



**Computer Science
Higher Level
Paper 1 Mock Exam**

Dec 2017

2 hours 10 minutes Duration

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer all questions.
- The maximum mark for this examination paper is **[100 marks]**.

6 pages



Section A

Answer **all** questions.

1. Outline two different types of testing. [2]
Black Box – means testing by running the program, without reading code
White Box – means reading the code and trying things out in your head or on paper
2. Identify **two** common causes of data loss. [2]
User errors – like pressing the wrong button by accident and deleting files
Intentional destruction – like hackers deleting files on purpose
3. Identify **two** reasons for releasing a software update. [2]
To fix bugs that were discovered after the software was released
To improve the software to meet new needs, like new protocols
4. Explain how cache memory can speed up the processing within a computer. [2]
Cache memory is a small amount of very fast memory (faster than RAM) that temporarily stores copies of often used data, like the code in a loop that is being repeat.
Through cache, it is not necessary to repeatedly load the commands from RAM
5. One of the functions of an operating system is memory management. Describe how this function prevents the system from crashing when more than one program is run at the same time. [2]
When a program begins executing, a copy must be loaded from the hard-disk. It must be copied into RAM memory. This means the OS must find empty RAM space that is not already being used by other programs. Without this function, either the machine would be limited to running a single program, or new programs would be randomly loaded into space that might already be occupied, causing occasional crashes.
6. Explain the importance of complying with the OSI standard networking model. [2]
Since almost all networked devices comply with the OSU model, it is possible to replace modules with assurance that the new modules (and old system) will work correctly. Without standards, every manufacturer would do what they find convenient or cheap, resulting in incompatibilities.
7. Outline one advantage and one disadvantage of **data compression**. [4]
Advantage – compression makes file smaller so they download more quickly
Disadvantage – the resulting files must be decompressed (unpacked) before they an be used. This requires specific software to be installed. It also takes extra time for the unpacking.
8. Explain how the use of media access control (MAC) addresses can improve security. [2]
Every networked device has a unique MAC ID. In a LAN, it is possible to limite access to only specific devices that have been authorized.
9. Identify two advantages of using a Linked-List rather than using an array. [3]
Dynamic – a Linked-List can be expanded to become longer and longer as needed, whereas an array has a fixed size
Flexible Pointers – new nodes can be inserted by changing a few pointers, without the need to move any data. This is generally faster than inserting in an array, where old data must be moved out of the way before inserting.
10. Outline one difference between storing data in a binary tree as opposed to storing it in a linear data structure. [2]
A binary tree contains branches, where one node points to 2 children. In a linear structure, like an array or Linked-List, each item has just one item following it.
11. Identify **two** features of an autonomous agent acting within a larger system. [2]
An autonomous agent functions automatically, without direct control from a computer system. It collects data or produces results that are stored for future use by another program

Section B

Answer **all** questions.

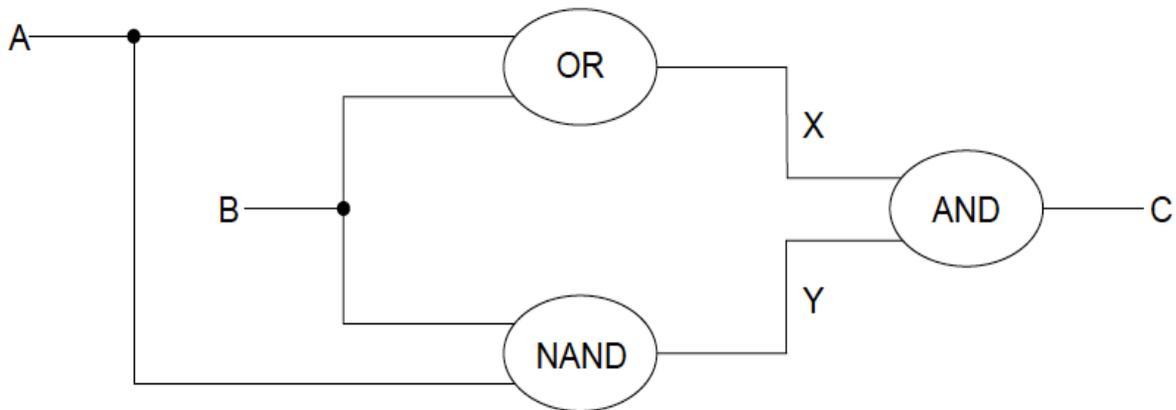
12. A large company has taken over another business. This takeover has required various changes to be made. One of the changes requires data migration.

(a) (i) Define the term **data migration**. [1]
Data migration means copying data from on system into a different system, usually a new system that is replacing an old one.

