1. Julie wants to earn her living by being a successful app developer.

Before she even writes any code, she thinks it would be sensible to find out some basic facts about app development and the market for apps in order to maximise her chances of being successful.

* *'It is possible to use computational methods as a way of predicting the success of an app.'*
Discuss the extent to which you agree with this statement.

[9]

2. A supermarket chain stores over 3 petabytes (10^{15} bytes) of data about sales and customers. The supermarket chain carried out a data mining exercise in which they discovered that whenever there was a hurricane warning, sales of fruit pies increased. This had not been noticed before the data mining exercise. The next time there was a hurricane warning, they placed the fruit pies at the end of the aisles and there was a dramatic increase in sales.

Explain how computational methods were able to reveal this unexpected result.

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[4]

3(a). Describe what is meant by a *heuristic* approach to problem-solving.

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[2]

(b). Describe how heuristic methods are used when making a decision about when to cross a busy road.

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[3]

(c). * Virus checkers work by looking for patterns in the program code. They also use heuristic approaches. Evaluate the effectiveness of heuristic and pattern matching approaches to virus detection.

[9]

4(a). When a house is being built, the following activities take place:

- plans are drawn
- foundations are laid
- bricks are ordered
- bricks are delivered
- walls are built
- windows are installed
- electric wiring is installed
- plumbing is installed
- roof rafters are installed
- tiles are put on roof.

Describe the term *pipelining*.

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[2]

(b). Describe **two** examples of where pipelining is used in any computer system.

1

2

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[4]

5(a). A flight simulator allows a user to take control of a simulated aeroplane. The user can fly the plane in an environment that can simulate different weather conditions and additional planes in the sky.

Air traffic controllers are considering introducing a new flight path.

Explain **two** reasons why they might use the new flight path in the simulation before implementing it in the real world.

1

2

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[4]

(b). Abstraction has been used in the design and creation of the flight simulator.

Explain, using an example, the need for abstraction in the creation of the flight simulator.

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[3]

6. The layout for a 2-player board game is shown in Fig 2.1

START	1	2	3	4	5	6	7
15	14	13	12	11	10	9	8
16	17	18	19	20	21	22	23
31	30	29	28	27	26	25	24
32	33	34	35	36	37	38	39
47	46	45	44	43	42	41	40
48	49	50	51	52	53	54	55
END	62	61	60	59	58	57	56

Fig 2.1

The game is played by rolling two 6-sided dice and moving that number of spaces. Both players start on the START space. If a player lands on a space occupied by the other player, they move to the next available space.

The board is to be stored as a 2-dimensional array.

The board shown in Fig 2.1 is a visualisation of the problem. Explain what visualisation means in this example.

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[2]

7. * A multi-national retailer has a very large database storing customers, stock and orders.

The retailer uses data mining to retrieve a variety of information.

Evaluate the use of data mining by the retailer.

[9]

8(a). Dexter is leading a programming team who are creating a computer program that will simulate an accident and emergency room to train hospital staff.

Identify **two** features of the problem that make it solvable by computational methods.

[2]

(b). *Dexter has used decomposition and abstraction during the analysis of the problem.

Explain and evaluate the use of decomposition and abstraction in the creation of this simulation.

[9]

9. An encryption routine reads a line of text from a file, reverses the order of the characters in the string and subtracts 10 from the ASCII value of each letter, then saves the new string into the same file.

The program is split into sub-procedures. Three sub-procedures are described as follows:

- Read string from file
- Push each character of the string onto a stack
- Read and encrypt each character message

(i) Identify **one** further sub-procedure that could be used in the program.

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[1]

(ii) Describe **two** advantages of splitting the problem into sub-procedures.

