T6

Automated and emerging technologies

CHAPTER ASSIGNMENT · 82 MARKS

Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Show your working. You may use the chapter page to help you.

Questions from *Cambridge IGCSE and O Level Computer Science*, 2nd edition, David Watson and Helen Williams (Hodder Education), for classroom use.

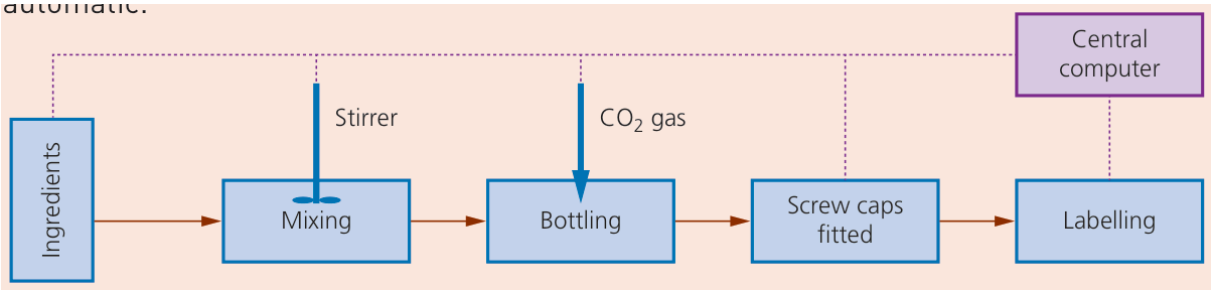
Activities from the chapter

6.1

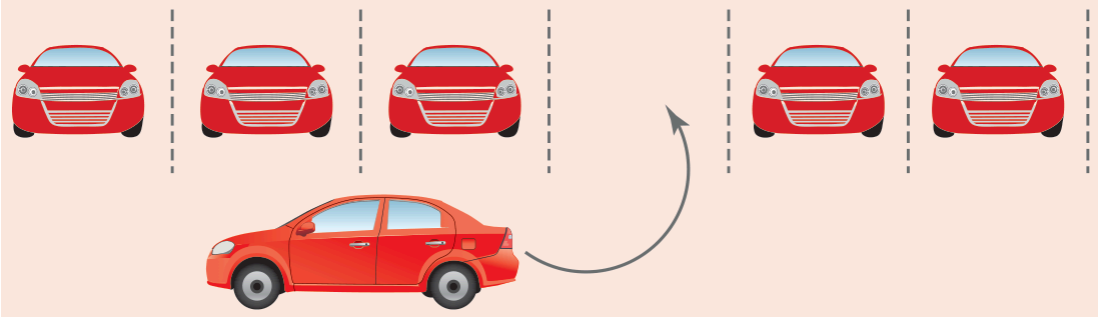
(a) Describe how the sensors, actuators and central computer would be used to monitor and control this bottling plant automatically. You may wish to add/show sensors and actuators in the diagram given above.

(b) A company manufactures fizzy drinks that are then labelled and bottled: The system is fully automatic. Sensors are used to ensure the correct amount of each ingredient is added. A stirrer is activated whenever ingredients Finally, describe the advantages and disadvantages of fully automating this bottling plant (you can assume that none of the ingredients used in making the drink are harmful). are added. The bottling plant is again monitored by sensors to ensure the correct amount of drink is added to each bottle, and that the right amount of carbon dioxide gas is added to each bottle. The whole process is computer-controlled and is totally automatic. ▲ **Figure 6.3**

automatic.



6.2 ▲ **Figure 6.5** This time the driver needs to reverse in between two other cars and park at 90° to the direction of travel. Describe what additional information is needed to allow the car to park between two cars within the parallel lines. What extra sensor device(s) might be needed to give this additional information?



6.3 Assuming the following stopping distances: Using figure 6.7 and the data in the table above, explain how the on-board computer would calculate if a car was too close to the vehicle in front and apply the brakes if necessary. (It is not necessary to show all the maths, it is sufficient to explain what would need to be done. However, this could be a class exercise using a spreadsheet or small computer program).

Car's speed (kph)	Stopping distance (metres)
40	17
50	24
60	32
70	42
80	53
90	64
100	77
110	92
120	107

6.4 Find out all of the advantages and disadvantages of using automated weather stations. Gather all the results from the whole class, and put your results into a table as follows:

Advantages	Disadvantages

6.5

(1) Describe how automated weather stations can be used in the fight against climate change.

