Name: _____ **Student ID**: _____

Indian Institute of Technology Jammu
End-Term Examination
Executive MTech (AIML)
October 22, 2023

Course Title: Computer Vision **Maximum Time: 2 Hrs.**
Course Code: CSC003P5E **Maximum Marks: 100**

Instructions:

- Conditions of Examination: Closed book; No dictionary; Non-programmable calculator is allowed.
- This question paper contains total of 5 Questions. **Make an appropriate assumptions wherever necessary.**

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1. **[20]**
   You are given an image database containing images of animals and human faces. You are required to extract discriminative features for each of the image in the database and design an inference system to automatically detect between animals and human faces. Describe all the steps with an example.

2. **[20]**
   You are given the following image $I_{10\times10\times1}$ (Table **??**) and a filter $F_{3\times3}$. The values of the cells in the filter F are numeric equivalent of your **full name** in the lower case. The alphabets [a ... z] corresponds to [0 ... 25] numeric values. [Note: In case of short names a dummy integer of your choice in the range [26 ... 255] can be chosen.]

Table 1: Grayscale Image $I_{10\times10\times1}$

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	10	1	1	20	0	0	0
0	0	0	10	1	1	20	0	0	0
0	0	0	10	1	1	20	0	0	0
0	0	0	10	1	1	20	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

   a) [5] Compute the feature map after applying correlation operation on image I with filter F.

   b) [5] Compute the feature map after applying convolution operation on image I with a filter which computes average of the patches in the image I. [Note: Design an appropriate filter for the task]

   c) [10] Design an algorithm to compute the values of filter F for a given feature map O and Image I after applying convolution operator.

3. **[20]**
   a) [6+4] Compute the filter for computing gaussian blur on an input Image I. Also, discuss the effect of variance parameter in term of smoothness.

   b) [5 + 5] Represent a detailed diagram of convolutional layer in convolution neural network for an Input of size $4 \times 4 \times 1$ and a filter of size 3×3. Also, discuss the effect of adding dense layer to this convolution layer.

4. **[20]**

a) [10] Explain the Laplacian of Gaussian (LoG) and difference of Gaussians (DoG) with an example. What is the importance of LoG and DoG in SIFT based feature extraction in the image data.

b) [10] Compute the Fourier transform for the following grayscale image (Table **??**):

Table 2: Grayscale Image

1	0	0
0	1	0
0	0	1

5. **[20]**

a) [4+6] Compute the aperture size of a lens camera with focal length 35mm having f-Number 100. Also, comment on the exposure time and image quality when compared with the pinhole camera with pinhole size equivalent to the computed aperture size.

b) [6+4] Derive the relationship between f-number and depth of field (DoF). Comment on both of these parameters with respect to the modern mobile phone camera of high resolution.