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Diploma Programme
Programme du diplôme
Programa del Diploma

Information technology in a global society
Higher level
Paper 1

Tuesday 17 May 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]**.

2222 – 5511

9 pages

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Section A

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

1. Medical data shared in online apps

Many people use smartwatches to monitor their vital signs and manage their health. Information such as heart rate, blood pressure and body temperature can be obtained from an app* like *yourHealth* on a smartwatch.

Figure 1: The *yourHealth* app and smartwatch

Some users of the smartwatch app are concerned that their privacy might be invaded.

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* app: small specialized program run on mobile devices, the internet, a computer or other electronic device

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

(ii) Identify **two** ways the smartwatch and cellphone (mobile phone) could use to communicate with each other. [2]

The uniform resource locator (URL) for the smartwatch app in **Figure 1** is https://www.yourhealthwatch.com/2020/03/export-data-yourhealth-watch-health-app.html.

(iii) State the domain name. [1]

(iv) State the protocol used in the URL. [1]

(This question continues on the following page)

(Question 1 continued)

(b) (i) The team developing the smartwatch app followed the product development life cycle (PDLC).

Explain why end-users should be involved in the development of products such as the smartwatch app. [3]

(ii) Explain why a feasibility study would be used in the development of products such as the smartwatch app. [3]

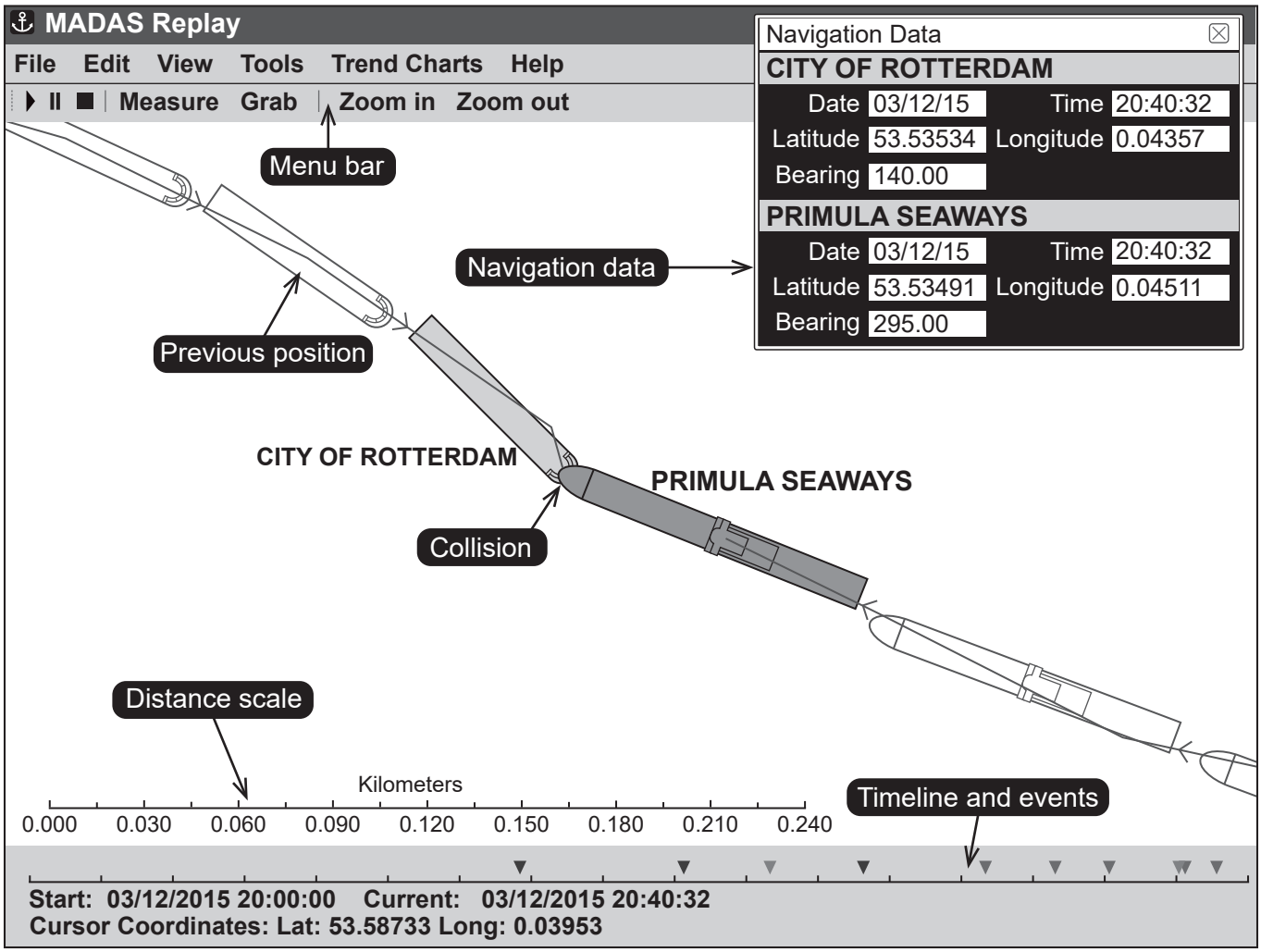
(c) Many people use smartwatches to monitor their vital signs and manage their health.