(2) A large greenhouse is being used to grow tomatoes under controlled conditions. For optimum growth, the tomatoes require the right lighting levels, correct temperature and regular watering. Describe how automated systems could be used to ensure the correct growing conditions are maintained. The only human involvement would be as a remote supervisor. (You might find it useful to draw a diagram of your automated system showing sensors, microprocessor and any actuators.)

(3) A new car being developed utilises many automated systems. In particular:

(i) the ability to recognise road signs

(ii) the ability to predict when to change to the correct gear for the road condition. Describe how sensors, actuators and an on-board computer allow the car to take the necessary action automatically if: – it encounters road works with a speed limit of 60 kph so that the car maintains the correct speed – the car is on a very twisty road where the correct gear is needed for optimum performance.

(4) One example of an automated system is the control of entry and exit to a car park. Cameras take a photograph of a car's number plate on entry before opening a barrier. At the exit, another camera captures a car's number plate before raising the barrier. Describe how sensors, cameras, actuators and a microprocessor can be used to:

(i) control the raising and lowering of the entry and exit barriers

(ii) ensure that the car exiting the car park has paid the correct parking fee before it can exit

(iii) describe the advantages and disadvantages of this car parking system.

6.6 What are the advantages and disadvantages of using these immersive games consoles? Are any other sensors used in games consoles other than accelerometers and proximity sensors?

6.7

Statement	True	False
automated systems lead to less consistent results or less consistent products		
automated systems are more expensive to set up than traditional manual systems		
automated systems would be quickly overwhelmed by the amount of data presented to it		
automated systems are inherently less safe than manual systems		
automated systems generally require enhanced maintenance when compared to manual systems		
automated systems allow processes to run at optimum conditions at all times		
software failures, due to unforeseen conditions, are unlikely to impact on an automated system		
automated systems will react more quickly to unusual process conditions		

(1) Name suitable sensors for each of the following automated systems.

(a)

(i) Manufacture of a new vaccine that requires the mixing of four liquids in the ratio 1:2:3:4 as a single batch. The four liquids must be totally mixed and the temperature must be maintained at 35°C (+/- 1°C) which is a critical temperature.

(ii) A lighting display has been set up in one room of an art gallery. A random sequence of different coloured lights is under microprocessor control. The display in the room only switches on when visitors walk into the room; at the same time, the room lights are also dimmed to give the most dramatic effect of the light display.

(iii) A train uses automatic twin-doors. Both doors open automatically when the train stops. Both doors close again when no-one is still boarding or leaving the train. The doors have a safety mechanism so that a passenger cannot become trapped between the two closing doors. The train can only move off when every door on the train has been safely closed.

(b) For **each** application in **part** advantages and **two** disadvantages of using automated systems.

(2) The eight statements on the left-hand side of the table are either true or false. Tick (appropriate box to indicate which statements are true and which statements are false.

(a) , give **two** ✓) the

6.8 Look through all the notes on use of robots in agriculture, and make a table showing all the advantages and disadvantages of using robots.

6.9

(1) Describe three areas where robots can be used in agriculture to increase efficiency and reduce labour requirements. For each example, write down the advantages and disadvantages of using robots.

(2) Five statements are shown on the left and five computer terms are shown on the right. By drawing lines, connect each description to its correct computer term. dependent robot actuator end-effector autonomous robotics machine that requires human interface to operate and allow it to supplement human activities branch of computer science that brings together the design, construction and operation of 'intelligent' mechanical machines devices attached to a robotic arm which allows it to carry out various tasks device, under the control of a microprocessor, which allows it to operate pumps, wheels, motors and pistons, for example

no direct human control and has the ability to carry out human activity totally on its own

6.10 Research five robots used as entertainment.

(a) Give the names of these five robots.

(b) Write down the advantages and disadvantages of the five robots you chose.

6.11

(1) Write down **four** advantages and **four** disadvantages of using robots in the manufacturing industry.

(2) To be referred to as a robot, it needs to be demonstrated that it has the following three characteristics: – ability to sense its surroundings – ability to move in some way – a perceived intelligence. For **each** of these **three** characteristics, describe **two** features you could use to demonstrate that a device could be called a robot.

(3) Choose suitable words/phrases from the following list to correctly complete the paragraph that follows: Word list: activators lasers actuators light detection and ranging autonomous primary vision cameras radar and ultrasonics lane assist sensors Driverless cars are described as .....; these vehicles use ....., ..., microprocessors, software and ..... to allow them to function. A 3D image of the surroundings is produced by using ..... . Parking and nose to tail driving is achieved by using ..... in the bumpers.

