VCE Algorithmics (HESS) 2023
Unit 3 School-based Assessment

Video 5
Planning the
Unit 3 Outcome 2 SAC

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Acknowledgement of Country

The VCAA respectfully acknowledges the Traditional Owners of Country throughout Victoria and pays respect to the ongoing living cultures of First Peoples.

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Phil Feain
Digital Technologies Curriculum Manager
VCAA

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Purpose of this session

- to build the capacity of teachers to develop compliant, rigorous and engaging VCE assessment tasks in line with the VCE assessment principles
- provide an overview of how to plan for the Unit 3 Outcome 2 School-assessed Coursework (SAC) task.

Outline of the presentation

This presentation will cover:

- Unit 3 Outcome 2
- Key knowledge
- Key skills
- The assessment task
- Planning the task

Unit 3 Outcome 2

Unit 3 Outcome 2 – The outcome

On completion of this unit the student should be able to define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns, and implement the algorithms.

Key knowledge

- basic structure of algorithms
- pseudocode concepts, including variables and assignment, sequence, iteration, conditionals and functions
- programming language constructs that directly correspond to pseudocode concepts
- conditional expressions using the logical operations of AND, OR, NOT
- recursion and iteration and their uses in algorithm design
- modular design of algorithms and ADTs
- characteristics and suitability of the brute-force search and greedy algorithm design patterns
- graph traversal techniques, including breadth-first search and depth-first search
- specification, correctness and limitations of the following graph algorithms:
  - Prim's algorithm for computing the minimal spanning tree of a graph
  - Dijkstra's algorithm and the Bellman-Ford algorithm for the single-source shortest path problem
  - the Floyd-Warshall algorithm for the all-pairs shortest path problem and its application to the transitive closure problem
  - the PageRank algorithm for estimating the importance of a node based on its links
- induction and contradiction as methods for demonstrating the correctness of simple iterative and recursive algorithms

Key skills

- interpret pseudocode and execute it manually on given input
- write pseudocode
- identify and describe recursive, iterative, brute-force search and greedy design patterns within algorithms
- design recursive and iterative algorithms
- design algorithms by applying the brute-force search or greedy algorithm design pattern
- write modular algorithms using ADTs and functional abstractions
- select appropriate graph algorithms and justify the choice based on their properties and limitations
- explain the correctness of the specified graph algorithms
- use search methods on decision trees and graphs to solve planning problems
- implement algorithms, including graph algorithms, as computer programs in a very high-level programming language that directly supports a graph ADT
- demonstrate the correctness of simple iterative or recursive algorithms using structured arguments that apply the methods of induction or contradiction

Unit 3 Outcome 2 – The assessment task

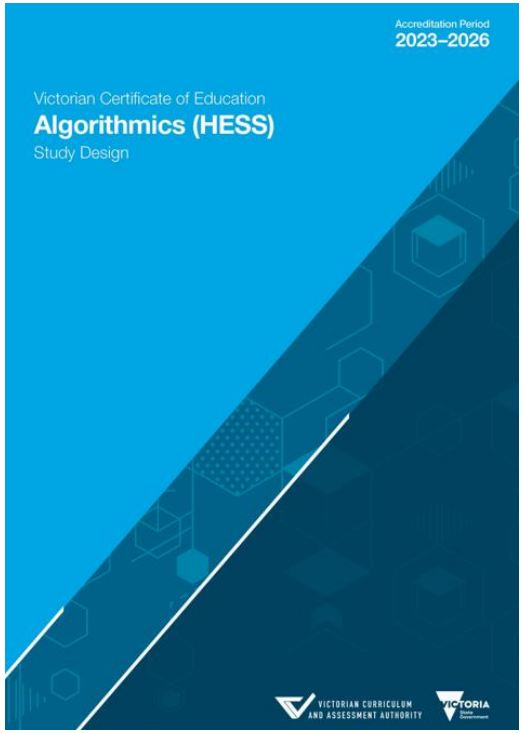
Contribution to final assessment

School-assessed Coursework for Unit 3 will contribute 12 per cent to the study score.

Outcomes	Marks allocated	Assessment tasks
Outcome 1 Define and explain the representation of information using abstract data types, and devise formal representations for modelling various kinds of real-world information problems using appropriate abstract data types.	**50**	In response to given stimulus material, create one or more designs of a data model using abstract data types to capture the salient aspects of a real-world information problem.
Outcome 2 Define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns, and implement the algorithms.	**50**	In response to given stimulus material: • create one or more designs of algorithms that apply algorithm design patterns or select appropriate graph algorithms to solve information problems • implement an algorithm.
Total marks	**100**	

Planning the Unit 3 Outcome 2 SAC task using VCAA resources

Unit 3 Outcome 2 Resources



Area of Study 2

On completion of this unit the student should be able to define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns, and implement the algorithms.

