**Phil Feain** - Hello and welcome to you all this afternoon and welcome to the VCE Algorithmics Implementation webinar. The purpose of this webinar is to support the teachers of Algorithmics with understanding the new study design that'll commence in schools at the start of next year, 2023. The main presenter for this webinar will be Georgia Gouros who teaches at Virtual School Victoria. Georgia is also the State Reviewer for Algorithmics and has been involved with the study since it first started back in 2015. Supporting Georgia tonight will be myself Phil Feain, the Curriculum Manager of Digital Technologies for the VCAA and we'll also have Tony Norman from the VCAA helping us out in the background as well.

Before we start this afternoon's webinar, we'll do the Acknowledgement to Country. The VCAA respectfully acknowledges the Traditional Owners of Country throughout Victoria and pays respect to the ongoing living cultures of First Peoples. This presentation will cover the following topics this afternoon. The changes to the new Algorithmics Study Design. Changes to School-based Assessment. We'll look at Unit 3 Outcomes 1-3 and Unit 4 Outcomes 1-3. And finally, we'll look at the new support material, formally known as Advice for teachers. There are a few changes to the new study design. Firstly, there are minor changes to Unit 3 Areas of Study 1-3 and Unit 4 Areas of Study 1-2 and there are major changes to Unit 4 Area of Study 3 and also School-based Assessment from 2 SATs to 3 SACs and 1 SAT involving 3 outcomes.

Looking at the changes to the School-based Assessment here on this slide there are now 3 School-assessed Coursework tasks or SACs. So, Unit 3 Outcome 1, Unit 3 Outcome 2 and Unit 4 Outcome 3. And there's one School-assessed Task or SAT and that's Unit 3 Outcome 3, Unit 4 Outcome 1 and Unit 4 Outcome 2. However, the percentage weighting of each of the components is still the same. So, the 3 SACs or School-assessed Coursework tasks contribute to 20%. The SAT or School-assessed Task contributes to 20% and the end of year examination still contributes to 60% of the score for the year for the study score.

All right, before we go on any further, how many of you will be teaching Algorithmics for the first-time next year? If you're able to put that into the Q&A, we'll see if we can respond tonight. Right, so it looks like a couple of you will be first time teaching. That's good. All right. Okay well look, we'll hand over to Georgia at this stage and what Georgia will do she'll go through, Units 3 and 4. She'll also go through each of the outcomes, talk you through what is going on within them and talk to you about the SACs, each part of the SAT and also what some of the content could look like in those tasks. Thanks very much Georgia. I'll hand over to you and Georgia just let me know when you want to change slides as well.

**Georgia Gouros** - Sure thank you, Phil. Hi everyone, welcome. And yeah, I'm just going to go through, as Phil said, Unit 3 and Unit 4 for 2023. So yeah, if you could put on the next slide.

So, Unit 3, the focus is Algorithmic problem-solving, and the Unit 3 Area of Study 1 is pretty similar to the current Area of Study 1. There's minor changes, the data modelling with abstract data types. So, in this area of study, students develop and apply knowledge and skills in data abstraction, and students consider the structure of information through a study of the definition of properties of abstract data types. They select appropriate ADTs and use them to model salient aspects of real-world problems. And students study a variety of collection-based data types, with a particular focus on the graph abstract data type, which encapsulates nodes and edges interconnections, and the students explore how the graph ADTs can be applied to network problems, such as social transport network problems and planning problems.

So, I think the only new abstract data type being introduced next year, I could be wrong. I think it's the set is a new one that's being added to the current repertoire of abstract data types. I have a feeling that's the only new one that's being added. So, if you could put the next slide on Phil. So, on the completion of this unit there will be a SAC assessment and students need to be able to 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. And this is assessed through the SAC, which is next slide, please Phil.

So, the Unit 3 Outcome 1 is now a SAC task. This is different to the current study design. So, the SAC covers Outcome 1. Define and explain the representation of the abstract data types. And it's 50 marks. And it's the stimulus material can be things like create one or more designs of a data model using abstract data types to capture salient aspects of real-world problem, real-world information problems. So, can I have the next slide Phil please? So, this is an example of something that could be presented to students as a stimulus material for SAC. The SAC for Outcome 1 Unit 3 students could be asked to create a data model using the abstract data types in the course. This example is showing representations of characters and relationships in a novel. So, you can do a bit of cross-curricular work with your English teachers and perhaps get the students to create those models of the characters in their novels that they're studying. And of course, part of the assessment would also be the students have to explain how their data model captures the details of the characters and relationships in the movie or novel that they're representing. So, the next slide, please Phil.

So, these are the current draft performance descriptors for Unit 3 Outcome 1. So, this is still subject to change, and I can't really read them all that well the way they're printed just there, but they are going to be included in the teacher support material that's coming out soon. And of course, the rubric has the very low to very high criteria against different aspects there for Unit 3 Outcome 1.

So, there's not a lot of change other than the introduction of the set abstract data type to the 2023 curriculum. It's pretty similar to the current design in terms of content. The assessment is now a SAC assessment, rather than a SAT. And I think that's the main differences. So, does anyone have any questions regarding this Unit 3 Outcome 1?

**Phil Feain** - So we'll just see if there's any questions coming in Georgia. We've had one question from before. Question asked was, will these slides be available after tonight? Yes, we are recording this. The recording will be made available. And normally we make the slides available to people that registered for the session as well. But this session goes into a bit more detail to the sessions we've got for the on-demand videos, which hopefully you've all seen as well. No questions so far Georgia.

