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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Digital Technologies and Hangarau Matihiko 2025

91908 Analyse an area of computer science

Credits: Three

Achievement	Achievement with Merit	Achievement with Excellence
Analyse an area of computer science.	Analyse, in depth, an area of computer science.	Critically analyse an area of computer science.

This assessment has TWO parts. Complete BOTH parts of the assessment.

Ensure that you have Resource Booklet 91908R.

You should aim to write **800–1,500 words** in total.

INSTRUCTIONS

This assessment has TWO parts.

Part One contains questions on three areas of computer science:

- Computer graphics (page 3)
- Computer vision (page 5)
- Complexity and tractability (page 8).

Choose only ONE area of computer science **on which to answer questions**. Enter the name of your selected area of computer science in the box below.

Part Two has four questions. Answer all four questions.

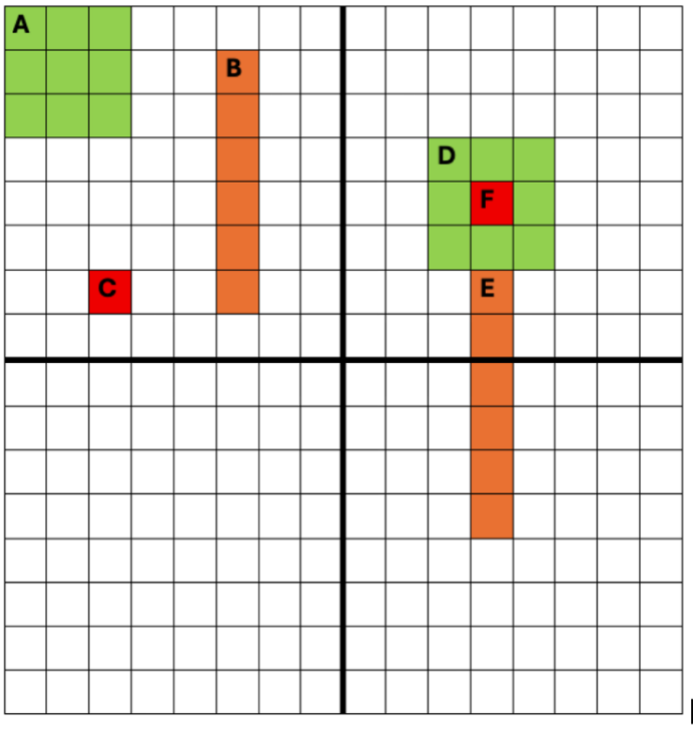
Read both parts of this assessment before you begin your responses.

PART ONE

EITHER:

COMPUTER GRAPHICS

Translation, scaling, and rotation can all be performed on a single shape. Consider the graphic below.



The origin (0,0) is at the centre of the diagram and the positive direction is to the right and up.

(a) What values would you use to transform each of the shapes on the grid above?
Enter the vectors needed to do this transformation in the boxes below for points A, B, and C.

Point A → D	
X	
Y	

Point B → E	
X	
Y	

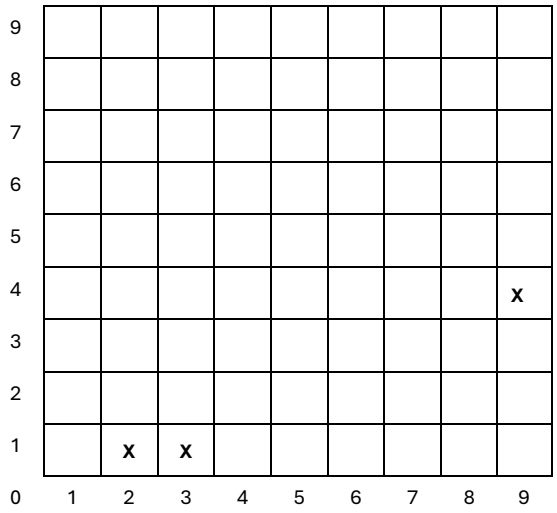
Point C → F	
X	
Y	

Name the type of transformation that occurred above, and provide an example of where this transformation would be used in a computer graphics application.

(b) Using either of the algorithms in Resource A on page 2 of the resource booklet, calculate the points that would be plotted in order to draw a line between (2,1) and (9,4).