- ▸ Step 1: Requirements of the outcome
- ▸ Step 2: Determining teaching and learning activities
- ▸ Step 3: Designing the assessment task
- ▸ Step 4: Conditions of the assessment task
- ▸ Step 5: Marking the assessment task

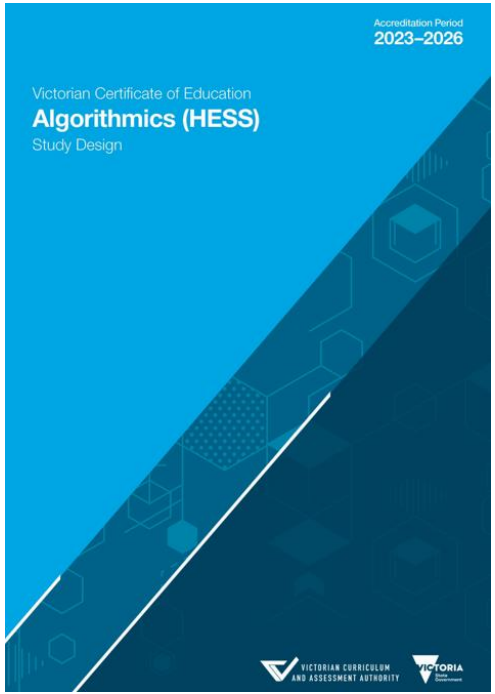
VCE Algorithmics (HESS): Performance descriptors

ALGORITHMICS (HESS) UNIT 3 OUTCOME 2
SCHOOL-ASSESSED COURSEWORK

Performance descriptors

	DESCRIPTOR: typical performance in each range				
	Very low	**Low**	**Medium**	**High**	**Very high**
Unit 3 Outcome 2 **On completion of this unit the student should be able to define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns, and implement the algorithms.**	Identifies limited elements of sequence, selection and repetition in a given algorithm. Manually executes a simple sequence of simple steps within pseudocode.	Interprets simple structured pseudocode with sequence, selection and simple iteration with minimal errors. Identifies some recursive, iterative, brute-force search design pattern and greedy design pattern features within pseudocode for an algorithm. Describes some elements of the concept of modularisation.	Interprets and manually executes pseudocode containing nested iteration and the use of ADTs. Describes the concepts of the recursive, iterative, brute-force search and greedy design patterns. Describes how the concept modularisation has been applied within a particular piece of pseudocode for an algorithm.	Interprets and manually executes pseudocode containing complex use of ADTs or simple recursion. Describes how the recursive, iterative, brute-force search or greedy design pattern have been applied within a particular piece of pseudocode for an algorithm.	Interprets and manually executes pseudocode containing complex use of ADTs and recursion. Completely and precisely describes how the recursive, iterative, brute-force search or greedy design pattern have been applied within a particular piece of pseudocode for an algorithm.
	Designs simple algorithms and writes these in pseudocode with significant task scaffolding required, and the final algorithm is only an effective method for a trivial subset of problem instances. Identifies some algorithm design approaches.	Designs simple algorithms and writes these in pseudocode, with some task scaffolding. The algorithm is an effective method for a non-trivial subset of problem instances. Explains the principles of the brute-force search or greedy algorithm design patterns, utilising appropriate examples.	Designs and applies algorithms including use of iteration and writes these in pseudocode with minimal errors. Designs modular algorithms. Applies a given algorithm design pattern to design an algorithm to solve a problem.	Designs algorithms using iteration and recursion for problems that have a structure that does not allow for the direct application of one of the studied algorithms. Explains the attributes required of problems for one of the algorithm design patterns to be applied.	Designs algorithms using iteration, recursion and non-trivial functions for problems that have a structure that does not allow for the direct application of one of the studied algorithms. Selects suitable algorithm design patterns for solving information problems and applies the design patterns to design algorithms and find solutions.

