Exam instructions:

1. Carefully read the exam instructions.
2. Create a folder named with your name in English and your ID number, e.g., AnnaLevant\_12345678.
3. For Section A answers, create a notebook in your folder named SectionA.
4. For Section B answers, create a Word document in your folder named SectionB.
5. At the end of the exam, copy your folder to the submission folder.

**Section A: Python Coding Questions (60 marks)**

For this part use the provided image "baboon.png"

**Question 1: (20 marks)** Write a Python script using OpenCV that:

1. Loads an image from file.
2. Converts the image to grayscale.
3. Applies Gaussian blur to the image.
4. Performs Canny edge detection on the blurred image.
5. Displays the original image and the edge-detected image side by side.

**Question 2: (20 marks)** Write a **Python function** that takes an image as input and applies a series of transformations: rotation by 45 degrees, scaling by 0.5, and translation by (50, 50) pixels. Use OpenCV to perform these transformations.

**Question 3: (20 marks)** Given the following code snippet for a neural network, explain what each line of code is doing. Assume the input is an image dataset.

model = Sequential()

model.add(Conv2D(32, (3, 3), activation='relu', input\_shape=(64, 64, 3)))

model.add(MaxPooling2D(pool\_size=(2, 2)))

model.add(Conv2D(64, (3, 3), activation='relu'))

model.add(MaxPooling2D(pool\_size=(2, 2)))

model.add(Flatten())

model.add(Dense(128, activation='relu'))

model.add(Dense(10, activation='softmax'))

model.compile(optimizer='adam', loss='categorical\_crossentropy', metrics=['accuracy'])

model.fit(train\_images, train\_labels, epochs=10, validation\_data=(test\_images, test\_labels))

**Section B: Theoretical Questions (40 marks)**

**Question 1 (5 marks):** What is the bias-variance trade-off?

**Question 2 (5 marks):** What is regularization, and why is it important? Provide 3 examples of regularization techniques.

**Question 3: (5 marks)** Define the role of activation function and give 3 examples

**Question 4: (5 marks)** Explain the difference between supervised and unsupervised learning. Provide an example of each in the context of computer vision.

**Question 5: (5 marks)** What is the role of the loss function in training neural networks? Name commonly used loss function for classification problems.

**Question 6: (5 marks)** What is edge detection in image processing? Name two algorithms used for edge detection and explain briefly how they work.

**Question 7: (10 marks)** What is the difference between a kernel (filter) used in convolution operations and a pooling operation in computer vision?

**Bonus Question: (10 marks)**  
Explain the process of data augmentation and why it is important in training deep learning models. Provide at least three examples of data augmentation techniques used in image processing.