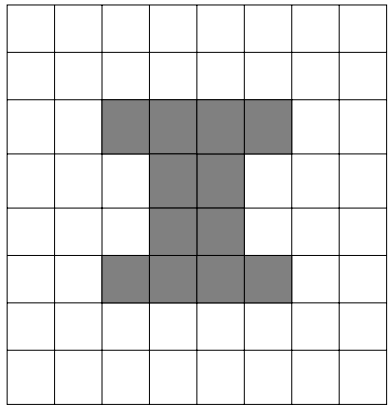
CS 482 Midterm (100p), 10/24/2002

Name:

1. (15p) You are given a camera with adjustable focal length. Describe how it could be used for size constancy; i.e., to make different objects appear to have the same image sizes. Show the relevant math.

2. (30) You are given the following binary image.



Assume that a coordinate system with x-axis pointing right and a y-axis pointing up is added. The coordinates of the left bottom pixel are $(0, 0)$. Compute the following parameters:

a) (3p) area,

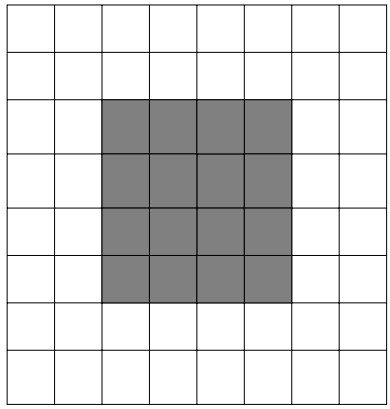
b) (3p) perimeter (describe your algorithm),

c) (4p) center of mass,

d) (10p) second order moments M_{11}, M_{20}, and M_{02}.

e) (10p) central moments μ_{11}, μ_{20}, and μ_{02}.

3. (15p) You are given the following gray level image.



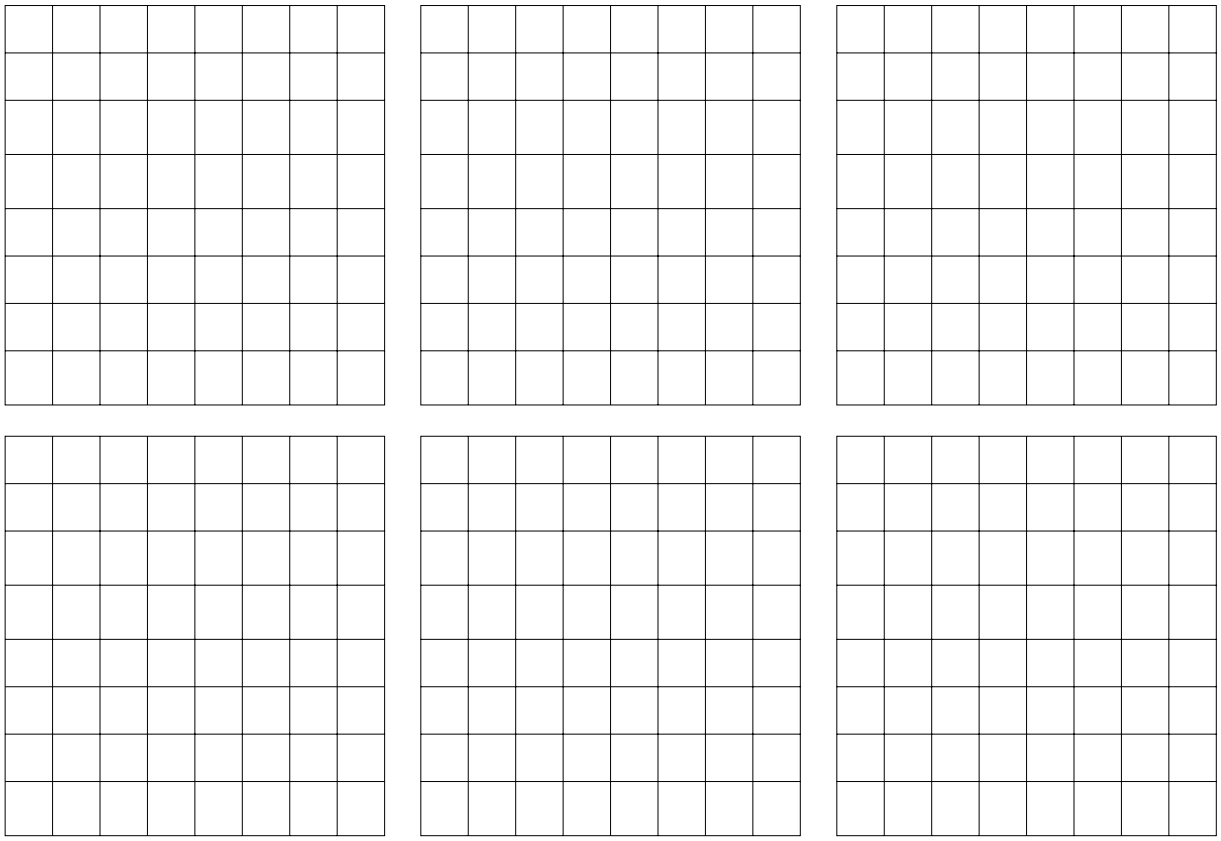
All nonzero pixel values are equal to 2. Assume that a coordinate system with x-axis pointing right and a y-axis pointing up is added. The coordinates of the left bottom pixel are $(0, 0)$.

