

Artificial Intelligence – Revision Quiz

Total Marks: 100

Duration: 2 Hours

Instructions

This quiz is **partially open book**.

You are allowed to bring **two A4-sized pages of notes** with you during the quiz. You may write any information you wish on these pages before the quiz.

During the quiz:

- Only **these two A4 pages** may be used as reference material.
- **No other notes, textbooks, slides, electronic devices, or online resources are permitted.**

The quiz will **start exactly at 10:00 AM** and will run for **2 hours**.

Please answer questions clearly and show all working where calculations are required.

⚠ Important: Your **final exam will NOT be open book**.

This quiz is intended to help you prepare for the final exam, and **the structure and style of questions in the final exam will be similar to this quiz**.

Section A [50 Marks]

Answer ANY TWO questions from this section.

Question 1 – AI Perception and Generative Models [25 Marks]

A robotics company is developing an **AI perception system for autonomous delivery robots**.

The system uses **Convolutional Neural Networks (CNNs)** to recognise obstacles and **Generative Adversarial Networks (GANs)** to generate synthetic training images.

1.1

Explain the role of the following components in a CNN used for image recognition:

- convolutional layers
- pooling layers

- activation functions

[6 marks]

1.2

Describe how the **Generator and Discriminator interact during GAN training**.
Explain how this adversarial process helps improve the quality of generated images.

[6 marks]

1.3

Discuss **two risks** associated with deploying AI perception systems in real-world environments.

Relate these risks to **Responsible AI principles** such as safety, transparency, or accountability.

[5 marks]

1.4

An input image of size **64 × 64 × 3** is passed through a convolutional layer with:

- 32 filters
- kernel size **3 × 3**
- stride **1**
- padding **1**

Calculate the **output feature map dimensions**.

Show the formula and final result.

[4 marks]

1.5

Suggest **two techniques** for designing **computationally efficient CNN models** for embedded devices.

[4 marks]

Question 2 – Search Algorithms and Evolutionary Methods [25 Marks]

A research team is designing optimisation algorithms for **urban traffic control systems**.

2.1

Explain the concept of **local search algorithms**.

Use **hill climbing** as an example and describe how it works.

[6 marks]

2.2

Hill climbing may become trapped in **local maxima, plateaus, or ridges**.

Describe **two strategies** that can help overcome these limitations.

[6 marks]

2.3

Write **pseudo-code for a basic Genetic Algorithm**, including the following stages:

- population initialization
- fitness evaluation
- selection
- crossover
- mutation
- termination condition.

[6 marks]

2.4

A chromosome is represented as:

$x = a\ b\ c\ d\ e\ f\ g\ h$

Each gene can take a value from **0–9**.

Parent 1

5 1 4 2 7 6 3 8

Parent 2

2 9 0 5 4 1 7 6

Perform **two-point crossover** with cut points between genes **3|4** and **6|7**.

Show the **two offspring chromosomes**.

[4 marks]

2.5

Given the fitness function:

$$f(x) = (a + c) - (b + e - d) - g + f + h$$

Calculate the **fitness of both offspring** produced in Question 2.4.

[3 marks]

Question 3 – AI Capability and Explainability [25 Marks]

A research laboratory is developing two AI systems:

- **System Alpha** – a specialised AI system used for fraud detection in financial transactions.
- **System Omega** – an experimental system capable of transferring knowledge between domains.

3.1

Define **Weak AI (Narrow AI)** and **Strong AI (Artificial General Intelligence)**.

Use the examples of **Alpha and Omega** to explain the difference.

[5 marks]

3.2

Identify and explain **three capabilities** that a Strong AI system would require but that current machine learning systems typically lack.

[6 marks]

3.3

Discuss **two ethical or societal risks** associated with highly autonomous AI systems.

Relate these risks to **Responsible AI principles**.

[6 marks]

3.4

Explain how **Explainable AI techniques** can improve trust in complex machine learning systems.

Provide **two example methods**.

[4 marks]

3.5

Critically evaluate whether **Artificial General Intelligence** could realistically emerge within the next **20 years**.

[4 marks]

Section B [50 Marks]

Answer **BOTH** questions in this section.

Question 4 – Generative AI Systems [25 Marks]

A digital media company is developing a **Generative Adversarial Network (GAN)** to create realistic digital artwork.

4.1

Explain the roles of the **Generator** and **Discriminator** in a GAN architecture.

[6 marks]

4.2

Describe the **training process of a GAN**, including how real and generated data are used during training.

[6 marks]

4.3

During training the GAN starts producing **very similar images repeatedly**.

Identify **two possible causes** and suggest **one solution for each**.

[6 marks]

4.4

GAN-generated images are sometimes used as **synthetic training data** for CNN models.

Discuss **two advantages** and **one potential risk** of using synthetic data.

[4 marks]

4.5

Draw and label a **basic GAN architecture diagram**, showing:

- noise input
- generator
- discriminator
- feedback loop.

[3 marks]

Question 5 – Responsible AI and Regulation [25 Marks]

A company called **SafeDrive Analytics** develops an AI-based driver monitoring system that uses **computer vision** to detect fatigue and unsafe driving behaviour.

However, concerns have been raised regarding:

- incorrect alerts,
- performance differences across demographic groups,

- privacy issues from continuous video monitoring.

5.1

Identify and explain **three ethical concerns** raised by this system.

Link each concern to **Responsible AI principles**.

[6 marks]

5.2

Suggest **two methods** that could be used to detect and reduce **bias in computer vision models**.

[5 marks]

5.3

Recommend **two explainability techniques** that could help drivers and managers understand the AI system's decisions.

[5 marks]

5.4

Based on the **EU AI Act**, determine the likely **risk classification** of this system and explain the key compliance obligations.

[5 marks]

5.5

Propose **two governance or oversight mechanisms** that could improve accountability and trust in the deployment of such systems.

[4 marks]