**Georgia Gouros** - Okay, well maybe we should press on with the next outcome. So, the next, sure. So, Unit 3 Area of Study 2. This is the algorithm design area. In this study, students learn how to formalise processes as algorithms and execute them automatically. They use the language of algorithms to describe general approaches to problem-solving and give precise descriptions of how specific problems can be solved. Students learn how to decompose problems into smaller parts that can be solved independently. And this forms the basis of modularisation. Students explore a variety of problem-solving strategies and algorithm design patterns.

And 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 use of a library. So, thank you Phil if you pass on the next slide.

I think this area, this outcome in Unit 3 is very, very similar to the current Outcome 2 Unit 3. I think there's just minor changes with, ... just got the study design here. I have a feeling the minor change is related to, ... I think everything's pretty much the same. I've just printed this off. I'm just having a quick look at it. It looks pretty similar to what we currently have for 2022. So, it encompasses all those graph traversal techniques and those graph algorithms as well. So, on the completion of this unit those students should be able to define and explain algorithmic design principles, design algorithms to solve information problems using basic algorithm design patterns and implement those algorithms. So, can I have the next slide please Phil?

So, this is now assessed with a SAC assessment. This outcome that's a change to the current course. So, students have to in Outcome 2 SAC for Unit 3, In response to given stimulus material: create one or more designs of algorithms that apply the algorithm design patterns or select appropriate graph algorithms to solve information problems and implement an algorithm in a coding language that has supports graph abstract data type capabilities in the form of a library. So, can I have the next slide, Phil?

So, this is an example of something you could present as stimulus materials to your students. Something they're familiar with, possibly from their Maths. Some do lots of cross-curricular now it's the Maths teacher's turn so they can write or implement an algorithm to generate a Pascal's triangle to K levels. And they could actually make it as a connected tree or graph, whatever you wanted them to do to test their understanding of creation of algorithms and implement their algorithm in a coding language. Suggested languages that you can use that do have graph libraries. Of course, the SnapApps/Edgy is still around and still functioning. And you can also, or instead of that, you can use Python with NetworkX libraries or other graphing libraries in Python and or other languages as you need to. So that's just an idea and that's something you could do in an assessment in the classroom. So can I have the next slide please, Phil.

**Georgia Gouros** - So this is the draft of the Unit 3 Outcome 2 the descriptors of course is very, very tiny, but it's current draft and it's subject to change. And as for the previous outcome, it will also be included in the teacher support material. Yeah, so is there any questions regarding Unit 3 Outcome 2? Which was the algorithm design outcome. Is there any questions Phil I can't see any?

**Phil Feain** - It's all good now here we're happy to move on.

**Georgia Gouros** - Edulists. Somebody saying can it be shared on Edulists? I don't know what Edulists is, what is Edulists? Don't know. I never used that I'm sorry. Okay so we'll move on to Unit 3 Area of Study 3, which is Applied algorithms. So, in this area of study, students combine their knowledge of data modelling and algorithm design to solve real-world problems. Students consider the 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. So, can I have the next study, slide please?

So, on completion of this unit the student should be able to design suitable solutions for real-world problems that require the integrating of algorithms and data types, including the communication of the solutions and their justification. Can I have the next slide please? So, in this Unit 3 Outcome 3 the assessment is a SAT assessment. And in this assessment, the students are required to design a data model and algorithm combination to solve a real-world problem, including: a specification of the problem, a consideration of multiple solution options, the selection of suitable coherent clear and fit for purpose solution. So, this is similar to what's currently being assessed in the current course design with a SAT at my school, we call this our project. So, this is a project task, a project SAT task, and it encompasses the application of knowledge and skills learned in Outcome 1 and 2. So can I have the next slide please Phil?

So, here's a very sort of open-ended kind of problem for assessing Unit 3 Outcome 3. This is designing an algorithm solution for the Travelling Archaeologist problem and it's good to have constraints defined. So, this would be something the teacher would include in the stimulus material for the student to proceed with this SAT. The student would select the abstract data types and maybe prompts for students to consider the graph algorithms studied and graph an algorithm design patterns studied in Unit 3. Students of course, have to be able to justify their selection of abstract data types and algorithms in their solution and explain their selection process. This is done at Virtual School Victoria through a blog as well as a formal documentation. So that's an idea for you to keep in contact with your students while they're working on their project to have some sort of blog activity online so they can record how they're going and we call it a journal at my school, but yes essentially a blog. So, can I have the next slide please Phil?

So, the draft for the Unit 3 Outcome 3 will have 4 criteria and this is the draft subject to change, which are 1 to 4: Skills in understanding and modelling a real-world problem. Skills in the selection and design of algorithms to solve a real-world problem. Skills in the implementation of algorithmic solutions to a real-world problem and Skills in the evaluation of algorithmic solutions to a real-world problem. Now the thing that teachers have to keep in mind is that this project will continue into Unit 4. So, it's important to consider that the problem that is presented to the students in Unit 3 is able to continue to work, to be worked on in Unit 4, possibly expanded with extra criteria to be able to fulfill the assessment tasks in Unit 4. So now the next slide, please Phil. Okay so are there any questions relating to Unit 3 Outcome 3?

**Phil Feain** - Yeah, we've had one question Georgia. I'm not too sure whether they got it right. The question was, how long does the SAC need to be? We've been talking about Unit 3 Outcome 3, the SAT. So, the person that asked that question might just sort ask and clarify. Were you asking about Unit 3 Outcome 2 or the Unit 3 Outcome 3 SAT? Alright. Outcome 1 and Outcome 2. You'd be talking about a number of lessons wouldn't you Georgia?