To what extent should an individual use a smartwatch to manage their health? [8]

2. Investigation of ocean disasters

A system called the Marine Accident Data Analysis Suite (MADAS) uses data collected from marine accidents to create a simulation to help understand what has happened (see **Figure 2**).

Figure 2: An example of a MADAS simulation



Cruise ships are required to carry a voyage data recorder (VDR), which uses sensors to monitor the conditions in the ship at all times. The data from the sensors is collected and input into a relational database (see **Figure 3**) that is a part of the MADAS system (see **Figure 4**).

Figure 3: Part of the relational database in the MADAS system

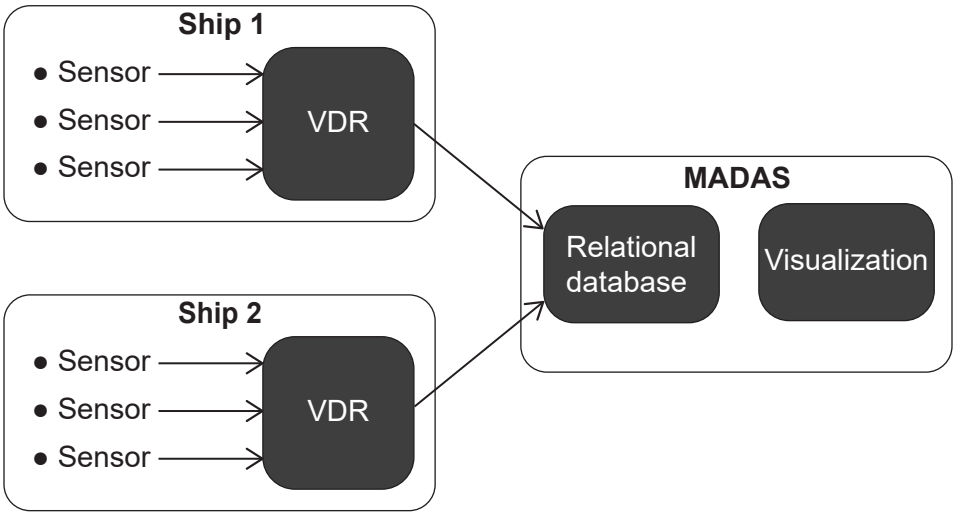
Accident
Accident_ID
Ship_ID
Date
Location
More fields

Ship
Ship_ID
Year_Built
Country_of_Reg
Length
More fields

(This question continues on the following page)

(Question 2 continued)

Figure 4: The MADAS system



(a) The voyage data recorder (VDR) records weather conditions during a voyage.

(i) Identify **two** sensors that may be used to detect data about the weather conditions. [2]

(ii) State the primary key in the Ship table in **Figure 3**. [1]

(iii) State the relationship between the Ship table and Accident table in **Figure 3**. [1]

(iv) Outline **one** advantage of using a relational database rather than a flat-file database. [2]

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

(ii) The MADAS system uses data visualization.

Explain why data visualization is used by the MADAS system. [4]

(c) To what extent can the use of simulations like the MADAS system help prevent future accidents? [8]

3. Schools told not to use cloud computing software applications

Schools in the German state of Hesse will no longer be able to use cloud computing services and software applications, such as G Suite and Office 365, due to new data protection rules. This has identified the risk of schools' data being stored and accessed by third parties from outside of Germany.

