



# ClearRevise Exam tutor and practice papers

# OCR A Level **Computer Science**

H446

Complete exam walk through

# Clear**Revise**® OCR A Level Computer Science H446

Exam tutor and practice

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# COURSE OVERVIEW

### Paper 1: Computer Systems

Covered in this book 140 marks 2 hrs 30 mins Written paper **40%** 

# Paper 2: Algorithms and Programming

Covered in this book 140 marks 2 hrs 30 mins Written paper **40%** 

## **NEA: Algorithms and Programming**

Covered in the book "Tackling A Level Projects in Computer Science OCR H446" Ceredig Cattanach-Chell ISBN: 978-1-910523-19-3

70 marks Non-exam assessment **20%** 



 $\checkmark$ 

# WHAT MAKES THIS GUIDE SPECIAL?

# This guide is your personal exam tutor. It offers you a complete walk-through of the specification and related questions in a convenient format.

The best way to ace an exam is to practise... but that doesn't mean just endlessly doing past exam papers.

Imagine you were going to run a 100-metre race. If you really wanted to win it, you'd need a coach. They would analyse how you run and give you advice and lots of little improvements that you could make to win. Of course, you'd do some practice runs, but without coaching, you would have little idea how to improve.



# Section 2

Exam	
paper	:

#### Complete a full set of practice exams

Now is your chance to have a go at real papers. You need to attempt 140 marks in 150 minutes (2 hrs 30 mins), so allow yourself around 1 mark per minute, plus 10 minutes at the end for finding and correcting those silly mistakes we all tend to make.

There are two papers for this course - Paper 1 and Paper 2. When you take these papers, make sure you have a clear desk, turn off your phone and find somewhere quiet. Give yourself the same amount of time as a real exam. We suggest leaving at least a few hours, if not days, between sitting each paper so that you can give your brain a rest and recharge your batteries.

Once you've completed each paper, the answers are in the back of the book for you to mark yourself. Good luck!

# [1] √

Mark your work using the mark scheme provided at the bottom of each page.

By the end of Section A, you will have gone through lots of model answers and had a go at questions on every topic in the entire specification.

If you still feel that a topic needs more work, just use the smile icons ③ or make a note on the page so that you can look up the topic later or ask your teacher for help.

# THE SCIENCE OF REVISION

#### 'Low stakes' examination practice

Practising past examination questions is a powerful way to revise and improve your understanding of the subject. Mark schemes and professional guidance provide valuable information too. Without the added pressure of the big day and the stressful atmosphere that an exam hall may create, studying all of this in a calm atmosphere where the results don't matter to anyone but yourself, creates the most effective environment for the retrieval of information.

#### **Retrieval of information**

Retrieval practice encourages students to come up with answers to questions.<sup>1</sup> The closer the question is to one you might see in a real examination, the better. Also, the closer the environment in which a student revises is to the 'examination environment', the better. Research shows that students who had a test 2–7 days away did 30% better using retrieval practice than students who simply read, or repeatedly reread material. Students who were expected to teach the content to someone else after their revision period did better still.<sup>2</sup> What was found to be most interesting in other studies is that students using retrieval methods and testing for revision were also more resilient to the introduction of stress.<sup>3</sup>

#### Feedback and note-taking

The tips and advice included with each model answer constructively focus purely on how to get more out of each question or type of question. Every topic shows model questions and answers, along with advice from experienced teachers and opportunities for students to try further similar questions. Answers and tips are displayed on the same page allowing for immediate feedback.<sup>4</sup> There is space for notes – use this if you need to. Making summarised points at the end of a revision session is the most effective way to use notes.<sup>4</sup>

#### Ebbinghaus' forgetting curve and spaced learning

Ebbinghaus' 140-year-old study examined the rate in which we forget things over time. The findings still hold true. However, the act of forgetting things and relearning them is what cements things into the brain.<sup>5</sup> Spacing out revision is more effective than cramming – we know that, but students should also know that the space between revisiting material should vary depending on how far away the examination is. A cyclical approach is required. An examination 12 months away necessitates revisiting covered material about once a month. A test in 30 days should have topics revisited every 3 days – intervals of roughly a tenth of the time available.<sup>6</sup>

#### Summary

Students: the more tests and past questions you do, in an environment as close to examination conditions as possible, the better you are likely to perform on the day. If you prefer to listen to music while you revise, tunes without lyrics will be far less detrimental to your memory and retention. Silence is most effective.<sup>5</sup> If you choose to study with friends, choose carefully – effort is contagious.<sup>7</sup>

- 1. Roediger III, H. L., & Karpicke, J.D. (2006). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science*, 17(3), 249–255.
- Nestojko, J., Bui, D., Kornell, N. & Bjork, E. (2014). Expecting to teach enhances learning and organisation of knowledge in free recall of text passages. Memory and Cognition, 42(7), 1038–1048.
- Smith, A. M., Floerke, V. A., & Thomas, A. K. (2016) Retrieval practice protects memory against acute stress. Science, 354(6315), 1046–1048.
- 4. Kluger, A & DeNisi, A. (1996). The effects of feedback interventions on performance. Psychological bulletin, 119(2), 254–284.
- 5. Perham, N., & Currie, H. (2014). Does listening to preferred music improve comprehension performance? Applied Cognitive Psychology, 28(2), 279–284.

6. Cepeda, N. J., Vul, E., Rohrer, D., Wixted, J. T. & Pashler, H. (2008). Spacing effects in learning a temporal ridgeline of optimal retention. *Psychological Science*, 19(11), 1095–1102.

7. Busch, B. & Watson, E. (2019), The Science of Learning, 1st ed. Routledge.

# HOW TO FIX MISTAKES IN YOUR EXAM

We all make mistakes, and the chances are that you'll make one or two in the exam.

If you realise that you've made a mistake in an answer, it's no problem.

Cross the answer out so that it is obvious that it's a mistake.

