Diploma Programme
Programme du diplôme
Programa del Diploma

Information technology in a global society
Higher level
Paper 1

Tuesday 7 November 2017 (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. Voice biometrics technology in banking

Telephone passwords and security questions could soon become obsolete as financial institutions such as *CBR Bank* implement technology that can authenticate a customer's identity based on the characteristics of their voice. *CBR Bank* is now introducing voiceprint biometrics technology that can identify customers when they telephone the bank.

As part of the registration process, the customer has to say the phrase, "my voice is my password" three times. This provides a "voiceprint" that will be used to verify the customer's identity in future telephone calls to the bank.

[Source: adapted from www.cbc.ca]

(a) (i) Identify **two** forms of biometric identification other than voice. [2]

(ii) Identify the steps used by the voiceprint biometric technology to authenticate a customer calling *CBR Bank*. [4]

(b) *CBR Bank* holds a large amount of information on its customers. Some customers are concerned about the security, privacy **and** anonymity of their data.

For **each** of the concerns above, explain **one** policy that *CBR Bank* could use to address the concerns of its customers. [6]

(c) The chief executive officer (CEO) of *CBR Bank*, Alice McEwan, said in a recent interview, "*CBR Bank* will be replacing all passwords, PINs and personal verification questions for our online banking and mobile banking with voice biometric recognition."

Discuss whether the changes proposed by Alice are beneficial for **both** *CBR Bank*'s customers and *CBR Bank*'s IT support. [8]

2. Goal-line technology in soccer (football)

In 2010, at the soccer World Cup tournament in South Africa, England were denied a goal in a match against Germany, even though the ball had clearly crossed the goal-line. This led football officials to introduce goal-line technology in the 2014 World Cup in Brazil. The referees wore watches that vibrated and displayed the word “GOAL” every time the ball crossed the goal-line.

Goal-line technology includes 14 cameras that track the ball around the pitch and uses a network of high-speed video cameras to track the ball in flight. The cameras create high resolution images.

The software calculates the ball’s location in each frame by identifying the pixels that correspond to the ball. The software can track the ball and predict its flight path, even if the view of several cameras is blocked. An encrypted message is sent to the referee’s watch in less than one second to let the referee know whether the ball has crossed the goal-line.

[Source: © International Baccalaureate Organization 2017]

Figure 1: Illustration of goal-line technology in action

[Source: www.goalcontrol.de]

All of the information collected by the goal-line technology is stored in a database.

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(Question 2 continued)

(a) (i) Define the term *resolution*. [2]

(ii) Using the following assumptions:
1 pixel is made of 24 bits
1 kilobyte (KB) = 1000 bytes
1 megabyte (MB) = 1000 KB

Calculate in megabytes (MB) the storage requirements for an image size of 2000 pixels by 4000 pixels. [2]

(iii) The system records the ball's flight path into a database.

Identify **two** fields that would be found in the goal-line technology database. [2]

(b) The goal-line technology is capable of collecting vast quantities of data. To make this manageable three policies are needed: for the collection, storage **and** sharing of data.

Explain how **each** of these **three** policies could be implemented so that the quantity of data is manageable. [6]

(c) Many sports have introduced technology to assist officials with their decision-making at critical moments. These include whether to award a goal in soccer (football), whether a shot in tennis is in, or whether a sprinter has made a false start.

To what extent do the advantages of introducing technology in sport outweigh the disadvantages? [8]

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3. Social media and political tension

National governments sometimes block websites at a time of political tension. One example was in 2011, when a government prevented its citizens access to *Twitter*, *Facebook* and YouTube. Images on these websites were considered inappropriate, with the potential to cause hatred, violence and political unrest in that country. The national government gave direct orders to the internet service providers (ISPs) to block access to these sites for four hours. The aim was to give enough time for site officials to remove the offending images from their websites.

Despite these attempts by the government, some citizens were still able to access these images using proxy servers.

Many people, such as academics, believe that this approach is not appropriate and governments should focus on the education of their citizens so that they are able to make informed decisions about how to react to potentially offensive information on websites and social media.

