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Information technology in a global society

Higher level

Paper 1

25 pages

Critical Thinking – explanation, analysis and evaluation

These trigger words often signal critical thinking. The bold words are the key terms in the various criteria.
Explanation – *Because, as a result of, due to, therefore, consequently, for example*
Analysis – *Furthermore, additionally, however, but, conversely, likewise, in addition, on the other hand, whereas*
Evaluation – *My opinion, overall, although, despite, on balance, weighing up*

Examiners should be aware that in some cases, candidates may take a different approach, which if appropriate should be rewarded. If in doubt, check with your team leader.

In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. In all other cases where a question asks for a certain number of facts *eg* "describe two kinds", mark the **first two** correct answers. This could include two explanations, two descriptions, one description and one identification, or two identifications.

- It should be recognized that, given time constraints, answers for part (c) questions are likely to include a much narrower range of issues and concepts than identified in the markband. There is no "correct" answer. Examiners must be prepared to award full marks to answers which synthesize and evaluate even if they do not examine all the stimulus material.

Section A

1. Parents "cyber-spying" on their children

Note to examiners:
- *All part (a) questions are marked using ticks and annotations where appropriate.*
- *Part (b) and part (c) are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded.* ***Do not use ticks.***

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

Answers may include:
- spyware collects data/information about a person, such as internet surfing habits, passwords, log in details, monitors keystrokes / keylogger, accesses data stored on the device
- spyware is hidden from the user/is anonymous - the user is not aware of its presence (hence the name: it is like a spy) and has not given consent
- spyware can have different functions
  - some spyware only collects data and monitors what the user does
  - others can install additional software
  - start controlling the computer (for example hijacking the modem, controlling the camera etc.)
  - can weaken the computer security by disabling firewalls and antivirus software
  - can detect when the user is engaged in suspicious activity
  - can access the content of emails sent and received
- spyware can take different forms such as adware or trojan horses
- spyware is usually regarded as malicious and harmful, but not always, for example when used by law enforcement and security/intelligence agencies
- spyware is installed on a user's computer without their knowledge.

Note to examiners: The question stem does not make a clear distinction between "spyware" and "monitoring software". The terms should therefore be regarded as equivalent/synonymous in candidates' responses.

Award ***[1]*** *for identifying each feature of spyware up to a maximum of* ***[2]****.*

(ii) Identify the steps taken by a GPS device to determine its location. **[4]**

Answers may include:
- GPS device gets signal from the first satellite
- uses radio signals
- GPS device calculates how far it is this first satellite (based on how long it took for the signal to travel)
- GPS device does the same for 2-3 (or more) other satellites (minimum total number is 3 satellites. At least 4 satellites are required for accurate location.)
- GPS device calculates the distance from the 3 or more satellites (called triangulation)
- GPS device uses this calculation to determine the latitude, longitude and altitude of its current position
- GPS device takes this location information and displays it on map files stored in its memory.

Award ***[1]*** *for identifying each step taken by a GPS device to determine its location up to a maximum of* ***[4]****.*

(b) The developers of Qustodio decided to use automated keyword detection to monitor for signs of cyber-bullying.

Analyse this decision. **[6]**

Answers may include:

Advantages of using automated keyword detection

- the suspicious message could be stopped even before it appears on the child's device
- automated keyword detection is immediate and can instantaneously draw parents' attention to suspicious messages and their authors
- there is no need for parents to read through all the messages
- the system may help discourage children who know they are being monitored from sending suspicious messages.

Disadvantages of using automated keyword detection

- some terms may be wrongly detected as sign of cyberbullying when in fact they are innocuous in context
- some people may use alternative spelling or leetspeak to go around this issue, for example "I8u" for "I hate you". Teenage language evolves more rapidly than the software could incorporate new keywords
- cyberbullying is not just about words but also tone, style, intention, sarcasm, which automated keyword detection could not spot
- not all cyberbullying is carried out through text (e.g. image-based) so a keyword detector would not be effective in these cases
- the software might only be able to detect keywords in certain commonly-spoken languages.

