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YEAR 12 *Trial Exam Paper*

2017

COMPUTING: SOFTWARE DEVELOPMENT

Written examination

Sample responses

This book presents:

- high-level sample responses
- mark allocations
- tips & guidelines

SECTION A – Multiple-choice questions

Question 1

Answer: C

Explanatory notes

An object description contains all the information about the properties of a class instance. In object-oriented programming languages, a class is instantiated to create an object, which is a concrete instance of that class. Pseudocode is a high-level description of an algorithm and internal documentation consists of descriptive comments within code written by a developer. A data dictionary is metadata that stores structured information about data, such as its data type, its format and its purpose.

Tip

- *A good analogy for remembering the difference between a class and an object is to think of the plans that are used to build houses. A house plan shows all the elements that will be built into the house – walls, floor space, doors, windows – but it is not actually a house itself; this plan is similar to a* ***class****. A house that has been built from the plan is a physical creation that exists in the real world, and there can be more than one house made from the same plan. Each house is an 'object' that is an* ***instantiation*** *of the house plan.*

Question 2

Answer: B

Explanatory notes

While the heart rate could be stored as a string, this would not be as efficient as storing it as an integer, because the heart rate will be used in calculations and so the string would need to be converted to a numeric value. A character could store a single digit, but not two or three (which would be needed for typical heart rates), and would have the same inefficiencies as strings in that it would require conversion to an integer to be useful. Boolean values are True or False (1 or 0), which would not be appropriate in this context.

Question 3

Answer: A

Explanatory notes

The use of a thumbprint to access a computer system would be biometric. Zoned security typically involves building and perimeter restrictions, such as private access areas in a workplace. Transport Layer Security (TLS) is software security, and access logs are not equipment.

Question 4

Answer: C

Explanatory notes

The goal of the company is to not lose money on bets. The best way to achieve this is to have data that is accurate. Data characteristics and storage media are not relevant in this context, and while security is important overall, it is not the most relevant aspect of data collection in regards to meeting the company's needs.

Question 5

Answer: D

Explanatory notes

Linear and binary are both types of searching, rather than sorting. Quick sort would generally be faster than selection sort in an average sort. Selection sort has an average time complexity of n^2, whereas quick sort has an average time complexity of $n \log_2 n$. To best understand this difference, consider a sort of 64 restaurants: 64^2 (4096) is a much larger number compared to $64 \times \log_2 64$ (384).

Question 6

Answer: D

Explanatory notes

There are two indicators as to which stage this algorithm is in. The first is the value of *i*, which is a counter (as is *k*) – this is indicated in the trace table on the left. The second is the swapping of two numbers: 2589167 and 8444218. As the lowest number in the list, 2589167 has been moved to position 0. However, the second number, 7579544 is not the second-lowest number in the list, so the algorithm must have only passed through the list once.

Question 7

Answer: C

Explanatory notes

The tree of an XML file is the entire XML document: in the example, lines 2–25 inclusive. The root of the tree is `dict`, as seen on line 2. Attributes belong to XML elements, and are designed to contain data related to that element; an example is `lang`, as used on lines 4, 12, 17 and 21.

Question 8

Answer: A

Explanatory notes

The first line of an XML file is always used as a prolog to define the XML version and character encoding used. This line is mandatory for the XML document to be considered well formed.

Question 9

Answer: A

Explanatory notes

To process all terms, an iteration must be used. Selection represents a conditional statement, such as 'if-then-else', whereas a sequence is a set of steps processed in order. An instruction is a single line of code.

Question 10

Answer: C

Explanatory notes

A single `termEntry` contains at least two arrays of data, which precludes a one-dimensional array being feasible. The first is a `langSet`, and the second the terms (`term`) within the `langSet`. A hash table would be unnecessary as `langSet` is limited to two in the translation program (English and Indonesian). An associative array is the most appropriate as it would allow the lookup of a `langSet` (1 or 2), allowing it to return the matching `term` values for that `langSet`. While a record could also be used to store the data from the XML file, it would take far more processing to search for language terms than using an associative array.

