

THEME A: CONCEPTS · A4.1

Machine learning fundamentals

Original practice questions · 33 marks · about 50 minutes · covers A4.1.1–A4.1.2

Instructions. Answer all questions. The maximum mark for this paper is [33 marks]. The marks available are shown in brackets. Parts badged **HL** assess higher level only content; standard level students may leave these out.

1**Total: 6 marks**

A farming co-operative wants to use machine learning. It holds thousands of photographs of crop leaves, some already labelled by an expert as healthy or diseased, and years of unlabelled records about its member farms.

- (a) Distinguish between supervised learning and unsupervised learning. **[3]**

- (b) Identify the type of machine learning that would sort the member farms into similar groups without being told in advance what those groups are. **[1]**

- (c) The co-operative also receives thousands of written comments from the shops it supplies. Outline how sentiment analysis could help it use these comments. **[2]**

Only 400 of the co-operative's leaf photographs have been labelled by the expert. A large model that already recognises general features of plants is publicly available.

- (a) Describe the steps the co-operative would follow to build its leaf classifier from the publicly available model. [3]

- (b) Explain why transfer learning is a good choice for the co-operative. [3]

3

Total: 5 marks

The co-operative also runs an experimental tractor that steers itself between rows of crops.

- (a) Outline what distinguishes deep learning from other machine learning approaches. [3]

- (b) Identify the type of machine learning used by the tractor, which improves by trying manoeuvres and receiving a score for each attempt, and justify your answer. [2]

The co-operative must decide what hardware to buy. Training the leaf model uses 90,000 high-resolution photographs and will be repeated each season.

- (a) Describe **two** factors the co-operative should consider when choosing hardware for training. [4]

- (b) Outline **one** reason a standard laptop would be unsuitable for this training. [2]

The co-operative compares specialised processors and considers renting computing power instead of buying it.

- (a) Distinguish between a graphics processing unit (GPU) and a tensor processing unit (TPU). [2]

- (b) Explain why the co-operative trains its model on a cloud-based platform rather than buying its own high-performance computing cluster. [3]

Once trained, the model runs on a small computer mounted on the tractor. The fields have no reliable mobile network coverage.

- (a) Explain why the trained model runs on an edge device on the tractor rather than in the cloud. [3]

- (b) Outline **one** hardware limitation of running the model on an edge device. [2]

END OF QUESTIONS