#### Example 1 – Put a line through the incorrect answer:

(c) Andy wants to get some photos printed in a shop.Explain a suitable storage device or media he could use to transfer the files from home to the shop.

[2]

[2]

He should use a magnetic tape because it has a low cost per megabyte.

He should use a solid-state SD card because it is highly portable.

#### Example 2 – Put a line through each incorrect word.

(c) Andy wants to get some photos printed in a shop.
 Explain a suitable storage device or media he could use to transfer the files from home to the shop.

He should use a magnetic tape because solid-state SD card because it is highly portable.

### Example 3 – Put a cross through a section of writing.

(a) Discuss the impact of replacing checkouts with self-service tills. Consider the impact on customers.

Shop assistants will be able to deal with many customers at a time. This will make them more efficient.

The job may also be more stimulating. However, fewer shop assistants will be required which will likely

result in people losing their jobs.

Customers who are shy or like to listen to music whilst shopping may prefer self-service tills where

human interaction is minimal. Some customers may find that they are able to process their items

#### But DON'T scrub out answers:

(C)	Andy wants to get some photos printed in a shop. Explain a suitable storage device or media he could use to transfer the files fro	m home to the shop.
2		Exam tip
		If you cross out an answer but don't write anything else, the examiner is allowed to mark it.
		But they can't mark it if they can't read it because you scrubbed it out.

# PAPER 1 COMPUTER SYSTEMS (H446/01)

# Information about Paper 1

Written exam: 2 hour and 30 minutes 40% of the A Level 140 marks

All questions are mandatory.

You will need: A black pen (and some spares)

You cannot use: A calculator



Taper 1 Computer Systems	
1.1.1 BUSES Start on the left hand page 1.1.1 Structure and function of the processor (a) Buses: data, add	D Left pages contain example questions with model answers. The answers will get full marks. Iress and control
The specification points covered in the topic are given here. Make sure you understand them all before you attempt the questions on the right.	Do you romombor?
<ul> <li>The diagram below shows how buses interact with other hardware components of a computer system.</li> <li>CPU Memory Input and Output</li> </ul>	What are the three buses that computer systems have?
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Address bus Data bus Control Bus
Control Bus	Exam tip
(a) Identify the <b>two</b> buses, Bus #1 and Bus #2, in the diagram above. Bus #1: Data bus	answer from a number of possibilities. They require short answers.
Bus #2: Address bus	[2]
(b) <b>Describe</b> how buses are used when the CPU reads data from an address in <i>The CPU puts the address onto the address bus. The control bus is then</i> and set waiting for data. The PAM then puts the data onto the data bus and set	n RAM. set to show that the CPU is
The CPU bus is then able to read the data from the data bus.	[ <b>4</b> ]

# Exam tip

Compute

Donor 1

Describe questions require a detailed account of a situation, event, pattern or process.

#### More info

Buses are used to communicate data between the internal components of computer systems.

Bus	Purpose
Data bus	Sending and receiving data between components. Data flows between components.
Control bus	Coordinates activity between components. Prevents two components from using the data bus at the same time (causing data collisions).
Address bus	The address in RAM that the CPU is trying to read or write data from.



Look at the right-hand page and have a go at some exam style questions on the same topic. The questions below are worth five marks, so you should be able to finish them in five minutes.

Write your mark here

2 The diagram below shows three buses in a computer system.



- (a) Identify the bus labelled Bus #1.
- (b) One input device is a keyboard. When a key is pressed, a binary representation of a letter needs to be sent to the CPU. Identify the bus that this binary representation is placed onto.
  - ......[1]

.....[1]

(c) Describe how buses are used when the CPU writes data to an address in RAM.



Are you confident? Fill in one of the faces to show whether you feel you did well in the topic or if it needs more revision.

Total / 5

- Answers
- 2 (a) Control bus<sup>[1]</sup>.
  - (b) Data bus<sup>[1]</sup>.
  - (c) The CPU puts the data onto the data bus,<sup>[1]</sup> and the address the data will be stored onto the address bus<sup>[1]</sup>. It then sets the control bus to show that data is waiting to be written to RAM<sup>[1]</sup>. The memory controller reads the data from the data bus<sup>[1]</sup> and writes/stores it in the correct address in RAM<sup>[1]</sup>.

1.3.1

# LOSSY AND LOSSLESS COMPRESSION, RUN LENGTH ENCODING AND DICTIONARY CODING

**1.3.1 Compression, Encryption and Hashing** (a) Lossy vs Lossless compression, (b) Run length encoding and dictionary coding for lossless compression.

1 The individual items purchased at a supermarket are categorised as follows:

F	Н	С	Т	G
Food	Household	Clothing	Toys	Garden

A text file holds a record of each customer purchase.

The following is an extract from this file: FFFFFFHHFFFFCHHFFFFTTFFFHH....

(a) Explain why a lossy compression technique should not be applied to this data.

In a text file all of the data is necessary. Lossy compression

techniques permanently remove unnecessary data.

As there is no unnecessary data in a text file, lossy

compression would not be appropriate.

#### Do you remember?

**Compression** is a technique used to reduce the size of a file. This will result in less storage space being required to save the file or less data needing to be transferred if the file is to be transmitted. Compression may be **lossy** or **lossless**.

What do the terms lossy and lossless compression mean?

**Lossy** compression techniques permanently remove unnecessary data from files. This can result in smaller file sizes, but at the cost of a loss of quality.

**Lossless** compression has no loss of data and enables a complete reconstruction of the original file.

(b) Explain, using the example extract of data, how run length encoding could be used to compress the file.

For run length encoding, consecutive instances of the same character are replaced by a single instance

[2]

of the character and a count of how often that character occurred consecutively. The data extract shown

could be stored as 7F2H4F1C2H4F2T3F2H.

#### More info

The following methods are lossless methods to compress data.

Run length encoding (RLE) is a lossless compression technique. Occurrences of repeated data are stored.