Marks	***Level descriptor***
0	*No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.*
1–2	*A limited response that indicates very little understanding of the topic or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.*
3–4	*A description that is unbalanced or a partial analysis of the issues related to the use automated keyword detection to monitor for signs of cyberbullying. There is some use of appropriate ITGS terminology in the response.*
5–6	*A balanced and detailed analysis of the relative advantages and disadvantages of the use automated keyword detection to monitor for signs of cyberbullying. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) To what extent is it acceptable for parents to use apps such as Qustodio and TeenSafe to monitor their child's online activities? **[8]**

Answers may include:

Reasons why it is acceptable

- parents may want to control the contents of websites that their child is going to access
- parents may be worried about who contacts their child online and what messages they exchange/gives parents a sense of relief of knowing what their child is up to
- parents are responsible for the safety and wellbeing of their child and feel it is their duty, as parents, to monitor their child's online activities
- parents pay for the mobile devices, in most cases, so they feel that have the right to know how, when and for what purpose the devices are used.

Reasons why it is not acceptable

- children have a right to privacy, which these apps refute and deny
- the use of apps could involve data being sent to the app developers which potentially introduces new privacy issues
- children may not know that their parents monitor their messages and online activities, which can be detrimental to trust and honesty within the family
- there is no consent: the children may not be asked whether they agree or not
- younger children may need to be protected, but teenagers may feel they have a right to exchange messages in all confidentiality with other people, without their parents spying on them.

Marking note: Do not accept references to hacking. The question is about the acceptability of parents monitoring their child's online activities

Please see generic markband information sheet on page 27.

2. Braille keyboards

Note to examiners:
- *All part (a) questions are marked using ticks and annotations where appropriate.*
- *Part (b) and part (c) are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded.* ***Do not use ticks.***

(a) (i) Identify **two** features of American Standard Code for Information Interchange (ASCII). **[2]**

Answers may include:
- ASCII is the standard system to encode and represent English characters as numbers, (for example, upper case L is 76
- ASCII code numerically represents alphabet letters, but also signs such as "%" or "@" or even some actions such as "backspace" or "delete"
- ASCII is a simple "raw" format that any computer can understand (plain text, no formatting)
- the standard ASCII character set uses 7 bits for each character (though some non-English letters and graphic symbols use 8 bits)
- ASCII has 128 characters (each character is assigned a number from 0 – 127 *e.g.* L is 760.

Award ***[1]*** *for identifying each feature of ASCII up to a maximum of* ***[2]****.*

(ii) Describe **two** methods that Umair could have used to gather data from visually impaired people during the development of his system. **[4]**

Answers may include:

One-to-one interviews
Umair could have spoken with visually impaired people, individually, asking them about their experience or about their own particular needs from a Braille keyboard. At the very beginning of the development of his system, this could have helped him define and refine the specification, as they are the target users.

Focus groups
Umair could have spoken with a small group of visually impaired people, asking them to test and compare different versions of the overlay he was producing, discussing their advantages and advantages at the same time, encouraging them to share ideas and speak with one another.

Surveys
Umair could have carried out some quantitative research, with questionnaires in Braille, asking questions to a number of visually impaired people in order to collect data from a larger sample, more representative of the population of visually impaired people who may be the end users of his Braille keyboard.

Direct observation
Umair could have visited a place where visually impaired individuals use the system to observe how it is used, how it can be improved and make notes on what features would be appropriate for the new system. In other words, observe people using a braille keyboard

*Award **[1]** for identifying each method Umair could have used to gather data from visually impaired people during the development of his system and **[1]** for description of that method up to a maximum of **[2].***

*Mark as **[2] + [2].***

(b) Umair has decided to release his Braille software as open source software, rather than proprietary software.

Explain why Umair took this decision. **[6]**

Answers may include:

- Umair seems more motivated by "doing good" and helping visually impaired people than by making a profit
- the software could be gradually and freely improved by other experts, for example creating versions in different languages
- open source community is more active than a company's helpdesk, offering accessible and timely support
- the software may evolve/update more rapidly than if it was a commercial product
- the time taken to register the software and gain patents may lead to other software developers creating similar software that would reduce the impact of Umair's software if it became proprietary
- open source software is generally supplied free of charge making it more accessible to a wider range of people (e.g. schools, charities, people on low incomes etc.)
- open source software can be published under one of the Creative Common licenses, which are free to use. Proprietary software may require more complex and costly methods (e.g. patenting) to protect Umair's intellectual property rights.

Marks	***Level descriptor***
0	*No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.*
1–2	*A limited response that indicates very little understanding of the topic or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.*
3–4	*A description or partial explanation of why Umair released his software as open source software. There is some use of appropriate ITGS terminology in the response.*
5–6	*A comprehensive explanation of why Umair released his software as open source software. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) Umair has two options:
- Option 1: he could continue to develop his software and Braille keyboard by using crowdfunding.
- Option 2: he could sell the intellectual property rights to *AssistivIT*, a large company that develops software.

