

18.1 Artificial Intelligence (AI)

Name: _____ Class: _____ Date: _____

Total: 32 marks

KEY WORDS artificial intelligence 人工智能 • deep learning 深度学习

• machine learning 机器学习 • neural networks 神经网络 • deep neural network 深度神经网络

Objective

Build the skills to answer exam questions on **Artificial Intelligence** 人工智能 — graphs in AI, neural networks, and the types of machine learning.

You must be able to:

- explain how **graphs** help AI and how an **artificial neural network** works
- compare **supervised**, **unsupervised** and **reinforcement** learning
- explain **deep learning** and **backpropagation**

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

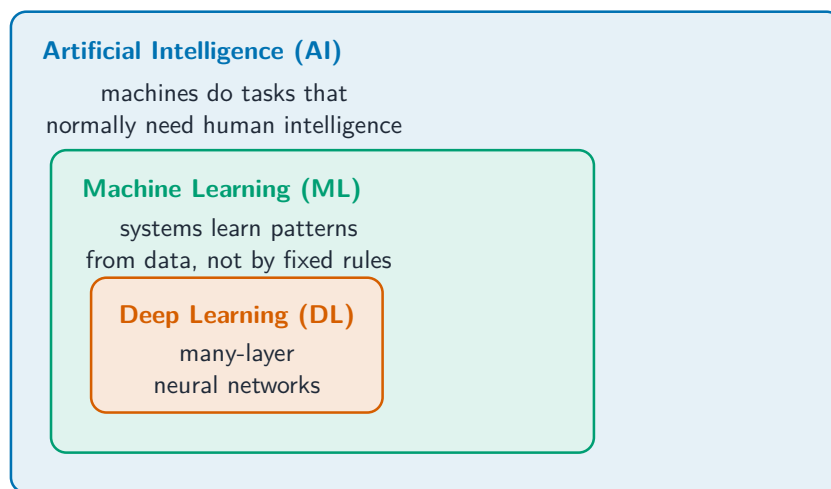
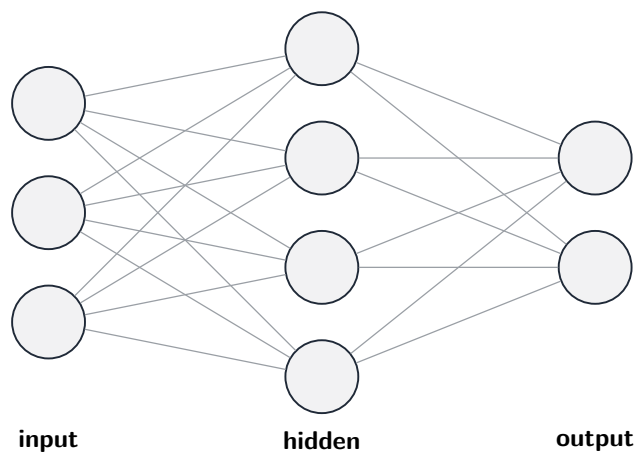
■ AI, ML and graphs

Machine learning (ML) learns patterns **from data** instead of fixed rules; **deep learning (DL)** is ML using deep neural networks. Many AI problems sit on a **graph** — **nodes** (states/places) joined by **edges** (moves, each with a cost). Two algorithms find the **shortest path**:

- **Dijkstra's algorithm** explores outward from the start, always extending the lowest-cost node, until it reaches the goal.
- **A*** does the same but adds a **heuristic** estimate of the distance **still to go**, which steers the search **toward the goal** — so it usually checks **fewer nodes** and is faster.

■ Neural networks

A network has an **input** layer, one or more **hidden** layers, and an **output** layer. Each connection has a **weight**; a neuron sums its weighted inputs (plus a bias), applies an **activation function**, and passes the result on:



How AI, machine learning and deep learning relate

■ Types of machine learning

- **supervised** — data has **labels**; learns input → label (classification, regression).
- **unsupervised** — **no labels**; finds structure (e.g. **clusters**).
- **reinforcement** — an **agent** acts, gets a **reward**, and learns a **policy** that maximises total reward by trial and error.

Training adjusts the weights by **backpropagation**: a forward pass computes the output, a **loss function** measures the error, and the error is propagated **backwards** to update each weight (gradient descent). Deep learning needs **lots of data and compute**.

2 Practice

Now apply the methods above.

2.1 State what **machine learning** is. [1]

2.2 Name the **three** kinds of layer in a neural network. [2]

2.3 In a graph used for **pathfinding**, state what an **edge** represents. [1]

2.4 State what a **weight** is in an artificial neuron. [1]

3 Exam-style questions

3.1 Describe the difference between **supervised** and **unsupervised** learning. [2]

3.2 Explain how **reinforcement learning** works, using the terms **agent**, **reward** and **policy**. [3]

3.3 Explain why **deep learning** needs a large amount of **data** and **computing power**. [2]

3.4 State the role of **backpropagation** in training a neural network. [2]

3.5 State the purpose of **Dijkstra's algorithm** and **A***, and outline **one** difference between them. [3]

3.6 A delivery company is building software to plan its routes and to read handwritten address labels.

(a) **Identify** one Artificial Intelligence algorithm suitable for finding the shortest distance between two depots on a road network, and **state** what the nodes and the edge weights represent. [3]

(b) **Describe** how that algorithm proceeds from the starting node. [3]

(c) The company also considers the **A*** algorithm. **State** the one thing A* uses that the algorithm in (a) does not, and **explain** the benefit. [3]

(d) **Describe** what is meant by **Deep Learning**, and **state** one example of where it is used. [3]

(e) **Explain** why Deep Learning suits the handwriting-reading task better than a set of hand-written rules. [3]
