University at Buffalo
Department of Computer Science and and Engineering
CSE 473/573 - Computer Vision and Image Processing

Fall 2024

Homework #3
Due Date: 11/05/2024, 11:59PM ET

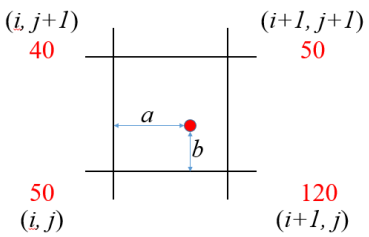
Instructions

- Answer the questions below, and provide as much of your work as necessary.
- Export or scan your homework and store it as a PDF version before submitting online to UBLearns.

1 Interpolation (40 points)

Interpolation allows us to compute the value of a pixel that may fall off the normal discrete 2D Grid. Given the four pixels below (i, j), $(i+1, j)$, $(i, j+1)$, and $(i+1, j+1)$:

- Write out the formula for the interpolated value at $f(x, y)$ at location (x, y) using bilinear interpolation.
- Assuming that $a = 0.6$ and $b = 0.4$, and the pixel values in red, compute the interpolated value $f(x, y)$.
  i) Using Average Interpolation
  ii) Using Nearest Neighbor Interpolation.
  iii) Using Bi-Linear Interpolation.



2 RANSAC (20 points)

While using the RANSAC algorithm to fit a set of points, we can use the following equation to estimate the success rate:

$$p = 1 - (1 - w^n)^k$$

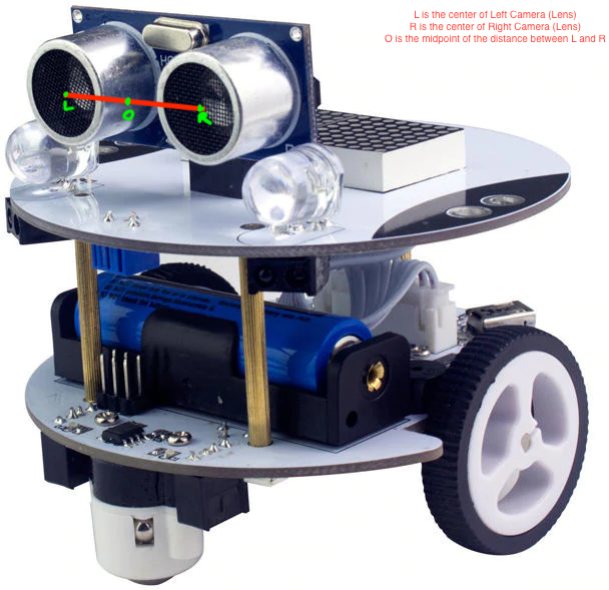
where,

p = probability of selecting only inliers,
w = ratio of inliers to total number of points,
n = minimum number of points required (for line, $n = 2$; for circle, $n = 3$),
k = number of iterations.

- What is the probability p of selecting only inliers, given a set of 50 points with 20 inliers and 30 outliers, if we fit a line using the RANSAC algorithm for $k = 6$ iterations? [10 points]
- For the above scenario, what is the minimum number of iterations k to achieve a 96% probability of selecting inliers? [10 points]

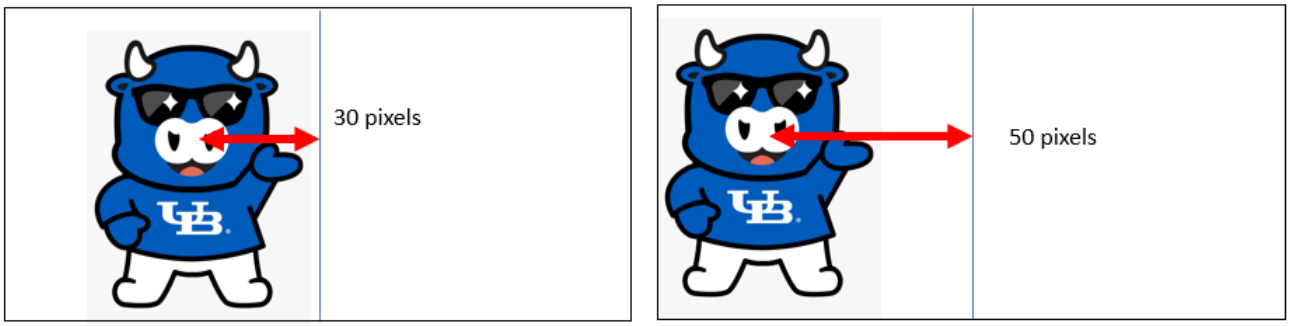
3 Stereo (40 points)

The image below shows a robot with two forward-facing cameras. The cameras are 30 cm apart and have a focal length of 50 mm.



Two frames from the camera pair are shown below. The object is 30 pixels left of the center of the image taken by the left camera and 50 pixels to the left of the center of the image taken from the right camera. The resolution of the camera is 20 pixels per cm.

Find the distance from the center point between the lenses of the robot to the center of the front of the object (realize that this is not just a single-dimensional problem). Show your work. At a



Left Image

Right Image

minimum, draw a diagram and write down two different equations showing the geometry you used to determine the distance.