# Module 2 - Image Processing with OpenCV and Pillow

#### What is a Digital Image?

- A digital Image can be interpreted as a rectangular array of numbers
- Images are comprised of a rectangular grid of blocks called pixels
  - We can represent these pixels with numbers called intensity values
- An image can take on an almost unlimited number of values, but digital images have intensity values between zero and 255
- Pillow is a popular library for working with images in Python
- OpenCV is a library used for Computer Vision

### Image Processing with OpenCV - Ex1

Completed Lab Exercise - attached

#### **Manipulating Images**

- Copying allows you to create a new image independent of the original
- Flipping images changes the image's orientation We can flip an image by changing the index value of a pixel or intensity

#### **Manipulating Images One Pixel at a Time**

- · Cropping is cutting out the part of the image and throwing out the rest
- OpenCV can perform pixel manipulations

# Basic Image Manipulation with Pillow - Ex2

Completed Lab Exercise - attached

# Basic Image Manipulation with OpenCV - Ex3

Completed Lab Exercise - attached

#### **Pixel Transformations**

- Histograms: A histogram counts the number of occurrences of a pixel, and it's a useful tool for understanding and manipulating images
- Intensity Transformations: An Intensity Transformation changes an image one pixel at a time. Some image transformations depend on neighbouring pixels

#### **Histograms and Intensity Transformations**

Completed Lab Exercise

#### **Geometric Operations**

- Geometric Transformation: We change the coordinates of the image x and y. In PIL we can scale the image by specifying the integer number of pixel's using the method .resize()
- Geometric Scaling: Scaling is where we reshape the image, we can shrink
  or expand the image in a horizontal and or vertical direction. .resize() can
  also be used to scale an image in OpenCV or PIL
- Geometric Translation: Translation is where we shift the image, we can shift an image horizontally or vertically. In OpenCV, .warpAffine() allows you to translate an image by x pixels in the horizontal direction and y pixels in the vertical direction
- Geometric Rotation: Rotates an image by an angle theta. In OpenCV,
   .getRotationMAtrix2D() allows you to rotate an image by the angle inputted

#### **Geometric Transformations with Pillow**

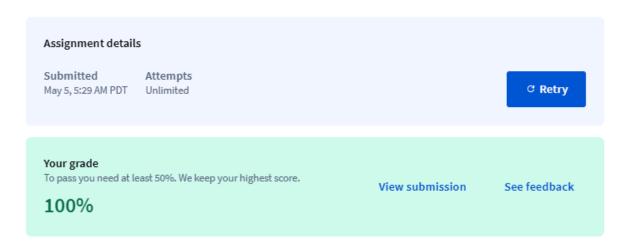
Completed Lab Exercise

#### **Spatial Operations in Image Processing**

- Linear Filtering: Linear filtering applies a linear convolution between an image and a kernel (also called a mask or filter). The output pixel is a weighted sum of its neighbours, determined by the kernel.
- Edge Detection: Edge detection identifies areas of rapid intensity change.
   These areas often correspond to object boundaries in an image
- Median Filters: A non-linear filtering technique where the output pixel is the median of the surrounding neighbourhood. It's effective for removing saltand-pepper noise while preserving edges

#### **Practice Assessment Completion**

#### Practice Assessment



1.	What type of image operation can convolution perform?	1 point
	C Edge Detection	
	○ Sharpening	
	Blurring	
	All of the above	
2.	What is linear filtering?	1 point
	O It is a standard way to add text data	
	It is a standard way to filter Images using convolution	
3.	A video sequence is a :	1 point
	sequence of images	
	o a large image	
4.	OpenCV:	1 point
	has more functionality than PIL library, but is more difficult to use	
	identical to PIL	
5.	In OpenCV an image is a:	1 point
	a numpy array, with intensity values as 8-bit unsigned	
	on image object	

### **ChatGPT Q&A**

https://chatgpt.com/share/6818ae99-5ed4-8001-ba28-3af775924913