10 MCQ – Final Exam Guess Questions

1. Pattern Recognition mainly deals with:

A. Discovering hidden web links
B. Classifying data into categories
C. Building hardware circuits
D. Managing databases

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2. Which of the following is a supervised learning method?

A. K-Means
B. DBSCAN
C. K-Nearest Neighbor (KNN)
D. PCA

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3. Bayes Decision Theory is used to:

A. Reduce dimensionality
B. Make optimal classification decisions
C. Perform clustering
D. Remove noise from data

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4. PCA works by:

A. Maximizing entropy
B. Reducing variance
C. Maximizing variance in new components
D. Grouping similar clusters

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5. SVM tries to find:

A. Minimum spanning tree
B. Largest margin hyperplane
C. Smallest cluster radius
D. Posterior probability

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6. Naïve Bayes assumes:

A. Features are highly correlated
B. Features are independent
C. No need for prior probability
D. Non-linear kernels

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7. DBSCAN is best suited for:

A. Spherical clusters only
B. Density-based clustering
C. Reducing feature dimensions
D. Linearly separable data

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8. Which technique is used for dimensionality reduction?

A. KNN
B. PCA
C. DBSCAN
D. HMM

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9. Autoencoders are mainly used for:

A. Clustering
B. Feature learning and reconstruction
C. Decision tree generation
D. Bayes classification

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10. HMM is widely used in:

A. Static image recognition
B. Sequential pattern recognition
C. Database normalization
D. Feature scaling

10 Short Questions and Answers

1. What is Pattern Recognition?

Answer:
Pattern Recognition is the process of automatically identifying patterns and regularities in data using algorithms and mathematical models.

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2. What is the difference between supervised and unsupervised learning?

Answer:

- **Supervised** → Uses labeled data for training

- **Unsupervised** → Uses unlabeled data to find patterns/clusters

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3. What is Bayes Decision Theory?

Answer:
A probabilistic framework that minimizes classification error using prior probability and likelihood functions.

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4. Define PCA.

Answer:
Principal Component Analysis (PCA) is a dimensionality reduction technique that transforms correlated variables into a smaller set of uncorrelated variables called principal components.

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5. What is KNN classifier?

Answer:
K-Nearest Neighbors classifies a sample based on the majority label among its k nearest data points using distance metrics.

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6. What is a decision boundary?

Answer:
A surface that separates different classes in a feature space.

7. What is a kernel in SVM?

Answer:
A kernel is a function that transforms input data into a higher-dimensional space to make it linearly separable.

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8. What is clustering?

Answer:
An unsupervised learning technique that groups similar data points together based on similarity or distance.

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9. What are Autoencoders used for?

Answer:
Autoencoders are neural networks used for dimensionality reduction, data compression, and denoising.

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10. What is a Hidden Markov Model (HMM)?

Answer:
A statistical model for sequential data where the system is modeled using hidden states and observable outputs.

10 Long Questions (with Detailed Answers)

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1. Explain the components of a Pattern Recognition system.

Answer:
A complete Pattern Recognition system includes:

1. **Data acquisition** – Collecting raw data (image, voice, text).

2. **Preprocessing** – Noise removal, normalization, scaling.

3. **Feature extraction** – Converting raw data into meaningful features.

4. **Feature selection** – Choosing the most relevant features.

5. **Classification / Clustering** – Assigning class labels using algorithms like SVM, KNN, Naive Bayes.

6. **Post-processing** – Smoothing results, combining decisions.

7. **Performance evaluation** – Using accuracy, precision, recall, F1-score, ROC.

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2. Explain Bayes Decision Theory with an example.

Answer:
Bayes Decision Theory uses probabilities to classify data.
For a sample **x**, assign it to class **ωi** if:

$$P(\omega_i \mid x) > P(\omega_j \mid x)$$

Using Bayes theorem:

$$P(\omega_i \mid x) = \frac{P(x \mid \omega_i)P(\omega_i)}{P(x)}$$

Example:
If a feature vector belongs to two classes:

- Class A probability = 0.6

- Class B probability = 0.4
  Then the system chooses Class A.

It minimizes the classifier error.

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3. What is PCA? Describe its steps.

Answer:
PCA reduces dimensionality while retaining maximum variance.

Steps:

1. Standardize the data

2. Compute covariance matrix

3. Compute eigenvalues & eigenvectors

4. Sort eigenvectors based on eigenvalues

5. Select top k principal components

6. Transform data into new subspace

Used for image compression, face recognition, preprocessing for ML.

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4. Compare PCA and LDA.

Answer:

PCA	LDA
Unsupervised	Supervised
Maximizes variance	Maximizes class separability
Works without labels	Needs labeled data
Reduces noise	Enhances class discrimination

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5. Explain SVM with diagram and kernel trick.

Answer:

- SVM finds the **maximum margin hyperplane** between classes.

- Support vectors are the closest data points to the hyperplane.

- If data is not linearly separable, the **kernel trick** maps data to higher dimensions.

Common kernels: RBF, Polynomial, Sigmoid.

Used for image classification, bioinformatics, text classification.

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6. Explain neural network architecture: MLP and CNN.

Answer:

MLP (Multilayer Perceptron):

- Input layer → Hidden layers → Output layer

- Fully connected

- Uses activation functions (ReLU, Sigmoid)

CNN (Convolutional Neural Network):

- Convolution layers extract features

- Pooling reduces dimensions

- Fully connected classification layers

- Best for images

- Detects patterns like edges, textures, shapes

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7. Explain K-Means clustering algorithm.

Answer:
Step-by-step:

1. Choose number of clusters **k**

2. Initialize centroids randomly

3. Assign each point to nearest centroid

4. Update centroid based on mean of assigned points

5. Repeat steps 3–4 until centroids stabilize

Advantages:

- Simple and fast

Disadvantages:

- Requires k

- Sensitive to outliers

- Works poorly with non-spherical clusters

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8. Describe the EM algorithm and its role in GMM.

Answer:
EM (Expectation-Maximization) improves parameter estimates iteratively.

Steps:

1. **E-Step:** Compute expected membership probabilities

2. **M-Step:** Update parameters (mean, covariance, weight)

Used in **Gaussian Mixture Models** for clustering overlapping clusters.

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9. How is Pattern Recognition used in Image Processing and NLP?

Answer:

Image Processing:

- Object detection (YOLO, Faster-RCNN)

- Face recognition

- Medical imaging

- Scene understanding

NLP:

- Sentiment analysis

- Text classification

- Named entity recognition

- Speech-to-text

Both fields rely heavily on CNNs, RNNs, Transformers.

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10. Discuss ethical issues in Pattern Recognition.

Answer:

1. **Bias:** ML models may discriminate based on race, gender.

2. **Privacy:** Facial recognition systems may track people without consent.

3. **Security:** Data breaches can leak biometric data.

4. **Transparency:** Black-box deep learning models lack explainability.

5. **Misuse:** Surveillance and profiling can be used maliciously.