# Assignment 1: Harris Corner Detection

## CSE 185 Introduction to Computer Vision, Fall 2023

Description: For this assignment, you are asked to implement Harris corner detection algorithm in python using Google Colab. You will get familiar with basic concept and techniques for corner detection including Harris matrix, eigen decomposition, and non-maximum suppression etc.

Related lecture: Topic 4 on Harris corner detection. `http://mengtang.org/cse185/files/lec04_corner.pdf`

# 1   Harris Corner Detection

Implement Harris corner detection algorithm that has the following steps.

1. Smooth an image with Gaussian filtering (Use kernel width of a few pixels).

2. Compute $x$ and $y$ derivatives of the smoothed image. Visualize derivatives.

3. Compute product of derivative at each pixel

$$I_{xx} = I_x \cdot I_x, \quad I_{yy} = I_y \cdot I_y, \quad I_{xy} = I_x \cdot I_y. \tag{1}$$

4. Compute the weighted sum of products of derivatives at each pixel using Gaussian smoothing

5. Define at each pixel (x,y) its Harrix Matrix $H(x, y)$

6. Compute response of the detector at each pixel

$$R = Det(H) - k \cdot (Trace(H))^2. \tag{2}$$

where $k$ is often set to 0.04 or so empirically. Another commonly used response function is

$$R = \frac{Det(H)}{Trace(H)}. \tag{3}$$

You can choose either way to compute response. Visualize response.

7. Threshold on value R. Try various threshold until satisfactory corners are obtained. Run non-maximum suppression (A pixel is only maximum if its response is greater than all pixels in a local window e.g., 5x5 window). Visualize detected corner on the input image.

Input image: `http://mengtang.org/cse185/files/resource/horse.jpg`

**Submission**   : Convert your notebook to PDF (click File $->$ Print $->$ Save as PDF) and submit the PDF to Catcourses. **Include all cell output and visualization in the PDF submission.** Submission deadline is **11:59PM on September 17**.