Tip

- *In the VCAA study design, associative arrays are listed alongside references to dictionary and hash table. You should make sure you understand what all of these data structures are, including similarities and differences between them. Typically, an associative array is the generic term used to refer to the abstract data type (ADT) that represents collections of (key, value) pairs, such that each key appears at most once in the collection (i.e. they are unique, if they appear at all). A dictionary (also known as a 'mapping' in some programming languages) is a typical implementation of the associative array ADT. A hash table is another implementation of the ADT. It uses a hashing function to compute an index value that determines where a desired value can be stored or found.*

Question 11

Answer: A

Explanatory notes

Use case diagrams are diagrammatic ways of showing how a user interacts with a program. It is a method of showing what the system must actually do at the highest level. These types of diagrams are very useful as a high-level view of the system, as they do not require technical knowledge of programming languages to understand; thus they are a good communication tool for stakeholders.

Question 12

Answer: A

Explanatory notes

The *Copyright Act* is not relevant in this case, as the patient information is not 'creative or artistic work'. Both the *Charter of Human Rights and Responsibilities Act* and the *Privacy and Data Protection Act* are Victorian-based laws.

Question 13

Answer: D

Explanatory notes

The *Spam Act* requires that message senders comply with three main rules: consent, identification and providing the ability to unsubscribe. Users must give inferred or implied consent to receive commercial electronic messages. Having purchased from a company in the past means that the user has a prior relationship with the company delivering the advertisement. This provides the means for **inferred consent** to have been given to receive advertising material.

Question 14

Answer: A

Explanatory notes

Dante is testing to see if the computer program detects that he has used the wrong data type – in this instance, a string instead of an integer. Range checking would be checking if a value is within a certain range, such as Victorian postcodes being in the ranges 3000–3999 and 8000–8999. Existence checking would involve deliberately leaving fields blank to see if the system handles this appropriately. Logic checking is not a part of validation testing; testing algorithm logic would occur much earlier through desk checking or via trace tables.

Question 15

Answer: A

Explanatory notes

Virtual private networks (VPN) allow for secure point-to-point connections to be made over an existing, dedicated connection. They typically employ traffic encryption while data is being transferred, and allow for the remote use of the resources available within the private network.

Question 16

Answer: C

Explanatory notes

While the application is being written for a smart watch that is likely connected to a mobile phone, the application Jana is writing requires information from only the watch itself. This means that it is a stand-alone application that does not need to be connected to any other system to work. Internet applications require connection to the internet, and a peer-to-peer application is a distributed application architecture that partitions workload or tasks across multiple systems.

Tip

- *Make sure you understand the different types of modern architecture, as sometimes their names can be misleading. It is also easy to make incorrect assumptions based on traditional uses of that architecture type; for example, a 'rich client' does not mean that the system must be a desktop machine, even though traditionally that would be where you would find them.*

Question 17

Answer: B

Explanatory notes

Both 1 and 3 are quantifiable statements that can be measured. This would allow their success to be assessed, making them organisational objectives. Both 2 and 4 are not easily measured and are 'big picture' statements. Their broadness makes it very difficult to determine the best way to meet them. As such, these are organisational goals.

Question 18

Answer: D

Explanatory notes

While the testing of a program may involve 'code testing', this is a colloquial term rather than a technical term. Stress testing involves putting a program, network or device under suboptimal conditions (such as simulating large numbers of concurrent users) to see if the system maintains a level of effectiveness. Range testing involves checking to see if data is within a valid range. Useability testing is a way to see how easy it is to use a software product. The testing involves real users, often those who have no prior knowledge of the software system they are testing. Users are asked to complete tasks while they are being observed by a researcher. If they encounter problems or difficulties, this information can be used to refine the software to improve its useability.

Question 19

Answer: B

Explanatory notes

Records are collections of data that are frequently of different data types. One-dimensional arrays can only store data of the same type. Both arrays and records require finite collections of items.

Tip

- *While arrays and records require finite collections of items, some programming languages allow for both records and arrays to be unfixed in size. In this study, make sure you answer questions about fundamental programming features such as data structures in relation to the traditional implementations of those data structures, rather than language-specific implementations.*

Question 20

Answer: D

Explanatory notes

Each postcode must be divided by 7 and the remainder obtained. The remainder is used as an index value. The remainders are shown in the table below.

