COMPUTER SCIENCE

Paper 0478/12
Computer Systems

Key messages

This was the first exam for the updated syllabus and contained questions on new topics including robotics and artificial intelligence. Candidates demonstrated an understanding of artificial intelligence but were not always able to apply it to the context appropriately.

General comments

Candidates strengths lay in the conversion of binary numbers, the description of malware, and methods of data transmission.

Some candidates found questions in context more challenging. Where specific values and scenarios are given in a question candidates must make sure they refer directly to this in their answers, instead of giving generic responses. For example, in the justification of serial or parallel data transmission, the distance between the values was relevant.

There were some imaginative responses to the artificial intelligence questions, with some candidates demonstrating an understanding of how artificial intelligence can be used by programs to learn and adapt.

Comments on specific questions

Question 1

(a) Many candidates were able to answer this question correctly. A common misconception was that the software analyses the data and then posts this to a website (answer **C**). The spyware itself transmits all data recorded and the analysis is done separately to identify key data, the results of which are not necessarily posted to a website.

(b) The most common examples of malware given were virus, worm, and trojan horse. Some candidates inaccurately identified hacking as being malware – which might make use of malware but not necessarily. Some candidates also identified phishing as malware, whereas this is not software that is installed in a computer but requires the user to click on a link to be directed to a fake website (or equivalent).

When describing the malware candidates often identified that a virus replicates, when describing a worm some candidates identified that it replicates but did not differentiate this from a virus; a worm replicates over a network, whilst a virus replicates within a computer.

Candidates often gave accurate actions that the malware could take, for example corrupting data.

Some candidates identified ransomware and described how this locks data from the user. Some candidates expanded this by repeating the term ransom i.e. a ransom needed to be paid, without identifying what a ransom is.

Some candidates repeated spyware as another type of malware, but this was already given in the question.

(c) Some candidates demonstrated a clear understanding of firewalls and proxy servers. The most common similarities included the checking of incoming and outgoing data, blocking signals, and having a criteria for traffic.

Candidates often found the difference more challenging with some candidates only giving one side of the difference, for example, that a proxy hides the user's IP address without identifying how the firewall is different. Candidates need to make sure they give enough information in their answer to demonstrate their understanding, for example, some candidates identified that a proxy has cache – without reference to what this cache is because a firewall could also have cache, but it would not be used in the same way.

Question 2

(a) Many candidates chose a high-level language for the most appropriate language, but a significant number also chose a low-level language. Candidates were required to justify their choice. The most common answers for high-level languages included the speed and ease of writing, testing, and debugging the program, with some candidates also identifying the need for a portable program between different hardware.

Candidates who selected a low-level language often justified it with the need for specialised hardware and a more efficient program.

Some candidates confused the two types of language, most commonly by selecting low-level and incorrectly justifying that this was easier to write than a high-level language.

(b) This question required a description of the operation of a compiler and an interpreter, some candidates gave benefits of compilers and interpreters instead of describing the operation, for example, that a compiled program can be used without the translator.

Many responses gave partial answers that required more precision to demonstrate their understanding. For example, stating that a compiler translates the code and runs it does not clearly explain how all of the code is translated before any of the code is run. An interpreter also translates code before running the code, but the interpreter translates one line, then executes that line, then moves on to the next. This level of detail is required for candidates to demonstrate their understanding of the differences in how they work.

The most common answers included a compiler producing an executable file and an interpreter stopping the translation as soon as an error is found.

Question 3

(a) Candidates need to understand the difference between binary and denary prefixes. A binary prefix, for example, mebibytes requires the use of 1024 in calculations; a denary prefix for example megabytes requires the use of 1000 in calculations. In this question binary prefixes were used, therefore candidates needed to use the value of 1024 in calculations. Many candidates used the conversion of 1000, for example, 4 GiB = 1000 MiB instead of 1024 MiB.

(b) Many candidates were able to give an example of data that is commonly stored in RAM. Some responses needed to give further information about this data to identify what was stored in RAM. For example, ‘Software’ is inaccurate, because the data for software is stored in secondary storage, the currently running parts of the software will be stored in RAM. This level of detail was missing from some responses.

(c) This question was often answered well with candidates identifying secondary storage as non-volatile.

Question 4

(a) Candidates were commonly able to define the term resolution as the number of pixels in the image. Fewer candidates could define a pixel. Some responses describe a pixel as all of the colours in the image, or all of the squares that make up the image. The stronger responses commonly defined it as the smallest component of an image, and some responses accurately described it as a single square that stored a single colour.

(b) This question was often answered well with many candidates gaining the mark for showing their working, with many of these also gaining the correct final answer.

(c) Most candidates were able to identify solid-state as being non-volatile. Some candidates correctly identified it is made of transistors whilst more correctly identified they were laid out as a grid. Some candidates were also able to identify that gates control the flow of electrons.