a) (5p) Use symmetric difference masks to compute partial derivatives in x and y directions. Recall that $f_x = \frac{1}{2}(f(x+1, y) - f(x-1, y))$, and $f_y = \frac{1}{2}(f(x, y+1) - f(x, y-1))$.

b) (5p) Compute gradient magnitudes at all image points.

c) (5p) Compute gradient directions at all image points.

You can use these grids to show your results:



4. (50p) You are given a template N and a binary edge image M.

   a) (5p) Represent N so that it can be used by the GHT (Generalized Hough Transform) algorithm.

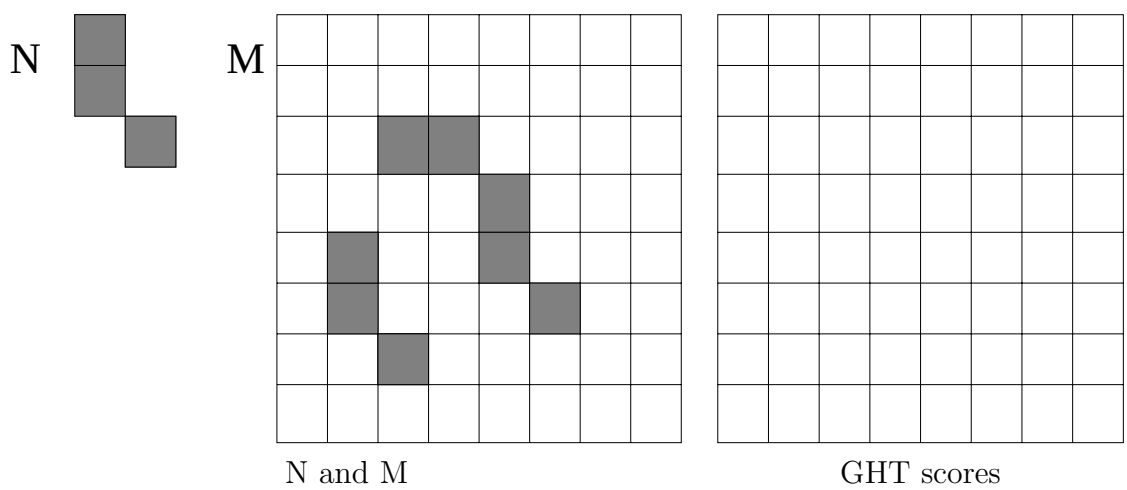
   b) (15p) Use GHT to find N in M. How many matches did you find? You can use the grid above for the GHT accumulator array.

   c) (10p) Use forward/backward pass algorithm to compute the distances of all points in M from the edge points of M. You can assume that the distance between any pair of 8-neighbors is 1.

   d) (15p) Use Chamfer matching to find N in M. Show all placements with scores lower than 10. You can assume that the placement of N is at the position of the topmost pixel of N. What are the best matches?

   e) (5p) Show how the distance transform array could be used to perform a Hausdorff distance matching on N and M. Show the best match(es).

Template N, edge image M, and the GHT scores.



Distance transform and Chamfer match scores

forward pass

backward pass

match score

Hausdorff distance matching