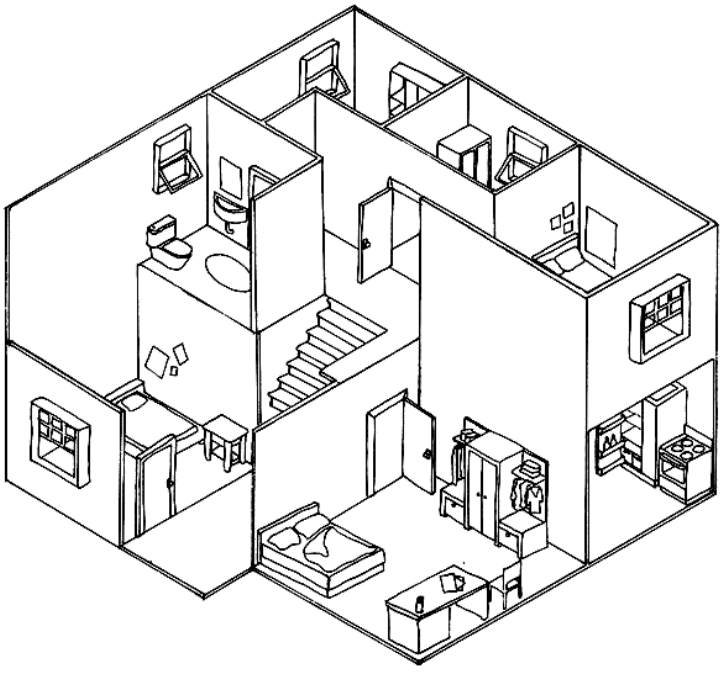
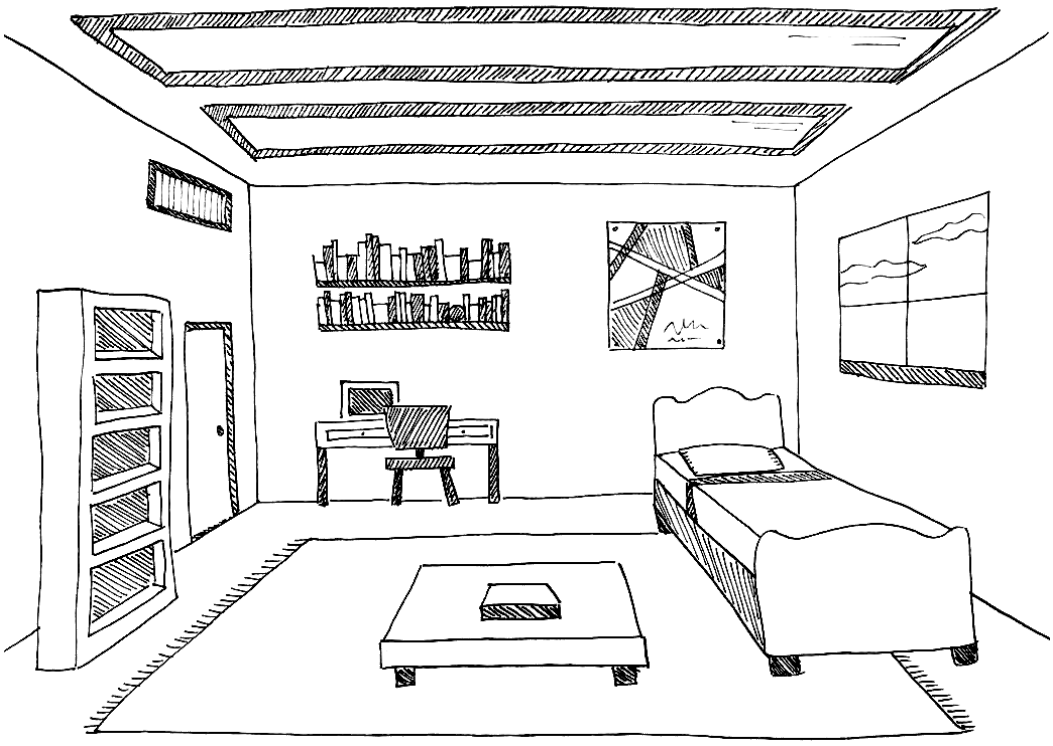
CS436/CS5310/EE513 - Computer Vision Fundamentals - Spring 2019

Roll Number:_____ Written Assignment 1

Q1 - Artists usually use 0 point, 1 point, 2 point or 3 point perspectives to draw scenery. On the 4 examples provided, indicate the point perspective used and draw the following (if applicable):