Postcode	Remainder
3872	1
5383	0
5909	1
6759	4
8592	3
9545	4
9622	4

The remainder is used as an index value. Only two index values contain two or more postcodes. The postcodes stored at these index positions are 3872, 5909, 6759, 9545, 9622.

SECTION B – Short-answer questions

Question 1

Sample response

Jasmine is correct if there are large numbers of elements to search through. If there are n elements, linear search would need to check every element to find the one being searched for in a 'worst case' scenario. Binary search would only need to check $\log_2 n$ elements.

Eleni is correct when there are small numbers of elements to search through. Binary search is not necessarily faster when you consider that the elements need to be sorted for a binary search to work. The overall efficiency of binary search therefore is highly dependent on the efficiency of the sort algorithm used to sort the elements beforehand.

Mark allocation: 4 marks

- 2 marks for explaining Jasmine's side. There must be an appropriately technical discussion to receive both marks. For example, the first sentence in the sample response would receive 1 mark, with the explanation following required for the second mark to be awarded.
- 2 marks for explaining Eleni's side. There must be an appropriately technical discussion in relation to how the efficiency of binary search is dependent on the sort algorithm used to sort the elements beforehand.

Question 2

Sample response

Trace tables are multi-row, multi-column tables, where each column shows a variable and each row shows the initial and subsequent values of those variables when executing an algorithm. Trace tables help developers reduce the likelihood of logic errors occurring in the algorithms they write, as they allow a programmer to manually check the logic of their algorithm in the same way it would be executed in a compiler.

Mark allocation: 2 marks

- 1 mark for describing what a trace table is
- 1 mark for describing how trace tables are used in programming

Question 3

Sample response

Any two of the following responses are acceptable to attain full marks.

Project plans such as Gantt charts are useful even if a project is small – and with the increase in clients, there is no guarantee that the projects will remain small.

All projects have deadlines, and therefore they will all have milestones that need to be met. Even though there are only two programmers, the best way to manage their time efficiently would be to divide up their work between themselves and coordinate the completion of tasks to maximise efficiency. The simplest way to do this is to track the duration of tasks on a Gantt chart, and determine sequence and order after considering the dependencies of each task.

Project plans are also useful in tracking and managing delays and unforeseen events in the lifecycle of a project. Slack time is visually apparent, as well as dependent tasks.

Gantt charts can help determine the number of programmers needed for a task and the amount of time they need to spend, which can help when constructing budgets or preparing quotes for clients.

Mark allocation: 4 marks

- 2 marks for each well-explained reason as to why project plans are of benefit (up to 4 marks)

Question 4

Sample response

Data store: ‘Orders’ or ‘Customers’

Entity: ‘Customer’ or ‘Payment Processor’

Process: ‘order items’ or ‘create account’

Marking allocation: 3 marks

- 1 mark per correct response (up to 3 marks)

Question 5

Sample response

Option 1 would have more reliable connections than Option 2, but the number of connections within each room would be limited to the number of Ethernet connections at each outlet.

Option 2 would allow Paula to add new systems to her network quite easily, but wireless connectivity would not be as fast or as secure as the wired network.

There are other advantages and disadvantages that could be discussed, including the following:

- Maintenance for Option 1 would likely be more difficult and more expensive than for Option 2 (cables behind walls and under floors).
- Interference would be a concern for Option 2, and the decorative panelling may exacerbate this.
- Option 1 may become dated if fibre-optic cable to the home becomes the standard.

Mark allocation: 4 marks

- 2 marks for explaining one advantage and one disadvantage of Option 1
- 2 marks for explaining one advantage and one disadvantage of Option 2

Question 6

Sample response

Internal documentation included headers on each of the program files in the project. Headers included the author's name, a description of the code in the file, its current version number and its revision details. Above each function or method was a short description of what it does and its purpose in the whole program. Hungarian notation was used for all variables and functions. This means that the name used for these items included its intention or data type within the name itself. For example, 'arrAddress' would be an array of addresses.

Note: Other responses may be accepted.