For example, below is an extract from an image showing the individual pixels.



The original format for storing the data of this image could be RRRYYYYBBBBYYYBBBRRRYY. Run length encoding would recognise the repeat pixels within this and could record the pattern as 3R4Y4B3Y3B3R2Y. This would reduce the amount of data required to store the file. Note that R3Y4B4... would also be acceptable.

**Dictionary-based compression** is another lossless technique where commonly used character sequences are stored and a pointer is used to represent these in the file rather than storing all the characters individually.

For example, if we consider the phrase "It was a big crocodile - a very big - very hungry crocodile", rather than store the data for each character separately, a value can be assigned to common words. This could then be rewritten as 1234583648675. The binary representation to point to each word would be considerably shorter that the binary needed for each individual character in the word. Remember, the dictionary will need to also be stored in the file and this will require some additional space.

1	lt
2	_was
3	_a
4	_big
5	_crocodile
6	_very
7	_hungry
8	

[2]

<b>2</b> An	nedical research company has sequenced a section of DNA as follows: GGGCCCCTTTCCCCAAAA	Write your mark here
(a)	Show how the DNA sequence could be compressed using run length encoding (RLE).	
(b)	Explain why the company would want to use lossless compression rather than lossy compression.	
(C)	The research company needs to store large sequences of DNA. State <b>one</b> advantage and <b>one</b> disadvantage of the sequences being compressed.	
	Advantage:	
	Disadvantage:	
(d)	The company has photos of their laboratories on their website. Give <b>one</b> reason why it would be appropriate to use a lossy compression on these photos.	
	[1]	Total

- 2 (a) 3G4C3T4C4A <sup>[1]</sup> This is a show question. Show questions ask for the steps in a derivation or calculation. In this case, the steps are obvious, so only one mark is awarded for the answer.
  (b) The company needs the sequence to be exactly the same after compression and decompression has occurred<sup>[1]</sup> as any change to the sequence could cause significant problems for their research (as a change of even one letter may change the properties of the DNA).<sup>[1]</sup>
  (c) Advantages: Less storage/hard drive space will be required to store the sequences.<sup>[1]</sup> When sharing the sequences across a network/the Internet, transmission will take less time.<sup>[1]</sup> Disadvantages: It will take time to compress and decompress the data.<sup>[1]</sup> Anyone needing to read or write the data, will need to have a compression tool installed.<sup>[1]</sup>
  - (d) If unnecessary data is removed (for instance, colours may not perfectly match the original), this is unlikely to be noticed by the end user<sup>[1]</sup>. The images/photos will download more quickly.<sup>[1]</sup>

# 1.4.2 TREES AND BINARY SEARCH TREES

**1.4.2 Data Structures** (b) The following structures to store data: tree and binary search tree, (c) How to create, traverse, add data to and remove data from the data structures mentioned above. (*NB this can be either using arrays and procedural programming or an object-oriented approach*).



A tree is shown below.	E H J F
(a) Describe the steps taken to determine if t	he letter D is in the binary search tree.
	[3]
(b) Describe the steps taken to determine if t	he letter G is in the binary search tree.

Write	your
mark	here

[3]

Total / 10  $\odot$  $\odot$ 

#### Answers

3

3 (a) C < E, so go left<sup>[1]</sup>, D > C, so go right<sup>[1]</sup>, D is found<sup>[1]</sup>.

(c) Describe the steps taken to delete node H from the tree.

(b) G > E, so go right<sup>[1]</sup>, G < I, so go left<sup>[1]</sup>, G < H, so go left<sup>[1]</sup>, G > F, but no right child node, so G is not in tree<sup>[1]</sup>.

[4]

(c) Search for node  $H^{[1]}$ , node F left pointer changed to point to node I  $^{[1]}$ , delete node  $H^{[1]}$ .

# 1.5.2 MORAL AND ETHICAL ISSUES

**1.5.2 Moral and ethical issues** The individual moral, social, ethical and cultural opportunities and risks of digital technology.

A medical centre has decided to upload all patient records to a university database in order to analyse the data for research purposes.
 Patients have not been informed of this use of their medical records but will be permitted to decline their records being uploaded if they write to the medical centre.

Discuss whether or not you agree with this use of personal information showing you have considered both points of view.

#### Exam tip

The discussion requires you to state if you agree with use of data in the given context. The examiner won't mind if you agree or disagree, but your decision needs to be based on the discussion you have written.

The university will benefit from uploading the data as they will be
able to analyse it as part of their research. This could lead to new therapies or drugs being developed
that would be able to help patients and society. The use of a large dataset allows the university to use
advanced artificial intelligence techniques, such as deep learning, to establish patterns in the data.
Deep learning needs more data points than machine learning would. By not asking the patients for
permission to upload the data, a much larger number of records will be made available.
Despite all the advantages, there are a number of factors that need to be considered.
Firstly, many patients will consider their medical data to be theirs and not for sharing.
For example, the data may contain highly personal information such as a patients sexual health
or history. The data is classified as 'special category' data which has more protection due to its
sensitivity. If personal details such as name and address are provided with the data, it would not be
allowed to be shared under the Data Protection Act. Whilst the act normally expects consent before
data can be used, 'vital interests' is another basis for sharing data. This avoids the need for consent,
however, this is not the case for 'special category' data. Patients therefore would have a right to consent
to the use of their data. Equally, from a moral and legal point of view, they should be informed of how
their data will be used, which doesn't appear to be happening in this case. The Data Protection Act has
significant penalties for breaches. These are up to £17.5 million or 4% of annual turnover. For a single
medical centre, this would be enough to bankrupt them.
The data should be anonymised where possible, patients should be informed and patients should

consent and opt-in to this use of their data. Given that none of these seem to be planned, I do not agree with this use of personal information. [9]

#### Exam tip

The above answer is an example of an answer that would achieve high marks. It shows an advanced level of knowledge which can be incorporated. However, don't worry if you don't know all these points, you could use other points to get the marks.