(d) This question was often answered well. The most common answers included the reduction in file size, the increase in transmission speed, or the reduced storage space. Some candidates identified the file as needing less space – but did not specify what the space was i.e. storage space.

Question 5

(a) (i) This question was often answered well with candidates commonly identifying the sender's IP address and the receiver's IP address. Some candidates gave both of these within one answer space, when an answer has two numbered sections each item needs to be written on a separate line. Only the first answer on each line will be considered.

Some answers did not clearly identify the data being stored, for example 'the sequence' is not enough for the packet number because the whole sequence will not be stored.

(a) (ii) This question was also often answered well with many candidates giving the other two correct elements of a packet.

(b) (i) There were a range of answers from candidates, some selecting serial and others parallel.

The candidates who gave serial often justified it with the distance being more than a few metres and hence there would be less errors and the data will arrive in the order it was sent.

The candidates who gave parallel often justified it with the distance might still only be a few metres and therefore the data will not go out of sync, as well as the transmission speed being faster. Some candidates stated that parallel was faster, but not what it was faster at doing i.e. the transmission rate.

(b) (ii) This question was answered well with many candidates giving a complete, accurate, answer.

(c) (i) There were a mix of responses to this question, but some candidates got both bits correct and others gave one or both incorrect.

(c) (ii) Some candidates were able to identify when a parity byte check will not detect an error, although some responses required more precision – for example, multiple bits changing can still be detected because multiple can be an odd number. The identification of the even number, or transposition of bits, was important. Fewer candidates were able to explain how a parity block check can detect these errors. The most common correct answers described the need to check horizontally and vertically.

(c) (iii) This question was answered well by many candidates who correctly identified the bit and byte number.

(d) (i) This question was answered well by many candidates. The most common answers included storing bookmarks and history.

(d) (ii) Candidates took a range of approaches to this question. Some candidates identified the data that would be stored by the cookies and some candidates described how the web page would use the data. The most common answers included the storage of login details so that the user did not need to enter these each time, storing preferences so the web page appears how the user wants it to, and the use of a virtual shopping basket.

Some candidates gave repeated answers, for example 'storing websites the user has visited' for the first way, and then expanding this on the second way with 'to give tailored advertisements'.

Question 6

(a) There were a range of responses to this question, some candidates were able to accurately convert each number. Candidates found the hexadecimal more challenging than the binary conversions.

(b) This question required an understanding of what is meant by robotics, many candidates instead describe what a robot is instead of the field of robotics which is more than a robot. The stronger responses included a description of the design and construction of robots, whilst the weaker responses described a robot as simulating human actions.

(c) Some candidates were able to give a clear description of how the sensor and microprocessor work together. Few candidates were able to demonstrate an understanding of a sensor continually sending data to the microprocessor for analysis, instead suggesting that the sensor only sends data when an object is detected.

Where a question has specific values in the scenarios candidates need to use these clearly in their answer. In this case, there was a given distance, therefore the data received from the sensor needed to be converted to a value which was then compared to the 10 cm to determine if it was less than or equal to 10 cm or greater than 10 cm. Some candidates repeated the information in the question at this stage, for example stating that the distance to the object was compared to 10 cm without clear reference to the data received from the sensor.

Many candidates were able to accurately identify the need for an actuator to make the robot turn or to move forward.

When describing the commands to move the robot some candidates again repeated the information in the question, for example, if the object is less than or equal to 10 cm the robot turns. Candidates needed to demonstrate their understanding of the steps involved in this decision and action, i.e. the value is compared, and then if the result is true the microprocessor sends a signal to the actuator to make the movement. Some candidates may benefit from considering the steps as a flowchart to gain the depth of understanding in their answers.

(d) (i) This question asked for the characteristics of artificial intelligence; some candidates describe different scenarios that could make use of artificial intelligence or described different types or categories of artificial intelligence, which did not answer this question. For example, by describing the use of an expert system.

The most common responses described how artificial intelligence involves adapting and learning from past mistakes or experiences. Some candidates described how the artificial intelligence system can be trained and that it makes use of rules.

(d) (ii) There were a range of responses to this question with many candidates describing feasible ways that the program could use artificial intelligence. The stronger responses described how machine learning could be used, for example by storing data about the obstacles it meets, storing how to get past the obstacles, and then using this next time it meets the same type of obstacle. Other strong responses described the use of backtracking by storing the decisions as to which way the robot moved, and then when a dead end is reached the robot goes back to one of these decision points and goes in a different way.

Some of the weaker responses described the use of an expert system in this scenario, which is not appropriate for the scenario due to there not being a user to answer the questions to move to an outcome. Some of these responses, however, included the collecting of data or storing of the choices.

A few responses referred to the use of image recognition to detect what was in front of the robot, for example in the use of identifying obstacles.

