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Information technology in a global society
Higher level
Paper 1

Friday 4 November 2022 (afternoon)

2 hours 15 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer two questions.
- Section B: answer one question.
- Each question is worth **[20 marks]**.
- The maximum mark for this examination paper is **[60 marks]**.

Section A

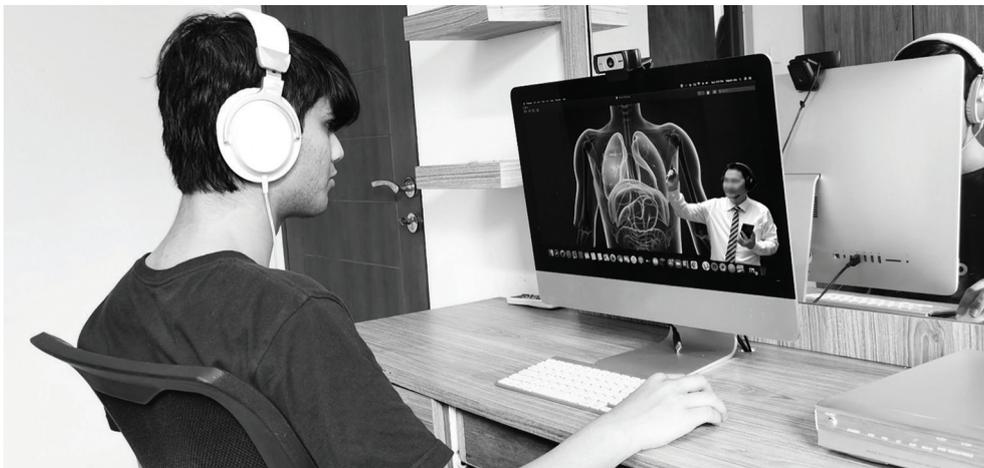
Answer **two** questions. Each question is worth [20 marks].

1. Virtual learning environments

A new university is being developed to offer online degree courses through a virtual learning environment (VLE) (see **Figure 1**). This initiative will enable students from anywhere in the country to access higher education.

Each university lecturer records their lectures and transfers them to the cloud for remote access by the students.

Figure 1: A virtual learning environment



- (a) (i) Identify **two** hardware devices that a university lecturer could use to record a lecture. [2]
- (ii) Identify the steps that a university lecturer may use to upload course material to the virtual learning environment (VLE). [4]
- (b) The university needs to choose between open-source software and proprietary software to develop the virtual learning environment (VLE).
Analyse these two options. [6]
- (c) Students are in the process of selecting a university to complete their degree. They have two options:
- **Option 1:** A traditional university using face-to-face environments.
 - **Option 2:** A university only offering online courses using a virtual learning environment (VLE) platform.
- Evaluate these two options. [8]

2. The use of simulators to train military personnel

An army has developed a simulator to train its soldiers (see **Figure 2**). The simulator uses high-resolution images to represent the local environment. It allows a soldier to click on any region on a virtual globe and train in that environment.

To restrict access to the simulator, the army requires soldiers to use biometric authentication.

Each soldier is also provided with documentation that explains how to use the simulator.

Figure 2: Simulation-based training



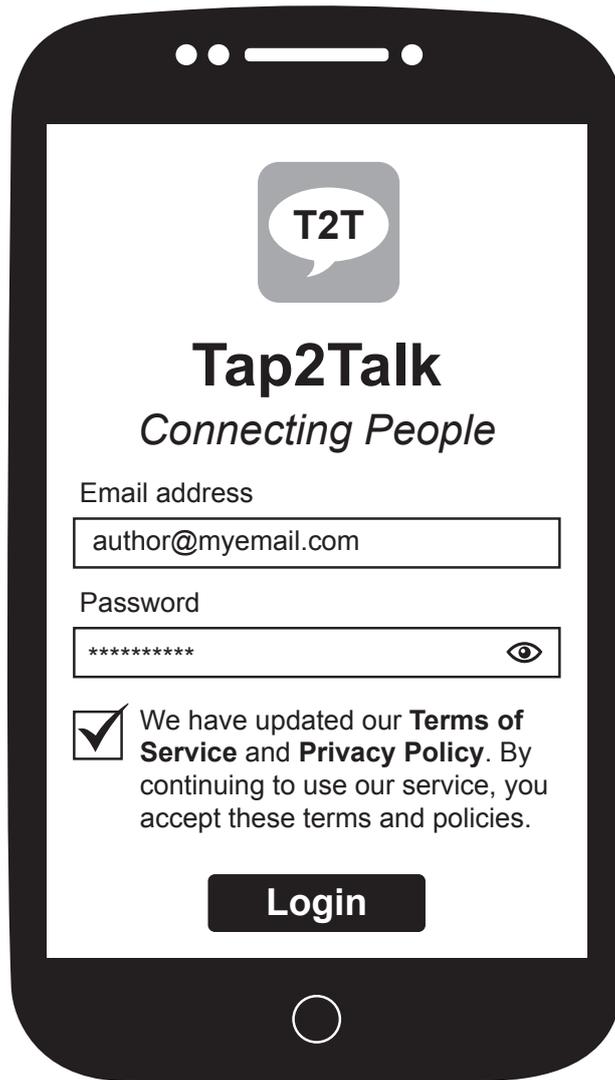
- (a) (i) Identify **two** file formats that could be used to save an image in the simulator. [2]
- (ii) Define the term *image resolution*. [2]
- (iii) Identify **two** biometric authentication methods that could be used to access the simulator. [2]
- (b) (i) Distinguish between a model and a simulation. [2]
- (ii) Explain why the quality of user documentation is important for the success of the simulator. [4]
- (c) To what extent do the benefits of using simulators for training soldiers outweigh the concerns? [8]