**Georgia Gouros** - I don't know I can't really, ... the current SAT task that we assess Unit 3 Outcome 1 and 2 are said to be like between 45 and 60 minutes long.

**Phil Feain** - But we're not following that the same way. From my perspective. One of the things that's worried us is a lot of assessment has just been very short tests and it doesn't enable the type of responses that we want to see through the outcome. So, we would expect our SACs, so School-assessed Coursework and SATs, School-assessed Tasks to be longer. They're not one period tests or anything like that anymore. So, in the ... what used to be the Advice for teachers, what will call support material, we'll have some material in there around timings for the outcomes. And I think next year, what we're hoping to do with the on-demand videos at the start of the year that we'll put up to support it is give some suggested timings and things for these tasks.

**Georgia Gouros** - Just trying to have a quick look. ...

**Phil Feain** - descriptors worked out.

**Georgia Gouros** - Yeah, I don't think it currently says much about whether there's any timings or anything does it so.

**Phil Feain** - No, but we could give some ideas next year.

**Georgia Gouros** - Okay. I guess one or two periods would be a practical consideration in most school settings.

**Phil Feain** - Yeah, I think one period for SAC is pretty brief from our perspective, Georgia. Very brief and not enabling what we'd like, yeah.

**Georgia Gouros** - Okay. Okay so I don't think we can answer the question like explicitly, minutes or anything like that at present.

**Phil Feain** - No, we're not having timings put into the new study design. And that was because we were getting tests-like assessment. And I know some people don't quite understand, but tests are not a form of assessment for School-based Assessment. And we were seeing tasks that were basically looking like the exam, but it was like people giving exam questions and even multiple-choice questions for SAT components, which is not really what we were wanting, but we can look at that at the start of next year. Georgia, you want to move on.

**Georgia Gouros** - Yes, so if you can go to the next slide. So, we're studying on Unit 4 Principles of algorithmics. So next slide please Phil. So, this is formal algorithm analysis. Unit 4 Area of Study 1. 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 practice 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. So next slide, please Phil.

So, Unit 4 Outcome 1, on the completion of this unit the student should be able to establish the efficiency of simple algorithms and explain soft limits of computability. So, the next slide please Phil.

So, this is a continuation of the work done in this SAT from Unit 3. This is the assessment continuing on that project, whatever you're going to call it at your school. Outcome 1 Unit 4 on the SAT task. And in this assessment, the student has to establish the efficiency of the simple algorithms they created in their project task, or their SAT task in Unit 3 and explain the soft limits of computability. And the assessment involves 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. So next slide please Phil.

So, this is continuing the project from Unit 3. So, the students will have created an algorithmic solution for Unit 3 that they now have to do an analysis of and establish the time complexity of their solution. This example continues on with the Travelling Archaeologist problem as defined by the constraints set out in the Unit 3 prompts and the students would evaluate and investigate and report on the time complexity of their own solution that they created in Unit 3 for this assessment. Next slide please Phil. Oh, is that the next slide? It's the same as the one before it's a double up. Oh yes, it is. Can I have the next slide please Phil?

Okay so Unit 4 Outcome 1. These are the draft SAT criteria. There are three criteria currently in the draft. Skills in the classification of problems. Skills in determining the time complexity of algorithms. Skills in the comparative formal analysis of algorithmic solutions to a real-world problem. So, I guess as part of their SAT assessment they could also investigate other approaches they could have used for their developing their SAT in Unit 3. So, can move to the slide please Phil? So, are there any questions regarding Unit 4 Outcome 1?

**Phil Feain** - Yeah, we've got a couple of questions come through Georgia. So, first question is, if students write a fairly simple algorithm for their project, how can we assess all of 4.1 just using their algorithm as an example?

**Georgia Gouros** - And that's an excellent question. Of course, if the student has a very small algorithm with minimal content, they do need to be able to continue on, have some teacher support to add features or something extra to their algorithm that they had assessed in Unit 3, to be able to complete Unit 4, the Unit 4 assessment in Outcome 1. So some sort of model, perhaps the teacher could advise the student what they need to do to be able to prior to starting the SAT assessment that you'll the teacher will know at the end of Unit 3 whether the SAT is going to be able to assess all the criteria for Unit 4 and will be able to advise the student how to amend the algorithmic solution and include elements that will allow them to access the highest criteria in Unit 4.

**Phil Feain** - We've actually written something into the support material. So, if any of you're familiar with Data Analytics and Software Development, we actually have a paragraph in our Administrative information for School-based Assessment. So, if there's issues coming out of Unit 3 Outcome 2 that would impact them going into Unit 4 Outcome 1 what can actually be done. We have comments there made for students if there's issues coming out of Unit 3 Outcome 3 going into Unit 4 Outcome 1 and likewise going from Unit 4 Outcome 1 into Unit 4 Outcome 2. And you'll see those comments in there when the support material is published. And I think you're involved in writing that Georgia. So, I do remember checking those comments at some point, but that was to guide teachers around if students didn't have everything they needed, what process could be followed to enable not to have consequential issues going into the next outcome.

**Georgia Gouros** - So this outcome is essentially in terms of key knowledge and key skills is really, really similar to the current course. There are a few extra things, extra bits and pieces. NP-Hard is explicitly mentioned as part of the key knowledge this time in Unit 4 Outcome 1. And also, what else is, I'm just trying to look here. That's the only new thing. Yes, so for the NP-Hard category of problem classification is explicitly mentioned. Now we're only as during the time complexity analysis for Big-O. Worst-case time complexity is no longer, there is no longer best-case time complexity in the new course. So, it's just the worst-case complexity analysis that's required. So that's slightly different.