#### Try this...

The following features have been used to get high marks for this question. Highlight or circle sentences or sections in the answer above to identify at least one example of each of the following features:

- Clear application of knowledge to the context
- Thorough knowledge and understanding
- Evidence/examples explicitly relevant
- Use of examples or evidence
- A logically structured line of reasoning
- A statement of agreement or disagreement with this use of personal information

	The university will benefit from uploading the data as they will be able to analyse it as part of their	<ul> <li>Clear application of knowledge to the context.</li> </ul>
efits	patients and society. The use of a large dataset allows the university to use advanced artificial	Thorough knowledge.
Ben	intelligence techniques, such as deep learning, to establish patterns in the data. Deep learning needs	
	more data points than machine learning would. By not asking the patients for permission to upload the	Evidence/examples explicitly relevant.
	data a much larger number of records will be made available	
		Clear application
		of knowledge to
		the context
	Despite all the advantages, there are a number of factors that need to be considered. Firstly, many	This is a striking
	a stranta will serve i day the since a live I day to be the size and wet free allowing Free server 10 the state	avample and evolicitly
	patients will consider their medical data to be theirs and not for sharing. For example, the data may	
		relevant to a moral
	contain highly personal information such as a patients sexual health or history. The data is	concern.
S	classified as 'special category' data which has more protection due to its sensitivity. If personal details	This goes into more
9		detail than is expected,
÷	such as name and address are provided with the data, it would not be allowed to be shared under the $^{\circ}$	but demonstrates a very
a		thorough knowledge of
e e	Data Protection Act. Whilst the act normally expects consent before data can be used 'vital interests' is	the Data Protection Act
2	,	and its application to
S	another basis for sharing data. This avoids the need for consent bounder this is not the case for special	this case
ξI	$\frac{1}{1}$	this case.
0	catagone data Datignts therefore would have a vight to concept to the use of their data Equally from a	
Ĕ.	calegory adia. Fallents therefore voodia have a right to consent to the use of their data. Equality, from a	Clear application of
8		knowledge to the
$\mathbf{\tilde{\mathbf{v}}}$	moral and legal point of view, they should be informed of how their data will be used, which doesn't	context.
	appear to be happening in this case. The Data Protection Act has significant penalties for breaches. These	Thorough knowledge.
	are up to £17.5 million or 4% of annual turnover. For a single medical centre, this would be enough to •	Clear application of
		knowledge to the
	bankrupt them.	context
		context.
		Cummon ( of the line of
	The data should be anonymized where possible patients should be informed and patients should consent	Summary of the line of
2	רוב ממומ לוטמונים של מוטרוקרווזבט וערוברב בישטוב, במווברוז לוטמומ של וווטררובט מרום במוטרול לווטרוז לא מרובר בי מיני בישטוב בישטוב בישטוביים בישטוביים בישטוביים בישטוביים בישטוביים בישטוביים בישטוביים בישטוביים בישטוביים בי	reasoning presented.
.e		
	ana opt-in to this use of their aata. Given that none of these seem to be planned, <mark>I do not agree with this p</mark>	It doesn't matter if you
6		agree or don't agree.
	use of personal information. [9]	What is important is that
		your choice follows
		from the reasoning in
		your discussion.

# Logically structured line of reasoning

#### Do you remember?

You need to be aware of moral, social, cultural and ethical issues surrounding the following areas:

- Computers in the workforce
- Automated decision making •
- Artificial intelligence •
- Environmental effects
- Censorship and the Internet •

- Monitoring behaviour
- Analysis of personal information •
- Piracy and offensive communications
- Layout, colour paradigms and character sets

Think of a context for each area then make a mind map for each one that covers 'key computer science aspects', the advantages and the disadvantages and risks and opportunities of digital technology.

# PAPER 2 ALGORITHMS AND PROGRAMMING (H446/02)

# **Information about Paper 2**

Written exam: 2 hour and 30 minutes 140 marks 40% of the A Level

All questions are mandatory.

You will need: A black pen (and some spares)

You **can** use: A ruler (cm/mm) An HB pencil

You cannot use: A calculator



2.1.3 2.1.4

# PROCEDURAL AND LOGICAL THINKING

2.1.3 Thinking procedurally (a) Identify the components of a problem, (b) Identify the components of a solution to a problem, (c) Determine the order of the steps needed to solve a problem, (d) Identify sub-procedures necessary to solve a problem.

2.1.4 Thinking logically (a) a) Identify the points in a solution where a decision has to be taken,(b) Determine the logical conditions that affect the outcome of a decision, Determine how decisions affect flow through a program.

1 An app is made for a children's game. The player has to place the rings in order onto a pole with largest ring at the bottom to complete the game.



Fig. 1

(a) One sub-procedure that will be necessary in the game is a function addRing() which will add a ring if those beneath are larger. Identify **two** other sub-procedures that would be necessary for the game in Fig. 1.

removeRing() – removes the top most ring.	
ringComplete() – returns True if all rings are added correctly.	2]

(b) The pole has been implemented with an array of type integer. Each ring is represented by an integer. If a position in the array is empty, the number 0 will be used.

A function **addRing(pole, number)** adds a ring of size **number** to an array named **pole** if the ring is smaller than those below it. The pole is then returned from the function.

Write pseudocode to show the steps needed for the function addRing.

#### function addRing(pole, number)

top = 3	Do you remember?	
if pole[0] == 0 then	Notice how the following have	ć
pole[0] = number	been used:	
return pole	The order of steps needed	
endif	to solve a problem are	
for i = 1 to top	instructions.	
if pole[i] == 0 AND pole[i-1] > number then	• A decision is taken for the	
pole[i] = number	case of the bottom of the	
return pole	A different decision is taken	
endif	for a situation of the pole	
endfor	being empty and the position	ſ
return pole	number than the number of	
endfunction [5]	the ring being added.	

