053 m