3. Messaging apps*

Tap2Talk is a messaging app with over two billion users worldwide. The app lets users chat, text, make voice calls and video calls, share media and receive notifications. The data that is shared between users is encrypted.

Tap2Talk frequently reviews and updates its terms of service and privacy policy. To continue to use *Tap2Talk* services, users must agree to the changes (see **Figure 3**).

Figure 3: The *Tap2Talk* app



Users can choose whether to store their data, such as logs of their chats, audio files, video files, and documents, on their mobile device or on a *Tap2Talk* cloud-based server.

* apps: small specialized programs run on mobile devices, the internet, a computer or other electronic devices

(This question continues on the following page)

(Question 3 continued)

- (a) (i) Identify **two** disadvantages of a user’s data being stored on their mobile device. [2]
- (ii) Identify **two** characteristics of encrypted data. [2]
- (iii) Identify **one** advantage for *Tap2Talk* users of receiving notifications. [1]
- (iv) Identify **one** disadvantage for *Tap2Talk* users of receiving notifications. [1]

- (b) A number of *Tap2Talk* users are concerned about ticking a single check box to agree to the new terms of service and privacy policy (see **Figure 3**).

Explain why *Tap2Talk* users might be concerned about ticking a single check box to agree to the new terms of service and privacy policy. [6]

- (c) *Tap2Talk* has decided to share its users’ data with a third party, *GlobalConnect*. This will mean that all user data, such as text messages, locational information and media, will be held in *GlobalConnect*’s database.

Discuss the impacts of this decision for *Tap2Talk* users. [8]

Section B

Answer **one** question. Each question is worth [20 marks].

4. Artificial intelligence (AI) and machine learning help detect fraud

Coco Financial, a company specializing in financial advice, is concerned that the growth of online shopping has led to more opportunities for fraud such as identity theft and credit card details being illegally accessed. *Coco Financial* currently uses expert systems to detect fraud.

Another way in which fraud may be detected is the use of an artificial neural network (ANN) that can use either supervised learning or unsupervised learning. An ANN is an example of machine learning.

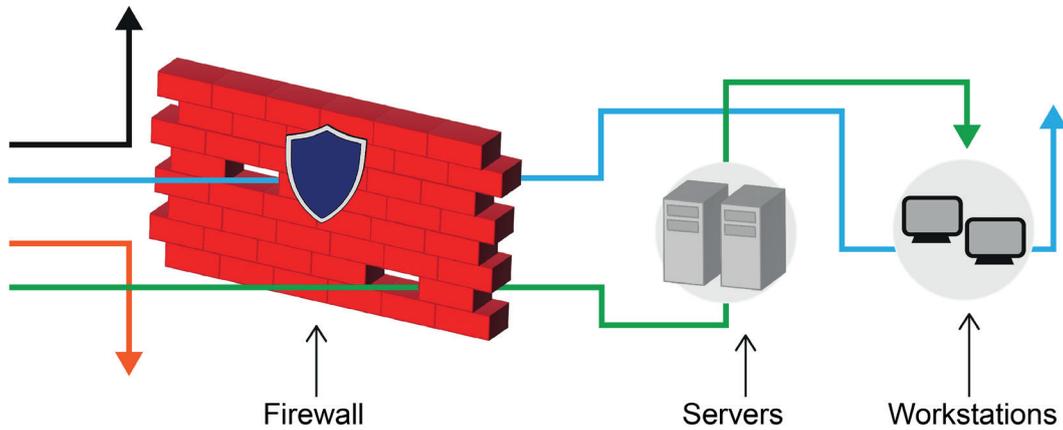
A new ANN for fraud detection is being developed for *Coco Financial*. It will be developed following the system development life cycle (SDLC). A feasibility study and stakeholder analysis have been completed.

