Final Exam

Name: Julia Yilmaz

Question 1 (5 points):

Explain the concept of a pixel and its role in digital images. Such as how are pixels used to represent color? or how they are stored?

Answer:

Pixels are stored ∨ as integers to represent and contain light
                  in data
information. Pixels can store brightness in black and white, or
red, green, and blue values in color (3 integer pixel values)
Integers values go from a value of 0 to a maximum of 255.
Images are essentially a layer of pixels. These Integers are stored
in 3D arrays.

Question 2 (5 points):

- Which of the following statements regarding color spaces is true?

  1. ~~RGB and HSV are the only color spaces used in digital systems.~~
  2. Color spaces have no impact on how color is perceived by humans.
  ③. HSV separates brightness, hue, and saturation for encoding color information.
  4. Color spaces are primarily used for file compression purposes.

Answer: 3

Question 3 (5 points):

- Which of the following file formats is commonly used for high-quality practical compression of raster images?

    1. AI
    2. JPEG
    3. PDF
    4. SVG

Answer: 2

Question 4 (5 points):

- Which of the following is the purpose of a mask in image processing?

    1. To convert an image from BGR to RGB color space.
    2. To analyze or transform a specific region in an image.
    3. To apply mathematical operations to the whole image.
    4. To increase the contrast of an image.

Answer: 2

Question 5 (5 points):

- Which of the following statements about NumPy arrays is correct?

    1. NumPy arrays cannot be accessed using indices.
    2. Only NumPy arrays can slice/filter out elements.
    3. NumPy arrays do not support mathematical operations.
    4. NumPy arrays can set data types and support mathematical operations.

Answer: 4

Question 6 (5 points):

- What is the purpose of converting an image to grayscale before applying a Threshold filter?

    1. To remove any color information and only focus on brightness values.
    2. To identify the locations of black pixels in the image.
    3. To calculate the total number of pixels in the image.
    4. To improve the resolution and quality of the image.

Answer: 1.

Question 11 (5 points):

- Which step in the Canny edge detection process involves applying a Blur/Gaussian filter to the input image?

    1. Double thresholding.
    2. Finding intensity gradients.
    3. Non-maximum suppression.
    4. Smoothing/Noise Reduction

Answer: 4

Question 12 (5 points):

- What does the 4:2:2 color subsampling in image compression leverage about the human eye?

    1. The higher sensitivity of the human eye to color than to brightness.
    2. The higher sensitivity of the human eye to brightness than to color.
    3. The ability of the human eye to distinguish a wide range of color shades.
    4. The ability of the human eye to adapt to changes in lighting conditions.

Answer: 2

Question 13 (5 points):

```
contours, hierarchy = cv2.findContours(dst, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)
```

The above line of code is used to find the contours in an image. What does *hierarchy* represent?

    1. The number of contours in the image.
    2. The number of pixels in each contour.
    3. The relationship between contours.
    4. The relationship between pixels in each contour.

Answer: 1

Question 7 (5 points):

- Which interpolation method uses a 4x4 frame and 16 nearest neighbors to find the new pixel value?

    1. Linear Interpolation
    2. Bi-Linear Interpolation
    3. BiCubic Interpolation
    4. Nearest Neighbor Interpolation

Answer: 3.

Question 8 (5 points):

- What happens if the sum of the kernel used for convolution does not equal one?

    1. The image becomes sharpened.
    2. The image becomes blurred.
    3. The image becomes lighter or darker.
    4. The image remains unchanged.

Answer: 3

Question 9 (5 points):

- What is the purpose of applying an edge filter to an image?

    1. To de-emphasize the differences in adjacent pixels.
    2. To emphasize the differences in adjacent pixels.
    3. To change the RGB values of each pixel.
    4. To sharpen the image.

Answer: 2.

Question 10 (5 points):

- Why do the Prewitt and Sobel filters use two kernels?

    1. The two kernels enhance the overall image contrast by applying different intensity transformations.
    2. The two kernels enable noise reduction and image smoothing for better visual clarity.
    3. The two kernels ensure compatibility with different color spaces, such as RGB and grayscale.
    4. The two kernels allow for more accurate edge detection in both vertical and horizontal directions.

Answer: 4

Question 14 (5 points):

- What makes corners important features in image processing?

  1. Corners have a consistent brightness value throughout the image..
  (2) Corners exhibit significant brightness variations in all directions.
  3. Corners are primarily located in the center of the image.
  4. Corners provide a measure of image sharpness and contrast.

Answer: 2

Question 15 (5 points):

- Which of the following statements accurately describes the Viola-Jones algorithm used for face detection?

  1. It uses a neural network to detect faces in real-time.
  (2.) It searches for rectangular patterns that capture local structures and compares them with a neighboring region.
  3. It uses color histograms to identify facial regions.
  4. It relies on color-based thresholding to distinguish faces from the background.

Answer: 2

Question 16 (5 points):

- What is the main purpose of binary image analysis?

  (1.) Searching for corners to segment an image and extract objects.
  2. Converting color images to a grayscale representation.
  3. Enhancing image resolution and clarity.
  4. Applying color-based filters to highlight specific regions.

Answer: 1.

Question 17 (10 points):

Using convolution apply this kernel to the following image. What is the resulting pixel value?
Center the kernel on the middle pixel(30).

$$\text{Image} \begin{bmatrix} 50 & 40 & 30 \\ 40 & 30 & 20 \\ 30 & 20 & 10 \end{bmatrix} \text{X} \begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & 0 \\ 0 & -1 & 0 \end{bmatrix} \text{Kernel}$$

Answer:

$(50 \times 0) + (40 \times -1) + (30 \times 0) + (40 \times -1) + (30 \times 5) + (20 \times 0)$
$+ (30 \times 0) + (20 \times -1) + (10 \times 0)$

$ -80$
$ + \; -20$
$ \underline{ 150 }$
$ 50$

The pixel value is 50

Question 18 (10 points): Question: How can you use OpenCV to find the bounding boxes of objects in an image? The objects in the image are on a white background so the background will not be an issue.

Please provide a step-by-step approach using OpenCV to find the bounding boxes of objects in an image. Pseudo code only. You do not need to write any OpenCV code. Just describe a step-by-step process. Please explain why your approach will work. Please explain any limitations of your approach.

Answer:

Import the image and use cv2 to convert it to grayscale, Canny edge detection can be used for declaring the edges. Next, Find contours using hierarchy. This can be done using a loop. after the farthest contours are found, another loop can be used to draw the bounding box. Then display image. I believe this will work as it finds the location of the most intense contours and implements the found location to draw a box. this approach is limited when used on photos with complicated backgrounds.