# Indian Institute of Science Education and Research Bhopal
Computer Vision (DSE312/DSE602/ECS320)
Assignment-2

Deadline: 05-10-2025 (including bonus days), 11:59 PM　　　　　Max mark: 20

Please follow the instructions carefully.

1. **All questions are mandatory. Plagiarism and copying from anywhere (similar submission) can disqualify you from this course and invite the academic dishonesty policy.**

2. **Implement all algorithms purely in Python without using specialized libraries like OpenCV or PIL for the processing. You may use libraries for basic operations (like loading an image), but the algorithms themselves should be coded from scratch. Use of scikit-learn is permissible for implementing the SVM classifier.**

3. **Comment on your code extensively to explain your logic and the steps you are implementing.**

4. **Make a short 7-minute video and explain your code.**

5. **You must submit a report (.pdf), code file (.py or .ipynb), and video explaining the code.**

1. Perform the following tasks on the provided image.

   (i) Implement a function to compute the integral image representation. Also, write a function to verify the correctness by comparing the sum of pixel values in a subregion obtained from the integral image with the direct summation from the original image for a particular region. The code must be generic, which should work on any image or matrix to compute the integral image. **(2+1)**

   (ii) Implement Haar-like feature extraction on the cameraman image for all three different Haar patterns shown below. Apply the filter to the center $50{\times}50$ pixels of the image. Use a minimum filter size of $24{\times}24$ pixels. Discuss how these features could be useful in object detection tasks. Again, the code must be generic, which should work on any filter size.**(4)**
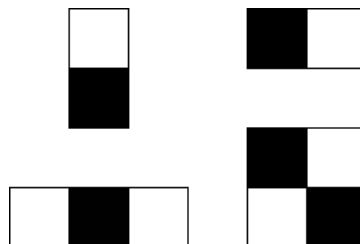
2. Using dataset KTH-TIPS,(**link**), implement a model to classify images into different categories based on their texture features. In this problem, you will perform texture classification using the KTH-TIPS dataset in grayscale mode.

  (i) Train and evaluate an SVM classifier using raw pixel intensity values (after resizing all images to a fixed size, if required). Report the accuracy and discuss the limitations of this representation.**(3)**

  (ii) Train and evaluate an SVM classifier using local binary pattern histograms as features. Compare performance against raw pixel-based classification.**(3)**

 (iii) Perform an image classification using the Bag-of-Words (BoW) features and an SVM classifier. **(3)**

 (iv) Implement a function to compute the HoG features for the image. Visualize the gradient orientations and the resulting HOG feature map. Perform an image classification using the HoG features and an SVM classifier, and compare and contrast the performance of different feature algorithms you used in terms of performance, computational cost, etc. **(4)**

Your training data should be at least 70% of the entire dataset. Perform classification for all 10 classes