(a) (i) In addition to providing access to the Internet, identify **two** functions of an internet service provider (ISP). [2]

(ii) Identify **two** characteristics of a proxy server. [2]

(iii) Identify **two** ways that the government could have determined the identity of the persons responsible for posting the offending images on the social media. [2]

(b) Many schools block access to social networking websites such as *Twitter*, *Facebook* and YouTube. However, other schools are investigating two different options:

- monitoring the network to view what websites the students are viewing, or
- giving different ages of students different levels of access to social media sites.

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

(c) Many citizens have raised concerns about the surveillance of their web browsing history or censorship of selected websites by their national government.

To what extent is it appropriate for national governments to use surveillance and censorship to control citizens' access to websites? [8]

Section B

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

4. Expert systems in healthcare

The administrators at Turkistuva Hospital in Finland are concerned about the effectiveness of the current medical expert system that is used to diagnose and treat patients, so they are considering introducing a new medical expert system. Currently, doctors are required to follow the advice of the current medical expert system unless they can present significant evidence for a different approach.

Doctors have complained that the current medical expert system relies on evidence based on averages. For example, if a 45-year-old woman has a set of symptoms that matches the average 45-year-old woman, a diagnosis and treatment are provided that would work for the average 45-year-old woman. However, doctors argue that each patient is unique, and that their intuition, which is based on many years of clinical experience, and their personal relationship with the patient should be the most important factors in making the final decision about treatment.

Patients believe that the evidence for their treatment should be explained better and be more personalized. They also believe that patients should be more involved in deciding what might be the best treatment for them.

Kiko Tuikistov, the project manager, will ask a systems analyst to gather information from patients that will be used to help design the new medical expert system.

He believes that the increased use of patient data will help to increase the ability of doctors using the new medical expert system to make the correct diagnosis and plan of treatment for a patient's condition. This should increase the number of patients that doctors at Turkistuva Hospital can treat.

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(Question 4 continued)

(a) (i) Identify **two** features of the user interface of the new medical expert system that would make it easy to use. [2]

(ii) In addition to gathering information from patients, identify **two** tasks that a systems analyst would carry out. [2]

(iii) Identify **two** characteristics of an expert system. [2]

(b) Kiko Tuikistov is considering using either questionnaires or interviews to gather information from patients that will be used to help design the new medical expert system.

Analyse **both** questionnaires and interviews as methods of data collection to gather information from patients that will be used to help design the new medical expert system. [6]

(c) For this new medical expert system to be effective Kiko Tuikistov must ensure it will enable the best quality care for each patient, as well as meeting the requirements of the administrators and doctors.

To what extent is it possible to develop a new medical expert system that will achieve these goals for these **three** different stakeholders? [8]

5. Patrolling train stations with a Segway

The Segway Patroller is a two-wheeled, battery-powered electric vehicle. On a Segway, when you lean forward the machine powers the wheels to go forward. When you lean back, the Segway slows down. Recently, Segway Patrollers have been used for security purposes at various public venues. Managers at Oliverstadt train station in Germany have decided to experiment with using them for security purposes. Security personnel standing on the Segway Patrollers are 20 cm (8 inches) above the ground, so the officers can easily monitor activity in the station and can easily be seen by people in the station. The Segway Patroller can travel up to a speed of 20 kilometres per hour (about 12 miles per hour) and travel about 40 kilometres (25 miles) in distance before it needs to be recharged.

[Source: © International Baccalaureate Organization 2017]

Figure 2: A Segway Patroller at Oliverstadt train station

[Source: Urban Mobility GmbH – from https://en.wikipedia.org/wiki/File:Segway_Polizei_4.jpg]

Managers at Oliverstadt station have also asked Segway to develop a customized smart Segway Patroller with added features:

- voice recognition
- navigation system
- bomb detection
- proximity sensor
- control display panel.

The prototype of the smart Segway Patroller has been designed. It has also been alpha tested and is now ready for beta testing.