**Phil Feain** - We also have another question, Georgia. How do we ensure the equity of a formal time complexity analysis as each student will design their own algorithm?

**Georgia Gouros** - That's a really good question. That's really similar to the one before. So, at the end of Unit 3 when the student has finished their project, you should be able to assess whether they're going to be able to achieve all the criteria in Unit 4. And so, whatever's in the criteria that's published in the final version of the course for Unit 4 Outcome 1 you need to keep that in mind when you're assessing Unit 3 Outcome 3 and advise the student that they need to do whatever is required to be able to get to those highest scores possible in Unit 4. So basically, whatever the key skills and key knowledge are for Unit 4, that they're sort of driving what you have to teach. But of course, the criteria determine how you want to advise your student about their project and adding extra functionality perhaps to achieve, to be able to reach those highest scores in the rubric. Hope I've answered that question. It's really similar to the one before.

So, because it's such an open-ended SAT project students can decide to not do very complicated algorithms. And then that gives them less scope, of course, for doing formal time complexity analysis. So, it just needs to be picked up by the teacher at the end of the Unit 3 assessment and every assessment will be different. You could provide a model solution, what you're expecting students to have going into Unit 4 and have them add that or include that kind of functionality or I hope I've answered that question.

**Phil Feain** - Do we have any other questions at all? All fairly quiet at the moment, Georgia we can move on.

**Georgia Gouros** - Okay so we'll go to the next Unit 4 Area of Study 2. This is 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 practice. They explore examples of such problems with real-world relevance and learn how such problems can be tackled by computing near-optimal solutions.

Thanks Phil and then next slide please. So, this is on the completion of this unit the student should be able to solve a variety of information problems using algorithm design patterns and explain how heuristics can address the intractability of problems. So, this is essentially ... it's pretty similar to the current study. There are a few new things. The binary search algorithm is explicitly in now in the key knowledge. What else is new? The A\* algorithm has been included in the study of heuristics in this outcome. Just trying to see what else is new here. Yeah, that's the new addition. So those two things are new binary search algorithm and A\* algorithm. I can't remember what was left off. There are a few things that have been left off. Minimax is no longer there, that's gone, for those people who have been teaching it for a while. I think that's the major changes. Okay so yes so thank you Phil next slide please.

So, this is continuing on from that project from Unit 3. So, this is now the student takes their solution that they created in Unit 3 for solving that problem that was presented in Unit 3 in their SAT. And they are asked as part of this assessment design of an improved data model and algorithm combination to solve the applied problem, including: the selection of efficient, coherent, and fit for purpose solution, time complexity analysis of their new solution and a comparison to the original solution. So, this is applying the skills being taught in this Unit 4 Outcome 2. So, the advanced algorithm design patterns which are the backtracking, dynamic programming and divide and conquer. And also, the heuristics that are taught in this topic, this area of A\* randomised heuristics, simulated annealing and hill climbing. So yeah, so thank you Phil, next slide please.

So, suggestion is to have a problem that's actually quite challenging presented in Unit 3 so that these advanced algorithm design patterns can be applied. Now the Travelling Archaeologist problem is akin to the travelling salesman problem. So now the student can actually include ... update their solution and include those advanced algorithm design patterns as well as those heuristics in this ... taught in this Unit 4 Outcome 2 and compare the solution to the original solution that they did in Unit 3. Some new constraints may be required to be added. Maybe some features need to be optimised, which will then enable the students to use the heuristics as part of their solution. And maybe some of the criteria for ... and constraints for the problem might need to be changed so that they have to use things like backtracking or other advanced design patterns. Of course, a student has to compare their new solution to their prior solution that they created in Unit 3. So next slide please Phil.

So, these are the Unit 4 Outcome 2 draft SAT criteria. Currently draft of course. Subject to change skills in the selection and design of advanced algorithms to solve a real-world problem. Skills in the implementation of advanced algorithmic solutions to a real-world problem and skills in the evaluation of advanced algorithmic solutions to a real-world problem. So next slide please Phil. And are there any questions relating to Unit 4 Outcome 2?

**Phil Feain** - All quiet at this stage Georgia.

**Georgia Gouros** - So the project's bigger than ... oh, project's very big.

**Phil Feain** - How important is the comparison? If we add constraints, can we still compare?

**Georgia Gouros** - Well, what does the student know in Unit 3? You could possibly put those constraints in Unit 3, and they could try and address them with brute-force methods, which are taught in Unit 3. And then come to Unit 4 where you try and perhaps make the solution a bit more responsive, a bit more faster, but using heuristics. So, I guess if you wanted to, you could impose those constraints right from Unit 3, or you could put them on later. It's important to have something there that is going to actually cause the solution to become inefficient either with large data sets.

Should you constrain what sort of algorithm that they use? I can't really answer that, but we'll coming in Unit 4, some of the algorithms that are studied that are the classic travelling salesman, problem, knapsack and map colouring. There are different scenarios where you could disguise those problems to your students in different settings for the Unit 3 project and perhaps have fewer constraints that you tighten in Unit 4. They are studying all those graph algorithms as well in Unit 3. So, they have all those shortest path algorithms to do. Yeah, so that's why maybe adding extra constraints in the Unit 4 might be the way to go, because you don't want them to do everything perfectly in Unit 3. Otherwise, they've got nothing to do in Unit 4 if they've already applied heuristic solutions in Unit 3, I don't know what you can do for Unit 4. I hope I've answered this part.

