Diploma Programme
Programme du diplôme
Programa del Diploma

Information technology in a global society
Higher level
Paper 1

Friday 5 November 2021 (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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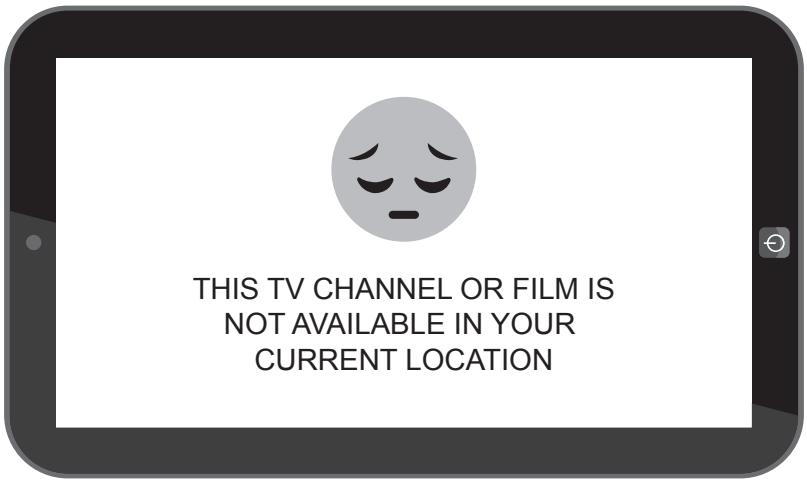
Section A

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

1. Accessing online media

Rajesh frequently travels for his job and has found that he is unable to watch his favorite films and TV channels when abroad (see **Figure 1**). He has been informed that he can subscribe to an internet protocol television (IPTV) service or use a virtual private network (VPN) to stream or download this content.

Figure 1: An example of blocked content



(a) (i) Identify **two** hardware devices that Rajesh could use to view his internet protocol television (IPTV) channels. [2]

(ii) Identify **two** characteristics of an IP address. [2]

(iii) Rajesh is downloading a film for offline viewing. The download speed is 80 mbps.

Calculate the amount of data, in megabytes (MB), that will be downloaded in 10 minutes. [2]

(b) (i) Explain why Rajesh downloaded the films rather than streaming them when he was travelling. [4]

(ii) Rajesh has been told that subscribing to an internet protocol television (IPTV) service may compromise his anonymity.

Distinguish between anonymity and privacy. [2]

(c) To what extent is it acceptable for Rajesh to use services like a virtual private network (VPN) to access content that may be blocked in the country he is visiting? [8]

2. Singapore shipping

SingShip is a cargo shipping company based in Singapore. It transports goods between ports in Southeast Asia. The company is planning to expand its services to 10 more destinations.

In *SingShip's* head office, staff use a range of software, such as word processing, databases and spreadsheets (see **Figure 2**).

Figure 2: Excerpt from a spreadsheet used by *SingShip*

	A	B	C	D
1	**Shipment_ID**	**Shipment_Date**	**Containers_Used**	**Destination**
2	SS-567	12-Sep-20	232	Singapore
3	SS-568	15-Oct-20	223	Klang
4	SS-569	18-Oct-20	546	Tanjung Pelepas
5	SS-570	15-Nov-20	345	Chennai
6	SS-571	22-Dec-20	656	Laem Chabang
7	SS-572	12-Jan-21	234	Ho Chi Minh City
8	SS-573	18-Jan-21	235	Singapore
9	SS-574	21-Feb-21	633	Singapore
10	SS-575	11-Mar-21	435	Tanjung Priok
11	SS-576	18-Mar-21	347	Ho Chi Minh City
12	SS-577	21-Apr-21	235	Ho Chi Minh City
13	SS-578	28-Apr-21	545	Klang
14	SS-579	18-May-21	447	Tanjung Pelepas
15	SS-580	21-May-21	564	Mumbai

(a) (i) Identify **two** reasons why a spreadsheet would be used to store the information in **Figure 2**. [2]

(ii) State the formula to calculate the total number of containers used in Column C. [1]

(iii) State the data type for the column headed **Shipment_Date** (column B). [1]

(iv) Outline **one** reason why *SingShip* would use mail merge when producing letters for customers to advise them about their shipments. [2]

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(Question 2 continued)

(b) (i) Distinguish between data validation and data verification. [2]

The product development life cycle (PDLC) was used to develop the database for *SingShip*.

(ii) Explain **one** advantage for *SingShip* of using a development methodology, such as the product development life cycle (PDLC). [2]

(iii) Explain **one** disadvantage for *SingShip* of using a development methodology, such as the product development life cycle (PDLC). [2]

(c) The head of IT at *SingShip* has recommended that all the information stored by the company in various spreadsheets should be integrated into a single relational database.