- (a) (i) Identify **two** methods of data collection that could have been used in the stakeholder analysis. [2]
- (ii) Identify **two** components of a feasibility study. [2]
- (iii) Describe the difference between supervised machine learning and unsupervised machine learning. [2]
- (b) Explain the difference between an artificial neural network (ANN) and an expert system. [6]
- (c) Discuss the impact on *Coco Financial* of using artificial intelligence (AI) algorithms to detect fraud. [8]

5. Cybersecurity: software testing

Organizations use penetration testing to identify and correct security weaknesses in their systems, networks and applications. Penetration testing is an example of software testing (see **Figure 4**).

Figure 4: A visualization of penetration testing



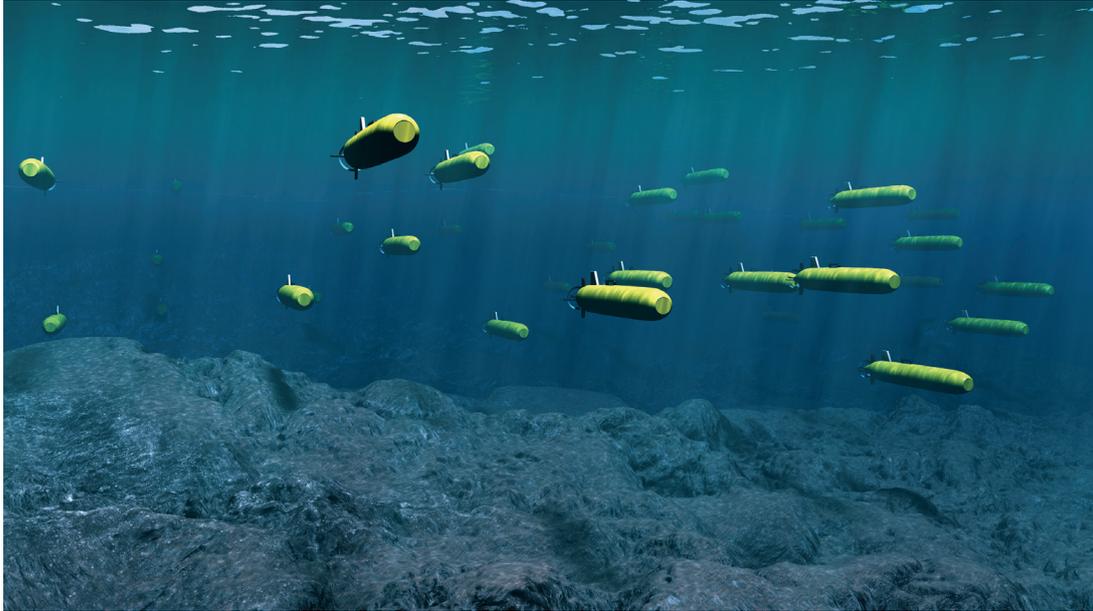
TSE Global is concerned about the security of its customers' accounts. To test the security of these accounts, it uses black-box penetration testing. The testing is carried out by artificial intelligence (AI) using deep-learning algorithms.

- (a) (i) Identify **two** features of artificial intelligence (AI). [2]
- (ii) Outline **one** benefit of using deep learning. [2]
- (iii) Identify **two** features of an algorithm. [2]
- (b) *TSE Global* needs to decide whether to use black-box **or** white-box testing. [6]
Analyse these two options.
- (c) Discuss whether *TSE Global* should incorporate ethical design at each stage of software development. [8]

6. Autonomous underwater robots

Coral reefs are fragile ecosystems and have been seriously affected by climate change. One way of monitoring the effects of climate change is to use autonomous underwater robots (see **Figure 5**).

Figure 5: An example of a swarm of underwater autonomous robots



Octoworld is a company that plans to use autonomous underwater robots to monitor the condition of coral reefs worldwide. The robots will be equipped with sensors so they can measure their own motion relative to the coral reefs and the surrounding water.

The prototype of the *Octoworld* autonomous robot will use a navigation system that is capable of avoiding obstacles. The navigation system will use fuzzy logic embedded in the underwater autonomous robot to train the robot's behaviour.

The autonomous robots will use artificial intelligence (AI) to process information gathered about the coral reef and make decisions, such as whether to restore it.

- (a) (i) Identify **two** sensors required by the autonomous underwater robots. [2]
 - (ii) Identify **two** items of data that could be collected by the autonomous underwater robots. [2]
 - (iii) Identify **two** advantages of fuzzy logic compared to inference rules. [2]
 - (b) (i) Explain **one** reason why an agile project development (scrum) methodology would be used for the development of the underwater robots. [2]
 - (ii) Explain **two** reasons why prototyping would be used in the development of the autonomous underwater robots. [4]
 - (c) Discuss whether autonomous underwater robots instead of humans should be used to monitor the condition of coral reefs and make decisions, such as whether to restore them. [8]
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References:

Figure 2. Berner, A., 2013. *Virtual reality training*. [image online] Available at: https://commons.wikimedia.org/wiki/File:Virtual_reality_training_130417-A-BZ540-114.jpg [Accessed 8 July 2021].

Figure 5. © Woods Hole Oceanographic Institution, T. Silva.

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