L.J Institute of Engineering and Technology, Ahmedabad
Computer Vision Practice Book (SEM-VII-2024 CSE and IT Engineering)

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Sr No	Unit Number	Question_Text	MCQ Answer	Marks	Option A	Option B	Option C	Option D
UNIT 9 GENERATIVE ADVERSARIAL NETWORK (GAN) FOR IMAGE GENERATION								
TOPIC NAME: Introduction to GANs: GAN architecture (generator and discriminator),Training GANs: Loss functions and optimization,Applications of GANs								
1	9	What are the two main components of a GAN?	B	1	Generator and Tester	Generator and Discriminator	Encoder and Decoder	Transformer and Classifier
2	9	What is the goal of the Generator in a GAN?	B	1	To generate real data samples	To fool the Discriminator with fake data samples	To distinguish between real and fake samples	To minimize the Discriminator's accuracy
3	9	Which loss function is used by the Discriminator in GANs?	C	1	Cross-Entropy Loss	Mean Squared Error	Binary Cross-Entropy Loss	Hinge Loss
4	9	What is a common issue during GAN training where the generator produces limited outputs?	C	1	Overfitting	Vanishing Gradients	Mode Collapse	Exploding Gradients
5	9	What type of data does the Generator in a GAN take as input?	B	1	Real-world data samples	Noise vector from a latent space	Discriminated data	Pre-processed images
6	9	In GANs, which of the following is true for the Discriminator during training?	B	1	It tries to maximize the Generator's performance	It tries to distinguish between real and generated samples	It generates fake data	It uses the latent space for training
7	9	What is the purpose of the latent vector z in a GAN?	A	1	It serves as a noise input to the Generator	It represents real data points	It is used for loss calculation in the Discriminator	It helps in data augmentation
8	9	Which of the following is a practical application of GANs?	B	1	Text-to-Speech	Image Generation	Regression Analysis	Sentiment Analysis
9	9	What is the key role of the Discriminator in a GAN?	C	1	Generate new data samples	Minimize its loss function	Differentiate between real and generated data	Optimize the latent vector
10	9	Which Python library is most commonly used to implement deep learning models, including GANs?	B	1	Pandas	TensorFlow	Matplotlib	Scikit-learn
11	9	Which function is typically used in Keras (within TensorFlow) to create a sequential model for GAN?	A	1	Sequential()	model()	Linear()	ConvNet()
12	9	In a GAN model implemented using TensorFlow/Keras, which layer is typically used as the output layer of the Discriminator?	C	1	Dense layer with softmax activation	Conv2D layer with ReLU activation	Dense layer with sigmoid activation	Dropout layer with linear activation
13	9	In GANs, which TensorFlow function is typically used to compile a model?	A	1	compile()	build()	initialize()	optimizer()
14	9	Which Python library is used along with TensorFlow to handle numerical operations and tensors efficiently?	A	1	NumPy	Pandas	Scipy	PyTorch
15	9	Which of the following is used to generate random latent vectors for the Generator in GANs using NumPy?	B	1	np.random.rand()	np.random.normal()	np.random.choice()	np.random.random()
16	9	Which function in TensorFlow/Keras is used to compile the Discriminator with a suitable optimizer and loss function?	A	1	discriminator.compile()	model.compile()	discriminator.build()	discriminator.optimize()
17	9	If the Discriminator predicts D(x)=0.9 for a real image, what is the Discriminator's loss for that image using the Binary Cross-Entropy loss function?	D	1	0.9	0.105	0.1	0.045