Evaluate this decision. [8]

3. Smart farming

A government in East Africa is using the expertise of scientists at a university in the region to promote the culture of smart farming and increase the productivity of farmers (see **Figure 3**).

Figure 3: An example of farming in East Africa

The new smart farming system uses a mobile app[1] that connects to a data logger[2] using Bluetooth technology (see **Figure 4**).

Figure 4: Example of a data logger

The data collected by the app is sent to the university by lossless compression.

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

2 data logger: a device that records data over time

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(Question 3 continued)

(a) (i) Identify **two** zip file formats. [2]

(ii) Identify **two** characteristics of Bluetooth. [2]

(iii) Identify **two** types of data collected by the sensors in the data logger. [2]

(b) (i) Explain **one** advantage of using lossless compression to send the data to the university. [2]

(ii) Explain **one** disadvantage of using lossless compression to send the data to the university. [2]

(iii) Explain why protocols are used when data is sent from one computer to another. [2]

(c) The scientists who developed the app have received many complaints from farmers who have been unable to use it. They are considering two options:

- Making the existing system more user friendly.
- Educating the farmers to use the existing system.

Evaluate these two options. [8]

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Section B

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

4. Smart warehouse

Greenwood Industries' current warehouse uses a smart storage solution.

The smart warehouse uses robots that automate the picking process. An expert system enables the robots to use the most efficient route for picking products (see **Figure 5**).

Figure 5: The *Greenwood Industries* smart storage solution

In the future, the system could use fuzzy logic to determine the most appropriate container to use for shipping based on the type, number, size and weight of the product.

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

(ii) Identify **two** input devices the warehouse robots might have. [2]

(iii) Identify **two** characteristics of fuzzy logic. [2]

(b) *Greenwood Industries* is considering using either a direct changeover method or a phased changeover method for the introduction of the next smart system.

Analyse these options. [6]

(c) *Greenwood Industries* is considering introducing artificial intelligence (AI) in the warehouse, rather than using the existing expert system, to select the most appropriate route for picking products.

Discuss the implications of introducing an AI system to select the most appropriate route for picking products. [8]

5. Airport expert systems

The managers at Kamchatka Airport have introduced expert systems to improve the efficiency of their airport. The expert system uses a decision tree* to assign gates to arriving and departing flights. This information is displayed on a flight information screen (see **Figure 6**).

Figure 6: Flight information screen at Kamchatka Airport showing airplane gates

DEPARTURE

TIME	FLIGHT	TO	CHECK-IN INFO ROW	CHECK-IN INFO STATUS	GATE INFO GATE	GATE INFO REMARK
16:10	IB2346	London	F		C14	
16:10	IB0265	Singapore	H		G8	
16:10	IB5804	Los Angeles	H			
16:15	IB8931	Manila	G		C13	
16:20	IB4581	Jakarta	J		C26	
16:30	IB7302	Beijing	B			

The assigning of airport gates needs to be completed within a short time frame, as aircraft are constantly taking off and landing. Artificial intelligence (AI) technology in the form of either neural networks or machine learning could also be used to solve this scheduling problem.

* decision tree: a tool that enables the expert system to decide between possible options

(a) (i) Identify **two** user requirements for the flight information screens. [2]

(ii) Identify **two** features of the expert system's user interface that make it easy to use. [2]

(iii) Outline the relationship between the knowledge base and the inference engine in an expert system. [2]

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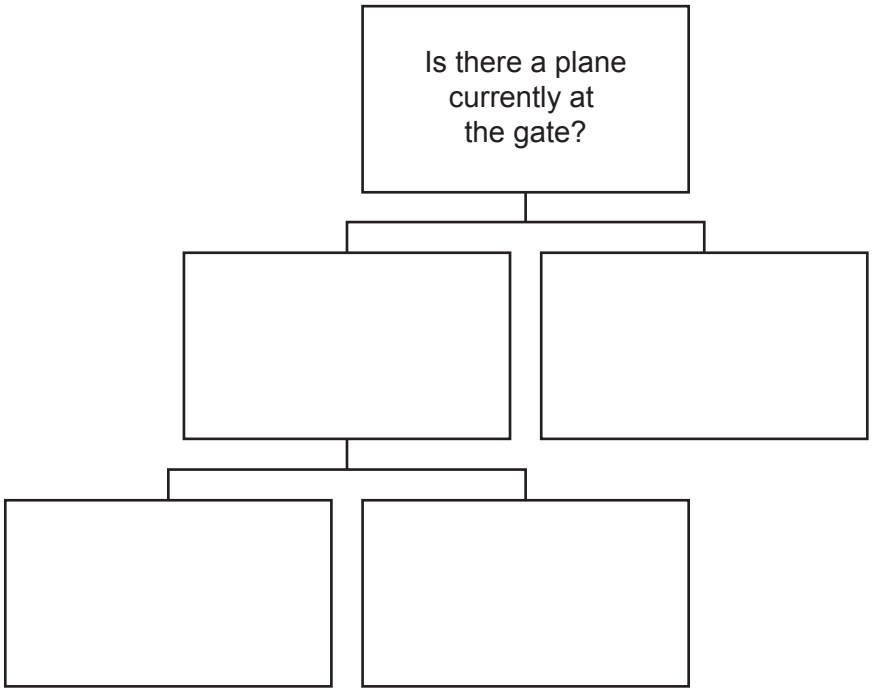
(Question 5 continued)