Points plotted	P	x coordinate	y coordinate
1	–1	2	1
2	5	3	1
3			
4			
5			
6			
7			
8		9	4

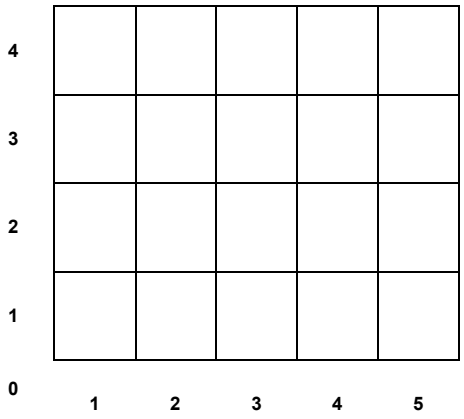
(c) In the grid below, place an ‘x’ at the points you calculated in the table above. The start and end points, and one other point, have been plotted for you.



(d) Explain why Bresenham’s algorithm is better in computer graphics than using the simple $y = mx + b$ formula for drawing a line.

OR:

COMPUTER VISION



Consider that the matrix above has pixel values as follows:
[[10, 5, 5, 0, 0], [10, 10, 5, 0, 0], [10, 10, 10, 5, 0], [10, 10, 10, 10, 10]]

Use the pixel matrix provided above to answer part (a).

(a) (i) Illustrate the edges by marking them with Xs.

(ii) Describe how the change in pixel values facilitates edge detection in this specific instance.

Two images are taken simultaneously from a stereo camera set-up – one from the **left camera** and one from the **right camera**. These images capture the same scene from slightly different horizontal perspectives.

Source: https://people.duke.edu/~ng46/topics/stereo.htm

(b) Aside from the two images, identify and explain THREE key components or pieces of information required to compute a depth map using stereo vision.

Use the images below to answer part (c).

Source: http://bit.ly/41j2T4C

Original image		

(c) (i) Complete the table above by identifying which image has likely used the Canny edge detection technique, and which has likely used another algorithm, such as the Sobel / Prewitt algorithm.

(ii) Explain what led you to make this decision.

OR:

COMPLEXITY AND TRACTABILITY

Source: https://www.101computing.net/big-o-notation/

(a) Discuss the importance of time complexity to computer scientists. Why is it crucial for developers to understand and consider time complexity when designing algorithms?

(b) (i) Provide an example of an algorithm that operates with O(log(N)) complexity. Explain how this complexity affects its performance as the size of the input increases.

(ii) Provide an example of an algorithm that operates with $O(2^N)$ complexity. Explain how this complexity affects its performance as the size of the input increases.

Part (c) below relates to the analysis of algorithm efficiency and complexity growth.

A company is developing a logistics system that needs to process a set of n orders.
They are considering three different algorithms:

1. Algorithm A uses n^2 operations.
2. Algorithm B runs in $n \log_2 n$ operations.
3. Algorithm C runs in 2^n operations.

The system typically gets around 10 orders to process at a time, but the company hopes that one day they will receive up to 100 orders to process.

(c) (i) Explain which algorithm is the most efficient as n increases.

(ii) At what approximate value of n does Algorithm C become infeasible for real-world computation? (Consider computational limits such as 10^9 operations per second.)

PART TWO

Refer to the resource booklet to answer parts (a), (b), and (c).

(a) Discuss the significance of your chosen area from Part One within the broader field of computer science. Why is it considered a critical component of the discipline?

(b) Identify TWO specific algorithms or mechanisms that are central to your chosen area of computer science from Part One.

Algorithm or Mechanism 1:

(i) Explain how your identified algorithm or mechanism functions, and discuss why it is important to the field.

Algorithm or Mechanism 2:

(ii) Explain how your identified algorithm or mechanism functions, and discuss why it is important to the field.

(c) Explain how your chosen area of computer science from Part One is applied and implemented in a real-world scenario.

In your answer, provide detailed examples to show what this area of computer science can do and what its limits are.

(d) Sometimes, technologies in this area of computer science can benefit certain groups of people while disadvantaging or negatively impacting others, either directly or indirectly.

Discuss how the issues and opportunities associated with your chosen area can impact society.