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(Question 5 continued)

(a) (i) Identify **two** pieces of data that the customized Segway Patroller would automatically collect. [2]

(ii) Outline **two** reasons why it is necessary to test the added features of the prototype. [4]

(b) The prototype underwent both alpha and beta testing. Explain why **both** were necessary before releasing the customized Segway Patroller for sale. [6]

(c) Segway Patrollers have been very successful in other areas, including airports and city centres (downtown). If these Segway Patrollers are successful in Urumqi train station, the managers are considering whether to introduce a new version of the Segway that uses machine learning. This will allow employees to enter the GPS coordinates of the location within the train station they want to go to and the new Segway will navigate itself to that location.

Over a period of time it is hoped that the new Segway will be able to navigate Urumqi train station with little or no human input, having "learned" the most efficient routes.

Discuss whether the managers of Urumqi train station should upgrade the Segway to include machine learning capabilities. [8]

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6. Student counselling

Muscat High School in Oman has grown quickly over the last three years. As a result, the school's counsellor, Savannah Mendez, does not have enough time to interview every student before they choose their Diploma Programme (DP) subjects. To help Savannah, the principal is considering purchasing the Student Counselling System from *EduSolve* in the next three months. Students would fill out online questionnaires provided by the system to determine their interests, abilities and future goals. After the completion of the online questionnaire, the Student Counselling System would provide Savannah with recommendations for each student regarding the appropriateness of their proposed choice of subjects in the Diploma Programme. These recommendations should allow Savannah to spend less time with every student but also to be able to interview every student, something she cannot do now.

The Student Counselling System is a proprietary management information system (MIS) that has been developed by *EduSolve*, a company which is located in the United States. The Student Counselling System is based on artificial intelligence and will use fuzzy logic rather than inference rules to provide more relevant information and recommendations for Savannah.

The principal has involved the network manager, Debbie Hudson, in the feasibility study. One aim is to integrate the Student Counselling System with the school's existing student information management system (SIMS).

(a) (i) Identify **two** reasons why the network manager is involved in the feasibility study. [2]

(ii) Outline **two** reasons why the feasibility study should be carried out before any decision is made to purchase the Student Counselling System. [4]

(b) Explain **three** reasons why fuzzy logic would be used in the development of the Student Counselling System, rather than relying solely on inference rules. [6]

(c) The Principal at Muscat High School has decided to use the Student Counselling System from *EduSolve* that uses fuzzy logic.

To what extent should Savannah rely on the recommendations of the Student Counselling System, rather than relying on her own professional judgment and intuition, when advising students about what subjects to study in the DP? [8]

7. Social robots

When many people think of robots, they think of them in large-scale industrial settings, such as manufacturing automobiles (cars), but this is not always the case. **Figure 3** shows an image of Jibo, the first social robot for the home. Jibo can be purchased for US$599.

Figure 3: Jibo

[Source: Photo by Signe Brewster]

Jibo is connected to the Internet of Things (IoT). The IoT is "the network of physical objects – or "things" – embedded with electronics, software, sensors and network connectivity, which enables these objects to collect and exchange data"[1].

Jibo is able to carry out simple tasks, such as reminding someone when they have an important meeting, or turning the heating or air conditioning on or off in a person's house while they are away.

[1] Wikipedia, "Internet of things" (https://en.wikipedia.org/wiki/Internet_of_things)

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(Question 7 continued)

(a) (i) Identify **two** sensors that Jibo could use. [2]

(ii) Identify the steps Jibo would take in order to turn the air conditioning on and off. [4]

(b) It has been decided to provide only online access to documentation for Jibo. There will be no downloadable PDFs.

Analyse this decision. [6]

(c) Jibo's website claims that "Jibo is friendly, helpful and intelligent. He can sense and respond, and learns as you engage with him". Some of the customers who own Jibo are considering whether they could extend the range of tasks Jibo could perform, or whether they should allow Jibo to make decisions for them.

To what extent should individuals rely on robots such as Jibo to act as decision-makers for them? [8]