Algorithmics (HESS) Study Design



Key skills

- explain the role of ADTs for data modelling
- read and write ADT signature specifications
- use ADTs in accordance with their specifications
- identify and describe properties of graphs
- apply ADTs to model real-world problems by selecting an appropriate ADT and justifying its suitability
- model basic network and planning problems with graphs, including the use of decision trees and state graphs

Area of Study 2

Algorithm design

In this area of study, students learn how to formalise processes as algorithms and to execute them automatically. They use the language of algorithms to describe general approaches to problem-solving and to give precise descriptions of how specific problems can be solved. Students learn how to decompose problems into smaller parts that can be solved independently. This forms the basis of modularisation. Students explore a variety of problem-solving strategies and algorithm design patterns. Students explore example applications of these design patterns and learn about their implications for efficiently solving problems. They learn about recursion as a method for constructing solutions to problems by drawing on solutions to smaller instances of the same problem.

Students are required to implement algorithms as computer programs. The programming language used must explicitly support the ADTs listed in the key knowledge in Area of Study 1 either directly or by using a library.

Outcome 2

On completion of this unit the student should be able to define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns, and implement the algorithms.

To achieve this outcome the student will draw on key knowledge and key skills outlined in Area of Study 2.

Key knowledge

- basic structure of algorithms
- pseudocode concepts, including variables and assignment, sequence, iteration, conditionals and functions
- programming language constructs that directly correspond to pseudocode concepts
- conditional expressions using the logical operations of AND, OR, NOT
- recursion and iteration and their uses in algorithm design
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- specification, correctness and limitations of the following graph algorithms:
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Contribution to final assessment

School-assessed Coursework for Unit 3 will contribute 12 per cent to the study score.

Outcomes	Marks allocated	Assessment tasks
Outcome 1 Define and explain the representation of information using abstract data types, and devise formal representations for modelling various kinds of real-world information problems using appropriate abstract data types.	50	In response to given stimulus material, create one or more designs of a data model using abstract data types to capture the salient aspects of a real-world information problem.
Outcome 2 Define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns, and implement the algorithms.	50	In response to given stimulus material: • create one or more designs of algorithms that apply algorithm design patterns or select appropriate graph algorithms to solve information problems • implement an algorithm.
Total marks	**100**	

School-assessed Task

The student's level of achievement in Unit 3 Outcome 3, Unit 4 Outcome 1 and Unit 4 Outcome 2 will be assessed through a School-assessed Task. Details of the School-assessed Task for Units 3 and 4 are provided on page 18 of this study design.

External assessment

The level of achievement for Units 3 and 4 is also assessed by an end-of-year examination, which will contribute 60 per cent to the study score.

Sample approaches to developing an assessment task

Area of Study 2

On completion of this unit the student should be able to define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns, and implement the algorithms.

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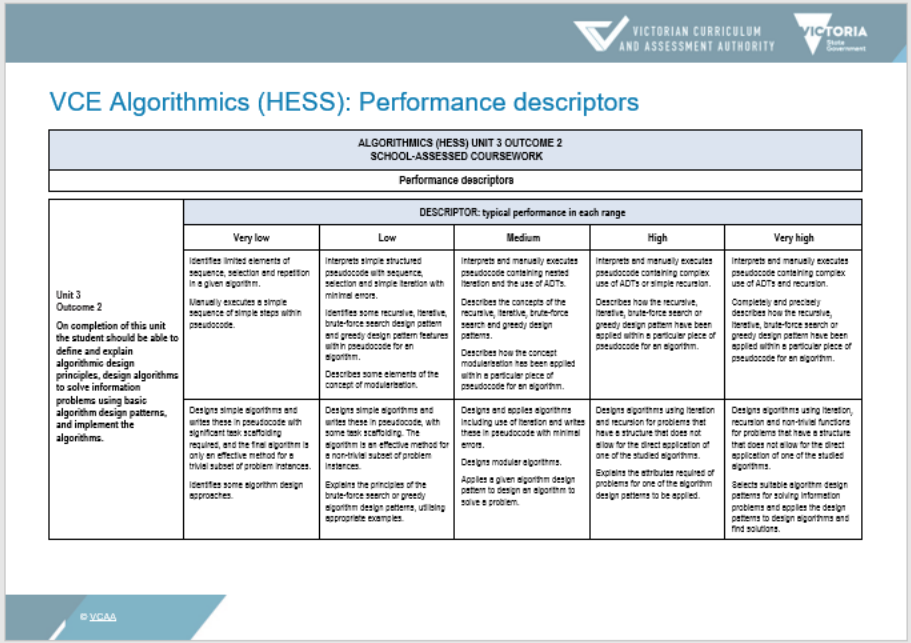
Performance descriptors



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VCE Algorithms (HESS): Performance descriptors

