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CLASS X · ARTIFICIAL INTELLIGENCE (417) · SKILL SUBJECT · CBSE BOARD EXAMINATION 2027

PART B · UNIT 2

Advanced Concepts of Modeling in AI

Unit Booklet · Short Notes · Board-Pattern Questions · Model Answers

Part B · 11 of 40 theory marks | 29 questions with model answers | Sonakshi Ma'am | Taught: Tue 24 Nov

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STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

UNIT FINISHED ON _____

OBJECTIVE SELF-CHECK _____ / 16

1

READ THIS FIRST · SHORT NOTES

Unit Notes

AI, ML and DL; data words you must know; rule-based and learning-based models; supervised, unsupervised and reinforcement learning with classification, regression, clustering and association; and how a neural network makes a decision.

THIS UNIT IN THE BOARD PAPER

11 / 40

Unit 2 is the **biggest** AI unit: **11 of 40** marks. In the CBSE sample paper it gave **4 one-mark items** (one was a perceptron sum), **two 2-mark** questions (identify the model; compare learning types) and **two 4-mark** questions (unsupervised learning; four scenarios to classify).

SYLLABUS 2026–27 · WHAT CBSE LISTS FOR THIS UNIT

- AI, ML and DL – differences; common data terminology
- Rule-based vs learning-based approach
- Supervised, unsupervised and reinforcement learning
- Classification, regression, clustering, association
- Deep learning: ANN and CNN
- Neural networks: layers; how AI makes a decision
- Activity: Human Neural Network game; TensorFlow Playground

HOW THE CBSE SKILL-SUBJECT PAPER IS SET (THEORY 50 MARKS · 2 HOURS)

1 mark
Objective: MCQ, assertion–reason, fill in the blank, true/false, match. Q1 is Part A; Q2–Q5 (answer 5 of 6 in each) are Part B.

2 marks
Short answer in **20–30 words**: two clear points. Part B: answer any 4 of 6 (Q11–Q16).

4 marks
Long answer in **50–80 words**: four points, or 2 + 2. Answer any 3 of 5 (Q17–Q21); often case-based.

Part B = 40
Objective 20 + short 8 + long 12. Part A (Employability Skills) = 10. Practical = 50.

Write in points, start each point with the key word, and stay inside the word limit. Objective answers: write the option letter **and** the answer.

1 AI, ML and DL

Term	Meaning	Example
Artificial Intelligence (AI)	Machines that copy human abilities: thinking, learning, deciding	Chess-playing computer, smart assistant
Machine Learning (ML)	A part of AI in which machines **learn from data** and improve without being programmed for every case	Spam filter, movie suggestions
Deep Learning (DL)	A part of ML that uses **neural networks with many layers** and very large data; finds features by itself	Face recognition, voice typing

AI ⊃ ML ⊃ DL: all DL is ML and all ML is AI, but not the other way round.

2 Data words

Term	Meaning
Data / dataset	Facts collected for the project / a whole collection of them, often a table
Data point (record)	One row of the dataset, e.g. one student
Feature	An input column the model uses, e.g. hours studied, attendance
Label (target)	The output the model must predict, e.g. pass or fail
Labelled data	Data in which each record already has its correct label
Unlabelled data	Data with no labels given
Training / testing data	Part used to teach the model / part kept aside to check it

3 Rule-based vs learning-based

	Rule-based approach	Learning-based approach
Rules	Written by the **developer**	Found by the **machine** from data
New situations	Cannot handle cases outside its rules	Can adapt as it gets more data
Data needed	Little	A lot of data
Example	"If marks ≥ 33 then pass"	Spam filter that learns from emails marked spam

4 Three types of machine learning

- **Supervised learning:** the model learns from **labelled** data, like a student taught with answers. Used to predict labels for new data.
- **Unsupervised learning:** the model gets **unlabelled** data and finds **hidden patterns or groups** by itself.
- **Reinforcement learning:** an **agent** learns by **trial and error**, getting **rewards** for good actions and **penalties** for bad ones. Used in games, robots, self-driving cars.

