XAVIER COLLEGE
SAT Notification Sheet 2025

STUDENT NAME:

SUBJECT	**Unit 3 Outcome 3: Algorithmics (HESS) – Test theme: Applied Algorithms**
UNIT OUTCOME	On completion of this unit the student should be able to design suitable solutions for real-world problems that require the integration of algorithms and data types, including the communication of solutions and their justification. To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 3.
DATE/PERIOD	Monday 21st of July – (Term 3 Week 1)
TIME/FILE SUBMISSION	**Reading:** 10 minutes **Writing:** 360 minutes **Files for submission:** 1 Microsoft Word doc & any coding files. (No links)
TOPICS/SKILLS	**Key Knowledge:** • characteristics and applicability of ADTs and algorithm design patterns. • suitability of ADTs and algorithm design patterns for a variety of problem contexts. • combinations of ADTs to meet complex problem requirements. • the application of algorithms to answering real-world problems. **Key Skills:** • describe how complex information can be represented by a combination of ADTs. • select combinations of ADTs and algorithms that are fit for purpose. • justify the suitability of ADTs and algorithm design patterns for particular problems. • communicate the design of data models and algorithms. • explain the interpretation of computed solutions in terms of their meaning to the original real-world problem being solved.

REVISION RESOURCES	• Please note, this is an open book assessment. However, please do not use Generative AI to complete your work. All work must be your own and based on legitimate research using APA referencing.

Total marks available – 40 marks

COMPULSORY STUDENT DECLARATION

I, (*print your name neatly*) _____ acknowledge that I have read the SAT conditions and understand which items/materials I am permitted to use and have in my possession.

****If you have any doubts as to what is permitted, raise your hand and DO NOT sign this declaration****

Student's Signature: _____

Student's Name: _____

Teacher's Name: _____

This grade is subject to statistical moderation by the Victorian Curriculum and Assessment Authority (VCAA) and may change once end of year examinations have been completed.

VCE Algorithmics (HESS): Performance descriptors. Criteria 1-4

Criterion 1

VCE Algorithmics (HESS): School-assessed Task 2023							
Assessment Criteria	**Levels of Performance**						
	Indicators	**Not shown**	**1–2 (very low)**	**3–4 (low)**	**5–6 (medium)**	**7–8 (high)**	**9–10 (very high)**
Unit 3 Outcome 3 **1. Skills in specifying a problem and modelling its key features.**	• Specifies an algorithmic problem.	Insufficient evidence	Identifies some algorithmic aspects of the real-world/applied problem context.	Outlines some aspects of an algorithmic problem relevant to the real-world/applied problem context.	Formulates an algorithmic problem from the real-world/applied problem context.	Explains how the algorithmic problem is formulated from the real-world/applied problem context.	Provides clear and precise specification of the algorithmic problem, suitably formulated from the real-world/applied problem context.
	• Explains the salient features of the real-world/applied problem.		Lists arbitrarily-selected features of the real-world/applied problem.	Identifies some relevant features of the real-world/applied problem and outlines reasons for their selection.	Describes salient features of the real-world/applied problem and reasons for their selection.	Identifies features of the real-world/applied problem, and by considering their characteristics, chooses a suitable set of features to model.	Identifies a comprehensive range of features of the real-world/applied problem, and by considering their relevant characteristics, selects a suitable set of salient features to model.
	• Models the problem using ADTs		Makes a limited attempt to model the selected features of the problem using ADTs that may not be suitable.	Models some features of the problem using suitable ADTs.	Models the selected features of the problem using a combination of suitable ADTs. Outlines how some features of the problem map to the data model.	Models selected features of the problem using a coherent combination of suitable ADTs. Describes how some features of the problem map to the data model. Describes signatures for some operations of the data model.	Models selected features of the problem using a coherent and fit-for-purpose combination of suitable ADTs. Describes how features of the problem map to the data model. Describes signatures for key operations of the data model.
		0 ❑	1 ❑ 2 ❑	3 ❑ 4 ❑	5 ❑ 6 ❑	7 ❑ 8 ❑	9 ❑ 10 ❑

Criterion 2

VCE Algorithmics (HESS): School-assessed Task 2023							
Assessment Criteria	**Levels of Performance**						
	Indicators	**Not shown**	**1–2 (very low)**	**3–4 (low)**	**5–6 (medium)**	**7–8 (high)**	**9–10 (very high)**
Unit 3 Outcome 3 **2. Skills in the design of an algorithm to solve a real-world/applied problem.**	• Considers suitable algorithmic approaches to the problem.	Insufficient evidence	Identifies an algorithm design approach that has some relevance to the problem.	Outlines a few algorithm design approaches that could form the basis of a solution.	Considers relevant characteristics of several algorithm design approaches.	Compares the suitability of some algorithm design approaches to then determine an appropriate approach.	Thoroughly compares the suitability of several algorithm design approaches to then determine the most appropriate approach.
	• Describes the design of an algorithmic solution to the real-world/applied problem.		Identifies some aspects of an algorithm to solve the real-world/applied problem.	Outlines a simple algorithm to solve the problem.	Describes a non-trivial algorithm that solves some aspects of the specified problem.	Describes an algorithm that solves the specified problem and involves some combinations of algorithms or algorithm design patterns.	Clearly explains an algorithm that solves the specified problem and involves combinations or modifications of algorithms or algorithm design patterns.
		0 ❑	1 ❑ 2 ❑	3 ❑ 4 ❑	5 ❑ 6 ❑	7 ❑ 8 ❑	9 ❑ 10 ❑