1 ---

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2 ---

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[4]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			* Mark Band 3–High Level (7–9 marks) The candidate demonstrates a thorough knowledge and understanding of a wide range of considerations in relation to the statement; the material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence / examples will be explicitly relevant to the explanation. The candidate is able to weigh up both sides of the argument which results in a supported and realistic judgment as to whether it is possible to use computational methods as a way of predicting the success of an app. *There is a well–developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* Mark Band 2–Mid Level (4–6 marks) The candidate demonstrates reasonable knowledge and understanding of a range of considerations in relation to the statement; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation. The candidate makes a reasonable attempt to come to a conclusion showing some recognition of influencing factors that would determine whether it is possible to use computational methods as a way of predicting the success of an app. *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* Mark Band 1–Low Level	9	AO1: Knowledge and Understanding The following is indicative of possible factors / evidence that candidates may refer to but is not prescriptive or exhaustive: Indicative Content: • Some issues can be quantified – these are easier to process computationally – simple statistics can help identify likely sales. • Examples given of quantifiable data such as sales figures. • Past performance does not guarantee future. • Could easily make errors in choosing likely quantifiable attributes. • A new app might have no relevant predecessors. • Difficult to process whether app will appeal – might depend on reviews – these are unpredictable. • App might fail for unexpected reasons / examples given. • Issues could include platform limitations / restrictions. • Marketing of apps plays an important role. • App features such as “in app purchases” and cost play an important role in popularity. AO2.1: Application The selected knowledge / examples should be directly related to the specific question. The following is indicative of possible factors / evidence that candidates may refer to but is not prescriptive or exhaustive: • Discussions of abstraction in predicting behaviour. • Discussions of the difficulties of predicting markets, users, trends and other technical influences. • Issues surrounding validity of data gathered and how it is gathered.

Question			Answer/Indicative content	Marks	Guidance
			(1–3 marks) The candidate demonstrates a basic knowledge of considerations with limited understanding shown; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides nothing more than an unsupported assertion. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* 0 marks No attempt to answer the question or response is not worthy of credit.		• Considerations regarding the components of the problems and how they are sub divided. • Discussions around how decisions are taken and the conditions that affect the flow through a program. • Discussions around concurrency and how this affects the outputs. AO3.3: Evaluation Having considered the different sides to the argument candidates will need to reach a supported judgment based on the evidence included in their response. There should be no bias in marks as to the degree to which the candidate agrees with the statement but especially in the top mark band there must be a clear link between the points candidates have made and justification. The following is indicative of possible factors / evidence that candidates may refer to but is not prescriptive or exhaustive: • Discussions around how the problem is solvable using computational methods • Discussions around relevant stakeholders • Discussions around solutions and essential features and any inherent limitations • An explanation / description of how the problem can be decomposed • A description of the solution potentially describing algorithms, variables, data structures or the limitations there of.
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
2			• Data mining or description (1) which involves searching through unconnected data (1), pattern matching (1) and calculation of correlation (1). There may be no predetermined matching criteria (1); a brute force approach is possible with high speed computers (1).	4	Up to 4 marks for a valid explanation. Allow for other examples.
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
3	a		• Rule of thumb / educated guess approach (1 – AO 1.1) which is used when unfeasible to analyse **all** eventualities (1 – AO 1.1). • This leads to a "good enough" result (1 – AO 1.2) although it is not 100% reliable (1 – AO 1.2).	2	Up to 2 marks for a valid description. 1 mark for demonstrating knowledge (AO1.1). 1 mark for demonstrating application of knowledge and understanding (AO1.2).
	b		• We don't gather / measure all the data (1) about vehicle speeds (1). We scan for the data most likely to help us (1) and make a judgement based on experience (1).	3	Up to 3 marks for a valid description.
	c		*** Mark Band 3–High Level** **(7–9 marks)** The candidate demonstrates a thorough knowledge and understanding of heuristic and pattern matching approaches to virus detection; the material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence / examples will be explicitly relevant to the explanation. The candidate provides a thorough discussion which is well–balanced. Evaluative comments are consistently relevant and well–considered. *There is a well–developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Mark Band 2–Mid Level** **(4–6 marks)** The candidate demonstrates reasonable knowledge and understanding of heuristic and pattern matching approaches to virus detection; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation. The candidate provides a reasonable	9	**If only heuristic or pattern matching virus detection considered – MAX 5 marks.** **AO1: Knowledge and Understanding Indicative Content:** • Pattern matching requires a database of known viruses – needs to be updated regularly. • Should be successful at catching known viruses – similar viruses form a "family" should be picked up – all data about the viruses can be considered. • New viruses may be completely unlike existing ones – reliance on analytics may miss a totally new mechanism. • Heuristic looks at behaviour rather than structure – can uncover suspicious activity even if produced in a novel way. • Heuristic methods examine the susceptibility of the system to possible attacks. • Heuristic methods simulate the possible effects of a suspected virus. • Heuristic methods sometimes decompile the suspicious program, then analyse the resulting source code. **AO2.1: Application** The selected knowledge / examples should be directly related to the specific question. The following is indicative of possible factors / evidence that candidates may refer to but is not prescriptive or