(ii) Describe **two** problems, concerning **data migration**, which the company may have to overcome. [4]
*(1) incompatibility, caused by different data formats in the two systems
For example, the old system might use .docx files, while the new system uses a different word-processing format. This might cause some features, like formatting, to function differently or not at all.
(2) dynamic data – it may be difficult to make a “snapshot” of the current data, as it is constantly changing. Hence, the entire system must be shut down while data is being migrated.*

(b) Other than data migration, describe **two** aspects of change management that may arise from this takeover. [4]
*(1) user training – since new software usually functions differently from old software, the users in one company (or both) must be trained to function appropriately to maintain compatibility with the other company
(2) languages and date formats (and other data formats) may be different in the two companies*

The company produces industrial chemicals. One of the chemical processes is represented by the following logic diagram, where A and B are input signals and C is an output signal.



- (c) (i) Construct the truth table corresponding to this diagram. [3]

A	B	A or B = X	A nand B = Y	X and Y
0	0	0	1	0
0	1	1	1	1
1	0	1	1	1
1	1	1	0	0

- (ii) Identify the single logic gate that is equivalent to this diagram. [1]

A xor B

- (d) Outline how truth tables can be used to test that any two logic diagrams are equivalent. [2]

Create a truth table for each circuit. If they are equivalent, the last column of each table will be the same sequence of 0's and 1's.

13. (a) Copy the table below and use it to trace the following algorithm, where DATA is a Collection, and **B** and **C** are also collections. All 3 collections are initially empty.

```

DATA.addItem(2)
DATA.addItem(4)
DATA.addItem(-1)
DATA.addItem(3)

DATA.resetNext()
loop while DATA.hasNext()
  A = DATA.getNext()
  if A >= 0 then
    if A mod 2 = 0 then
      B.addItem(A)
    else
      C.addItem(A)
    end if
  end if
end loop
    
```

[4 marks]

DATA = 2, 4, -1, 3

DATA.hasNext() ?	A	A >= 0.	A mod 2 = 0 ?	Contents of B.	Contents of C
True	2	true	true	2	empty
True	4	true	true	2, 4	empty
True	-1	false		2, 4	empty
True	3	true	false	2, 4	

- (b) In Pseudocode, write an algorithm that calculates the average of the numbers in the DATA collection - it must also function for different values in DATA. [4]

```

SUM = 0
COUNT = 0
DATA.resetNext()

loop while DATA.hasNext()
  VAL = DATA.getNext()
  SUM = SUM + VAL
  COUNT = COUNT + 1
end loop
AVERAGE = SUM / COUNT
    
```

- (c) An Array called NUMBERS is to be searched to see if it contains a specified value. In Pseudocode, write a linear search algorithm that inputs a value to be searched for, searches through the NUMBERS array, and outputs either "Found" or "Not Found". [4]

```

FOUND = false
loop POS from 0 to MAX. // MAX is the size of the array
  if NUMBERS[POS]. then
    FOUND = true
  end if
end loop
if FOUND = false then
  output "Not Found"
else
  output "Found"
end if
    
```

- (d) A binary search could be performed on a sorted array NUMBERS that contains decimal values. Explain why the binary search will be considerably faster than a linear search. [3]

The BINARY SEARCH will start looking in the middle of the list.

If that is the target number, the search can stop.

*If the target number is smaller than the middle number,
the search will repeat using only the first half of the list*

Otherwise the search continues using the second half of the list.

This means the number of iterations is $\log(N)$, which is considerable fewer iterations than $N/2$, which is the average number of iterations for a linear search.

14.

A small business, TSPORT, sells T-shirts at sports events. They order their shirts from a foreign country and ship them in large quantities to their central warehouse in France. From the warehouse, shirts are distributed to employees in many different cities in a variety of countries, where the local employees sell them at local sports events. A typical city office has 5-10 employees, working in a small office with a small warehouse nearby. TSPORT has a central office with 50 employees who manage the entire company.

- (a) Describe 2 purposes for TSPORT to use a WLAN. [3]
The local offices can use use a WLAN to coordinate the work of the 5-10 employees, for example sharing their appointment calendars.
The central warehouse can use a WLAN to distribute work assignments and to collect data from the employees, like stock levels in the warehouse.

 - (b) Outline why a LAN might be used by some TSPORT employees. [2]
Assuming "LAN" refers to a wired LAN, employees might use it instead of WLAN to achieve a higher level of security. But they can only use it inside the buildings, not in an area like a sport stadium.

 - (c) Explain why standard protocols are important for the TSPORT networks. [2]
TSPORT probably wants to transfer data over a WLAN between the local offices and the central warehouse, for example ordering quantities of t-shirts or reporting sales data. Since the data will travel through the Internet, or through a VLAN, it must use standard protocols to function correctly with Internet routers.

 - (d) Describe 2 different computer platforms that are needed for different tasks in the organization. [3]
In the central warehouse, there are probably desktop computers used by office workers.
In the local offices the workers are likely to use cell phones or other mobile devices when they are working in the sport stadiums.

 - (e) Assume that TSPORT decides to create and use a new database system.
 - (i) Outline 2 methods for collecting user needs at the beginning of the project. [3]
Developers might use surveys to collect data from all the employees, such as common problems with the current system.
They might also conduct personal interviews, especially with manages to collect specific requests for improvements.