Mark allocation: 3 marks

- 1 mark for discussing how internal documentation was used
- 1 mark for a discussion on naming conventions used
- 1 mark for using specific examples as part of the discussion

Tip

- *When asked to describe techniques or processes, avoid being generic in your discussion, in particular as this question directly addresses you as a student and wants references to your experiences programming this year. You are encouraged to use examples where possible in order to provide depth and to demonstrate your understanding.*

Section C – Case study

Question 1

Sample response

Mark's belief is an organisational objective, as it is a quantifiable statement that helps achieve his goal of increasing profits.

Mark allocation: 1 mark

- 1 mark for correctly identifying the organisational objective

Question 2a.

Sample response

	Days											
Task	5	10	15	20	25	30	35	40	45	50	55	60
Collect data requirements												
Write laser drone code												
Test and debug laser drone code												
Write carrier drone code												
Test and debug carrier drone code												
Test and debug entire system												
Conduct useability tests												
Respond to useability tests, including testing and debugging												
Demonstrate complete system to Mark												

Mark allocation: 4 marks

- 1 mark for correct start and end dates for laser drone and carrier drone development, testing and debugging
- 1 mark for correct start and end dates for testing and debugging entire system
- 1 mark for correct start and end dates for conducting and responding to useability tests
- 1 mark for all dependencies accurately shown

Question 2b.

Sample response

The diamond represents a milestone, a zero-duration task that is considered a key date or deadline. In this instance, the milestone is the deadline that Mark has set for the entire system to be ready.

Mark allocation: 1 mark

- 1 mark for a correct explanation

Tip

- *It is important that you check the key words used in exam questions. For example, the verb 'explain' means that you need to do more than just state or list an item. In this question, an explanation of what 'milestone' means is required, rather than just indicating that it is one.*

Question 3

Sample response

Donna should go to Mon-Cheri Orchards and **observe** the layout of the trees. This will help determine how much room the drone will have available to fly around the trees themselves as, even though they are planted 8 m apart, the branches and leaves will be closer together.

She may need to schedule an **interview** with the drone company to discuss the technical specifications of the drones, if this information is not available in technical specification manuals. Such information could include the maximum weight the carrier drones will be able to handle.

Note: Other responses involving observations, interviews or reviewing data reports (such as previous harvests to understand how much fruit is typically picked) would also receive marks. It would be unlikely that a survey would be an appropriate data collection method in this situation.

Mark allocation: 4 marks

- 2 marks for each well-explained appropriate data collection technique (up to 4 marks)

Question 4

Sample response

Mark's potential advantages are that he will have a more efficient system of picking cherries, with far less manual labour. This will reduce the amount he needs to spend on payroll. The advantages to his staff are that they are less likely to be asked to pick cherries as the manual labour requirements will be reduced. Mark's engineers and technicians may be disadvantaged if they are expected to maintain the drone equipment; this may also involve retraining, which would be an added cost to Mark. Other disadvantages would mostly involve the seasonal labourers, as they are unlikely to be needed at Mon-Cheri in the future. There is also a risk that the lasers can damage the trees, which would be a disadvantage to both Mark and his horticulturalists. An advantage for both technicians and horticulturalists is that they can concentrate on their real jobs.

Mark allocation: 4 marks

- 1 mark for one advantage or disadvantage for Mark
- 1 mark for one advantage or disadvantage for Mark's horticulturalists
- 1 mark for one advantage or disadvantage for Mark's engineers
- 1 mark for one disadvantage for seasonal labourers

Question 5

Sample response

Constraints that influence solutions typically include the following factors: economic, legal, social, technical and useability. In this instance, as the drones are automated, there are no useability factors. While there may be aviation legal factors to consider, no mention was made in the case study that would be relevant to the Acts or Charter covered in the Study Design.

Economic
Mon-Cheri Orchards want multiple cutting-edge drones with expensive miniature cameras. The cost of the equipment will be a constraint on how many drones can be put in place for each of their orchards.

Technical
The number of drones available will have an impact on the speed of picking fruit. As the drone supplier has already been selected by Mark, a technical constraint is the technical specifications of the selected drones: in particular, the scanning of trees relying on the resolution of the miniature cameras.