REMEMBER WITH EXAMPLES

Supervised: thousands of fruit photos labelled "apple" or "mango" → identify a new fruit. Unsupervised: shop data with no labels → groups of similar customers. Reinforcement: a robot learns to walk by falling and trying again.

5 Supervised: classification and regression

	Classification	Regression
Output	A **category / class** (discrete)	A **number** (continuous)
Question	Which group does it belong to?	How much / how many?
Examples	Spam or not spam; disease yes/no; cat, dog or rabbit	House price; tomorrow's temperature; crop yield in quintals

6 Unsupervised: clustering and association

	Clustering	Association
Does what	Puts **similar** data points into **groups** (clusters)	Finds **rules** about items that occur **together**
Example	Grouping customers by buying habits; grouping news articles by topic	"People who buy bread often buy butter" (market basket)

7 Deep learning: ANN and CNN

- **Artificial Neural Network (ANN):** a model made of layers of connected nodes (artificial neurons), inspired by the human brain.
- **Convolutional Neural Network (CNN):** a deep network built to work with **images** (and video): it picks out edges, shapes and objects.
- Deep learning needs **huge data** and **powerful computers** (GPUs), but works best on images, speech and language.

8 Neural network: layers

1. **Input layer:** receives the data (one node per feature). No processing is done here.
2. **Hidden layer(s):** do the processing. Each node multiplies inputs by **weights**, adds a **bias** and passes the result through an **activation function**. More hidden layers = deeper network.
3. **Output layer:** gives the final answer, e.g. "cat" or "dog".

Weight = how important an input is. **Training** means adjusting the weights again and again until the network's answers are correct.

Features of neural networks: learn features by themselves; get better with more data; handle very large, complex data; used in face, speech and handwriting recognition.

9 How a neuron decides: the perceptron

A **perceptron** is the simplest neural network: one neuron.

> Weighted sum = $(x_1 \times w_1) + (x_2 \times w_2) + \ldots +$ bias. If the sum is **more than 0**, output **1** (yes); otherwise output **0** (no).

WORKED EXAMPLE

Should Riya go for a picnic? Inputs: weather good $x_1 = 1$ ($w_1 = 0.6$), friends coming $x_2 = 0$ ($w_2 = 0.4$), holiday $x_3 = 1$ ($w_3 = 0.3$); bias = –0.5.
Sum = 0.6 + 0 + 0.3 – 0.5 = **0.4** > 0 → output **1: go**.

In the **Human Neural Network game**, students act as nodes and pass on messages; it shows how many simple units together reach a decision.

Key terms

16 terms

- **Machine learning:** machine learns from data
- **Deep learning:** ML with many-layered neural networks
- **Feature:** input column used by the model
- **Label:** output to be predicted
- **Labelled data:** records with correct answers
- **Rule-based:** developer writes the rules
- **Supervised:** learns from labelled data
- **Unsupervised:** finds patterns in unlabelled data
- **Reinforcement:** learns by rewards and penalties
- **Classification:** predicts a class
- **Regression:** predicts a continuous number
- **Clustering:** groups similar data
- **Association:** finds items that occur together
- **Hidden layer:** processing layer of a neural network
- **Weight:** importance given to an input
- **Perceptron:** single-neuron network

Common mistakes and exam tips

AVOID THESE

- Classification → **class / category**; regression → **number**. “Predict the price” is regression even if it says “predict”.
- Clustering makes **groups**; association finds **“bought together”** rules. Both are unsupervised.
- The input layer does **no processing**; the hidden layers do.
- Reinforcement learning has an **agent**, **rewards** and **penalties** – name all three in an answer.
- In a perceptron sum, do not forget to add the **bias** (it is often negative).

PART A · 1 MARK EACH

A Objective Questions

16 questions: MCQs, assertion–reason, fill in the blanks and true/false, like Q2–Q5 of the board paper. Answers in Part E.