Evaluate these **two** options. **[8]**

Answers may include:

Reasons for Umair continuing to develop the software for his Braille keyboard using crowdfunding
- the Braille keyboard and associated software is very much Umair's vision and he may not want to relinquish control of it as he may have an emotional attachment to the software
- using crowdfunding would allow Umair to remain true to his principles such as using open source software
- Umair may be able to develop working relationships with other like-minded individuals who may be willing to fund his development work without him having to change his vision
- the use of crowd funding may lead to a relatively cheap product which may help to reduce the digital divide between sighted and visually impaired people
- crowdsourcing may enable more rapid development of the software and overlay
- Umair would lose any revenue from the software
- AssistivIT may increase the price of the software and make it inaccessible to many of the potential customers Umair was intending his low-tech solution for.

Reasons for Umair selling the IP for his software and keyboard to *AssistivIT*
- Umair may have gone as far as he can with developing the software and overlay and
  may realise that investing any more of his time and money in the venture will bring little additional benefits
- developments in both hardware and software may lead to solutions of a similar standard being developed more cheaply than Umair will be able to
- Umair may realise that his strengths lie in the development of innovate solutions rather than selling them, so he may have to accept that his head must rule his heart
- Umair may see the payment from *AssistivIT* as funding to start his next initiative
- *AssistivIT* will be able to provide reliable ongoing funds (e.g. for development / maintenance)
- *AssistivIT may have a larger development team that can develop the software more rapidly than Umair would be able to do so alone*.

Note to examiners: The bullet points above concentrate mostly on positive reasons for each decision. Examiners should give credit for valid reasons expressed as negatives.

Please see generic markband information sheet on page 27.

3. Hurricane warning systems

Note to examiners:
- *All part (a) questions are marked using ticks and annotations where appropriate.*
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(a) (i) Identify **two** file types that could be used for the image in **Figure 3**, which shows the potential tracks of Hurricane Irma. **[2]**

Answers may include:
- JPG/JPEG
- PNG
- TIFF
- GIF
- BMP

Accept video formats such as

- Mp4
- Mov
- Avi
- Wmv
- Flv

Award ***[1]*** *for identifying each file type that could be used to show the potential tracks of Hurricane Irma up to a maximum of* ***[2]****.*

(ii) Outline the difference between data and information. **[2]**

Answers may include:
- "data" is simply a list of facts or figures/raw data
- "information" is "data" which has a context/has been processed/analysed.

Award ***[1]*** *for a definition of either data and information, and* ***[1]*** *for a definition of the other up to a maximum of* ***[2]****.*

(iii) Outline why visualization is used to present data. **[2]**

Answers may include:
- visualization presents the data in a form that is easily understandable such as images and charts
- therefore, it can be presented to audiences who may not have the specialist knowledge required to understand the information in its raw form/aids the prediction of future events

- visualization may synthesise the data
- so it can be presented in a simplified, yet understandable, manner.

Award ***[1]*** *for identifying a reason why visualisation is used and* ***[1]*** *for a development of that reason up to a maximum of* ***[2]****.*

(b) (i) Distinguish between a model and a simulation. **[2]**

Answers may include:
- a model is a simplified version of reality/a program to replicate a real-life system
- a simulation is the operation of the model over time/uses a model to study a real-world system under certain conditions/allows the variables within the model to be changed over time and a series of "what-if" scenarios can be run to see the effects of these changes.

*Award **[1]** for a definition of either a model or a simulation and **[1]** for a definition of both up to a maximum of **[2]**.*

(ii) Different weather variables such as wind speed and temperature need to be collected in order to predict the track of a hurricane. Wind speed data is sampled more frequently than temperature data in a hurricane.

Explain **one** reason why wind speed data would be sampled more frequently than temperature data in a hurricane. **[2]**

Answers may include:
- the faster a variable such as wind changes
- the more frequently it must be sampled.

- wind speed is the critical and rapidly changing variable in the hurricane
- therefore, it needs to be sampled as regularly as possible to be able to monitor the possible trends

- sampling the wind speed frequently
- enables the track of the hurricane and its effects to be predicted more accurately.