Criterion 3

VCE Algorithmics (HESS): School-assessed Task 2023							
Assessment Criteria	**Levels of Performance**						
	Indicators	**Not shown**	**1–2 (very low)**	**3–4 (low)**	**5–6 (medium)**	**7–8 (high)**	**9–10 (very high)**
Unit 3 Outcome 3 **3. Skills in the communication of an algorithmic solution to a real-world/applied problem.**	• Communicates the algorithmic solution in pseudocode.	Insufficient evidence	Limited elements of the algorithm are expressed in pseudocode. The pseudocode includes some correct initialisation of variables and data structures.	Elements of the structure of the algorithm are expressed in pseudocode. The pseudocode includes the correct use of simple iteration and conditional control structures where appropriate.	The algorithm is expressed in pseudocode such that the structure of the design is apparent. The pseudocode includes the correct use of nested iteration and recursion where appropriate.	The algorithm is expressed in pseudocode that mostly reflects the solution design. Any errors are minor in nature and do not affect the overall structure of the algorithm. There is some attempt to use functional abstractions.	The algorithm is correctly and precisely expressed in pseudocode, which accurately reflects the solution design. A modular approach is employed including the use of ADTs and functional abstractions.
		0 ❑	1 ❑ 2 ❑	3 ❑ 4 ❑	5 ❑ 6 ❑	7 ❑ 8 ❑	9 ❑ 10 ❑

Criterion 4

VCE Algorithmics (HESS): School-assessed Task 2023							
Assessment Criteria	**Levels of Performance**						
	Indicators	**Not shown**	**1–2 (very low)**	**3–4 (low)**	**5–6 (medium)**	**7–8 (high)**	**9–10 (very high)**
Unit 3 Outcome 3 **4. Skills in the justification of an algorithmic solution to a real-world/applied problem.**	• Justifies a solution to the real-world/applied problem.	Insufficient evidence	Identifies relevant reasons in support of the selection of a solution.	Outlines the rationale for the selection of a chosen solution based on a limited set of merits and limitations.	Justifies the selection of a solution based on its comparative advantages over other approaches.	Justifies the selection of a solution based on arguments relating to its suitability, coherence or fitness for purpose.	Justifies the selection of a solution by clearly demonstrating its suitability, coherence, and fitness for purpose.
		0 ❑	1 ❑ 2 ❑	3 ❑ 4 ❑	5 ❑ 6 ❑	7 ❑ 8 ❑	9 ❑ 10 ❑

Task

Unit 3 Outcome 3 School Assessed Task (SAT)

Real-World Problem: Analysing a Cybercriminal Botnet

You are part of a cybersecurity investigation team analysing data captured during a Distributed Denial of Service (DDoS) attack. The attack was coordinated by a cybercriminal syndicate using a botnet, thousands of compromised devices under the control of command-and-control (C2) servers.

Your task is to model the structure of the botnet and design algorithms to analyse its structure and behaviour. This involves detecting key nodes, clusters of infected devices, and estimating potential attack strength or reach.

Task Description

Create a data model using appropriate Abstract Data Types (ADTs) to represent the structure and behaviour of the botnet. Then, design and justify algorithms to analyse its characteristics. This task must be completed using pseudocode and clear written explanations.

Prompts for Data Modelling

- Represent bots and command servers as nodes in a graph (directed, possibly weighted).
- Use edge attributes to represent control flow or message traffic.
- Store node metadata (e.g. packet rate, location, infection time) using dictionaries or lists.
- Combine ADTs as needed to represent complex behaviours.

Prompts for Algorithm Design

- Identify the most influential nodes (C2s) using measures such as in-degree or PageRank.
- Detect sub-botnets or infection clusters using BFS/DFS or modularity-based methods.
- Estimate attack potential by calculating total packet output from key clusters.
- Detect anomalies, such as devices reporting to multiple C2 nodes.

Prompts for Justification and Communication

- Justify your choice of ADTs and algorithms in terms of the problem requirements.
- Discuss alternative approaches and why they were not chosen.
- Explain the strengths and limitations of your model and solution.
- Reflect on what aspects might be improved or refined in a future version.

Submission Requirements

• Problem definition and explanation (approx. 150–200 words).
• Data model description and rationale (approx. 250–300 words).
• At least two algorithms in pseudocode with accompanying explanations.
• Justification and reflection (approx. 400–500 words).
• At least one visualisation or graph to support your explanation, created using Python (e.g. Matplotlib, NetworkX) or another appropriate programming language.

You are NOT expected to create the most efficient or optimised solution in Unit 3. In Unit 4, you will revisit this task to analyse time complexity and refine your algorithms for better efficiency and scalability. Please focus on clarity and correctness for now.

Alignment to VCAA Outcome 3 – Key Knowledge and Skills

This task addresses the following VCAA Key Knowledge and Key Skills from Unit 3, Outcome 3:

• Characteristics and applicability of ADTs and algorithm design patterns.
• Suitability of ADTs and algorithm design patterns for a variety of problem contexts.
• Combinations of ADTs to meet complex problem requirements.
• The application of algorithms to answering real-world problems.
• Describe how complex information can be represented by a combination of ADTs.
• Select combinations of ADTs and algorithms that are fit for purpose.
• Justify the suitability of ADTs and algorithm design patterns for particular problems.
• Communicate the design of data models and algorithms.
• Explain the interpretation of computed solutions in terms of their meaning to the original real-world problem being solved.