(b) (i) Assigning a gate for each airplane requires consideration of the following factors:

- Is there an airplane currently at the gate?
- Can the gate accommodate the size of the airplane?
- Is there a ground crew available to manage the arrival of the plane?

Using the information above, copy and construct a decision tree that can be used as part of an expert system to determine if a gate is available for an incoming airplane. [2]



(ii) Distinguish between machine learning and neural networks. [4]

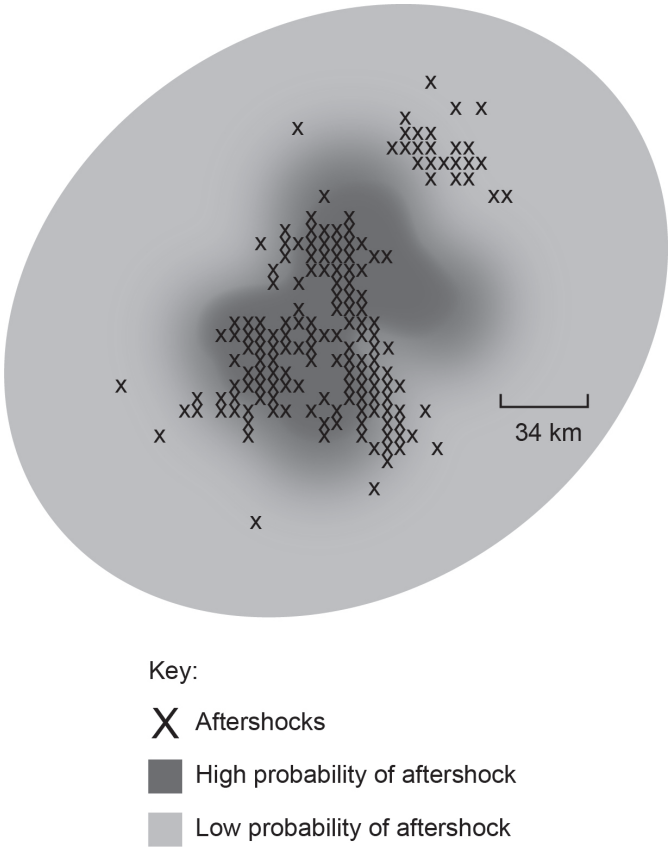
(c) Discuss the advantages **and** disadvantages of using expert systems to select or change the gates assigned to flights. [8]

6. Artificial intelligence (AI) predicts earthquakes

Scientists at universities are developing a machine-learning system to detect the warning signs that an earthquake is likely to occur. Using pattern-recognition algorithms similar to those in image and speech recognition, the system would be able to predict earthquakes a few days before they occur. Using machine learning, researchers will be able to run earthquake analysis 500 times faster than they could previously.

It is also possible to use machine learning to predict where the aftershocks* of an earthquake may occur (see **Figure 7**).

Figure 7: Prediction of aftershocks using machine learning



* aftershock: a smaller earthquake that follows a large earthquake

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(Question 6 continued)

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

(ii) Outline **one** reason why it might be difficult to collect accurate data that can be used for predicting earthquakes. [2]

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

(b) The scientists can choose to use either a PERT chart or a Gantt chart as a project management tool to develop the artificial intelligence (AI) system to predict aftershocks.

Analyse these two options. [6]

(c) Discuss the advantages **and** disadvantages of using machine learning to predict natural disasters like earthquakes. [8]

References:

Figure 3. Palmer, N., 2010. A farmer at work in Kenya's Mount Kenya region [image] [online] Available at: https://commons.wikimedia.org/wiki/File:2DU_Kenya_86_(5367322642).jpg (CC BY-SA 2.0) https://creativecommons.org/licenses/by-sa/2.0/deed.en [Accessed 18 May 2020].

Figure 5. gualtiero boffi / Alamy Stock Photo.