- temperature data does not change as rapidly as wind speed
- therefore the sample rate can be lower.

*Award **[1]** for identifying each reason why wind speed data would be sampled more frequently than temperature data in a hurricane and **[1]** for a development of that reason up to a maximum of **[2].***

(iii) Explain why the data collected about Hurricane Irma was not encrypted prior to being transmitted. **[2]**

Answers may include:

- the data being collected is not sensitive in nature
- therefore, there is no need to encrypt the data as a data breach would not cause an issue

- as data encryption is not a necessary measure
- the IT requirements to ensure the transmission of data are reduced so resources can be allocated elsewhere.

- not encrypting /decrypting the data will speed up processing
- in a time-critical scenario.

- not encrypting the data makes it immediately available to the wider scientific community
- which allows them to improve their hurricane models.

*Award **[1]** for identifying a reason why the data being collected about the hurricane does not need to be encrypted and **[1]** for a development of that reason up to a maximum of **[2]**.*

(c) *Panasonic* does not make its PWS model available to governments, as the company says that doing so would compromise its commercial interests.

Discuss whether governments should make private companies such as *Panasonic* share their data. **[8]**

Answers may include:

It is acceptable for governments to make private companies such as *Panasonic* share their data

- with its PWS, *Panasonic* has proved better than the American and European models at predicting the path of Hurricane Irma, so *Panasonic* should share its data, not only to help the government, but also to help people, rather than keeping vital information private and confidential
- hurricanes may have devastating consequences for people and property, so in such a situation of crisis, the government should have the power and the right to access any data, even private data, that can save life
- there is no issue of individual/personal privacy or confidentiality, so this is not a case where the government would infringe on people's rights or liberty.

It is not acceptable for governments to make private companies such as *Panasonic* share their data

- *Panasonic* has invested a lot of money and other resources (such as engineers' time) to develop its PWS model, so it is not fair towards the owners, shareholders and even workers that suddenly the government gets access for free to all the data collected by *Panasonic*
- if governments believe they should use data from aircraft and similar sources, like *Panasonic*, they should develop such programmes of weather predictions, rather than relying on weather balloons
- as a principle, governments should respect the private nature of data that belongs to independent companies, otherwise this could open the gate to many other cases in scientific research (*eg* with pharmaceutical drugs) where the governments overstep their boundaries and their rights
- if the data from the company is incorrect and there are serious repercussions as a result, who is accountable?

Please see generic markband information sheet on page 27.

Section B

4. Automated journalism software

Note to examiners:
- *All part (a) questions are marked using ticks and annotations where appropriate.*
- *Part (b) and part (c) are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded.* ***Do not use ticks.***

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

Answers may include:
- step by step instructions for performing an action or solving a problem
- set of rules that that precisely define a sequence of operations
- used by computers to process data
- order of the steps is important
- often includes decision trees
- has a finite number of steps.

Award ***[1]*** *for identifying each characteristic of an algorithm up to a maximum of* ***[2]****.*

(ii) Identify **two** types of logic that would be used in a machine learning algorithm. [2]

Answers may include:
- Decision trees
- If-then rules
- Probabilistic rules
- Statistical rules
- Fuzzy logic
- Boolean logic

Award ***[1]*** *for identifying each type of logic a natural language processor may use up to a maximum of* ***[2]****.*

(iii) Outline why human testers are required during the testing phase of the automated journalism software. **[2]**

Answers may include:
- humans read the information through a variety of perspectives
- so, the text may need to be adapted for a specific audience

- the computer is unable to test its own output
- so, there is no guarantee it is appropriate

- humans are the end-users
- so, the text needs to be appropriate for their needs.

Award ***[1]*** *for identifying a reason why human testers are required during the testing phase of the automated journalism software and* ***[1]*** *for a development of that reason up to a maximum of* ***[2]****.*

(b) Developers of automated journalism software need to understand how human journalists work.

Two methods of gathering this information from journalists are:
- Interviews
- Literature searches of existing work

Analyse these **two** methods of gathering information about how human journalists work. **[6]**

Answers may include:

Advantages of interviews
- allows a more in-depth discussion about the work
- this may allow the reasons behind the decisions made to be explored in more depth than if there is no real time face-to-face interaction
- may reduce the time required to carry out the investigation as the discussion is synchronous
- may be able to discuss work that is not available in Internet searches or in publications the researcher may not be aware of.

