Final Practice Questions

CPSC 425 2023

Final = **Thu Dec 14 19:00-21:00 pm CHBE 101**, **closed book**, no calculators

Question 18: [8 marks]

Suppose an image has 10 points. We know 4 come from a single line and 6 are outliers due to noise. We randomly select a pair of points (with replacement) and use them to form a line, for RANSAC.

(a) [2 marks] What is the probability that the selected pair of points comes from the line?

(b) [4 marks] What is the minimum number of iterations, k, of RANSAC required to have greater than 0.95 probability that the line is found? Note: It is not necessary to solve for k numerically. Instead, derive an equation for k and show the calculation you would perform if, for example, you had a scientific calculator available.

Question 19: [15 marks]

(a) [5 marks] Consider the following two consecutive 3×3 greyscale images. Assuming brightness constancy equation holds ($I_x u + I_y v + I_t = 0$), solve for (u, v) at the center pixel at time t using forward differencing for all required derivatives. Assume coordinate frame origin is at the top left corner for the purpose of application of filters. **Note**: You are only being asked to solve for u, v given information at single CENTER pixel. What can you say about u? v?

$$\text{Frame } t: \begin{bmatrix} 0 & 7 & 4 \\ 3 & 3 & 3 \\ 0 & 10 & 8 \end{bmatrix} \qquad \text{Frame } t+1: \begin{bmatrix} 10 & 3 & 5 \\ 3 & 5 & 1 \\ 6 & 7 & 1 \end{bmatrix}$$

Question 21: [10 marks]

Consider a linear classifier of the form

$$\hat{y}_i = \text{sign}(\mathbf{w}_n^T \mathbf{x}_i)$$

where $\hat{y}_i$ is the predicted class of data $\mathbf{x}_i$ and $\mathbf{w}_n$ is the weight vector at iteration n. This classifier is to be trained using the perceptron update rule:

$$\mathbf{w}_{n+1} = \begin{cases} \mathbf{w}_n + y_i \mathbf{x}_i, & y_i \hat{y}_i < 0 \\ \mathbf{w}_n, & \text{otherwise} \end{cases}$$

where y_i is the true class of data $\mathbf{x}_i$. The weight vector is initialized as $\mathbf{w}_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and data are presented to train the classifier in the following order:

$$\mathbf{x}_0 = \begin{bmatrix} -1 \\ -1 \end{bmatrix}, \quad y_0 = -1$$

$$\mathbf{x}_1 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}, \quad y_1 = +1$$

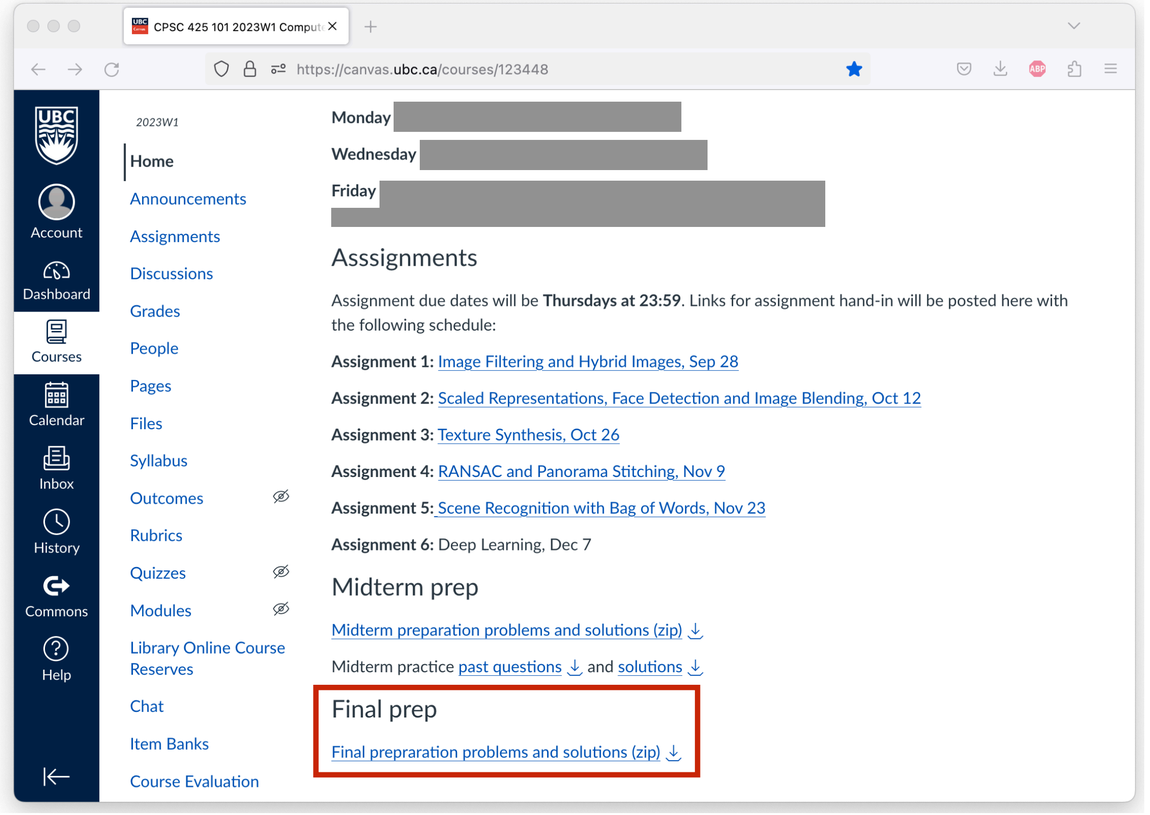
$$\mathbf{x}_2 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad y_2 = +1$$

$$\mathbf{x}_3 = \begin{bmatrix} -0.5 \\ 0.1 \end{bmatrix}, \quad y_3 = -1$$

Show the evolution of the weight vector as data are presented to the classifier, using sketches if helpful. Are all the data correctly classified at the end? Explain under what conditions the perceptron update rule would fail to classify all data correctly.

Final Practice Questions

- Questions and answers from today will be posted on Canvas
- For the final prep problems already on Canvas, some topics are **not** examinable
- The following topics will not be on the exam: Hough transforms, Dendograms



+ Good Luck!