**Phil Feain** - Yeah, we've had another question there. Can we add additional features in Unit 4?

**Georgia Gouros** - Additional features to the problem? Yeah, I think so if you add extra constraints. There are additional features I believe. You could ask them to use more, to include more information possibly. Would that be so you could ask them to include more information so that you could apply those advanced algorithm design patterns. That's why the optimisation is the one I can think of that leads to the use of say said something like dynamic programming or the use of the heuristics, but it's something to think about and... if a student writes a perfect solution in Unit 3 it is problematic. Where do you go to in Unit 4? If they've a student that's, an advanced student might have done ... put in heuristics of read ahead and read that you need to have simulated annealing and have a simulated annealing solution in Unit 3. That could be problematic. So, want to try and not have that happen.

**Phil Feain** - No other questions Georgia.

**Georgia Gouros** – Okay. Okay so the next slide please Phil. So, this is the Unit 4 Area of Study 3. This one has changed the most from the current study. Computer science: past and present. In this area of study, students examine the emergence of computer science as a field and the philosophical and technical ideas that support the emergence of modern artificial intelligence. They explore how the quest to develop methods for mathematical proof led to the proof that there exist problems that may not be computed automatically. Students investigate how machine learning algorithms learn from data and engage with several conceptions of artificial intelligence and whether it's possible. They examine and discuss some of the ethical issues posed by the application of data-driven algorithms. Students are not required to produce formal proofs or formal explanations concerning undecidability. Next slide please Phil.

So, on completion of this unit the student should be able to explain the historical context for the emergence of computer science as a field and discuss modern machine learning techniques and the philosophical issues they raise. So, this area of study has changed quite dramatically from the current study. So, this, we now have ... we now have two machine learning methods or algorithms incorporated into this Unit 4 Outcome 3, which are the support vector machine and the neural networks. This has changed. The DNA computing has gone completely. There is more formal connection with Hilbert and Ackermann's, now I can't even say that word, decision problem in German. Thank you. And the inclusion of ethics as well. And I think they're the main changes.

The ethical issues are relating to the accountability of data-driven algorithms, including transparency, accountability bias and machine ethics. Yeah, overfitting and underfitting relating to the machine learning. And of course, the machine learning has got more detailed explanations required. The Chinese Room Arguments still in there from the previous study. Turing test is included explicitly and a discussion of strong AI and weak AI as conceptions of artificial intelligence, that's new. Evaluate the output of a small multi-layer perceptron neural network using forward propagation. That's new as well. So, there are a few new skills. Quite a few new skills added to this Unit 4 Outcome 3, as well as the corresponding knowledge elements. So next slide please Phil.

So, this is assessed through a SAC task. So, in this SAC task, students select at least one task from the following: either a response to a case study or stimulus material, a written report, an annotated visual report, an oral report or structured questions. How much detail do they need to know about...? What's that question? Backward propagation? Well, it's not explicitly mentioned as a key skill. All they have to know is to evaluate as a skill, to evaluate using forward propagation. I'm just having a look at the study design myself, to see what it says about backward propagation. It's not explicitly mentioned, I don't think. But then it talks about the evaluation of outputs using forward propagation. That's what the key knowledge says. Is it possible for the supporting materials to give clarity of what is and isn't expected of students in this outcome? Well, the study design document is actually the is defining what knowledge and skills students need for this outcome. And I guess the criteria rubric will inform the assessment. I hope I ... Is it possible for the supporting materials to give the clarity of what is and isn't expected of students in this outcome? I think you'll find the study design outlines what is expected. I hope I've answered that question, I'm not sure.

What do you mean the dot points in the study design are open ended? Training a neural network by using ... oh yes. Yes, that bit is open ended. I did ask that question myself recently. Yes, there are a lot of things that is quite open ended. The resurgence of AI neural networks in the late 20th century. I think that can be explained by just referring to things in social media. Facial recognition in social media apps like Facebook and all of that kind of thing. And just the speed of processing on computers, really. I don't know anything further than that. I did read something that the gamers are actually responsible. The gamers are the people we need to thank for increased computer power. And sort of hitching off the back of that is the resurgence of neural networks apparently. But I don't know if that's the right answer. Yeah, deep learning. Deep learning is an area that's come off the resurgence of neural networks. I think computing power is basically the answer about the factors leading to the resurgence in neural networks. Any more questions there? Yep ... okay. Can I have the next slide please Phil?

So, in Unit 4 Outcome 3 SAC content, what stimulus material could you put as your questions or your structured questions? Things to like ... what support vector machines? What are they? Et cetera. Defining all these definitions. So, assessing all the key knowledge and then perhaps asking students to do more applied kind of demonstration of their learning. Find showing the hyperplane and support vectors for following inputs and data representations, et cetera. Okay next slide please Phil.

So, this is ... a sort of a prompt you might like to use. You could have a bad situation. A support vector machine has decided to put the hyperplane there for somewhat unknown reason. And of course, once that happens and you've got misclassified information you can then have students explore the technical concerns of underfitting or not enough training data and the ethical concerns relating to decisions based on the outcome of wherever that hyperplane has been placed regarding opacity and human interaction and privacy concerns and effects of AI concerns. What happens to outliers? I don't think anyone cares in the world of AI, but maybe we should be caring and asking students to think about that too. So next slide please Phil.

So, these are the draft performance descriptors for Unit 3 Outcome ... Unit 4 Outcome 3 I should say. And these are currently draft, and they will be included in the teacher support material. So next slide please Phil. So, are there any questions relating to Unit 4 Outcome 3 which has changed rather a lot from the current study design?