ASSERTION–REASON: HOW TO ANSWER

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

A1. Which statement is correct? [1]

(a) ML is a part of DL
(b) DL is a part of ML
(c) AI is a part of ML
(d) AI and ML are unrelated

A2. A model predicts the price of a used car from its age and kilometres run. This is: [1]

(a) Classification
(b) Regression
(c) Clustering
(d) Association

A3. A bank groups its customers into sets with similar spending habits, without any labels. This is: [1]

(a) Classification
(b) Regression
(c) Clustering
(d) Reinforcement learning

A4. An online store finds that people who buy cricket bats often buy cricket balls. This technique is: [1]

(a) Association
(b) Classification
(c) Regression
(d) Perceptron

A5. A computer learns to play a game by winning points for good moves and losing points for bad ones. This is: [1]

(a) Supervised learning
(b) Unsupervised learning
(c) Reinforcement learning
(d) Rule-based learning

A6. In a dataset that predicts whether a student will pass, the column "Pass / Fail" is the: [1]

(a) Feature **(b)** Label **(c)** Bias **(d)** Cluster

A7. Which layer of a neural network does no processing and only receives the data? [1]

(a) Input layer
(b) Hidden layer
(c) Output layer
(d) Convolution layer

A8. A perceptron has inputs $x_1 = 1$, $x_2 = 1$ with weights 0.2 and 0.3 and a bias of −0.6. If output is 1 when the sum is more than 0, the output is: [1]

(a) 1, because the sum is 0.5
(b) 0, because the sum is −0.1
(c) 1, because the sum is 0.1
(d) 0, because the sum is −1.1

A9. The deep learning network specially designed for images is the: [1]

(a) CNN
(b) Perceptron with one input
(c) Rule-based model
(d) Association model

A10. Which of these is an example of a rule-based approach? [1]

(a) A spam filter that learns from user reports
(b) "If temperature > 38 °C, show 'fever'"
(c) Face unlock that improves with use
(d) Grouping songs by mood

A11. ASSERTION–REASON [1]

Assertion (A): Supervised learning needs labelled data.

Reason (R): The model learns by comparing its predictions with the correct labels.

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

A12. ASSERTION–REASON [1]

Assertion (A): Deep learning works well even with very small datasets.

Reason (R): Deep learning models have many layers of neurons.

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

A13. FILL IN THE BLANK [1]

The importance given to each input in a neural network is called its _____.

A14. FILL IN THE BLANK [1]

Grouping similar data points together without labels is called _____.

A15. TRUE OR FALSE [1]

Classification predicts a continuous value such as temperature.

A16. TRUE OR FALSE [1]

Adding more hidden layers makes a neural network deeper.

B — Short Answer Questions

PART B · 2 MARKS EACH

Answer in 20–30 words: two clear points. Model answers in Part E.

B1. Differentiate between rule-based and learning-based approaches. MUST DO [2]

B2. Differentiate between supervised and unsupervised learning. MUST DO [2]

B3. Differentiate between classification and regression with one example each. [2]

B4. What is reinforcement learning? Give one use. [2]

B5. How is ML different from DL? [2]

B6. Name the three layers of a neural network and say what the hidden layer does. [2]

C

PART C · 4 MARKS EACH

Long Answer Questions

Answer in 50–80 words: four points, or two points with an example each. Model answers in Part E.

C1. Explain unsupervised learning and its two types with an example of each. MUST DO [4]

C2. Identify the type of learning or task: (a) predicting tomorrow's rainfall in mm; (b) sorting emails into spam and not spam; (c) a robot dog learning to climb stairs by trial; (d) grouping photos by similar faces without names. MUST DO [4]

C3. Explain the structure of an artificial neural network. [4]

C4. Write any four features of neural networks. [4]

C5. A perceptron decides whether to give a loan. Inputs: salaried $x_1 = 1$ (weight 0.5), owns house $x_2 = 0$ (weight 0.4), good credit $x_3 = 1$ (weight 0.3); bias –0.7. Output 1 (give loan) if the sum is more than 0. Work out the decision and explain what bias does. [4]

D

PART D · CASE AND COMPETENCY BASED

Case-Based Questions

Read the situation, then answer from it and from the unit. These are the 4-mark board questions that test application.