In contrast, many schools in other parts of the world use cloud computing services and software applications. These applications allow students to access software that was previously only installed on their computers.

(a) (i) Identify **two** types of cloud computing software applications that students might use at school. [2]

(ii) If the schools in Hesse can no longer use cloud computing software applications, they will need to store their data on a local file server and access it through a local area network (LAN).

Identify **two** ways in which data could be secured if the school stored it locally. [2]

(iii) The change from cloud computing software applications may require the school to change the type of licence they need to purchase.

Identify **two** types of licence that the school could purchase to allow them to install and run software applications on their local area network (LAN). [2]

(b) The European Union's (EU) General Data Protection Regulation (GDPR) governs data protection and privacy in the EU. Its regulations give users certain rights in terms of their data.

Explain **three** principles that should be included in data protection regulations such as GDPR. [6]

(c) A new school has opened in Switzerland and its IT Manager is considering two options:

Option 1: Using a local client–server network.

Option 2: Using a cloud-based service.

Evaluate the implications of these two options for the IT Manager. [8]

Section B

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

4. Cameras in school

The principal at Flynn School has received requests from parents saying that they would like to monitor their children's performance in school more closely. He is considering extending the school's IT system by installing cameras linked to facial recognition software that can record student behaviour in lessons.

The facial recognition software can determine a student's attention level and behaviour, such as identifying if they are listening, answering questions, talking with other students, or sleeping. The software uses machine learning to analyse each student's behaviour and gives them a weekly score that is automatically emailed to their parents.

(a) (i) Identify the steps used by the facial recognition software to identify an individual student. [4]

(ii) A data flow diagram was used in the development of the facial recognition software.

Identify **two** characteristics of a data flow diagram. [2]

(b) The school's IT manager has received a report of several IT-related incidents that occurred in the last week.

- Incident 1: Students installed and played a video game during a history lesson.
- Incident 2: The facial recognition software detected that students appeared to be talking a lot in a French class.
- Incident 3: There was an unreliable internet connection during the streaming of a video as part of a biology lesson.
- Incident 4: Internet connection was lost just as final-year geography students were about to begin online examinations.

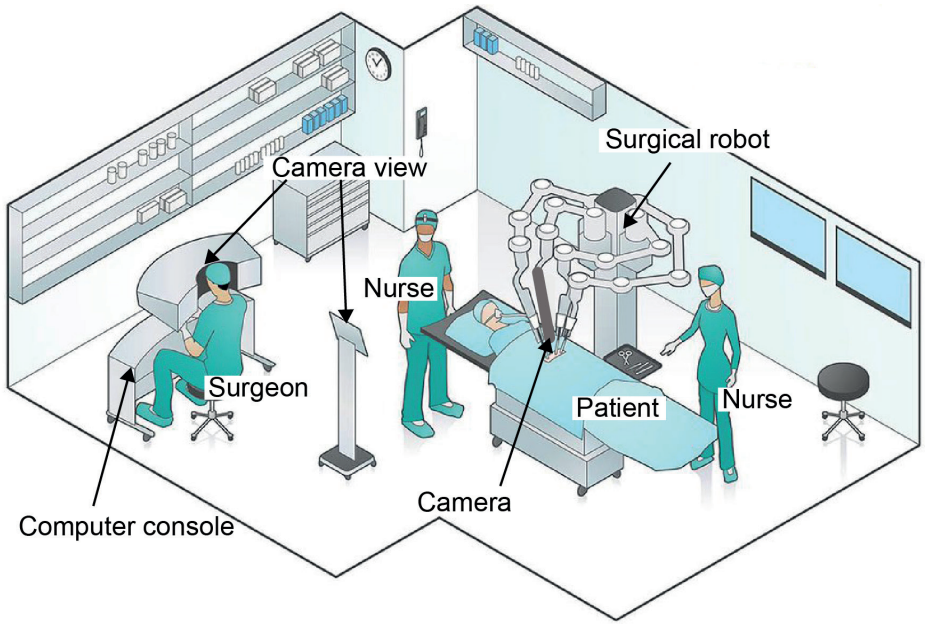
Explain how the IT manager could determine the order of priority for these four incidents. [6]

(c) Discuss whether Flynn School should introduce a facial recognition system that uses machine learning to analyse each student's behaviour and give them a score that is automatically emailed to their parents. [8]

5. Robotic Surgery

Sandy Parkar, the manager of a large hospital, is considering using robots controlled by surgeons to carry out surgical procedures. The surgeon uses a computer console to control the robot (see **Figure 5**).