Disadvantages of interviews
- the quality of answers depends on the quality of the questions
- can take a long time to conduct
- collect a lot of information which needs to be analysed.

Literature search

Approach 1 – using a literature search to find out about what experts are saying about how people write

Advantages
- can be done objectively
- a literature search would offer multiple points of view
- the journalist would be unable to influence the researcher by focusing the discussion on areas they want to discuss
- can be carried out at a convenient time for the researcher
- may be easier to analyse the information gathered as analytics may be available, for example, using comparison features in software such as Word.

Disadvantages
- does not allow for follow-up questions.

Approach 2 – using a literature search to analyze samples of how journalists write

Advantages
- analysis of the article can provide information to teach the software how to generate similar kinds of work

Disadvantages
- variety of styles and approaches make it difficult to generalize
- This kind of analysis takes a great deal of time

Candidates may take either approach one or approach two when discussing the literature search. Both are acceptable.

Marks	***Level descriptor***
0	*No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.*
1–2	*A limited response that indicates very little understanding of interviews and literature searches or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical and descriptive.*
3–4	*A description of the advantages and disadvantages of interviews and literature searches. There is some use of appropriate ITGS terminology in the response.*
5–6	*A balanced analysis of the advantages and disadvantages of interviews and literature searches. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) To what extent should newspapers rely on automated journalism software to create stories? **[8]**

Answers may include:

Reasons why automated journalism software should be used

- the paper can generate many more articles using this method
- articles can be generated faster – this is important for breaking news
- the error rate is much lower in some instances
- it allows papers to reach a lot of niche audiences therefore increasing its reach.
- it can give reporters more time to do in-depth analysis
- it can provide information *ie* data analysis that can enable reporters to see trends, for example, in elections
- it can provide background information for their reports
- it can free up reporters for stories that require human thought
- it can eliminate some of the more mundane/boring jobs and allow reporters to focus on more thought-provoking stories – this may improve the quality of their writing
- it can't deal with subjective material so reporter's jobs are not at risk.

Reasons why automated journalism software should not be used

- it takes time and money to train the software
- robots can provide statistics but not analysis
- robots can't provide the human perspective that makes articles interesting.
- robots can create and promulgate "fake news"
- robots can't discover news stories; they are restricted to information available online
- robots are designed by human and humans make mistakes so robots can make mistakes too
- the accuracy of the underlying data still matters
- newspapers will need to disclose what they are doing
- data will have to be constantly checked to make sure it is up to date
- journalists, especially inexperienced ones who are still learning will lose jobs.

Please see generic markband information sheet on page 27.

5. Artificial intelligence (AI) used to sentence criminals

Note to examiners:
- *All part (a) questions are marked using ticks and annotations where appropriate.*
- *Part (b) and part (c) are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded.* ***Do not use ticks.***

(a) (i) Identify **two** characteristics of artificial intelligence (AI) systems. **[2]**

Answers may include:
- ability to seem intelligent
- power to copy intelligent human behaviour
- capacity to learn
- decision making ability
- adaptation to circumstances
- well defined goals
- problem solving skill
- reasoning ability
- autonomy
- flexibility.

Award ***[1]*** *for identifying each characteristic of artificial intelligence systems up to a maximum of* ***[2]****.*

(ii) The developers of the AI software created a data flow diagram as part of the development process.

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

Answers may include:
- visualizes the flow of data through an information system
- does not show types of relationships between types of data
- shows type of input and output
- shows where the data will be stored
- shows where the data will come from and go to.

Award ***[1]*** *for identifying each feature of a data flow diagram up to a maximum of* ***[2]****.*

(iii) The developers of the AI software carried out an economic feasibility study.

Identify two other feasibility studies that should have been carried out at this time. **[2]**

Answers may include:
- Technological feasibility study
- Legal/Ethical feasibility study
- Operational feasibility study
- Schedule feasibility study
- Resource feasibility study
- Social/cultural feasibility study
- Marketing feasibility study.

Award ***[1]*** *for identifying each feasibility study up to a maximum of* ***[2]****.*

(b) The developers of the AI software decided to use machine learning instead of an expert system.

Explain this decision. **[6]**

Answers may include:

Reasons why machine learning is suitable

- when exposed to large amounts of data, machine learning can provide new and better results
- machine learning is not restricted to inference rules so it is more flexible and allows for complexity
- machine learning does not rely on exact matches.