Question			Answer/Indicative content	Marks	Guidance
			discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed. *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* Mark Band 1–Low Level (1–3 marks) The candidate demonstrates a basic knowledge of approaches to virus detection with limited understanding shown; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* 0 marks No attempt to answer the question or response is not worthy of credit.		exhaustive: • Discussion on different types of virus checkers • Issues around virus attack and protection • Discussion on heuristic and pattern matching approaches to virus detection • Discussion on anti–virus proactive scan for unknown viruses AO3.3: Evaluation Candidates will need to consider a variety of strategies taken in relation to virus detection and will make some evaluative comments about the issues and solutions they are discussing. The following is indicative of possible factors / evidence that candidates may refer to but is not prescriptive or exhaustive: • A comparison of the different types of pattern matching methods that can be used to identify viruses. • How effective are the approaches of virus detection using heuristic and different pattern matching methods? • The differences between the heuristic and pattern matching methods, explaining which one is better? • Likelihood of ‘false positives’ occurring for the different methods? How this problem could be solved? • Consideration of how fuzzing can affect the results of each method. • How updates for antivirus software alter the effectiveness of the methods. • Discussion of other factors that alter the effectiveness of antivirus software.
			Total	14	

Question			Answer/Indicative content	Marks	Guidance
4	a		• Data / processes arranged in a series output of one is input of next.	2	Up to 2 marks for a valid description.
	b		• Instruction processing (1) – some processors allow parts of instructions to be processed (1) without waiting to complete the whole instruction cycle (1). • Pipes to pass data between programs (1) from programs to peripherals / to programs from peripherals (1), example such as | symbol in Unix, or • Popen() or pipe() in C (1). • Graphics pipelines (1) separate processor renders graphics from data supplied by other processes (1), parts (vertices) of the image are pipelined at the same time as custom software (shader) that renders the display (1).	4	1 mark for each correct identification up to a maximum of two identifications plus up to a further 1 mark for each of two valid descriptions.
			Total	6	
5	a		1 mark per bullet e.g. • It is safer… (1) • …Real planes / lives are not put at risk by testing it in reality (1) • Time can be sped up / decreased … (1) • … do not need to wait to see what happens, can view changes immediately (1) • It will cost less… (1) • …Can make multiple changes / test all possibilities (1)	4	
	b		1 mark per bullet to max 3 • Removing unneeded complexities (1) • Saves memory / resources (1) • E.g. remove passengers, other planes, other obstacles, landscaping to reduce memory needed (1)	3	
			Total	7	