2	A re	tro computer game allows two players to race on a racing track as shown in <b>Fig. 2</b> .	Write your mark here
	(a)	Fig. 2 Give <b>two</b> examples of reusable components used in <b>Fig. 2</b> .	
	()		
		1:	
		2:[	\$]
	The thei by 1	speed of each car is shown to the player in kilometres per hour (km/h). The user can change r settings so that the speed is shown in miles per hour (mph). MPH is calculated by dividing km/ .609.	h
	(b)	Write a function that will take a speed in km/h and return the speed in mph.	
		function mphSpeed(kmhSpeed)	
		endfunction [	>1
	(C)	The cars cannot accelerate to any speed faster than 250 mph. Write a function that takes the current speed and returns 250 if any speed over 250 is an input t the function. For other speeds the current speed is returned. function newSpeed(currentSpeed)	0
		endfunction r-	Iotal / 8
	Ansv	vers	
	2 (a) (b)	The cars <sup>[1]</sup> , the finish line <sup>[1]</sup> , the track <sup>[1]</sup> , scenery/ trees/tyres <sup>[1]</sup> . function mphSpeed(kmhSpeed) mph = kmhSpeed / 1.609 return mph	
		endfunction endfunction	
		1 mark for converting the speed to mph. 1 mark each for:	
		<ul> <li>1 mark for returning the converted speed.</li> <li>Decision that the speed is over 250.</li> <li>Adjusts the speed to 250 and returns</li> <li>Returning the current speed if it is 250.</li> </ul>	it. ) or below.



# BACKTRACKING, DATA MINING, HEURISTICS, PERFORMANCE MODELLING AND PIPELINING

**2.2.2 Computational methods** (f) Learners should apply their knowledge of: backtracking; data mining; heuristics; performance modelling; pipelining; visualisation to solve problems.

[1]

- 1 A company is installing new antivirus software across the computers on its network.
  - (a) The software works by looking at different properties of viruses. For instance, it may look at suspicious behaviour in a file to build up a picture of whether a new file on the network looks like it may contain a virus.
     State the type of technique which is being used in this case.

Heuristics

You will find more information about **heuristics** in the A\* algorithm on **page 150**.

[1]

The company will use performance modelling before installing the software across the network.

(b) Define the term 'performance modelling'.

Performance modelling is simulating or testing how a system behaves before it is used.

		More info	
		More into	
(C)	Give <b>one</b> way that the system could be tested using		
	performance modelling.	The computers are all on the networ	rk.
		The antivirus software would need	
	The system could be tested with one computer to see how it	to contact a central server or the	
		Internet to get virus updates. Anothe	r
	would affect the performance of each individual machine	performance modelling test would	be
		to get all the computers to request the	he
	on the network. [1]	virus update file at the same time. Th	nis
	····· •	is an example of stress testing.	

2 A video streaming service collects data about users on which videos and films they watch. The retailer uses data mining when analysing the data.

Describe the use of data mining by the video streaming service provider.

Data mining is used to take large quantities of data and produce useful

information from it or find patterns contained inside it.

In this case, for each user there would be data such as how long they spend watching each film/video, when they start watching it and what they watch after. This data could be mined to find which films are most or least popular and then inform the video streaming service provider what content they need to produce or buy next.

## Do you remember?

You also need to be aware of **backtracking** and **pipelining**.

In the case of backtracking, in particular, you should consider how this is used when searching for an item stored in a tree structure.

Revise these before attempting any further questions.

If they had identified a problem with the service, such as certain customers not using the service often,

they could see if altering the content they are shown encourages them to use the service more. [4]



- Answers
- 3 (a) Pipelining feeds one part of the system through to another<sup>[1]</sup>. For example, each item that is purchased will result in the quantity in the supermarket's system being updated.<sup>[1]</sup> This will then feed through to other subroutines in the supermarket's system that cause more items to be ordered<sup>[1]</sup>. Accept other examples of where pipelining is used.
  - (b) The company could get/simulate all the self-service kiosks to process an order/update the database at the same time<sup>[1]</sup> (stress testing the system). Accept other appropriate tests for the scenario.
- 4 First go to the deepest node on the left.
  When there are no more nodes to visit (e.g. N)<sup>[1]</sup>
  Go back to the previous node (e.g. A)<sup>[1]</sup>
  To check further nodes (e.g. B)<sup>[1]</sup>

# **PRACTICE PAPERS**

Information about the practice papers

Before attempting the papers, go through the previous section of the book and revise any sections that you weren't confident about. Use the face icons at the end of each topic to reflect on your level of understanding and make your own judgement of what needs more revision.

#### Now to the papers.

You should do each of these papers under exam conditions.

Aim to make the desk you sit at look as similar to that in the exam room. Turn off your mobile phone, music and remove all other distractions.

Let everyone in the house know that you can't be disturbed for 2 hours 30 minutes whilst you do the paper.

Don't do both papers in one sitting. We advise leaving at least a day between attempting each paper.

You will need: A black pen (and some spares)

You cannot use: A calculator

For Paper 2 **only**, you **can** use a ruler and an HB pencil.



Please write clearly, in BLOCK CAPITALS and black ink	
Centre number Candidate number	
First name(s)	
Last name	
Date attempted Time allowed: 2 hours 30 minutes	

# **A Level Computer Science**

# H466/01 Computer Systems

# PRACTICE PAPER 1

# DO NOT USE

• A calculator.

# INSTRUCTIONS

- Write in black ink
- Write your answer to each question in the space provided.
- Answer all the questions.

# INFORMATION

- The total mark for this paper is **140**.
- The marks for each question are shown in brackets [].
- Quality of written communication will be assessed in this paper in questions marked with an asterisk (\*).
- This paper has 20 pages.

# ADVICE

• Read each question carefully before you start to answer.