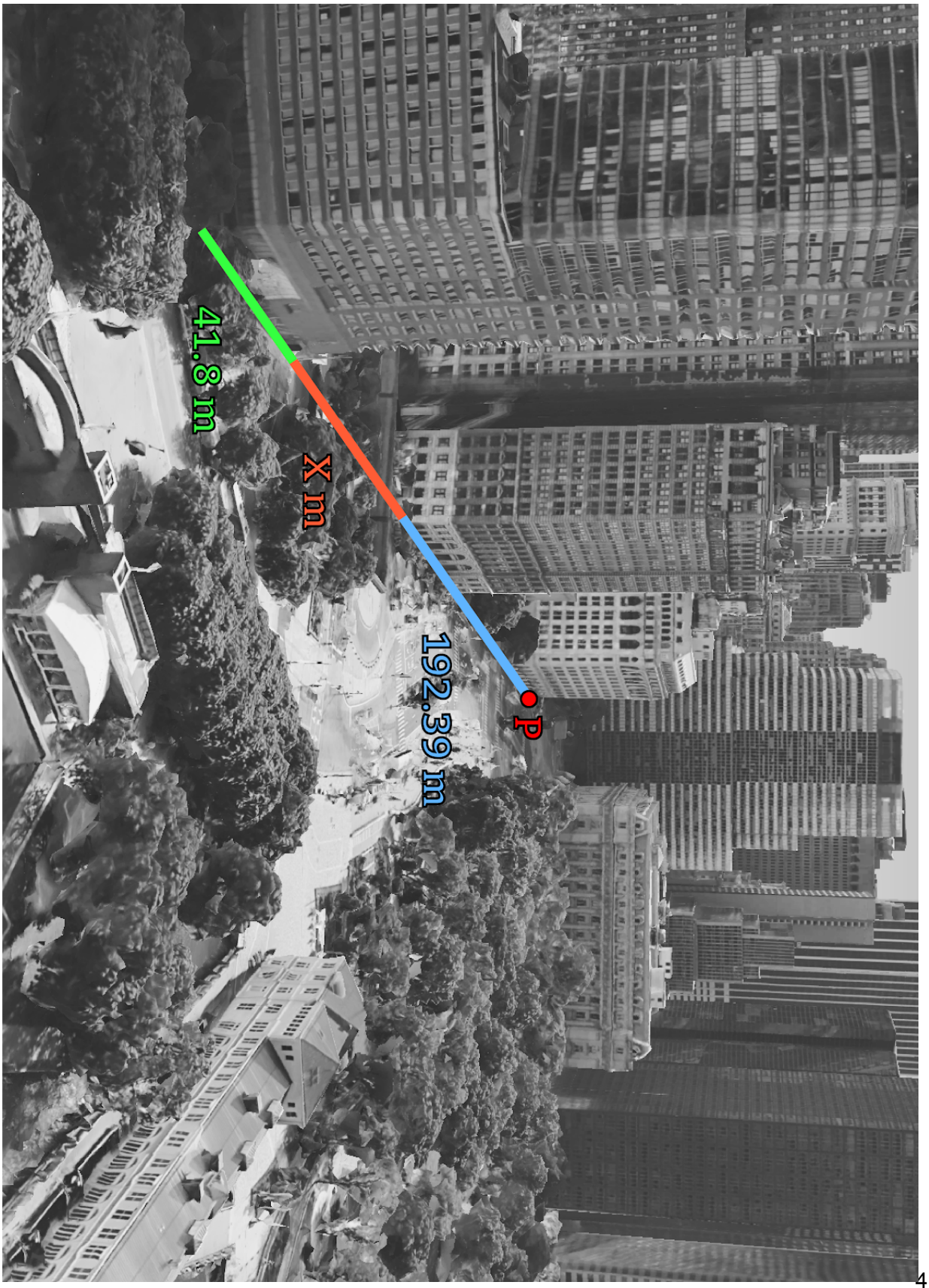
- Lines that lead to the vanishing point(s) / perspective point(s)
- The line of the horizon