**Phil Feain** - No new questions at this stage Georgia.

**Georgia Gouros** - Okay. So, I think some people had some relevant questions. How much time these topics are very large. Some of these topics in Unit 4 Outcome 3, but realistically speaking, you're teaching, this is a third of the time you have allocated for Unit 4 to teach this outcome, however many weeks that is at your school. So, I mean, you've got the study design to focus your mind on the key knowledge and key skills. So really things that have one sentence, like explain and discuss ethical issues relating to AI and data-driven algorithms. I mean, you could do that a whole, whole year of that at university I'm sure, but you will probably only get one week to do it in your setting probably, if that, don't know. So that's something you need to keep in mind. How much of the curriculum you have to teach in the time available at your school.

**Phil Feain** - And Georgia, keep in mind too, that in the support material will actually have Sample weekly planners. So similar to what we've got with Data Analytics and Software Development. There's a plan of how you could implement this over the course of a semester. So, where you could fit these outcomes in and where you could be doing content week to week. Now we know every school has different timetabling arrangements for a semester. So, I know some people look at it and go look that doesn't fit to my school. Well, we know that, but we are giving you a model of, these are models done by our teachers. And you can look at this to get some ideas of how you could fit a plan around a course outline and what you could be doing week to week as well. And we haven't had that in this study before. We haven't had any Advice for teachers before. So now we'll have that support material coming to assist with supporting the study design for the life of this new study design.

**Georgia Gouros** - Yeah and of course at Virtual School Victoria, we use, well, traditionally we've used the GAT week to separate our Unit 3 and Unit 4, but the GAT seems to move have moved around this bit this year and other years due to COVID. So, we kind of we still have 16 weeks of Unit 3 and sort of twelvish, fourteenish weeks of Unit 4. But every school is different in the way they plan that. But as Phil said, the teacher support materials have suggested sequences.

**Phil Feain** - And look, we know it's different in some schools, particularly where Term 2 will vary where schools have their exams and the way they wrap up Semester 1. And we've got a question here about starting Unit 4 earlier. I'm always a little bit reluctant to say start something earlier. Unit 4 should start ideally when the end of Semester 1 ends. So, Semester 2 starts probably around last two weeks of Term 2. That's really where it should be starting. But we also know Unit 4 is a lot shorter than Unit 3 because generally most schools are wanting to finish Unit 4 by that last week of Term 3. And that way they deal with exam prep. While we are auditing, not so much in Algorithmics, but I see in Software Development and Data Analytics in some schools, they're finishing Unit 4 in the first couple of weeks of Term 3.

And you get really nervous about that because you look at how they're doing their School-based Assessment and the problem you see is they're probably not getting all that learning that they should in class. We know some schools do a lot of exam prep in the last couple of weeks, but if the teaching and learning is really good throughout the course of developing an outcome. If you've got really good School-based Assessment and that does take time, what we find is a lot of the learning for the students is going to be a lot more superior than less time. And that's also stuff that they remember a lot better leading into your exam prep time. Then over the years, I've spoken to a lot of people about a lot of models they've done and really trying to find a good amount of time to deliver each outcome. Fit it in. Look at how long you're going to spend on assessment. Look at how long you're going to spend on the teaching and learning with the support material. And Georgia will tell you more about this because she was one of the co-writers of the teaching and learning activities that we've got to help support delivering each of the key knowledge dot points.

One of the biggest concerns over the years and you see different models and what Advice for teachers used to be. But a lot of teachers will often say, well, how does that, or what do activities look like that can help me teach students around that. So, we've actually got that coming in haven't we Georgia?

**Georgia Gouros** - Yeah and you can actually use them as practice tasks for your students in the lead up to the actual SAT and SAC tasks. That's what they're there for. So, the students get an opportunity to fully understand what's expected of them.

**Phil Feain** - And I think to, before going on I know we'll talk more, a little or a bit more about this towards the end of presentation. It's very hard trying to develop an idea of what information we can provide to support teachers for assessment tasks, because we can't give you all the details that textbooks would give you. We're not in the position to do that. We can't give pedagogy and all of those things, but what we can try and do is to try and develop some support material at the start of next year that scaffolds some ideas about developing tasks, so timelines, et cetera. And that's something we're looking at.

The biggest challenge for us is actually getting teachers to write that with us. We are an incredibly small community and as such, I have to rely on our teachers to help us write these things and it's getting increasingly difficult. So, this year, normally by now we would have a draft of the support material or the Advice for teachers to show you. It's taken us a bit longer this year because it's been challenging trying to get things done at different points with people getting COVID and timelines spreading out a bit more time. Normally we would try and have some more draft material around the SAT, but again, it's been difficult with people being available to do it and when we can actually have it done by. But as that material becomes available, we will put out through the Notices to School.

So once the support material's available and published, we'll actually let you know. When we've got the Administrative information for School-based Assessment in a draft form, we're hoping to have a focus group to actually go through that later on this year. If we get the time to do that and that'll be published early next year. Normally in time before school's back. So that's the plan there. Georgia, my question there, do you have any suggestions for independent activities for students over the summer?

**Georgia Gouros** – Well, we get all sorts of students at Virtual School Victoria, like kids who haven't even coded ever before, because there's no prerequisite for this study other than Maths Methods 1 and 2. So I ask those students to get the textbook that I wrote. I don't want to be promoting that in front of you all, but I have written-

**Phil Feain** - You're not meant to be promoting products here come on.

**Georgia Gouros** - But that's what I ask them to do. If they've never coded before, especially if they've never coded before are rusty or feel that they're rusty to actually get that book over the summer and actually work through the first few chapters, just to build up their understanding of bit of application of coding and a bit of understanding of reading an algorithm. It helps because of course, if you're learning it for the first time ever, you need a bit of help because there'll be other students in your class that are very familiar with that environment. So, you want to help those students so.