(4) Choose suitable words/phrases from the following list to correctly complete the paragraph that follows: Word list: actuators environment programs adaptive intelligence repetitive controller microprocessor sensors end-effectors physical system Robots can collect data from their surroundings by using ..... . The data is then sent to a ..... to allow the robot to build up an image of its ..... Robots can perform various tasks by using different ..... . The 'brain' of the robot is often called a ..... which contains ..... to allow it carry out various tasks automatically. Many robots are not (artificially) intelligent, since they only do ..... tasks rather than requiring ..... human characteristics.

(5) Autonomous robots are used in space exploration and in undersea exploration. These robots have to either work in the near vacuum of space or the very high-water pressures under the oceans. They need to be equipped with many sensors and cameras to carry out their remote tasks.

(a) Undersea robots are being used to investigate shipwrecks. Describe how the sensors and cameras could be used to photograph the shipwrecks. Also describe the role of the microprocessor and actuators in taking photographs and any samples needed from the shipwreck for further investigation.

(b) A space exploration robot has been sent on a mission to Mars. The robot needs to move around the surface of the planet safely

6.12 Which computer terms, connected to AI, are being described below?

(a) a repository of facts made up of a collection of objects and their attributes

(b) informs the user of the reasoning behind the expert system's conclusions and recommended actions

(c) made up of user interface and inference engine

(d) a sub-set of AI where machines mimic human activities and can manipulate objects using end-effectors all the way through to autonomous vehicles

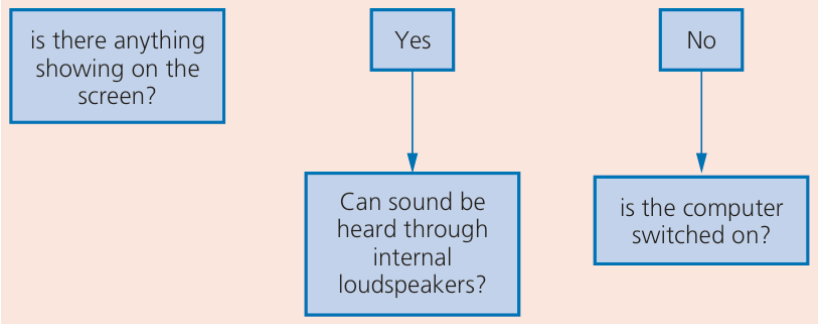
(e) contains a set of inference rules.

6.13

(1) Use words/phrases from the following list to complete the paragraph below: Word list: artificial intelligence expert systems machine learning attributes explanation system robotics cognitive inference engine rules base database inference rules search engine
..... is a branch of computer science where the ..... function of the human brain is studied. ..... are a branch of AI which mimic the knowledge and experience of humans. The application uses an ..... to explain its reasoning and logic to the user. The main element of this application is an ..... which acts like a ..... by applying ..... to a knowledge base.

(2) John has bought an expert system to help him find faults in computer systems. John has been asked to look at a computer that won't play music through some external speakers, attached to a computer using a USB port. »The music is stored in a file on the solid state drive (SSD). »The computer uses a sound card to output sound. »The external loud speaker is plugged into a USB port.

(a) The expert system asks John a series of questions. Each question is dependent on his response to a previous question. For example: Write a further series of questions that helps John identify that there is actually a fault in the external loud speaker plugged into his computer.



(b) ▲ **Figure 6.28** Describe three other uses of expert systems.

(3) Define the term **machine learning**.

(a)

(b) Explain how **machine learning** and **artificial intelligence (AI)** differ.

(c) Describe how a search engine might use machine learning to determine the most appropriate results based on a user's search criteria.

Exam-style questions

1 A distribution company has decided to automate its packaging and dispensing of items to online customers. The system is totally automated, where each required item is identified using barcodes. Once found, the item is packaged, an address label applied and then placed in a delivery van.

(a) Describe the advantages and disadvantages to the company of using robots to automatically find, package and load parcels. [5]

(b) Some humans will still have to be present in the building to carry out special tasks. Describe what safety systems need to be part of the robot to prevent any risks to the humans when walking around the building. [3]

2 A company is developing a new game for a hand-held console: The console is moved in various directions to control movement and speed of a racing car on a television screen. Gear changes can be done using the LCD screen on the device itself. Name and describe which sensors would need to be used for the game to be as realistic as possible. [5]



3 A robot is being used to deliver the post around the headquarters of a large company, which is housed in a 20-storey building. The robot moves around the corridors picking up the post and delivering the post throughout the building. If a person comes close to the robot, it stops and waits until the person is out of range.