D1. Case-Based · Smart school canteen [4]

A school canteen has two years of records: date, day, weather, number of students present, and the number of samosas sold. The manager wants an AI to tell her how many samosas to make each day. Later she also wants to find which items students usually buy together.

(i) Is the samosa prediction classification or regression? Why? [1]

(ii) Name two features and the label in this dataset. [1]

(iii) Which type of learning finds items bought together? Is it supervised? Explain. [2]

D2. Competency-Based · Rules or learning? [4]

An app gives a "heat alert" whenever the temperature goes above 40 °C. A second app studies ten years of weather data and learns to predict heat waves three days ahead.

(i) Which app uses a rule-based approach? [1]

(ii) Which approach does the second app use, and what kind of data does it need? [1]

(iii) Give two advantages of the second app over the first. [2]

E

PART E · ANSWERS IN CBSE MARKING-SCHEME STYLE

Answers

Objective key with a reason, then model answers: numbered value points, key word first, the mark for each point in orange, and the word count under each answer. Any other correct, relevant point also earns the mark.

Objective questions – answer key

Part A

Write the option letter **and** the answer, as the marking scheme does.

Q	Answer	Why (one line)
A1	**(b) DL is a part of ML**	AI ⊃ ML ⊃ DL.
A2	**(b) Regression**	Price is a continuous number.
A3	**(c) Clustering**	Grouping unlabelled data.
A4	**(a) Association**	Items bought together.
A5	**(c) Reinforcement learning**	Rewards and penalties.
A6	**(b) Label**	The output to predict.
A7	**(a) Input layer**	Processing is in hidden layers.
A8	**(b) 0, because the sum is –0.1**	0.2 + 0.3 – 0.6 = –0.1, which is not more than 0.
A9	**(a) CNN**	Convolutional Neural Network.
A10	**(b) "If temperature > 38 °C, show 'fever'"**	The rule is written by the developer.
A11	**(a) Both true; R explains A**	R explains A.
A12	**(d) A false, R true**	A is false: DL needs large data. R is true.
A13	**weight**	Adjusted during training.
A14	**clustering**	Unsupervised.
A15	**False**	Correct: regression predicts continuous values; classification predicts a class.
A16	**True**	Hence the name deep learning.

Short answers

Part B · 2 marks

B1. Differentiate between rule-based and learning-based approaches. [2]

1. **Rule-based:** the developer writes the rules; it cannot handle new cases. 1
2. **Learning-based:** the machine learns rules from data and adapts to new cases. 1

23 words · CBSE asks 20–30 words | Marking: 1 + 1 = 2 | 1 + 1 | MUST DO

B2. Differentiate between supervised and unsupervised learning. [2]

1. **Supervised:** learns from labelled data to predict labels, e.g. spam detection. 1
2. **Unsupervised:** finds patterns in unlabelled data, e.g. customer groups. 1

20 words · CBSE asks 20–30 words | Marking: 1 + 1 = 2 | 1 + 1 | MUST DO

B3. Differentiate between classification and regression with one example each. [2]

1. **Classification:** predicts a category, e.g. cat or dog. 1
2. **Regression:** predicts a number, e.g. house price. 1

15 words · CBSE asks 20–30 words | Marking: 1 + 1 = 2 | ½ meaning + ½ example, × 2

B4. What is reinforcement learning? Give one use. [2]

1. **Meaning:** an agent learns by trial and error, getting rewards and penalties. 1
2. **Use:** game-playing programs or self-driving cars. 1

18 words · CBSE asks 20–30 words | Marking: 1 + 1 = 2 | 1 + 1

B5. How is ML different from DL? [2]

1. **ML:** learns from data; often needs humans to choose the features. 1
2. **DL:** uses many-layered neural networks and huge data; finds features itself. 1

22 words · CBSE asks 20–30 words | Marking: 1 + 1 = 2 | 1 + 1

B6. Name the three layers of a neural network and say what the hidden layer does. [2]

1. **Layers:** input, hidden and output layers. 1
2. **Hidden layer:** processes inputs using weights, bias and activation. 1