Figure 5: Robotic surgery



All the robot's movements, and the surgical procedure, are recorded. This allows information to be collected about each procedure.

The software for the surgical robot was developed using an agile project management methodology that includes prototyping, alpha testing and beta testing.

(a) (i) System developers use prototypes as part of the development process.

Identify **two** characteristics of a prototype. [2]

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

(iii) Identify **two** characteristics of beta testing. [2]

(b) (i) The surgical robot uses machine learning software that utilizes neural networks.

Explain why neural networks are utilized in the machine learning process. [3]

(ii) Explain why an agile project management methodology would be used in the development of the software for a surgical robot. [3]

(c) In 2020, a patient died while undergoing a surgical procedure in which a surgical robot was used. A court case followed to determine who was accountable.

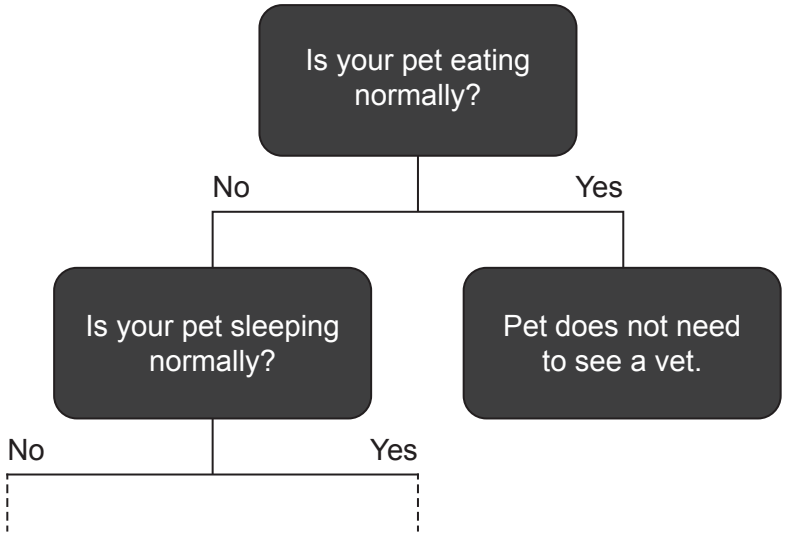
Discuss whether the surgeon, the manufacturer of the surgical robot, or the hospital manager should be held accountable. [8]

6. Marlowe sees the vet

Marlowe, Sandra's cat, has not been feeling well. He is one year old and has not been eating.

East Side Vets mainly treats dogs, cats, and rabbits. To reduce the work for the veterinarians* (vets), a new procedure has been introduced to determine if an appointment is necessary. Sandra will have to answer a series of questions from an expert system that will advise her whether Marlowe needs an appointment to see a vet. This expert system uses a decision tree, such as the one in **Figure 6**.

Figure 6: A decision tree in the *East Side Vets* expert system



Richard has also used this expert system to inquire about his 12-year-old cat, Scooby. Unfortunately, the expert system has output that Scooby may have multiple conditions and has suggested that Richard book an appointment for Scooby to see a vet.

* veterinarians: people qualified to treat sick or injured animals

(a) (i) Identify **two** components of an expert system. [2]

(ii) Identify **two** reasons why a prototype of the *East Side Vets* expert system would have been developed before its release. [2]

(iii) The vets have found that many pets have multiple conditions, and they are considering upgrading the expert system to one that uses fuzzy logic.

Identify **two** reasons why the *East Side Vets* expert system should use fuzzy logic. [2]

(b) (i) Explain why forward chaining is used in the *East Side Vets* expert system. [2]

(ii) When the *East Side Vets* expert system was introduced, a direct changeover methodology was used rather than a phased changeover.

Explain why a direct changeover methodology was used to introduce the new system. [4]

(c) To what extent does the use of the expert system by *East Side Vets* provide benefits for both the vets **and** their customers? [8]

References:

Figure 2. With permission from the International Union of Marine Insurance. Source adapted.

Figure 5. mathisworks / iStock.

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