Reasons why expert systems are not suitable

- inference rules are based on two possible outcomes, “Yes” or “No”
- inference rules are based on exact matches rather than a range of possible responses
- expert systems can fail when the situation isn’t in their knowledge base
- a chain of if/then rules is too restrictive and does not allow for complexity which is essential for evaluating human traits
- expert systems lack creativity so they cannot respond to unique situations. There may be wide variance in the situation of each defendant
- the knowledge of human experts is very subjective. In the case of sentencing, the approach of each expert may be different.

Marks	***Level descriptor***
0	*No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.*
1–2	*A limited response that indicates very little understanding of expert systems and machine learning, or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.*
3–4	*A description, unbalanced or partial explanation of why machine learning is suitable and expert systems are not. There is some use of appropriate ITGS terminology in the response.*
5–6	*A balanced and detailed analysis of why machine learning is suitable and expert systems are not. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) To what extent should the decisions of judges be based on algorithms rather than their knowledge and experience? **[8]**

Answers may include:

Arguments for using algorithms

- we don't know what is going on inside a judge's mind so it's a black box too
- judges can be biased
- this would be a more standardized process *ie* more uniform and logical
- risk assessment tools could lead to less incarceration and less crime
- this software could be used in conjunction with a judge's decision *ie* to provide guidance
- it could be one factor among many *ie* not the determinative factor
- the software could be used to identify outliers *ie* people very likely to commit a crime or people very unlikely to commit a crime
- the software could be based on the experience of many judges/experienced experts in this field, so it could be more reliable that the judgement of a single person.

Arguments against using algorithms

- the algorithms should not be "black boxes" *ie* they should be revealed
- it's almost impossible to define "fairness," so how can the algorithm be "fair"
- biases could be incorporated into the software because of the attitudes of the human beings who created it
- the value of the algorithm depends on the data it uses and criminal justice data is often unreliable
- algorithms look at group behaviour not individual behaviour
- algorithms don't look at how different factors interact (at least not yet).

Please see generic markband information sheet on page 27.

6. Robots in restaurants

Note to examiners.
- *All part (a) questions are marked using ticks and annotations where appropriate*
- *Part (b) and part (c) are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded.* ***Do not use ticks.***

(a) (i) Sally uses pattern recognition to tell the difference between the burgers and the buns.

Identify **two** characteristics of pattern recognition. **[2]**

Answers may include:
- uses training data
- learns from examples
- once trained the software can identify new examples of the items it has "learned"
- gives an estimate of the accuracy of the identification
- recognizes shapes within an image.

Award ***[1]*** *for identifying each characteristic of pattern recognition up to a maximum of* ***[2]****.*

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

Answers may include:
- built on the examination of large amounts of data
- learns from examples
- able to react to new inputs
- builds a general model from the training examples
- learns without human intervention.

Award ***[1]*** *for identifying each characteristic of machine learning up to a maximum of* ***[2]****.*

(iii) Prototypes will be created during the development of Sally.

Identify **two** reasons why a prototype would be used. **[2]**

Answers may include:
- show the client what to expect
- reduce revising the project
- test the design (allows clients to make changes)
- clarify costs
- fail cheaply and early
- eliminate approaches that don't work
- get feedback to help improve the product.

Award ***[1]*** *for identifying each reason why a prototype would be used up to a maximum of* ***[2]****.*

(b) The developers of Sally can choose to use a Pert chart or a Gantt chart to guide the project.

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

Answers may include:

Advantages of a Pert chart

- easy identification of order of precedence of the activities
- shows relationships between tasks
- easy identification of the critical path
- shows early start, late start and slack for each activity
- can show slack time so resources can be moved to more critical activities
- shows which tasks must be completed in sequence
- shows which tasks can be done in parallel I.e. not part of a sequence.

Disadvantages of a Pert chart

- charts can be very complicated
- can underestimate completion time particularly if delays occur
- inaccurate time estimates can make the entire plan incorrect
- can be difficult to interpret, especially with complex projects.

Advantages of a Gantt chart

- use of a Gantt chart visualizes the process *eg* helps to maintain organization
- it illustrates which tasks must be completed before the next one can begin
- task can be viewed against a calendar showing start and end dates
- resources required for tasks can be linked to the tasks on the chart
- shows how long a project should take to be completed.