15 words · CBSE asks 20–30 words | Marking: 1 + 1 = 2 | 1 + 1

Long answers

Part C · 4 marks

C1. Explain unsupervised learning and its two types with an example of each. [4]

1. **Meaning:** the model finds hidden patterns in unlabelled data. 1
2. **No labels:** no correct answers are given; it learns structure itself. 1
3. **Clustering:** groups similar items, e.g. customers by spending. 1
4. **Association:** finds items occurring together, e.g. bread and butter. 1

37 words · CBSE asks 50–80 words | Marking: 1 + 1 + 1 + 1 = 4 | 1 + 1 + 1 + 1 | MUST DO

C2. Identify the type of learning or task: (a) predicting tomorrow's rainfall in mm; (b) sorting emails into spam and not spam; (c) a robot dog learning to climb stairs by trial; (d) grouping photos by similar faces without names. [4]

1. **(a):** Supervised – regression (a number). 1
2. **(b):** Supervised – classification (two classes). 1
3. **(c):** Reinforcement learning (rewards and penalties). 1
4. **(d):** Unsupervised – clustering (no labels). 1

21 words · CBSE asks 50–80 words | Marking: 1 + 1 + 1 + 1 = 4 | 1 mark each | MUST DO

C3. Explain the structure of an artificial neural network. **[4]**

1. **Nodes:** made of connected artificial neurons, like the brain. 1
2. **Input layer:** receives the data; no processing. 1
3. **Hidden layers:** process with weights, bias and activation. 1
4. **Output layer:** gives the final result. 1

30 words · CBSE asks 50–80 words | Marking: 1 + 1 + 1 + 1 = 4 | 1 mark each

C4. Write any four features of neural networks. **[4]**

1. **Self-learning:** find important features without being told. 1
2. **More data:** perform better as data grows. 1
3. **Complex data:** handle images, sound and text. 1
4. **Uses:** face, speech and handwriting recognition. 1

27 words · CBSE asks 50–80 words | Marking: 1 + 1 + 1 + 1 = 4 | Any four, 1 mark each

C5. A perceptron decides whether to give a loan. Inputs: salaried $x_1 = 1$ (weight 0.5), owns house $x_2 = 0$ (weight 0.4), good credit $x_3 = 1$ (weight 0.3); bias −0.7. Output 1 (give loan) if the sum is more than 0. Work out the decision and explain what bias does. **[4]**

1. **Weighted sum:** $1\times0.5 + 0\times0.4 + 1\times0.3 = 0.8$. 1
2. **Add bias:** $0.8 - 0.7 = 0.1$. 1
3. **Decision:** $0.1 > 0$, so output 1: give the loan. 1
4. **Bias:** shifts the threshold, making the neuron easier or harder to fire. 1

38 words · CBSE asks 50–80 words | Marking: 1 + 1 + 1 + 1 = 4 | 1 + 1 + 1 + 1

Case-based answers

Part D

D1. Case-Based · Smart school canteen (passage printed in Part D) **[4]**

(i) Is the samosa prediction classification or regression? Why? **[1]**

Regression, because the output is a **number** of samosas.

(ii) Name two features and the label in this dataset. **[1]**

Features: **weather**, **students present** (also day). Label: **samosas sold**.

(iii) Which type of learning finds items bought together? Is it supervised? Explain. **[2]**

Association, a type of **unsupervised** learning: no labels are given; the model finds items that often occur together in bills.

Marking: 1 + 1 + 2 = 4 | 1 + (½ + ½) + 2

D2. **Competency-Based · Rules or learning?** (passage printed in Part D) **[4]**

(i) **Which app uses a rule-based approach?** [1]

The **first** app – a developer wrote the rule "above 40 °C".

(ii) **Which approach does the second app use, and what kind of data does it need?** [1]

Learning-based; it needs a **large amount of past data**.

(iii) **Give two advantages of the second app over the first.** [2]

(1) It can warn **in advance**, not only when it is already hot. (2) It **adapts** and improves as new data is added.

Marking: 1 + 1 + 2 = 4 | 1 + 1 + 2