**Phil Feain** - Georgia, would you say terminology when students are unfamiliar is important? So going through having the terminology. Terms to be used with each of the outcomes and maybe students being able to list them, define them.

**Georgia Gouros** - For sure.

**Phil Feain** - A bit more about them. That gives them a bit of background familiarity before they go into the study the following year.

**Georgia Gouros** - Yeah well, I agree. The cognitive load of learning new terminology, it can be overwhelming for those students who are unfamiliar with coding at all. So, they've just going to have a cognitive overload and they're going to be quite stressed because there will be students in your class that have done all of that before. So, they do need those students I feel need some help. The other students who are already participating in coding as a hobby, I don't think they need so much help over the school holidays.

**Phil Feain** - Georgia we've just had a question there about setting up a network. It is something we are working on. How we do it is something we've got to consider. One of our challenges is, yes, we are a small community. There are some people that would like to be involved, but it's trying to find those times when we can be involved and what that level looks like. So, we're trying to talk to the universities about it because it's the way we support the community. And they're still trying to get contracts with the universities, et cetera, to shore this up, but we are working on it, and it is something we would like to do.

And definitely coming out of the review process last year was something we all talked about wanting to meet a little bit more regularly, talk about what we're doing and working together. But it is feasible. We've just got to look at how we do it. What do you reckon, Georgia? We move on a bit and then we can wrap up with things after. We're doing well for time tonight I must say.

**Georgia Gouros** - Yeah, yeah. That's fine with me. I think I've finished talking to all my slides, Phil. Is that the last one for me?

**Phil Feain** - Oh you have. I could go through a couple more if you want there's ...

**Georgia Gouros** - Or is there some more material?

**Phil Feain** - Do you want me to go through that? I can do that.

**Georgia Gouros** - Oh, is that for me, okay.

**Phil Feain** - I can do that if you want.

**Georgia Gouros** - Well you know the answer. When is it available?

**Phil Feain** - I don't know the answer to that, but yes. Don't quite know the date myself. Yeah, look the support material. So, this is formally known as Advice for teachers. So, studies that are being implemented next year for the first year of the study design, rather than having the item that we used to have called Advice for teachers, will now be called Support material and it will have a very different appearance and break it down into Planning, Assessment, et cetera. So that it should be an easier menu. If you notice our Advice for teachers in some studies, it's a very difficult menu to navigate. So, what we're trying to do is create a much better way for people to access material they want. Unfortunately, not a lot of teachers want to go and search for things. We're also aware that some people will use old bookmarks, which will link to previous study designs. ‘Cause these things are archived on our website unfortunately. So, we often say to people you need to make sure you update your bookmarks.

But one of the things I'll do is just sort of go through what we've got with the support material. So, we'll have an overview of Unit 3 and Unit 4. There'll be teaching and learning activities and similar to other learning areas or other studies we'll go through and have activities for each of the key knowledge dot points and some more detailed examples. And a lot of Georgia's content has algorithms and things like that. So really will give you a good idea of things. They're the detailed examples. We'll have Sample approaches to developing an assessment task. They're fairly generic sort of processes there about stepping you through things that you should be considering.

And a lot of what we have there are the things you should consider, particularly around VCE assessment principles, which is fairly important. When, if we get the opportunity to create a couple of more documents for support material as resources at the start of next year, we can scaffold a few things there, but again, that's reliant on getting some teachers. School-assessed Tasks for Unit 3 Outcome 3 and also Unit 4 Outcome 1, Unit 4 Outcome 2 That talks to you about timelines, roughly when you should do that throughout the term. And that links also to the Sample weekly planners.

We have the Performance descriptors for the School-assessed Coursework tasks, the SACs. So, for Unit 3 Outcome 1, 2 and 3 and we have the Sample weekly planners as well for Unit 3 and Unit 4 that give you an idea of implementing the course for each of those semesters. And that's one thing we see that a lot of teachers struggle with. I was very adamant when we reviewed Applied Computing, we needed more detail for those. And we were very lucky we got the ability to do that. And I went to three teachers of each three sets of units and said, do a plan of what you'd do.

Likewise, for Algorithmics for Unit 3 and Unit 4 we've gone to two of our valued teachers here and said, what would your plan look like for Unit 3 and Unit 4? And that gives you a good place to start. We aren't far off that being something we can publish. I don't know quite when that will be. I got an email today about QAing at another level. So somewhere in the next few days, I'll have that done and then we'll see where that'll come, but that's not terribly far away. That's fairly advanced.

**Georgia Gouros** - And I sort of do think that teachers do need resources. And that's why I did write that textbook back in the day for my own students. Even though my course at my school is online students like having printed materials and they do. That's just a fact that, you can have your book open and be typing on your computer and trying things out. So that might suit your students too, I don't know.

**Phil Feain** - Any questions regarding support material at all?

**Georgia Gouros** - I don't know much about Edulists ... apparently.

**Phil Feain** - Look, it's not something I really want to discuss in this forum. Okay. It's not something we control, and it's not fully supported. Okay, look I'll just go through these last couple of slides. So, look just summing up the presentation tonight. We were going to talk about changes to the new Algorithmics Study Design. And we've gone through those. Look at changes to School-based Assessment. Had a look at Unit 3 Outcomes 1-3 and Unit 4 Outcomes 1-3. And we've had a look at the new support material and what we're going to do there to support the study and the study design.