1 A new smart television allows users to watch broadcast television and also watch content from video streaming apps. The television is controlled by either a remote control or a user speaking commands. (a) Other than a display, name **one** output device that may be part of the television. ..... .....[1] (b) Explain the purpose of **one** input device that may be part of the television. \_\_\_\_\_ ......[2] (c) The smart television makes use of a GPU. Describe the need for a GPU in the smart television. (i) (ii) State two other uses for GPUs in other computer systems. Use 1: \_\_\_\_\_

# PRACTICE PAPERS ANSWERS Paper 1





1						
1 (a)	Speaker(s) <sup>[1]</sup> . Accept other	appropriate answers such	n as LEDs.		1	1.1.3
1 (b)	A microphone <sup>(1)</sup> so that voice commands can be given. <sup>[1]</sup> Keypad <sup>(1)</sup> on the remote control, so that the user can pause/play/alter volume <sup>(1)</sup> (or any other common functions expected on a remote control). Accept common functions that may be present on a smart television such as power on/off: alter volume etc.			2		
1 (c) (i)	The main task of the smar customised to the decodi Decoding/displaying video	rt television will be to displ ng/playing of video <sup>[1]</sup> . The p requires a large amount	ay video. Therefore, a GPU will contain spe of processing which	a GPU (Graphics Processing Unit) is used as it is ecialist instructions that are suited to this $task^{[1]}$ . is far better suited to a GPU than a CPU <sup>[1]</sup> .	2	1.1.2
1 (c) (ii)	Modelling <sup>[1]</sup> , simulation <sup>[1]</sup> ,	machine learning <sup>[1]</sup> , data i	mining <sup>[1]</sup> , cryptocurre	ency mining <sup>[1]</sup> .	2	
1 (d)	The video/programme is i be moved to RAM <sup>[1]</sup> . This instructions to play the vic video plays, more video w removed from RAM <sup>[1]</sup> .	nitially saved (recorded) o is because the CPU/GPU deo will be located in ROM vill be moved from solid st	n the solid state stora cannot access the vio A <sup>[1]</sup> or may be copied ate storage to RAM <sup>[1]</sup>	age <sup>[1]</sup> . When the user plays the video, it will deo directly in the sold state storage <sup>[1]</sup> . The from solid state storage to RAM <sup>[1]</sup> . As the . Once a portion of video has played, it may be	4	1.1.3
1 (e)	Cache is a small amount of	of high performance merr	nory (next to the CPU	I) <sup>[1]</sup> , stores frequently used data/instructions <sup>[1]</sup> .	2	1.1.1
1 (f)	<ul> <li>1 (f) The operating system will have a user interface<sup>[1]</sup> which allows users to select apps that need to be loaded / select a particular television channel<sup>[1]</sup>. (Allow other features provided by a user interface such as control buttons (pause/play) or background images).</li> <li>File management<sup>[1]</sup> will correctly store video/recorded programmes on the solid state storage (with file names and folders/directories)<sup>[1]</sup>.</li> <li>The operating system provides a platform for the software/apps to run<sup>[1]</sup>. When an app is selected, the operating system will load the app<sup>[1]</sup> and allow it to access any libraries that are provided with the operating system<sup>[1]</sup>.</li> <li>The operating system will provide security for the television<sup>[1]</sup> such as allowing different users to have different accounts with a password<sup>[1]</sup>.</li> <li>Memory management<sup>[1]</sup> will load apps/video correctly into RAM<sup>[1]</sup> and make sure other apps cannot access them<sup>[1]</sup>.</li> </ul>		4	1.2.1		
1 (g)	1 mark for each correct co	olumn.			3	1.1.1
	Stage of fetch-decode- execute cycle	Pipeline Clock tick 1	Pipeline 2 Clock tick 2	Pipeline 3 Clock tick 3		
	Fetch	A	В	С		
	Decode		А	В		
	Execute			A		
1 (h)	(h) When one instruction is being decoded/executed, the next instruction will be fetched. <sup>[1]</sup> The CPU doesn't need to wait for the next instruction <sup>[1]</sup> which reduces/removes latency <sup>[1]</sup> . All parts of the processor will be in use at the same time <sup>[1]</sup>			2		
2	1					
2 (a) (i)	<ul> <li>A prototype is created<sup>[1]</sup>. The prototype is then evaluated (with the end user providing feedback) and the feedback is</li> <li>used to inform the next iteration<sup>[1]</sup>. The next iteration is developed<sup>[1]</sup>. This iterative process is repeated<sup>[1]</sup> until a prototype becomes the final product<sup>[1]</sup>.</li> </ul>			4	1.2.3	
2 (a) (ii)	<ul> <li>The software may be released quickly with basic features, then further features added later.<sup>[1]</sup></li> <li>ii)</li> </ul>			1		
2 (a) (iii)	a) Extreme Programming makes use of pair programming <sup>[1]</sup> (which is not necessary if the quality/robustness of code isn't iii) an issue).			1		
2 (b)	b) Their original source code won't be seen outside the company <sup>[1]</sup> which will help to protect their intellectual property / solutions to problems <sup>[1]</sup> .			1	1.2.2 1.2.3	
2 (c)	(C) The app can be tested on different operating systems/platforms <sup>[1]</sup> without needing to purchase all the different hardware/devices required <sup>[1]</sup> . If there are any major problems with the software that harm the computer/virtual machine, it will be easy to launch another virtual machine <sup>[1]</sup> . If the app causes a major problem, it will be possible to restore the virtual machine back to a previous (working) snapshot <sup>[1]</sup> .			3	1.2.1	
2 (d) (i)	There are not many conse which means that the dat RLE is well suited for com language <sup>(1)</sup> .	ecutive characters that are a compression will result i pressing simple images (w	e the same in the text n a similar/slightly rec vith lots of repeating p	<sup>[1]</sup> and all these are very short (e.g. ee, ll) <sup>[1]</sup> duced file size / could increase the file size <sup>[1]</sup> . pixels), but not suited for compressing natural	2	1.3.1