Other technical constraints exist; for example, drones will be flying outdoors in windy conditions, which will need to be accounted for in calculating the position of the cherry stalks.

Social
Social constraints include user experience, availability of technical support staff and equipment, and the timeframe given to produce the software. Particularly relevant in this case study would be availability of technical support staff if information is required about the drones, as the supplier has already been chosen. Similarly, delivery of the first drones is also a social constraint. As Mark wants the system to be ready by November, the timeframe given is also a constraint.

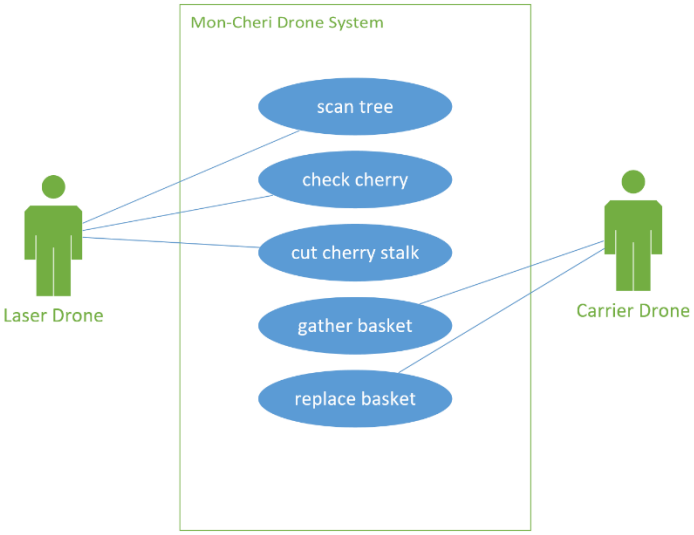
Mark allocation: 6 marks

- 1 mark for each relevant technical, economic or social constraint identified (up to 3 marks). More than one of each type can be given as long as the constraints differ.
- 1 mark for each well-explained constraint that refers to elements from the case study (up to 3 marks)

Question 6

Sample response

Use case diagrams need to have labels for all elements in the diagram (actors, use cases) and each use case should have appropriate associations.



Mark allocation: 4 marks

- 1 mark for correct names on actors
- 1 mark for correct associations for the laser drone
- 1 mark for correct associations for the carrier drone
- 1 mark for 'cut cherry stalk' or 'pick cherry' for the blank use case

Question 7

Sample response

Any four of the following responses are acceptable to attain full marks.

- scan tree
- determine height of tree
- determine number of branches on tree
- scan branch
- check cherry for ripeness
- fire laser at stalk

Note: The question only asks for functional requirements of the laser drone. The carrier drone would have the functional requirements of checking baskets or collecting them and replacing them.

Mark allocation: 4 marks

- 1 mark each for any of the functional requirements listed (up to 4 marks)

Question 8a.

Sample response

Mark needs to have a central storage system for the drones to upload their data. This could be an external hard drive or NAS (network-attached storage) connected to his networked system at the packing warehouse. It must have Bluetooth connectivity to allow for the transfer of data from the drones. It should be installed in the packing warehouse for security and protection from the elements.

Mark allocation: 3 marks

- 1 mark for suggesting appropriate hardware, specifically a storage system such as a NAS or external hard drive
- 1 mark for the location being in the packing warehouse, with a justification
- 1 mark for justification of the hardware, such as referring to how the Bluetooth transfer will be handled

Question 8b.

Sample response

Storage: Mark needs to make sure that he has backups enabled on the storage system in the packing warehouse. These should occur nightly during picking season, with the backups stored in a secure offsite location, such as a data centre or via cloud storage.

Communication: As Bluetooth is range-restricted (typically 10 m, but up to 100 m) and the 64 × 64 trees are planted 8 m apart, the drones would not have range coverage to transfer the data on-the-fly. He would need to have them 'check in' as often as he requires (possibly once a day, when picking is over) to transfer their data to the storage system via the Bluetooth connection.

Disposal: After each successful transfer to the main storage area, the data should be deleted from the drone to free up space and also to ensure that no data is duplicated. As the data being collected is not particularly sensitive, secure file deletion is not necessary.