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18	9	For a fake image, if the Discriminator predicts D(G(z))=0.3, what is the Discriminator's loss for that image using Binary Cross-Entropy?	B	1	0.125	0.522	0.845	0.625
19	9	For a Generator, if the Discriminator predicts D(G(z))=0.6, what is the Generator's loss using the modified non-saturating loss function?	C	1	0.511	0.654	0.221	0.114
20	9	If the Generator's loss is 0.693 and the Discriminator's loss is 0.916, what is the total loss for the GAN model?	A	1	1.609	1.052	2.0	0.845
21	9	If the Discriminator predicts D(x)=0.95 for real images and D(G(z))=0.05 for fake images, what is the total Discriminator loss?	D	1	0.0144	0.133	0.145	0.04455
22	9	Write a code for creating a basic GAN model in Python using TensorFlow and Keras		2				
23	9	In a GAN, the Discriminator's loss function for a real sample is given by:LD=−log(D(x)). If the Discriminator predicts D(x)=0.85 for a real sample, calculate the Discriminator's loss for this sample.		2				
24	9	The Generator's loss function for a fake sample is given by: LG=−log(1−D(G(z))). If the Discriminator predicts D(G(z))=0.25 for a generated (fake) sample, calculate the Generator's loss.		3				
25	9	If the Generator's loss starts at 1.2 and decreases by 0.1 after each epoch, what will the loss be after 10 epochs?		3				
26	9	The initial loss of the Generator is 2.5, and it decreases by 0.15 per epoch. What will the loss be after 5 epochs?		3				
27	9 9	In a GAN, the Discriminator's loss function is defined asgiven below. Given that D(x)=0.9 for real data samples and D(G(z))=0.2 for fake samples, and N=100, compute the Discriminator's loss. $L_D = -\left(\frac{1}{N} \sum_{i=1}^{N} \log(D(x^{(i)})) + \frac{1}{N} \sum_{i=1}^{N} \log(1 - D(G(z^{(i)}))) \right)$		3				
28	9	What is the difference between minimizing log(1 − D(G(z))) and maximizing log(D(G(z))) for the Generator? Why is the latter preferred		3				
29	9	What are the key components of the GAN architecture?		3				
30	9	How does the Generator improve during training?		3				
31	9	What is mode collapse in GANs, and how does it affect the Generator's output?		3				
32	9	Explain the role of loss functions in training GANs.		3				
33	9	List three practical applications of GANs in real-world scenarios.		3				
34	9	Why is the Discriminator critical to the success of a GAN model?		3				
35	9	How do GANs contribute to advancements in image generation?		3				
36	9	How would you modify the Discriminator model to classify real and fake images using TensorFlow/Keras?		5				
37	9	How can you train the Generator and Discriminator models together using a GAN model?		5				

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38	9	Write a Python function to train the GAN model for a given number of epochs using real and fake images.		5				
39	9	Write a Python program to visualize the generated images from the Generator model after training.		5				
40	9	What are some of the challenges encountered during GAN training, such as mode collapse and vanishing gradients? How can they be mitigated?		5				
41	9	Discuss the loss functions used in GANs for both the Generator and Discriminator. How do they contribute to the adversarial nature of the training?		5				
42	9	Describe some of the most common applications of GANs in image generation. Give examples.		5				
43	9	How does the Generator use the latent space to generate new data? Why is latent space important in GANs?		5				
44	9	Calculate Combined Loss for Discriminator and Generator for given data:D(x)=0.85 for real data, D(G(z))=0.25 for generated data ,Compute the Discriminator's loss and Generator's loss		5				
45	9	Consider a GAN where the Discriminator's output for a batch of N=5 samples is as follows: D(x)=[0.8,0.7,0.9,0.85,0.75] Generated samples D(G(z))=[0.2,0.3,0.1,0.25,0.15] Compute the individual Discriminator's loss also compute average Discriminator's loss		5				
UNIT 10 Motion detection and video processing								
TOPIC NAME:Optical Flow,Object Tracking,Video Capture and Processing,Video Generation								
46	10	Which algorithm is commonly used for estimating Optical Flow?	B	1	Canny Edge Detector	Lucas-Kanade Method	Gaussian Filter	Sobel Operator
47	10	What does Optical Flow represent in video processing?	B	1	Change in object shape	Movement of pixels between frames	Noise in the video	Image blurring
48	10	Which OpenCV function is used to compute dense Optical Flow?	C	1	cv2.calcOpticalFlowPyrLK	cv2.calcHist	cv2.calcOpticalFlowFarneback	cv2.findContours
49	10	In Optical Flow, the Brightness Constancy Assumption means:	A	1	The brightness of a point remains constant across frames	The brightness changes rapidly	The object's brightness fades with time	The brightness randomly fluctuates
50	10	Which method is used for feature-based object tracking in OpenCV?	A	1	KLT Tracker	Mean Shift Algorithm	Hough Transform	Histogram Equalization
51	10	Which video format is commonly used for capturing video frames in OpenCV?	A	1	AVI	PDF	MP3	JPEG
52	10	What does cv2.VideoCapture() function do in OpenCV?	C	1	Captures a still image	Starts a video recording	Reads frames from a video file or camera	Converts a video into a GIF
53	10	The Lucas-Kanade Optical Flow method is primarily used for:	B	1	Dense Optical Flow	Sparse Optical Flow	Edge Detection	Image Smoothing

