1. (5 Pts.) True or False: The orthographic projection of two parallel lines in the world must be parallel in the image.

2. (5 Pts.) Draw the set of qualitatively distinct images that a square can appear as under orthographic projection.

3. (15 Pts.) The filter kernel $\frac{1}{4}[1 \ 4 \ 6 \ 4 \ 1]$ is to be used for approximating Gaussian smoothing. What value should $A$ be?

4. (15 Pts.) Can repeated convolutions of an image with the kernel $[0.5 \ 0.5]$ be used to obtain the same result obtained using the kernel in problem 3? If yes, how many convolutions are needed? If no, explain why not.

5. (25 Pts.) Compare the Canny edge detector and the Laplacian-of-Gaussian (LoG) edge detector for each of the following questions.
   a) Describe each operator in terms of the order of the derivative that it computes.
   b) What parameters must be defined by the user for each operator?
   c) Which detector is more likely to produce long, thin contours? Briefly explain.

6. (15 Pts.) Compute the time complexity of convolution with an $n \times n$ kernel using direct convolution with the 2-D mask.

7. (20 Pts.) Find the Hough transform of the lines enclosing an object with vertices $A=(2,0)$, $B=(2,2)$, and $C=(0,2)$. Sketch the modified object enclosed by lines obtained by replacing $(\rho, \theta)$ of the object lines by $(\rho \ast \rho, \theta + 90)$. Calculate the area of the modified object.

8. (Extra Credit, 20 Pts.) Prove that convolving a 1-D signal twice with a Gaussian kernel of standard deviation $\sigma$ is equivalent to convolving the signal with a Gaussian kernel of $\sigma_c = \sqrt{2}\sigma$, scaled by the area of Gaussian filter. (Hint: make use of identity:

$$\int_{-\infty}^{+\infty} e^{-\frac{1}{2}A x^2 + Z x} \, dx = \sqrt{\frac{2\pi}{A}} e^{\frac{Z^2}{2A}},$$

with $A > 0$.)