# SPECIFICATION AND QUESTION MAP

1.1	Computer Systems	Paper 1
1.1	The characteristics of contemporary processors, input, output and storage devices	Question number (part)
1.1.1	Structure and function of the processor	1(e,g,h)
1.1.2	Types of processor	1(c)(i,ii)
1.1.3	Input, output and storage	1(a,b,d)
1.2	Software and software development	
1.2.1	Systems software	1(f),2(c)
1.2.2	Applications generation	2(b)
1.2.3	Software development	2(a)(i,ii,iii)(b)
1.2.4	Types of programming language	7(d)
1.3	Exchanging data	
1.3.1	Compression, encryption and hashing	2(d)(i,ii)(e), 3(f)
1.3.2	Databases	3(a-e)
1.3.3	Networks	6(a-d)
1.3.4	Web technologies	7(a-d)
1.4	Data types, data structures and algorithms	
1.4.1	Data types	4(a-f)
1.4.2	Data structures	8(a-d)
1.4.3	Boolean algebra	5(a,b)
1.5	Legal, moral, cultural and ethical issues	
1.5.1	Computing related legislation	3(g)
1.5.2	Moral and ethical Issues	3(g)

2	Content of Algorithms and programming	Paper 2
2.1	Elements of computational thinking	Question number (part)
2.1.1	Thinking abstractly	1(a)
2.1.2	Thinking ahead	2(c), 2(e,6(i))
2.1.3	Thinking procedurally	6(a,e,h)
2.1.4	Thinking logically	1(c)(ii)
2.1.5	Thinking concurrently	5(a)
2.2	Problem solving and programming	
2.2.1	Programming techniques	1(c)(ii), 2(a,d,e), 4(d), 6(a-e,g-i)
2.2.2	Computational methods	3(c), 5(b), 5(c)
2.3	Algorithms	
2.3.1	Algorithms	1(b-e), 2(e), 3(a,b,c), 4(a-c), 6(f)

# USEFUL REFERENCE

#### Logic gates and symbols

Meaning	Gate name	Gate	Notation	Example
Conjunction	AND		٨	АлВ
Disjunction	OR		V	ΑVΒ
Negation	NOT	->>	٦	¬Α
Exclusive disjunction	XOR		<u>v</u>	А <u>v</u> В
Equivalence			≡	$A \land A \equiv A$

### Half adder



# Multiple full adders

This shows multiple full adders for adding two 4-bit numbers



# **Big O notation**

Big-O	Name	Relationship of time taken to size of n
O(1)	Constant	Independent of n
O(n)	Linear	Directly proportional to n
O(n <sup>2</sup> )	Polynomial	In this example, proportion to $n^2$
O(n <sup>x</sup> )	Polynomial	In general, proportional to xth power of n
O(2 <sup>n</sup> )	Exponential	Doubles with each additional element
O(x <sup>n</sup> )	Exponential	Proportional to the nth power of x
O(log <sub>2</sub> (n))	Logarithmic	Additional time taken reduces as n increases.



Rule name	Rule / Law
Double negation	$\neg \neg A \equiv A$
Commutation	$A \land B \equiv B \land A$
	$A \mathbf{v} B \equiv B \mathbf{v} A$
Association	$A A (B A C) \equiv (A A C) A B$
	$Av (B v C) \equiv (A v C) vB$
Distribution	$A \wedge (B \vee C) \equiv A \wedge B \vee A \wedge C$
	$A\mathbf{v} (B \land C) \equiv A \lor B \land A \lor C$
De Morgan's	$\neg(A \lor B) \equiv \neg A \land \neg B$
Theorem	$\neg(A \land B) \equiv (\neg A \lor \neg B)$

# Full adder



# Flip flop



D	Data input
СК	Clock
Q	Output stored value
¬Q	NOT Q



# Little Man Computer Instruction Set

Mnemonic	Instruction
ADD mailbox	Add mailbox to accumulator
SUB mailbox	Subtract mailbox from accumulator
STA mailbox	Store accumulator in mailbox
LDA mailbox	Load into accumulator contents of <i>mailbox</i>
INP	Copy input into accumulator
OUT	Output value in accumulator
BRA	Branch always
BRP	Branch if the accumulator is positive
BRZ	Branch if the accumulator is zero
HLT	End program
DAT	Data location

#### HTML

<html></html>	Web page
<link/>	Link to a CSS file
<title></title>	Text shown in the browser window or tab title
<body></body>	The web page content
<h1> <h2> <h3></h3></h2></h1>	Headings (h1 is largest)
<img/>	Image. Attributes: src, alt, height, width
<a></a>	Hyperlink (anchor) href attribute
<div></div>	A section styled with CSS
<form></form>	An HTML form
<input/>	name attribute to identify the input
	type="text" – textbox
	type="submit" – submit button
	Paragraph
<ol></ol>	Ordered list
<ul></ul>	Unordered list
<li></li>	List element
<script></script>	

# JavaScript

<pre>myElement = document. getElementByID("text");</pre>	
<pre>myElement.innerHTML = "text";</pre>	
<pre>document.write("text");</pre>	Write text to HTML output
<pre>alert("Important text");</pre>	Message box with an OK button

## **Structured Query Language (SQL)**

SELECT fieldnames FROM tablename WHERE condition LIKE pattern AND, OR DELETE FROM tablename WHERE condition INSERT INTO tablename (col1,col2...) VALUES (val1,val2...); DROP TABLE tableName DROP DATABASE databaseName Wildcards \* and %

# CSS

	CSS added to an element with the style attribute
<pre>p {   color:blue }</pre>	Styling of elements (for use in external style sheets)
<pre>.errorBox {   background-color:red; }</pre>	Classes
<pre>#menu{    background-color:green; }</pre>	Identifiers

