**Phil Feain** - Hello and welcome to the VCE Algorithmics Implementation on-demand video on the new Algorithmics Study Design for 2023-2026. The purpose of this video is to introduce the new School-assessed Task for Algorithmics commencing next year in 2023. My name is Phil Feain and I'm the Curriculum Manager for Digital Technologies with the VCAA. This presentation will cover: Unit 3 Outcome 3 SAT - Part 1

- key knowledge, key skills and the assessment task Unit 4 Outcome 1 SAT - Part 2

- key knowledge, key skills and the assessment task Unit 4 Outcome 2 SAT - Part 3

- key knowledge, key skills and the assessment task And the Advice for teachers. On this slide we have a screenshot of the draught VCE Algorithmics Study Design. The School-assessed Task now involves Unit 3 Outcome 3, as well as Unit 4 Outcomes 1 and 2. An all-new Advice for teachers is currently being developed to support the study in 2023. And an all new Administrative information for School-based Assessment will be published at the start of 2023. This will have the new SAT criteria. Over the next few slides, we'll have a look at the School-assessed Task. Part 1 of the SAT involves Unit 3 Area of Study 3 - Applied algorithms. In this area of study, students combine their knowledge of data modelling and algorithm design to solve real-world problems. Students consider a variety of algorithms and ADTs before selecting a suitable combination. They justify their chosen combination of algorithms and data types relative to other possible choices. Typically, the fitness of a chosen combination could be measured in terms of the selection of salient features to achieve an appropriate level of abstraction and the quality of result produced by the algorithm. The outcome statement for Unit 3 Outcome 3 states: 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 justifications. The key knowledge for Unit 3 Outcome 3 is: - 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 and - the application of algorithms to answering real-world problems. And the key skills are:

- 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 and - explain the interpretation of computer solutions in terms of their meaning to the original real-world problem being solved. This slide shows the assessment task for Unit 3 Outcome 3 - Part 1 of the School-assessed Task. The task for Unit 3 Outcome 3 is: The design of a data model and algorithm combination to solve a real-world or applied problem, including: - a specification of the problem

- a consideration of multiple solution options

- the selection of a suitable coherent, clear and fit-for-purpose solution. Further details regarding the SAT criteria will be in the new Administrative information for School-based Assessment to be published at the start of 2023. Part 1 of the School-assessed Task will contribute 8% to the study score. Part 2 of the SAT involves: Unit 4 Area of Study 1 - Formal algorithm analysis. In this area of study, students investigate the efficiency of algorithms using mathematical techniques. Students learn how some computable problems require such a large amount of resources that in practise it is not possible to solve these exactly for realistic problem sizes. Students examine specific, widely occurring instances of such problems and the reasons why these problems cannot be solved. Students analyse time complexity formally and informally, while they study space complexity as a general concept. Students are not expected to derive the space complexity of algorithms. The outcome statement for Unit 4 Outcome 1 states: On completion of this unit the student should be able to establish the efficiency of simple algorithms and explain soft limits of computability. The key knowledge for Unit 4 Outcome 1 is:

- the concept of classifying algorithms based on their time and space complexity with respect to their input

- techniques for determining the time complexity of iterative algorithms

- the definition of Big-O notation and its application to the worst-case time complexity analysis of algorithms

- recurrence relations as a method of describing the time complexity of recursive algorithms

- the Master Theorem for solving recurrence relations

- examples and common features of algorithms that have time complexities

- the concept of the P, NP, NP-Hard and NP-Complete time complexity classes for problems

- consequences of combinatorial explosions and indicators for them and - the feasibility of NP-Hard problems in real-world contexts. And the key skills are:

- formally analyse the time efficiency of algorithms using Big-O notation

- read off a recurrence relation for the running time of a recursive algorithm that can be solved by the Master Theorem

- use the stated Master Theorem to solve recurrence relations

- demonstrate how exponentially sized search and solution spaces impose practical limits on computability

- evaluate the suitability of algorithms to particular contexts based on their time or space complexity

- estimate the time complexity of an algorithm by recognising features that are common to algorithms with particular time complexities and - describe characteristics of problems in the P, NP, NP-Hard or NP-Complete time complexity classes, including the consequences for a problem's feasibility of it belonging to one of these classes. This slide shows the assessment task for Unit 4 Outcome 1 - Part 2 of the School-assessed Task. The task for Unit 4 Outcome 1 is: A formal time complexity analysis of the designed algorithm for the applied problem and an explanation of the consequences of these results on the algorithm's real-world application. Further details regarding the SAT criteria will be in the new Administrative information for School-based Assessment to be published at the start of 2023. Part 2 of the School-assessed Task will contribute 6% to the study score. Part 3 of the SAT involves: Unit 4 Area of Study 2 - Advanced algorithm design. In this area of study, students examine more advanced algorithm design patterns. Students learn how to select algorithmic approaches from a wider range of options, depending on the structure of the problem that is being addressed. They investigate how some problems are solvable in principle while being intractable in practise. They explore examples of such problems with real-world relevance and learn how such problems can be tackled by computing near-optimal solutions. The outcome statement for Unit 4 Outcome 2 states: On completion of this unit the students should be able to solve a variety of information problems using algorithm design patterns and explain how heuristics can address the intractability of problems. The key knowledge for Unit 4 Outcome 2 is:

- the binary search algorithm

- divide and conquer algorithms that have linear time divide and merge steps, including mergesort and quicksort

- dynamic programming algorithms that require no more than a single dimension array for storage, including the Fibonacci numbers and change-making problem

- tree search by backtracking and its applications

- the application of heuristics and randomised search to overcoming the soft limits of computation, including the limitations of these methods

- hill climbing on heuristic functions, the A\* algorithm and the simulated annealing algorithm and - the graph colouring, 0-1 knapsack, and travelling salesman problems and heuristic methods for solving them. And the key skills are:

- apply the divide and conquer, dynamic programming, and backtracking design patterns to design algorithms and recognise their usage within given algorithms

- develop different algorithms for solving the same problem using different algorithm design patterns, and compare their suitability for a particular application

- apply heuristics methods to design algorithms to solve computationally hard problems

- explain the application of heuristics and randomised search approaches to intractable problems, including the graph colouring, knapsack and travelling salesman problems. This slide shows the assessment task for Unit 4 Outcome 2 - Part 3 of the School-assessed Task. The task for Unit 4 Outcome 2 is: A design of an improved data model and algorithm combination to solve the applied problem, including: - the selection of an efficient, coherent and fit-for-purpose solution

- a time complexity analysis and - a comparison to the original solution. Further details regarding the SAT criteria will be in the new Administrative information for School-based Assessment to be published at the start of 2023. Part 3 of the School-assessed Task will contribute 6% to the study score. So, let's have a look at the Advice for teachers that will be new to Algorithmics to support teachers with the study. The newly developed Advice for teachers will include the following topics to support the SAT:

- Overview of Unit 3 and 4

- Teaching and learning activities for the key knowledge bullet points in each of the outcomes

- Detailed examples of the teaching and learning activities

- School-assessed Task for Unit 3 Outcome 3, Unit 4 Outcome 1 and Unit 4 Outcome 2 and the - Unit 3 and 4 Sample weekly planners to help you develop your course outlines or timelines. Thank you for following this presentation. If you have any questions regarding this presentation, you can contact Phil Feain, the Digital Technologies Curriculum Manager, at the contact details below.

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