

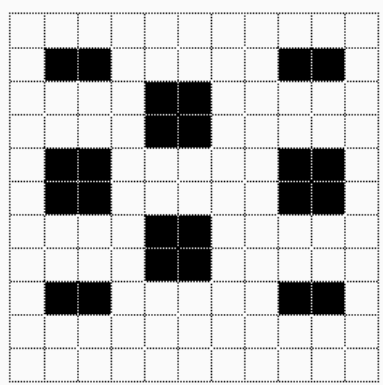
**CAP 5400 Digital Image Processing**  
**Exam# 2 Dec 8, 1999 (Max Points: 100 )**

Name:

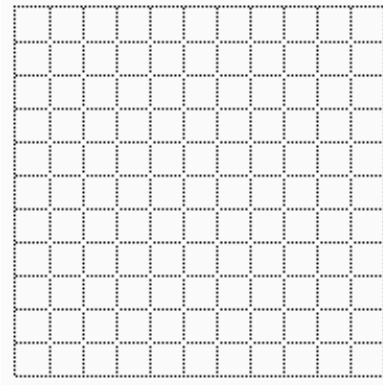
1. **Morphological Operations:** Draw in (b) below the result of the **union of the erosion** of the image in (a) by each of the structural elements listed below. You may use other blank templates for your intermediate work. (25 pts)

$$L_1 = \{(0, 0), (1, 0)\} \quad L_2 = \{(0, 0), (1, -1)\}$$

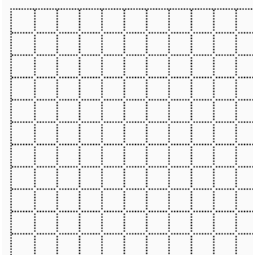
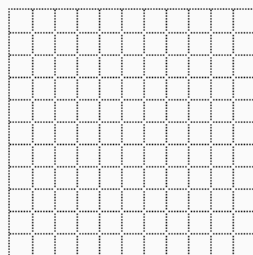
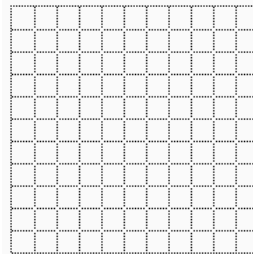
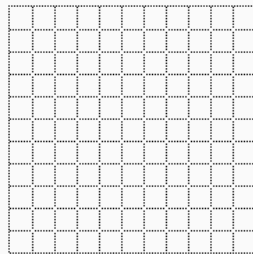
$$L_3 = \{(0, -1), (1, 0)\} \quad L_4 = \{(0, 0), (0, -1)\}$$



(a)



(b)



2. Derive the form of the optimal linear filter that restores a step edge in i.i.d. white noise in the minimum total squared error sense? (15 pts)

3. What is the shape of the voting region in the Hough space for a circle, when in addition to the location of a point on the circle we also have an estimate of the tangent to the circle at that point? (25 pts)

4. If the response of a linear shift invariant system to a step function is given by  $e^{-ax}$ , what is the impulse response of the system? (15 pts)