COMPUTER SCIENCE

Paper 0478/22

Paper 2 Problem-solving and Programming

Key Messages

Candidates, who read each question carefully and answered the question, as set on the paper, performed well. Candidates should take care when writing algorithms to use the method(s) stated in the question. For example, **Questions 2(a)**, **10(a)** and **10(b)** needed to be written in pseudocode as set out in the syllabus. **Question 11** answers could be written in pseudocode, Java, Python or Visual Basic. When using variables, constants and arrays the same identifier name should be used throughout the answer.

Trace tables should be clearly completed in ink, not in pencil with alterations made in ink, because both answers are visible when the answer is scanned.

General Comments

Most candidates attempted all questions.

Comments on Specific Questions

Question 1

Many candidates correctly identified the scope of the variable as local. All the other options were incorrectly identified by some candidates.

Question 2

(a) The full range of marks was seen for this question. Common errors seen, included confusing pre- and post-condition loops, and incorrectly identifying `FOR` as a statement to count.

(b) Generally, well answered. Most candidates wrote appropriate, well-constructed pseudocode statements using the given array `Number[]`. A common error seen was to not include a pseudocode statement to set the total to zero before the loop. Other errors seen included incorrectly using `ENDFOR` as well as `NEXT` and adding extra brackets to the `OUTPUT` statement.

Question 3

Most candidates could give an example of one type of test data, some candidates identified the purpose of test data, better candidates gave a good description of the purpose. An example of a good answer:

Description: Test data is used to see if a program behaves in the intended manner using a set of data.
The program should reject unwanted data and accept and process the required data.
Example: Normal data is a type of test data.

Question 4

Many candidates gained good marks for this question showing understanding of the use of variables and constants.

Question 5

The full range of marks was seen for this question. Most candidates correctly used a hierarchical structure for the diagram. Many candidates used the information given in the question and correctly completed the diagram. A common error seen was to add information not given in the question.

Question 6

(a) Most candidates identified the error in line five. Some candidates identified the error in the variable name at line six. Some candidates identified the error in the comparison operators used at line eleven. A common error seen was to incorrectly identify the Boolean operator used in line six and/or eleven as an error. Due to an issue with this question, the examiners considered the impact on candidates in the light of answers seen. Changes to the marking approach for this question were agreed to ensure that no candidates were disadvantaged by the issue.

(b) Most candidates gained good marks for this question. A common error seen was to incorrectly include the % sign in the comparison.

Question 7

(a) Generally, well answered.

(b) Generally, well answered.

Question 8

(a) The full range of marks was awarded with many candidates showing the skill of completing a trace table. Common errors seen, included not initialising the `NumberSales` and `Total` to zero or including a comma in the output column.

Some trace tables were completed in pencil with alterations made in ink, this made identifying correct answers difficult because both answers were clearly visible when the answer was scanned.

(b) A few candidates did not attempt this part of the question. Many candidates correctly identified the error, describing the required correction proved mor challenging for many candidates. An example of a good answer:

Error: Program does not deal with a negative sale value correctly since negative values should not be accepted.
Correction: It is necessary to have a special case of 'IS SaleValue < 0?' in a decision box immediately after the INPUT SaleValue box. If it is, ask user to re-enter input.

Question 9

(a) Generally, well answered.

(b) (i) Generally, well answered.

(ii) Generally, well answered.

(c) Many candidates gained good marks for this question showing understanding of data types used in database table fields. A common error seen was to give string instead of text.

(d) Many candidates gained good marks for this question showing understanding of structured query language (SQL). A common error seen was to include extra punctuation.

(e) Many candidates gained good marks for this question showing understanding of SQL. A common error seen was not to include quotation marks round the required author's name.

Question 10

(a) Those candidates who wrote pseudocode declarations usually gained good marks for this question. Common errors seen, included use of incorrect data types and syntax errors.

(b) Some candidates did not attempt this part of the question. The full range of marks was awarded. Common errors seen included not giving data types for the parameters or the function, incorrect use of ROUND, unsuccessfully attempting to use INT or MOD and incorrectly including the keyword CALL in the function call.

(c) A few candidates did not attempt this part of the question. Some candidates gave correct answers showing good understanding of how functions work, many candidates found this question challenging.

Question 11

Most candidates attempted this question writing solutions in pseudocode or Python, some solutions written in Java were seen and a few written in Visual Basic. Many good responses were seen.

Many candidates attempted to:

- total and output the points for the matches
- count and output the number of away wins, home wins, drawn matches and lost matches
- include a suitable loop structure
- comment their code

Some candidates attempted to:

- find and output the names of the teams with the highest and lowest points for the matches
- use the 1D array `TeamName[]` and an array `TeamPoints[]`
- include a suitable nested loop structure

Common errors included:

- not using a 2D array for TeamPoints[]
- outputting the number of points for the teams with the highest and lowest points not the team names
- not initialising counters to zero
- omitting comments