ALGORITHMICS (HESS) UNIT 3 OUTCOME 2 SCHOOL-ASSESSED COURSEWORK Performance descriptors					
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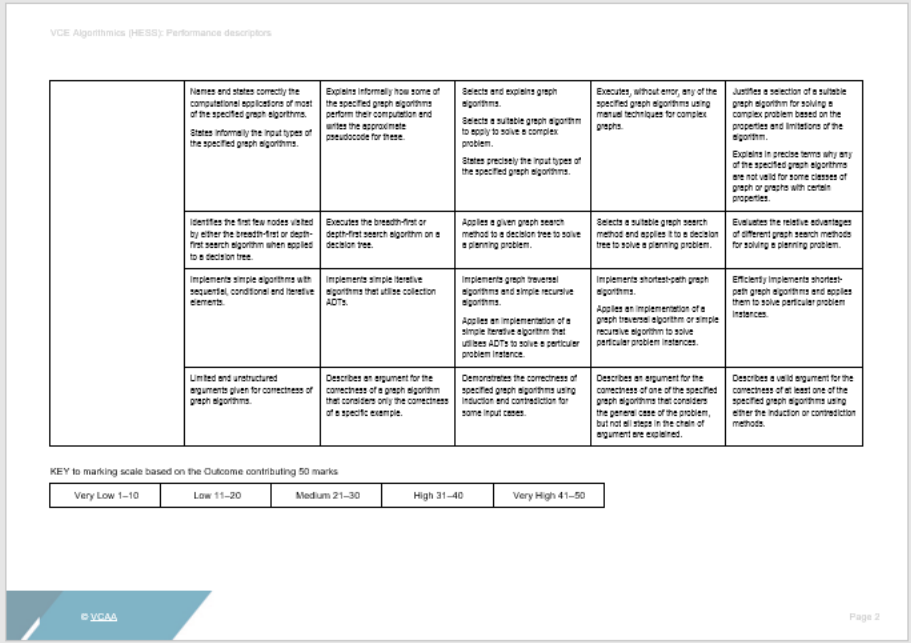

	Names and states correctly the computational applications of most of the specified graph algorithms. States informally the input types of the specified graph algorithms.	Explains informally how some of the specified graph algorithms perform their computation and writes the approximate pseudocode for these.	Selects and explains graph algorithms. Selects a suitable graph algorithm to apply to solve a complex problem. States precisely the input types of the specified graph algorithms.	Executes, without error, any of the specified graph algorithms using manual techniques for complex graphs.	Justifies a selection of a suitable graph algorithm for solving a complex problem based on the properties and limitations of the algorithm. Explains in precise terms why any of the specified graph algorithms are not valid for some classes of graph or graphs with certain properties.
	Identifies the first few nodes visited by either the breadth-first or depth-first search algorithm when applied to a decision tree.	Executes the breadth-first or depth-first search algorithm on a decision tree.	Applies a given graph search method to a decision tree to solve a planning problem.	Selects a suitable graph search method and applies it to a decision tree to solve a planning problem.	Evaluates the relative advantages of different graph search methods for solving a planning problem.
	Implements simple algorithms with sequential, conditional and iterative elements.	Implements simple iterative algorithms that utilise collection ADTs.	Implements graph traversal algorithms and simple recursive algorithms. Applies an implementation of a simple iterative algorithm that utilises ADTs to solve a particular problem instance.	Implements shortest-path graph algorithms. Applies an implementation of a graph traversal algorithm or simple recursive algorithm to solve particular problem instances.	Efficiently implements shortest-path graph algorithms and applies them to solve particular problem instances.
	Limited and unstructured arguments given for correctness of graph algorithms.	Describes an argument for the correctness of a graph algorithm that considers only the correctness of a specific example.	Demonstrates the correctness of specified graph algorithms using induction and contradiction for some input cases.	Describes an argument for the correctness of one of the specified graph algorithms that considers the general case of the problem, but not all steps in the chain of argument are explained.	Describes a valid argument for the correctness of at least one of the specified graph algorithms using either the induction or contradiction methods.

KEY to marking scale based on the Outcome contributing 50 marks

Very Low 1–10	Low 11–20	Medium 21–30	High 31–40	Very High 41–50

Review of presentation

This presentation covered:

- Unit 3 Outcome 2
- Key knowledge
- Key skills
- The assessment task
- Planning the task.

Contact

- **Phil Feain – Digital Technologies Curriculum Manager (VCAA)**
- **Ph: (03) 9059 5146**
- **Philip.Feain@education.vic.gov.au**

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