Diploma Programme
Programme du diplôme
Programa del Diploma

Information technology in a global society
Higher level
Paper 1

Friday 15 November 2019 (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]**.

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Section A

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

1. Biometric authorization

Bright Creativa is an advertising company with approximately 100 employees, who work in their head office in Seattle. The company has decided to introduce a biometric authorization system using fingerprint scanners (see **Figure 1**). This enables the employees to gain access to the company's resources, for example to enter the building, log on to the company network and even purchase items from the company cafe.

Figure 1: An employee using biometric authorization to access the office at *Bright Creativa*

[Source: adapted image (recoloured) "Fingerprint scanner in Tel Aviv" by David Shankbone (https://commons.wikimedia.org/). Under copyright and creative commons licence 3.0 (https://creativecommons.org/licenses/by/3.0/).]

The system is linked to the company database. The employee's identification number (employee ID) is the primary key field in the *Employee* table, which stores their personal details. The company database includes other tables that store data on when they access the building, the frequency that they log on to the network and the items they purchase from the cafe. Some employees are concerned about the increased level of surveillance within the company, but the company has reassured these employees that a privacy policy has been developed.

[Source: © International Baccalaureate Organization 2019]

(a) (i) Identify **two** fields that could be in the *Employee* table of the database. [2]

(ii) Identify **two** characteristics of a relational database. [2]

(iii) Identify **two** methods that could be used to ensure that the data input to the database is accurate. [2]

(b) As part of the implementation of the biometric authorization system, *Bright Creativa* has written a privacy policy.

Explain **three** features that *Bright Creativa* would need to include in a privacy policy linked to the company's biometric authorization system. [6]

(c) To what extent is the employees' improved access to company resources outweighed by their concerns about the level of surveillance by the company? [8]

Turn over

2. Wildfire modelling

The fire control centre in the Kinakora National Park in New Zealand often has to cope with the natural phenomenon of wildfires. Staff have been collecting data about wildfires since 1970.

The size of each fire is measured and the vegetation types affected are recorded. Data on the weather conditions is collected from sensors in the park. The staff at the fire control centre use this information to fight the fire.

A new computer modelling system is being developed using the product development life cycle (PDLC). With data collected from previous fires, this new system will improve the quality of the information available when fighting future fires.

The new system will enable staff at Kinakora National Park to send information to tourists in the park to warn them when they are in danger from a fire.

(a) (i) Identify **two** stages of the product development life cycle (PDLC). [2]

(ii) Identify **two** methods that could be used to train the staff to use the new modelling system. [2]

(iii) Identify **two** measurements that could be taken by the weather sensors in the Kinakora National Park. [2]

(b) Two methods for informing tourists about wildfires in Kinakora National Park are:
- Short Message Service (SMS) texting/text messaging
- Posting information on the Kinakora National Park website.

Analyse these **two** methods. [6]

(c) Evaluate Kinakora National Park's decision to use computer modelling to develop strategies for dealing with wildfires. [8]

3. Online learning

TailorEd is a free online learning system that personalizes students' learning by providing teachers with data about how students are progressing in their courses. Students create a personal profile and work through the assignments at their own pace. Teachers can log in to the learning system to see how the students are progressing. However, concerns have been expressed about the amount of data that is being collected.

The school has found that when students access the course platform some content is being blocked by the school firewall. The network administrator has been asked to investigate the situation. Teachers believe that it would be more appropriate to train the students to use the platform responsibly, rather than use technology to block their access to certain websites.

[Source: © International Baccalaureate Organization 2019]

(a) (i) Identify **two** ways that the *TailorEd* system could provide feedback to the students. [2]

(ii) Identify **two** ways that the data collected about students' academic progress could be used by *TailorEd*. [2]

(iii) Outline how a firewall functions. [2]

(b) There are two possible methods for ensuring students use the *TailorEd* online learning system responsibly. They are:
- Restrict access to sites that may be considered inappropriate.
- Educate the students about acceptable use.

Analyse these **two** options. [6]

(c) To what extent do the benefits of collecting students' progress data outweigh the concerns of the students, teachers and parents? [8]

Section B

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

4. Neural networks are changing surveillance

Currently, security cameras record activities in supermarkets and a security guard watches the camera footage in real time. If the guard sees something suspicious, action can be taken. The company *AI Security Innovations* is looking at ways to further develop this technology using artificial intelligence (AI) to automate the process.

The field of AI is developing rapidly, and is being transformed by machine learning using neural networks. *AI Security Innovations* wants to link the cameras to an AI system that can distinguish between something innocent, such as a child playing with a toy gun, and a crime, such as shoplifting (see **Figure 2**). These AI security cameras will be designed to make the decision about whether to intervene or not. This could include "locking down" the premises to secure all exits so that the suspect cannot escape, or sending an alert in real time to the police.

Figure 2: An example of a security camera

[Source: https://pixabay.com/photos/video-camera-surveillance-camera-3121655/]

These cameras will be part of extremely sophisticated detection systems based on pattern recognition. They will be able to detect humans, rapidly separate authorized personnel from intruders and match faces from multiple camera sources in order to track people moving from location to location. Researchers are even exploring systems that can detect the presence of concealed guns based on the way an individual walks.