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54	10	In object tracking, what is the role of the Kalman Filter?	B	1	Filter out noise	Predict the object’s future location	Identify multiple objects	Smooth motion of objects
55	10	What is the primary purpose of Optical Flow in motion detection?	C	1	To detect object color	To detect object speed	To detect motion patterns between consecutive frames	To detect object size
56	10	In Optical Flow, what does the term “warp” refer to?	C	1	Smoothing of frames	Frame interpolation	Motion compensation	Image sharpening
57	10	What function is used in OpenCV to write video frames to a file?	A	1	cv2.VideoWriter()	cv2.VideoStream()	cv2.VideoFile()	cv2.VideoLoad()
58	10	Which filter is commonly used to smooth video frames and reduce noise?	B	1	Median Filter	Gaussian Filter	Sobel Filter	Laplacian Filter
59	10	What is the output of the cv2.VideoCapture.read() method in OpenCV?	B	1	A single frame in a video	A boolean value indicating success, and the frame	The total number of frames	The resolution of the video
60	10	In motion detection, background subtraction is used to:	C	1	Enhance contrast	Remove noise	Separate foreground objects from the background	Track multiple objects
61	10	In object tracking, the KLT (Kanade-Lucas-Tomasi) algorithm works best for:	B	1	Edges	Corners	Textures	Regions of uniform intensity
62	10	Which method combines motion prediction and estimation in tracking?	A	1	Kalman Filter	Camshift	Optical Flow	KLT Tracker
63	10	What is the key limitation of sparse Optical Flow algorithms?	B	1	Computational complexity	Limited accuracy for fast motion	High memory usage	Inability to track slow objects
64	10	In Optical Flow, the aperture problem refers to the:	A	1	Difficulty in estimating motion at object boundaries	Difficulty in tracking transparent objects	Difficulty in estimating motion for small apertures	Difficulty in detecting motion at high frame rates
65	10	In video processing, frame rate is measured in:	A	1	Frames per second (FPS)	Bits per second (bps)	Frames per minute (FPM)	Pixels per frame (PPF)
66	10	In motion detection, which method provides a fast way to detect significant changes in a scene?	B	1	Edge Detection	Background Subtraction	Optical Flow	Histogram Equalization
67	10	In video generation, which method can be used to create a slow-motion effect?	C	1	Frame interpolation	Edge detection	Background subtraction	Object tracking
68	10	Which of the following is commonly used to represent motion vectors in Optical Flow?	A	1	Arrows	Circles	Rectangles	Points
69	10	What is the key characteristic of a Kalman Filter in object tracking?	A	1	Predicts future states of a moving object	Reduces noise in video frames	Segments objects based on color	Detects corners in video frames
70	10	Which function in OpenCV is used to split a video into individual frames?	D	1	cv2.split()	cv2.extract()	cv2.read()	cv2.VideoCapture.read()
71	10	Which of the following describes the purpose of the cv2.VideoWriter() function?	C	1	To process Optical Flow	To capture frames from a video file	To write video frames to a file	To perform background subtraction
72	10	Which OpenCV function is used to draw bounding boxes around detected objects?	B	1	cv2.boundingRect()	cv2.rectangle()	cv2.findContours()	cv2.HoughLines()

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73	10	Which of the following video frame properties can be retrieved using the cv2.VideoCapture.get() method?	B	1	Frame color depth	Frame size	Frame playback speed	Frame brightness
74	10	Which function is used in OpenCV to resize video frames?	A	1	cv2.resize()	cv2.shrink()	cv2.crop()	cv2.enlarge()
75	10	What is the primary challenge addressed by the aperture problem in Optical Flow?	A	1	Motion detection in uniform areas	Object occlusion	Background noise	Object speed estimation
76	10	Which filter is used to reduce noise in a video frame while preserving edges?	C	1	Gaussian Filter	Median Filter	Bilateral Filter	Laplacian Filter
77	10	Which function in OpenCV can be used to detect edges in video frames?	A	1	cv2.Canny()	cv2.calcHist()	cv2.meanShift()	cv2.medianBlur()
78	10	What is the key advantage of the Dense Optical Flow algorithm?	B	1	Fast computation	Provides motion information for all pixels	Low memory usage	Works well with small motion
79	10	What is the primary input required for computing Optical Flow between frames?	C	1	Frame size	Frame color	Pixel intensity change	Object shape
80	10	Which of the following describes Optical Flow in the context of motion estimation?	C	1	Flow of light in a video	Movement of objects in a scene	A representation of motion between consecutive frames	Reflection of light in different regions
81	10	Which of the following is used for blob detection in video processing?	A	1	cv2.SimpleBlobDetector()	cv2.HoughLines()	cv2.threshold()	cv2.erode()
82	10	The Kalman Gain K in the Kalman filter depends on which factors?	D	1	State transition matrix and measurement noise covariance.	Process noise covariance and initial state.	Predicted state and measurement matrix.	Measurement noise covariance and predicted error covariance.
83	10	Given a state prediction x^=[6 4], measurement z =5.5, and Kalman Gain K=[0.4 0.2], what is the updated state?	A	1	5.8,3.9	5.7,4.1	3.8,3.9	5.6,3,8
84	10	In a 3x3 window, the gradients are: $\text{Horizontal gradient}(G_x): \begin{bmatrix}1\\1\\1\end{bmatrix}, \text{Vertical gradient}(G_y): \begin{bmatrix}0\\0\\0\end{bmatrix}, \text{Temporal gradient}(I_t): \begin{bmatrix}-1\\-1\\-1\end{bmatrix}$ What is the optical flow vector (u, v)?	C	1	0,0	0,-1	-1,0	-1,1
85	10	What assumption does the Lucas-Kanade method rely on?	B	1	Motion is large and irregular.	Brightness constancy across frames.	Velocity is non-linear.	There is no spatial gradient in images.