Question			Answer/Indicative content	Marks	Guidance
6			2 marks, 1 for defining visualisation, 1 for application to the 2-d array and gridd • Presents data in an easy-to-grasp way (1) • An array is not actually a grid / table (1)	2	
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
7			**Mark Band 3 – High level** **(7–9 marks)** The candidate demonstrates a thorough knowledge and understanding of data; the material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context proided. Evidence / examples will be explicitly relevant to the explanation. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Mark Band 2 – Mid level** **(4–6 marks)** The candidate demonstrates reasonable knoledge and understanding of data mining; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation. The candidate provides a reasonable discussion, the majority of which is focused. Evaluative comments are, for the most part appropriate, although one or two opportunities for development are missed. *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* **Mark Band 1 – Low Level** **(1–3 marks)** The candidate demonstrates a basic knowledge of data mining with limited understanding shown; the material is basic and contains some inaccuracies. The candidates makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides a limited discussion which is narrow in focus. Judgements if made are weak and	9	**AO1: Knowledge and Understanding** **Indicative content** • Data mining looks through vast quantities of data • Searches for relationships between facts / components / events that may not be obvious • May include pattern matching algorithms • May involve anomaly detection algorithms • Used for business modelling • Used to plan for future eventualities **AO2: Application** • Can look for links between a customer's purchases • Give recommendations for future purchases • Check for days / times / months where increases are likely and what the increase will be purchasing • Look at matching sales, when people buy one product what else do they buy with it **AO3: Evaluation** Candidates will need to evaluate the benefits and drawbacks of using data mining. e.g. • Can improve marketing • Can improve quantity of stock needed • Ensure demand is met • Increase sales / profit • Takes vast processing requirements • Need powerful computers • Privacy concerns from customers • Misuse of information • Inaccurate information can produce false results

Question			Answer/Indicative content	Marks	Guidance
			unsubstantiated. *The information is basic and comunicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* 0 marks No attempt to answer the question or response is not worthy of credit.		
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
8	a		1 mark for each feature e.g. • Involves calculations • Has inputs, processes and outputs • Involves logical reasoning	2	Allow any suitable feature
	b		**Mark Band 3 – High level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of decomposition and abstraction; the material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation. The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistenly relevant and well considered *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Mark Band 2 – Mid level (4-6 marks)** The candidate demonstrates reasonable knoledge and understanding of decomposition and abstraction; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation. The candidate provides a reasonable discussion, the majority of which is focused. Evaluative comments are, for the most part appropriate, although one or two opportunities for development are missed. *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence* **Mark Band 1 – Low Level (1-3 marks)**	9	**AO1: Knowledge and Understanding** **Indicative content** Decomposition: • splits problem into sub-problems • splits these problems further • until each problem can be solved • Allows the use of divide and conquer Abstraction • Removing unnecessary elements using symbols • Removing unnecessary design/programming/computational resources **AO2: Application** • Split the simulation into subparts • E.g. generating rooms, patients, people, scenarios, interaction • E.g. replacing how instruments look with shapes, minimise features of human body **AO3: Evaluation** e.g. • Increase speed of production • Assign areas to specialities • Allows use of pre-existing modules • Allows re-use of new modules • Need to ensure subprograms can interact correctly • Can introduce errors • Reduces processing/memory requirements • Increases response speeds of programs

Question			Answer/Indicative content	Marks	Guidance
			The candidate demonstrates a basic knowledge of decomposition and abstraction with limited understanding shown; the material is basic and contains some inaccuracies. The candidates makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides a limited discussion which is narrow in focus. Judgements if made are weak and unsubstantiated. *The information is basic and comunicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* 0 marks No attempt to answer the question or response is not worthy of credit.		
			Total	11	

Question			Answer/Indicative content	Marks	Guidance
9		i	Save string in file	1 AO2.2 (1)	
		ii	1 mark per bullet, max 2 per advantage to max 4 e.g. • Procedures can be re-used • No need to reprogram / saves time • Program can be split between programmers • Can specialise in their area • Speed up completion time • As multiple procedures worked on concurrently • Easy to test / debug • As each module can be tested on its own then combined.	4 AO1.2 (4)	Allow any appropriate advantages **Examiner's Comment:** Part (i) was well answered where candidates had read the question stem and thought logically about the steps involved. Many candidates gained some credit in part (ii), but fewer could expand on the points they made to gain full credit.
			Total	5	