## **Properties**

background-color	Background colour
border-color	Border colour
border-style	Options: dotted, dashed, solid, double, none
border-width	In px (pixels) or thin / medium / thick
font-family	Such as: arial, sans-serif
font-size	In px or large, medium, small
height	Height of element in px or percentage of page
width	Width of element in px or percentage of page
color	With named or hex colours

# COMMAND WORDS

# The **command words** below will be used consistently in all assessment material and resources.

Command word	What you need to do
Add	Join something to something else so as to increase the size, number, or amount.
Analyse	Break down in order to bring out the essential elements or structure. Identify parts and relationships, and interpret information to reach conclusions.
Annotate	Add brief notes to a diagram or graph.
Calculate	Obtain a numerical answer showing the relevant stages in the working.
Compare	Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.
Complete	Provide all the necessary or appropriate parts.
Convert	Change the form, character, or function of something.
Define	Give the precise meaning of a word, phrase, concept or physical quantity.
Describe	Give a detailed account or picture of a situation, event, pattern or process.
Design	Produce a plan, simulation or model.
Discuss	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.
Draw	Produce (a picture or diagram) by making lines and marks on paper with a pencil, pen, etc.
Evaluate	Assess the implications and limitations. Make judgements about the ideas, works, solutions or methods in relation to selected criteria.
Explain	Give a detailed account including reasons or causes.
Give	Present information which determines the importance of an event or issue, or to show causation.
How	In what way or manner; by what means.
Identify	Provide an answer from a number of possibilities. Recognise and state briefly a distinguishing factor or feature.
Justify	Give valid reasons or evidence to support an answer or conclusion.
Label	Add title, labels or brief explanation(s) to a diagram or graph.
List	Give a sequence of brief answers with no explanation.
Name	Provide appropriate word(s) or term(s).
Order	Put the responses into a logical sequence.
Outline	Give a brief account or summary.
Refine	Make more efficient, improve, modify or edit.
Show	Give steps in a derivation or calculation.
Solve	Obtain the answer(s) using algebraic and/or numerical and/or graphical methods.
State	Give a specific name, value or other brief answer without explanation or calculation.
Tick	Mark (an item) with a tick or select (a box) on a form, questionnaire, etc., to indicate that something has been chosen.
What	Asking for information specifying something.
Write/Rewrite	Mark (letters, words, or other symbols) on a surface, typically paper, with a pen, pencil, or similar implement/write (something) again so as to alter or improve it.

# NOTES, DOODLES AND EXAM DATES

4

# Target grades

Paper 1:
Paper 2:
Overall grade:
Practice results
Practice paper results Paper 1:
Paper 2:
Overall grade:

Exam dates	
Paper 1:	
Paper 2:	
••••••	

# EXAMINATION TIPS

With your examination practice, use a boundary approximation using the following table. Be aware that boundaries are usually a few percentage points either side of this.

Grade	A*	А	В	С	D	E	U
Paper 1	77%	67%	56%	46%	36%	26%	0%
Paper 2	80%	70%	59%	48%	37%	26%	0%

**Note:** The grade boundaries given above are based on the average from 2017-2019. Years 2020/2021 have been excluded as their boundaries were significantly altered from their norm.

- 1 Make sure you apply answers to the scenario given.
- 2 Look carefully at the number of marks given for a question. For instance, if 3 marks are given for a describe question, you will need to include 3 distinct points.
- 3 If a question says that you may use a diagram to illustrate your answer, you should try to make use of the diagram to maximise your chance of getting the marks.
- 4 If a question asks you to perform a calculation and show your working, make sure that you use a clear layout that logically shows the steps you have taken.
- 5 When writing SQL statements, remember that strings use single quotes.
- 6 If you need to write a function, remember that it is most likely that it will need to return a value (e.g. **return answer**) rather than using output statements such as print.
- 7 When answering long answer questions such as 'discuss' questions, make sure that you give a conclusion. It is important that this conclusion is justified/reasoned from the points made in your discussion.
- 8 You may be asked to write code for CSS. Make sure you have revised and remembered the exact syntax style. For instance, a missing end-brace }, or using **color=blue** instead of **color:blue** for properties will lose marks.
- 9 When showing how to sort data, good answers that achieve high marks tend to use diagrams. Remember, an additional explanation will usually be required to get full marks.
- 10 If you need to swap the values stored in two variables, remember that you will need to create a temporary variable to help do this.
- 11 Many students forget that hyperlinks are made with the HTML: <a href="home.html">Home</a>

The a stands for 'anchor' and the href attribute stands for 'hypertext reference' (the web address).

- 12 Pay attention to details. For instance, if you are asked for an advantage of open-source software, an answer that says "you can amend the code" won't get the mark, whereas "you can amend the **source** code" will get the mark.
- 13 The exam board encourages solutions to Dijkstra's algorithm to be completed in tabular form.
- 14 When completing Dijkstra's algorithm, note that the algorithm doesn't stop until all nodes have been visited (even if the shortest path was found earlier in the algorithm).
- 15 If a truth table uses False/True then your answers should too. Equally, if it uses 1s and 0s, then your answer should use the same.
- 16 Marks are unlikely to be available for stating the obvious. For example, if you're asked to define the term 'multicore processor', the answer 'a processor with multiple cores' won't get the marks, whilst 'a number of processing units contained within a single processor' will. (You may need to give more details than this depending on the number of available marks).
- 17 Each year, lots of candidates lose marks on simple questions such as converting between binary and hexadecimal. These calculations are worth double checking as silly mistakes can happen.
- 18 Remember that relationships link tables within the same database, not separate databases.
- 19 When writing code, remember to use appropriate variable names, indent code and comment code where appropriate.
- 20 Make use of the additional space at the back of the paper rather than trying to squeeze your answer in. Remember, you must not write in the margin as these won't be scanned and marked. By contrast, examiners must mark additional pages first so that they aren't missed.

## Good luck!

# ALSO AVAILABLE FROM PG ONLINE

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