A4 MACHINE LEARNING · A4.3 · HL ONLY

Machine learning approaches

The algorithms that learn: **regression**, **classification**, **clustering**, reinforcement learning, genetic algorithms, **neural networks**, and how to evaluate a model. HL only.

01 Supervised

Regression	Predict a continuous value (line of fit).
Classification	Predict a category.
k-NN	Majority vote of nearest neighbours.
Decision tree	Yes/no splits; can overfit.
Hyperparam	Settings tuned before training.

02 Unsupervised & reinforcement

Clustering	Group similar items (k-means).
Association	Items that occur together.
Reinforcement	Agent + reward, trial and error.
Goal (RL)	Maximise cumulative reward.

03 Neural networks (ANN)

In

Input layer

Takes the feature values into the network.

Hid

Hidden layer(s)

Neurons sum weighted inputs and apply an activation function. Many layers = deep learning.

Out

Output layer

Produces the prediction. CNNs add convolution/pooling for images.

04 Genetic algorithms

Population	A set of candidate solutions.
Fitness	Scores how good each candidate is.
Selection	Keep the fittest candidates.
Crossover	Combine two to make offspring.
Mutation	Randomly tweak a solution.

05 Evaluating a model

Underfit	Too simple; misses the pattern.
Overfit	Too complex; fits the noise.
Test set	Judge on unseen data, not training.
Metrics	Accuracy, precision, recall, F1.
Tuning	Adjust hyperparameters; cross-validate.

06 Match the method to the learning type

Regression	Supervised: predict a continuous number from labelled data.	SUPERVISED
Classification	Supervised: predict a category (k-NN, decision trees).	SUPERVISED
Clustering / association	Unsupervised: find groups or co-occurring items in unlabelled data.	UNSUPERVISED
Agent + reward	Reinforcement: learn by trial and error to maximise reward.	REINFORCEMENT

FINAL PASS BEFORE THE EXAM

Rapid exam tips

Eight things that lose marks in Paper 1 if you slip on them. A4.3 is HL only. Skim before you walk in.

01

Regression = continuous; **classification** = categories. Both are supervised.

02

Clustering is unsupervised; don't confuse it with classification.

03

k-NN classifies by the majority vote of the nearest neighbours.

04

Reinforcement learning = agent + reward, learning by trial and error.

05

Genetic algorithm: selection, crossover, mutation, guided by a fitness function.

06

A neural net learns by adjusting **weights**; **CNNs** are best for images.

07

Hyperparameters are set before training; **weights** are learned during it.

08

Evaluate on a **test set** and watch for **overfitting**. A4.3 is HL only.