Disadvantages of a Gantt chart

- it's a linear *i.e.* step-by-step process so it is very inflexible. Changes are difficult to make/errors are difficult to correct
- changes could result in significant costs
- chart can be too simplistic *i.e.* does not provide enough detail for a complex project *i.e.* this chart leaves out the construction of the database
- it is difficult to show where there is slack time in the project
- inaccurate time estimates can make the entire plan incorrect
- on a large project they can become unmanageable
- the time for each task must be estimated before the chart can be completed.

Marks	***Level descriptor***
0	*No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.*
1–2	*A limited response that indicates very little understanding of Pert and Gantt charts or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.*
3–4	*A description, unbalanced or partial analysis of the issues related to whether a Pert or a Gantt chart should be used. There is some use of appropriate ITGS terminology in the response.*
5–6	*A balanced and detailed analysis of the relative advantages and disadvantages of whether a Pert or a Gantt chart should be used. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) The initial version of Sally follows a fixed set of procedures, and can only make hamburgers. Bruce Velison is already thinking about the second version of Sally (version 2.0). He would like Sally 2.0 to make a variety of foods. He would also like to use machine learning to create these foods and cloud computing to connect all 5000 Sallys with each other.

Evaluate Bruce's decision to improve Sally. **[8]**

Answers may include:

Reason why this is not a good idea

- could be expensive, *i.e.* the initial cost of the robots
- will require staff to clean and repair
- customers might react against the food being prepared by a robot *ie* lacks the human touch
- could increase the price of the food to cover the cost of the robots
- may eliminate jobs thus increasing unemployment
- staff could be blamed if Sally breaks down or doesn't provide what is expected
- if a robot fails, it will require time and staff to fix it
- the variety of dishes could be limited as the robot still needs to be programmed for each one
- since all Sallys are connected to the same network, security issues could occur.
- Bruce needs to deal with/decommission the old Sally 1.0s.
- may require more staff training if Sally 2.0 is not user friendly/intuitive
- might need to hire more technicians as the technology of Sally 2.0 is more complex
- Sally 2.0 may rely on the internet access.

Reasons why this is a good idea

- better quality food as it will be consistent
- faster, more efficient service because the robot can work faster than people
- saves money on staffing, *etc*
- might attract new customers who are interested in the robots
- could lead to better, new products
- will make the staff's job easier
- will provide new jobs in cleaning and repairing the robot
- kitchen work is dangerous so robots help eliminate the chance of being injured
- connecting all 5000 Sallys will make it very easy to share new programming for new products
- connecting all 5000 Sallys will make it easy to share what one robot has learned with all the others
- machine learning will enable Sally to learn from its mistakes
- because no employees touch the burgers, they will be more sanitary
- turnover in the fast food industry is huge; this could solve that problem
- storing data in the cloud ensures that it is secure even if the Sallys break down.

Please see generic markband information sheet on page 27.

SL and HL paper 1 part (c) and HL paper 3 question 3 markband

Marks	***Level descriptor***
No marks	• *A response with no knowledge or understanding of the relevant ITGS issues and concepts.* • *A response that includes no appropriate ITGS terminology.*
Basic ***1–2 marks***	• *A response with minimal knowledge and understanding of the relevant ITGS issues and concepts.* • *A response that includes minimal use of appropriate ITGS terminology.* • *A response that has no evidence of judgments and/or conclusions.* • *No reference is made to the scenario in the stimulus material in the response.* • *The response may be no more than a list.*
Adequate ***3–4 marks***	• *A descriptive response with limited knowledge and/or understanding of the relevant ITGS issues and/or concepts.* • *A response that includes limited use of appropriate ITGS terminology.* • *A response that has evidence of conclusions and/or judgments that are no more than unsubstantiated statements. The analysis underpinning them may also be partial or unbalanced.* • *Implicit references are made to the scenario in the stimulus material in the response.*
Competent ***5–6 marks***	• *A response with knowledge and understanding of the relevant ITGS issues and/or concepts.* • *A response that uses ITGS terminology appropriately in places.* • *A response that includes conclusions and/or judgments that have limited support and are underpinned by a balanced analysis.* • *Explicit references to the scenario in the stimulus material are made at places in the response.*
Proficient ***7–8 marks***	• *A response with a detailed knowledge and understanding of the relevant ITGS issues and/or concepts.* • *A response that uses ITGS terminology appropriately throughout.* • *A response that includes conclusions and/or judgments that are well supported and underpinned by a balanced analysis.* • *Explicit references are made appropriately to the scenario in the stimulus material throughout the response.*