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86	10	A robot moves in a straight line with an initial state vector: $$x_0 = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$$ (position = 3 m, velocity = 2 m/s). The state transition matrix is: $$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$ and the measurement matrix is: $$H = \begin{bmatrix} 1 & 0 \end{bmatrix}$$ The predicted state at $t = 1$ second is:		3				
87	10	Explain the concept of Optical Flow and its significance in motion detection.		3				
88	10	Discuss the Lucas-Kanade method for Optical Flow and its practical applications.		3				
89	10	Describe how Object Tracking works in video processing. Provide examples of algorithms used to do same.		3				
90	10	How does the Kalman Filter assist in Object Tracking? Explain its role in motion prediction.		3				
91	10	Compare and contrast dense Optical Flow and sparse Optical Flow.		3				
92	10	Explain how background subtraction is used in motion detection for separating moving objects from a static background		3				
93	10	Discuss the use of Video Capture and Processing in OpenCV. Write a Code to capture live video streams.		3				
94	10	What is the purpose of the cv2.VideoWriter() function in OpenCV, and how do you implement it?		3				
95	10	Explain the challenges of Object Tracking in video processing and how algorithms like Mean Shift and Camshift address them.		3				
96	10	How does frame interpolation work in video generation? Describe its role in creating slow-motion effects.		3				
97	10	Calculate the total number of frames captured in a 60-second video with a frame rate of 30 FPS.		3				
98	10	Given two consecutive frames of size 640x480, calculate the number of pixels where motion is detected if 10% of the pixels change.		3				
99	10	A video has a frame rate of 24 FPS. How many frames are captured in 10 minutes?		3				
100	10	Given a video of 120 seconds with a frame rate of 60 FPS, how many frames will be written to the video file if the capture drops 10% of the frames?		3				

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101	10	Calculate the size of a 3-minute video (180 seconds) at 24 FPS, where each frame is 1 M		3				
102	10	Write a program to capture video from a webcam using OpenCV and display the frames.		3				
103	10	Write a program to detect motion using background subtraction.		3				
104	10	Write a program to perform edge detection on live video using the Canny Edge Detector.		3				
105	10	Write a program to track feature points using Optical Flow (Lucas-Kanade method)		3				
106	10	An object is moving in a straight line with an initial state vector:(position = 2 m, velocity = 3 m/s). The measurement at t=1 second is z 1=4.5 m. Use the following parameters to estimate the updated state using a Kalman filter: 1. State transition matrix: $$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$ 2. Measurement matrix: $$H = \begin{bmatrix} 1 & 0 \end{bmatrix}$$ 3. Process noise covariance: $$Q = \begin{bmatrix} 0.1 & 0 \\ 0 & 0.1 \end{bmatrix}$$ 4. Measurement noise covariance: $R = 1$ 5. Initial error covariance: $$P_0 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$		3				

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107	10	Perform one complete iteration of the Kalman filter. Kalman filter. The initial state of the car is: $$x_0 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$ (position = 0 m, velocity = 1 m/s). The measurement at $t = 1$ second is $z_1 = 2$ m. Use the following parameters to perform one complete iteration of the Kalman filter (Prediction and Update steps): 1. State transition matrix: $$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$ 2. Measurement matrix: $$H = \begin{bmatrix} 1 & 0 \end{bmatrix}$$ 3. Process noise covariance: $$Q = \begin{bmatrix} 0.1 & 0 \\ 0 & 0.1 \end{bmatrix}$$ 4. Measurement noise covariance: $R = 10$ 5. Initial error covariance: $$P_0 = \begin{bmatrix} 1000 & 0 \\ 0 & 1000 \end{bmatrix}$$ Perform the following steps: 1. Predict the state and error covariance. 2. Compute the Kalman Gain. 3. Update the state and error covariance based on the measurement.		3				
108	10	We are given two frames of an image sequence: **Frame 1 (at t_1):** $$\begin{bmatrix} 10 & 20 & 30 \\ 20 & 40 & 60 \\ 30 & 60 & 90 \end{bmatrix}$$ **Frame 2 (at t_2):** $$\begin{bmatrix} 12 & 22 & 32 \\ 24 & 44 & 64 \\ 36 & 66 & 96 \end{bmatrix}$$ We aim to estimate the optical flow (motion vector (u, v)) at the center pixel $(2, 2)$ using the **Lucas-Kanade method.**		3				