(a) Proximity sensors are used to detect how close to a person the robot is. Describe how the microprocessor (which is built into the robot) would ensure the robot stops when it encounters a person. [4]

(b) The lighting throughout the building is controlled by sensors and a computer.

(i) Describe how the lighting in the corridors and offices are controlled by sensors and the computer.

(ii) Describe the advantages and disadvantages of using an automated system to control the building lights. [4]

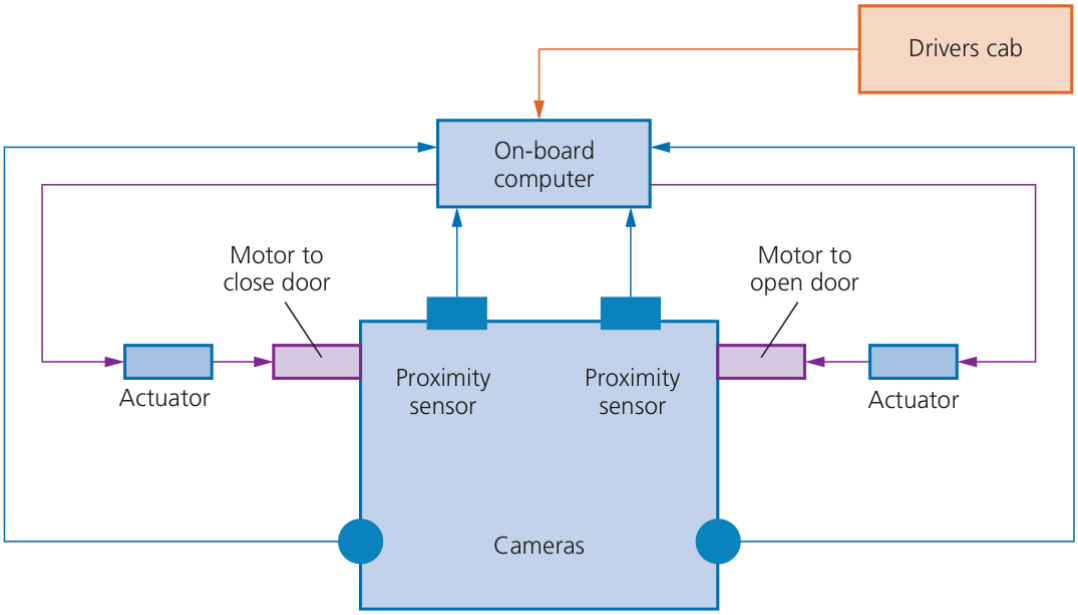
4 A computer has been designed to do a number of different tasks: »control a process »monitor a process (by taking data samples only) »run an expert system.

(a) The table below shows eight tasks which the computer could be carrying out. Tick ( ) the appropriate box to show if the task is an example of control, monitor or an expert system: [8]

Task	Control	Monitor	Expert system
automatic control of the atmosphere in a large greenhouse (to ensure ideal growing conditions)			
self-parking system in a car			
playing a strategy game, such as chess			
an automatic weather station sending data to pilots flying near an airport			
a 24/7 check on patients in an intensive care unit of a hospital			
automatic system used to diagnose the illness of a patient			
automatic closing and opening of the doors on a train			
fault identification in electronic devices together with suggested actions to rectify the fault			

(b) Name and describe the function of four of the components that make up an expert system. [4]

5 The following schematic shows how sensors, actuators and a computer can be used to control the opening and closing of doors in a train. As the train approaches a station and stops, the system automatically opens the doors. Passengers can then get on and off the train. After 30 seconds the computer automatically sounds an alarm and starts to close the doors. But if someone is still trying to get on or off the train at this point, then the doors automatically re-open and then try to close again. This is all done under the control of the computer. Cameras and sensors are used to send data back to the computer. The driver of the train is able to monitor the camera images from his cab and take any additional action if necessary.



(a) Describe how the sensors, cameras, actuators and computer are all used to safely operate the doors on the train. Name any sensors that you think would be needed. [6]

(b) Explain the advantages and disadvantages of using this computer- controlled system. [4]

(c) Explain why you think camera images are still sent to the driver in the cab. [2]

(d) The train company are slowly upgrading all their trains to be autonomous.