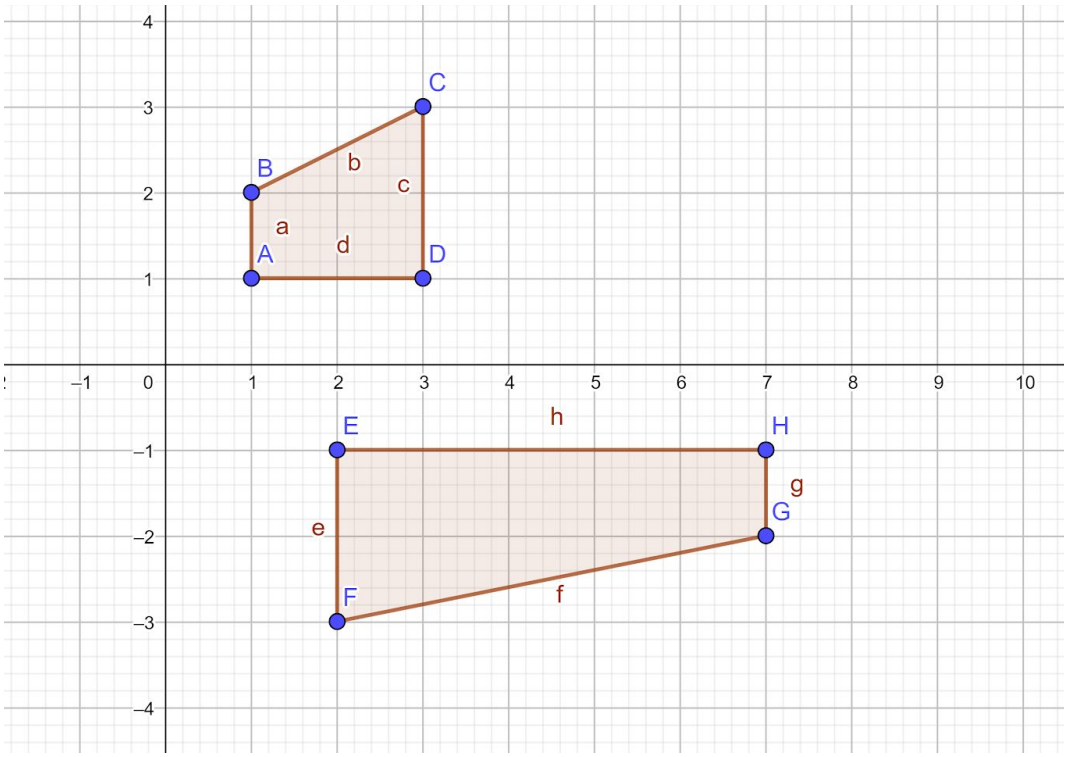
Q2 - On the next page is an image of New York city. It also shows Line segments with associated real-world distance values.

A. Measure Distances of each line using a ruler
B. Extend the existing line segment using a marker.
C. Find the vanishing point on this line. You can do this by drawing another line, that you believe is parallel to the original one in the real world.
D. Find the real-world distance X (using cross-ratio)
E. Find the real-world distance to the vanishing point from the point P. Is this the true distance to the vanishing point? explain.


41.8 m
X m
192.39 m
P

Q3 - Given an image, state algorithm of finding the line of the horizon for that image.
[For masters students. Question adopted from CS**436-17-3**]

Q4 - Show, with a series of transformation matrix multiplications, how you will transform the polygon ABCD into EFGH.



Q5 - using the least square solution, estimate the following models

- pseudo perspective model

$$x' = a_0 + a_1x + a_2y + a_6x^2 + a_7xy$$
$$y' = a_3 + a_4x + a_5y + a_6xy + a_7y^2$$

- Bilinear Model [Masters Students Only]

$$x' = a_0 + a_1x + a_2y + a_6xy$$
$$y' = a_3 + a_4x + a_5y + a_7xy$$

Q6. In which of the following cases changing the order of matrices would result in a different transformation (in each case provide a mathematical proof)

- `R1 * R2 * R3` (where `Ri` is any rotation matrix)

- `R1 * S1 * R2` (where `Ri` is any rotation matrix and `Si` is any scaling matrix)

- `T1 * T2` (where `Ti` is any translation matrix)

- `R1 * T1` (where `Ri` is any rotation matrix and `Ti` is any translation matrix)

Q7. Apply the least squares method to fit a plane to a set of point (in 3d)

$Ax + By + Cz + D = 0$ (Equation of a plane)

Q8.

A. Find the transformation between a given set of points using least squares (from P1 to P2. Accuracy upto 1/100 unit)

P1: (1,1) , (9,1) , (9,7) , (6,4) , (1,6)
P2: (1,1) , (5,3) , (7,7) , (4,8) , (2,11)

B. Find the transformation using pseudo inverse and compare it with your results from A.