(a) (i) Identify **two** characteristics of machine learning. [2]

(ii) Outline **one** reason why neural networks may be used for the processing of data from devices such as surveillance cameras. [2]

(iii) Outline how pattern recognition works. [2]

(b) Explain why an agile project management methodology would be used in the development of the new AI surveillance camera system. [6]

(c) To what extent should pattern recognition in AI systems be trusted to make decisions about sending real-time alerts to the police? [8]

5. Automated medical image analysis

EBBZS IT, based in Groningen, Holland intends to develop a system using artificial intelligence (AI) to assist doctors at Joelstraat Hospital to interpret medical images. The legacy system at the hospital is an expert system, but it is unable to keep pace with the advances in digital imaging.

Due to the increased quality of the digital images (see **Figure 3**), the new AI system will be able to learn from them to assist doctors when diagnosing patients' illnesses. It will also be able to cope with the significant increase in the volume of patients and the increased complexity of their symptoms and conditions. The managers at Joelstraat Hospital, including the information system manager, are unsure which changeover method to use to change from the expert system to the new AI-based system.

Figure 3: Examples of images used in the new AI system

[Source: adapted image (resized and recoloured) "Normal axial T2-weighted MR image of the brain" by Novaksean (en.wikipedia.org). Under copyright and creative commons licence 4.0 (https://creativecommons.org/licenses/by-sa/4.0/deed.en).
Lefevre, N, Naouri, JF, Herman, S, Gerometta, A, Klouche, S and Bohu, Y. 2016. A current review of the meniscus imaging: proposition of a useful tool for its radiologic analysis. Radiol Res Pract. 8329296. Published online 2016 Feb 11. doi: 10.1155/2016/8329296. Under Creative Commons Attribution License. Copyright © 2016 Nicolas Lefevre *et al*.]

(a) (i) Identify **two** features of a legacy system. [2]

(ii) Identify **two** reasons why a feasibility study is used during project development. [2]

(iii) Identify **two** stakeholders that the information systems manager should consult in the initial investigation. [2]

(b) Two changeover methods that could be used for the introduction of the new AI system are:
- Direct changeover
- Phased changeover.

Analyse these **two** changeover methods. [6]

(c) Joelstraat Hospital currently bases the diagnoses of patients' illnesses on:
- Information provided by the expert system
- Discussions between the doctors and the patients.

The new AI system will be a significant improvement over the current expert system.

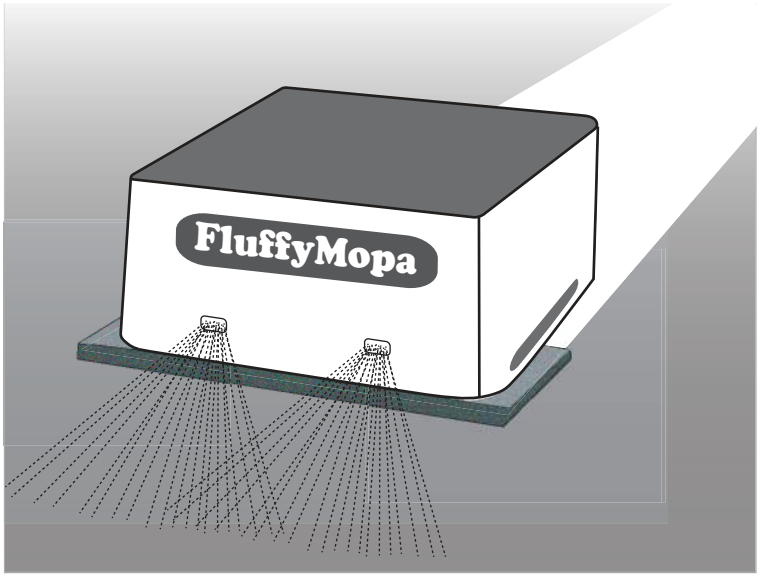
To what extent should the diagnosis of patients' illnesses be based on the information provided by the AI system? [8]

6. Robotic mops

The FluffyMopa is a robotic mop that is used to clean floors. It does this by spraying water onto the surface and then moving across the area to clean and dry it (see **Figure 4**). The FluffyMopa has the following features:

- Sensors to prevent the FluffyMopa colliding with walls
- Sensors to detect the dirtiness of the floor, or the nature of the floor surface
- WiFi receiver for control via a cell/mobile phone
- Programmable cleaning schedule.

Figure 4: The FluffyMopa



Systems analysts have gathered customer feedback about the FluffyMopa and have recommended that a new version, the FM2, is developed. The FM2 could include features such as:

- An app* that enables video output to a cell/mobile phone
- Natural language processing capabilities
- A camera to enable it to map the home.

The timeline for the development of the FM2 has been set out in a Gantt chart.

[Source: © International Baccalaureate Organization 2019]

* app: an app (application software) is typically a small, specialized program downloaded onto mobile devices; apps can also run on the internet, on a computer, or on a cell/mobile phone or other electronic device

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(Question 6 continued)

(a) (i) Identify **two** characteristics of a robot. [2]

(ii) The FluffyMopa is fitted with a proximity sensor that uses ultrasound to avoid collisions with walls and furniture.

Identify the steps that the FluffyMopa would take to prevent collisions occurring. [4]

(b) (i) Distinguish between a Gantt chart and a Pert chart. [2]

(ii) Explain why alpha and beta testing would be necessary for the development of the FM2. [4]

(c) During the development of the FM2, an app was created that could enable an owner of a FM2 to carry out the following tasks remotely:

- Check the quality of the cleaning using video footage from the FM2.
- Check the amount of charge remaining in the battery.
- Use natural language processing so that the owner can give instructions such as “OK Fluffy, clean the kitchen floor now”, or “Fluffy, return to the docking station to recharge”.

Discuss whether the FM2 should be developed to include these additional features. [8]