German University in Cairo
Faculty of Media Engineering and Technology
DMET 901 – Computer Vision

Assignment #2

Due on Thursday, 4th of December @ 11:59PM

The main aim of this assignment is to analyze the interaction between a corner detection scoring function (SUSAN) and automatic threshold detection (Convex Hull). As per that, the following components are to be implemented:

1. Corner detection:
    a. **SUSAN.**
2. Automatic threshold detection:
    a. **Convex hull.**

Corner Detection

You are asked to implement the **SUSAN Corner Detection algorithm:**

- **Input:**
  1. The Original Image.
  2. Tunable Parameter ***t*** (which will differ from one image to the other).
- **Output:**
  1. 2D array representing the resulting image.
  2. A histogram of the resulting image.

Automatic threshold detection:

You are asked to implement the **Convex Hull Algorithm** using these functions:

1. **CalculateHullPoints:**
   - **Input:**
     1D array representing the histogram.
   - **Output:**
     1D array of tuples representing the start point and the end of each region in the convex hull.

2. **GetHullValues:**
   - **Input:**
     1D array of tuples representing the convex hull points.
   - **Output:**
     1D array representing the hull values for each color.

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3. **GetThreshold:**
   - **Input:**
     1. 1D array representing the histogram.
     2. 1D array representing the hull values.
   - **Output:**
     The threshold according to the convex hull criteria.

4. **ApplyThresh:**
   - **Input:**
     1. 1D array representing the histogram.
     2. The Threshold value that we already got.
   - **Output:**
     1. **Two** 1D arrays representing the histogram after splitting it below and above the threshold.

Plotting Results:

DrawImages:

- **Input:**
  1. **First Threshold** representing the lower threshold.
  2. **Second Threshold** representing the higher threshold.
  3. **Image** the image resulted from the corner detectors.
- **Output: 3 images** representing the original image after splitting it into three regions which are:
  1. **lower region** which is the image below the threshold.
  2. **mid region** which is the image between the 2 thresholds.
  3. **higher region** which is the image above the higher threshold.

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Test Scenario:

Given an input image, the target is to produce **three output images**, one containing only **corners**, one containing only **edges**, and one containing **homogenous regions**. This is achieved as per the following steps:

1. Apply SUSAN detector on the image, which is expected to produce scores of the likelihood of a pixel of representing a corner.
2. As scores would vary between homogenous regions (scoring the highest values closer to 9), corners (scoring the lowest values closer to 0), and edges (somewhere in between), frequencies of scores would form three clusters, which are separated by applying automated threshold detection, the convex hull algorithm, twice, generating two threshold values.
3. Using the two threshold values, the SUSAN scores image is to divided into three images as per these thresholds.

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Submission Guidelines:

1. **Teams:**
   - This assignment is should be done in groups of **3 to 4** students. **All students must be from the tutorial groups of the same TA.**

2. **Assignment Submission:**

You should submit the assignment through **submission form** mentioned below **taking into consideration** the following notes:

- You are asked to deliver a notebook (.ipynb/.py) showing your implementation of all the required functions representing the outputs for each.
- The .ipynb/.py file containing your assignment's implementation **(the notebook should be submitted showing the cells being run before and representing the output).**
- You can use the sample image given **(provided in the assignment zipped folder)** to test your code **plus** at least one other image from your own side.
- The file should be uploaded on your drive and provide us with the link and make sure to **be accessible.**
- Submit the assignment through this form: https://forms.gle/WTSZUon1wxZSwMrm8

Note that:

- Copying code from other teams or ChatGPT is **totally prohibited**. A cheating detector will be used to confirm that. Any cheating case detected will be a **ZERO**.
- You **are not allowed** to use any **predefined functions for any of the requirements**.

- **The deadline to submit the assignment is on Thursday, 4th of December, 2025 at 11:59 PM**