Mark allocation: 6 marks

- 2 marks for discussing appropriate backup procedures
- 2 marks for discussing how often data should be transferred and how
- 2 marks for discussing and justifying when to delete data from the drone

Question 9

Sample response

The most appropriate data structure would be a one-dimensional array of a single data type – namely, integers.

Mark allocation: 2 marks

- 1 mark for stating an array
- 1 mark for a justification related to the data types being stored

Question 10

Sample response

As this question requires pseudocode to be written, there are many acceptable solutions. Use the descriptors in the marking allocation guide to determine correctness of the algorithm.

```
Begin
     Input ScanRange

     R ← ScanRange[0]
     G ← ScanRange[1]
     B ← ScanRange[2]

     If G < 61 And B < 61 Then
          If R > 180 Then
               Return "Over-ripe"
          Else If R > 129 Then
               Return "Ripe"
          Else
               Return "Not Ripe"
     Else
          Return "Not Fruit"
End
```

Mark allocation: 8 marks

- 1 mark for checking green values for fruit and not fruit
- 1 mark for checking blue values for fruit and not fruit
- 1 mark for checking red values for ripe fruit
- 1 mark for checking red values for over-ripe fruit
- 1 mark for checking red values for not ripe fruit
- 1 mark for correct return statements in all places (exact wording)
- 1 mark for correct boundary values
- 1 mark for all elements correct in the pseudocode

Question 11

Sample response

The company could ask Mark himself to be a useability tester, as he is the main stakeholder of the program and this system has been built specifically for him. Mark could be asked to use the application on the tablet to see how quickly he can manage drones in multiple orchards. He would be observed while doing this, and then asked a set of questions after he completes the test to see how easy he found the system.

Mark allocation: 3 marks

- 1 mark for an appropriate selection of a user to complete the test
- 1 mark for an appropriate set of tests for the user to complete
- 1 mark for discussing a method of collecting the useability test data

Question 12a.

Sample response

Using the data from the Bureau of Meteorology (BoM) would allow Mark to better schedule the drones to maximise picking times. For example, if the amount of fruit picked was low on days that the BoM predicted high winds, Mark could, in the future, choose not to use the expensive equipment on days with predictions of high winds and employ manual labour instead.

Mark allocation: 3 marks

- 2 marks for discussing how Mark could effectively use the data
- 1 mark for a relevant example in relation to the data collected (e.g. specific reference to comparing fruit amounts or averages across similar-weather days)

Question 12b.

Sample response

While Mark will benefit from using BoM data, his goal is dependent on the integrity of the data received. For example, if the data is not accurate, the correlation prediction would be worthless. He would also need to receive timely predictions of the weather – in this case, receiving it at the latest possible time is better than getting the data early, as weather predictions tend to be less accurate if the prediction is for too far in the future.

In this instance, authenticity is likely not a concern, as the BoM is a trusted source. Similarly, reasonableness is not likely relevant in this case, as it is unlikely that the BoM would predict wildly inaccurate or improbable weather conditions.

Mark allocation: 3 marks

- 1 mark for discussing accuracy
- 1 mark for discussing timeliness
- 1 mark for a well-explained discussion as to why accuracy and timeliness are relevant in this context

Tip

- *Always look at the number of marks when answering questions. As this is a 3-mark question, it is unlikely that only one element of data integrity would be enough to obtain full marks.*

Question 13

Sample response

Mark should consider the *Copyright Act* to determine the owner of the code – whether it is Mark himself, or the development company that wrote the code for him. If Mark does not own the code, he cannot give Harry permission to modify it, as he does not hold the copyright over it. Mark should also consider the security threats that may exist to his business and the data on the drones. Harry could be a direct competitor and agreeing to Harry's proposal may in fact be a deliberate threat to Mark's business. If he agrees, he should make sure that no data on the drones could be used to damage his business. Considering that the drones can also shoot lasers, Mark should also be concerned that Harry is evasive.

Mark allocation: 4 marks

- 2 marks for addressing the legal concern in relation to the *Copyright Act*
- 2 marks for addressing an appropriate security concern, such as data being stolen

END OF SAMPLE RESPONSES