(i) Explain the term **autonomous**. [1]

(ii) Describe what additional sensors and actuators may be needed to allow the trains to be upgraded to autonomous operation. [4]

(iii) Describe two advantages and two disadvantages of making this upgrade. [4]

6

(a) Give **three** characteristics needed to define a machine as a robot. [3]

(b) Robots can be described as **dependent** or **independent**. Explain what is meant by the two types of robot. [4]

7 Six descriptions are shown on the left and six computer terms are shown on the right. By drawing lines, connect each description to its correct computer term. [6]

a form of AI which has been developed to mimic knowledge base human knowledge and expertise a repository of facts and expertise in the form of a autonomous collection of objects and their attributes a sub-set of AI in which the algorithms are trained and can learn from their past experience and artificial intelligence examples simulated intelligence in machines; building of expert system machines capable of thinking like a human branch of (computer) science that brings together the design, construction and operation of robotics 'intelligent' mechanical machines machine learning

devices which can move between point 'A' and point 'B' without the need for any input from a driver or a pilot

8 Which computer terms are being described below?

(a) Attachment to a robot arm which allows it to carry out a specific task, such as spray painting.

(b) A kind of search engine used in an expert system which examines the knowledge base for information that matches the queries.

(c) General name of any robotic device that can operate independently without any human input.

(d) A sub-set of AI in which algorithms are trained and learn from past experiences and examples.

(e) A combination of software and hardware designed and programmed to work automatically without the need for any human intervention.

(f) A collection of rules and data which leads to the ability to reason, learn and adapt to external stimuli.

(g) Pop-up robots found on websites that appear to enter into a meaningful conversation with a web user.

(h) Robots that roam the internet scanning all websites and categorising them for search purposes.

(i) A branch of (computer) science that brings together the design, construction and operation of intelligent mechanical devices.

(j) The mental process of the human brain whereby it acquires knowledge and understanding through thought, experiences and the five senses.

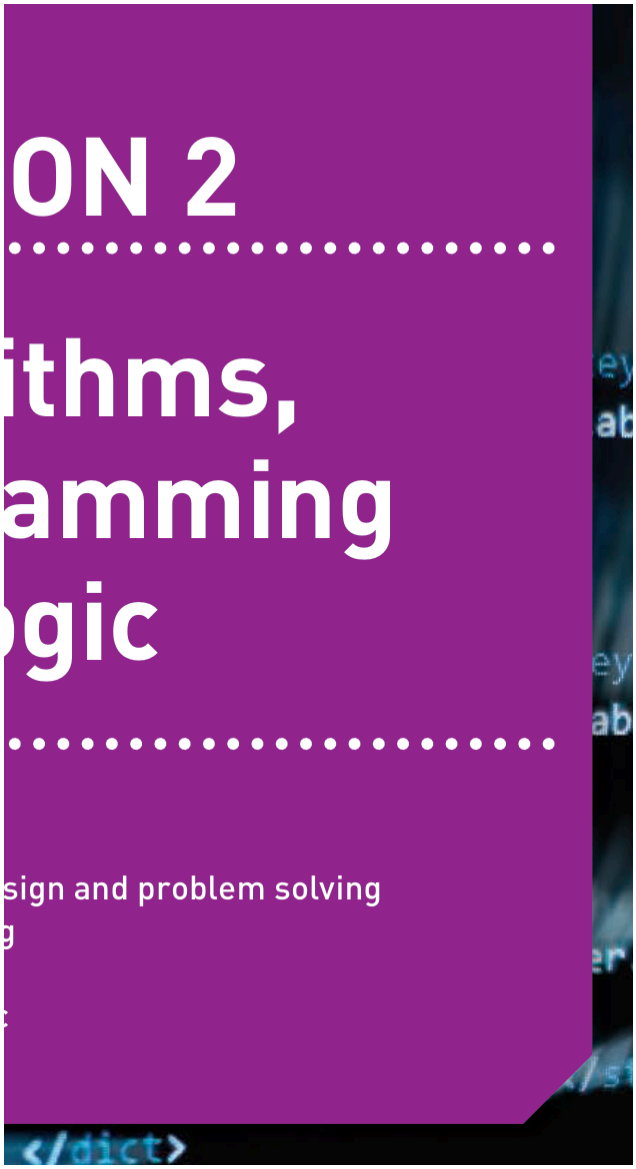
(k) Something that defines the objects stored in a knowledge base.

(l) A repository of facts which is a collection of objects and attributes.

(m) A flying robot that can be autonomous or under remote control; used for reconnaissance or deliveries.

(n) The name essentially given to a microprocessor which is in control of a process.

(o) Used by the inference engine to draw conclusions using IF statements. [15]



End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/computer-science/o-level/automated-emerging-technologies/