 - (ii) Explain the important role of prototypes in the development process. [2]
A Visual Prototype can be used to make initial plans for the overall system.
A functional prototype can be used to track specific problems that may develop when using the system.
In both cases, the prototypes support useful discussions between the developers and the potential users.
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15. A laptop computer supplements its primary memory by making use of **virtual memory**.

(a) Outline how **virtual memory** functions.

[2]

Virtual Memory refers to the OS using hard-drive storage to simulate actual RAM memory. Whenever the RAM is full, and the OS is asked to load a new program, then it finds a task (program) that is not doing very much, preferably idle. The OS “swaps” that program to the hard-disk (temporarily), making its allocated RAM space free. Then the OS can load the new program into that space. Later, when the old idle program is needed again, the OS swaps a different program to disk and loads the old idle program into the new free memory. This only makes sense in a multi-tasking OS.

The laptop has 1GB of random access memory (RAM) and a single processor. The laptop is using one of the latest operating systems to run multimedia gaming programs.

(b) Explain the limitations and consequences of using the laptop for this purpose. *1 GB of RAM is not very much, especially for running a video game, which has many graphics images, and possibly sound and video, that need to be available in RAM.*

[3]

One of the laptop’s game applications stores the data relating to the different actions of one of its characters in a **stack**.

(c) Suggest **one** reason why the character’s actions might be stored in a **stack**. *It’s possible that an action or actions must be reversed, and a stack is ideal for storing actions and then undoing them in reverse order, because the stack is a Last-In-First-Out structure.*

[2]

Sometimes during the game data is read from the stack (STACK) into a queue (QUEUE).

(d) Using appropriate access methods for stacks and queues, construct Pseudocode that reads the data from STACK and enters it into QUEUE. You should assume that the STACK and QUEUE already exist and STACK contains data.

[6]

```
loop while not STACK.isEmpty()  
    INFO = STACK.pop()  
    QUEUE.enqueue(INFO)  
end loop
```

(e) Outline **one** advantage of using a CIRCULAR queue rather than a simple linear queue.

[2]

In a circular queue, it is possible to keep searching forward and then loop around at the end and continue. This is a good structure for some applications, like a keyboard buffer.

16.

A candy company is designing a new **automated vending machine**, where customers can buy candy. These machines will be available in airports, shopping malls, on street corners, etc.

The goal is to make the machines work without using cash. They intend to create a system so that customers can pay by using their mobile phone. They will place a call to a phone number printed on the front of the machine and place their order. Then the candy will slide out of a slot in the machine. The candy company will collect money from the customer's telephone account.

The vending machines should be further automated. By using facial recognition technology, the vending machine will display advertisements chosen according to gender and age. For example, the machine might advertise chewing gum for girls, chocolate for boys, mints for men, etc.

The advertising choices will be based on the items that have actually been purchased by customers in the past. A large database will collect data on all the transactions over a long period of time, and analyse popularity according to age and gender. For this to be useful, the vending machines must have a permanent connection to the central database.

(a) Describe a type of **sensor** that could be used to activate the advertising screen whenever a pedestrian comes close to the machine. [2]

A motion sensor, like those used to activate lights in front of a house. But this should be tuned to only react on close approach, like less than a meter.

(b) Explain the purpose of one type of **actuator** in the candy machine. [2]
An actuator outputs a signal to activate a motor. In the candy machine, a motor is used to cause candy to drop out of the machine into a slot where the customer can pick it up.

(c) The **processing** for the facial recognition could be performed directly inside the vending machine, or it could be performed by a central computer. Describe **one advantage** and **one disadvantage** of using a central computer for doing the facial recognition processing. [4]

Disadvantage – to use a central computer, the candy machine requires a connection, probably a telephone line. If the connection is interrupted, then the facial recognition function must shut down.

Advantage – facial recognition is a processing intensive task. If a server is used, then all the facial recognition processing can be done in the server, so the candy machines do not require a large and expensive computing device to be installed

(d) Assuming that the facial recognition is performed by a central computer, outline **three other needs** for **three different microprocessors** in the vending machine. [3]

1 – a processor must be used to control and manage the communication with the server

2 – a processor must control the reaction to the sensors when a person approaches

3 – a processor must issue control signals to activate the motors to dispense a product

(e) The vending machine might require a **secondary storage device**.

Explain how the vending machine could display graphical advertisements if it does NOT contain a secondary storage device.

[2]

Advertisements are probably stored as videos in the secondary storage device – e.g. a disk drive. Since the advertisements are “targeted”, there should be a relatively large collection of ads for a variety of customers and a variety of ad products. But these videos could also be stored in and retrieved from a central server.

(f) Explain why there is probably no need to implement Virtual Memory Management in this vending machine.

[2]

Virtual memory is implemented in a multi-tasking OS, but the candy machine is probably not going to run lots of different tasks. Even if it does run multiple tasks, the machine should be designed with enough RAM to load all the necessary tasks at once – there is probably no reason to start a new task, since the functions of the candy machine are straight-forward and predicatable.