Now we already have some material for you to look at, to help you to get ready for next year. So, on the study page, if you go and look at the section at the section labelled 2023 Implementation there. So, looking at that screenshot there, that's how it looks. We have the new Algorithmics (HESS) Study Design for 2023-2026. Hopefully you've had a look at that. Then we've got some on-demand videos covering the Introduction to the new study design, Unit 3 Outcome 1 SAC, Unit 3 Outcome 2 SAC, Unit 4 Outcome 3 SAC and the School-assessed Task. So that's just to give you background information to what those things are.

Apologies for my voice in those videos. I had COVID at that time when we were trying to meet those timelines. At the start of next year, generally what we do now at the start of each year, we'll try and do some on-demand videos with any latest information for each of the assessment tasks. So that would be the 3 SACs and the SAT. So, we'll look at what we can add to that going into next year. We're also currently developing the new Administrative information for School-based Assessment and that has the SAT criteria for next year. That'll be published at the start of the year, but hopefully we can get together somewhere early on in Term 4 or mid-Term 4 to have a focus group to look at those.

And then we will also have a SAT webinar that we normally run early each year in Term 1. Normally we run it somewhere in late February or early March. Our timelines are normally dependent on all the other activities because there's VCE briefings at that time and several of other SAT studies at that time. So those things will be going out in the VCE Bulletin. So, if you look at those documents when they come out. If you haven't subscribed to the VCE Bulletin or Notices to School, you can do that. So, you can actually get those lists and see that information as it comes out to you.

All right so look before we close out for any final questions, I just want to thank you for attending this webinar today. And I especially want to thank Georgia for being involved with this today and not just for being involved with this. Georgia is one of our, I guess, old hands in the study. Been there from 2015 and she's helped support me the last couple of years. She's been heavily involved behind the scenes with the study. One of those valued people we have that we can't do without. Also, in the background support is from VCAA is Tony helping clear questions for me so I can read things on the screen without being interrupted. And also, I want to thank you as a community too. There's a few people in our community who will always take my calls. Always respond to emails and help us when we need help. We are unlike many other studies where we have many providers. At the moment we have eight. Year to year we have about eight providers.

So, when we're trying to get things done and run it the same way as every other study, it's very different when we rely on teachers. So, you've got to keep that in mind, but if you have any further questions as we move forward. Feel free to contact me there. My name's Phil Feain, for those of you that don't know me. I'm the Digital Technologies Curriculum Manager. Algorithmics is one of my studies. You can ring me at that number there or email me at that email address there. If you do ring me, please leave a voice mail if I can't get to the phone. I get a lot of dodgy phone calls these days You probably get it all through your work phones and your home phones. So always please leave a voicemail message for me and I'll get back to you. Email's great because I see email just about wherever I am, but I can get back to you there.

So, before we close out, are there any last questions? I think we had some before. Will you get this presentation? Yes, you'll get these slides. I don't know what we'll do with the recording. Generally, we make the recording made available to people that registered. Depends on what we've got to edit and things like that. But yeah, any last-minute questions from anyone?

**Georgia Gouros** - Oh, that's a very detailed question. That's a lot. I think that question is so detailed. Like I said earlier, all these topics are huge topics in Unit 4 Outcome 3. You could spend a whole semester on machine learning, and I don't know, I haven't done it at tertiary level, possibly even a whole year on it. So, we've only got a limited number of weeks. So, in my curriculum I wouldn't be teaching logistic regression. I would just be focusing on the binary classification aspects of an SVM and not really going into too much detail of the different kind of activation functions as well. Am I answering this question? Because it is such a huge topic.

Hopefully the students have some statistical background from their Maths classes and are able to understand things like mean, median, mode and all of those kind of statistical terms. So, you can incorporate that in your learning with the students and discussing outliers as well with regards to ethics. I did go to a lecture online with these AI experts and I did ask him about outliers, and they said, "Oh no, it takes too much time to worry about them." So, I don't know that's not very nice if you're an outlier anyhow.

**Phil Feain** - But I guess Georgia too, like anything, it depends how far you want to go. And yeah, sometimes key knowledge can look like it has a lot in it. You've got to look at the time constraints you have or your course timings so then what you would expect to see in a task. And we can't always determine what that would look like in any material we make too. I mean, it's like in other studies, sometimes people want to go to all these extents. What we would always say is always consider, particularly when you're developing a task, what is in the scope of the study. So, in that key knowledge, what is it in that key knowledge that you are really going to be needing to use?

And I know with Unit 4 Outcome 3 Georgia, you might remember when we were reviewing this particular outcome and looking at things, we were talking about the fact that you can just go off in so many directions here, but that wasn't the plan, was it?

**Georgia Gouros** - Well, I guess those topics of really big topics and really with the time constraints, you're only going to have time to give them a superficial kind of treatment and decide what are the essential elements that your students need to know about. ‘Cause of course the machine learning, both those algorithms are supervised learning algorithms. So, things about the data that you would possibly have to teach the students. How to ... what kind of data to use, how to use it. It's got to be certain kinds of data. And then, so there's not enough time to go into them in full detail because if you Google machine learning, you'll get so many resources. And if even if you just Google support vector machines, you'll get so many resources, and so many algorithms do you don't have time to teach all of that to your students in the last few weeks of Unit 4. So, really, it's a superficial, ... it's a superficial introductory treatment I would say to all those areas in Unit 4 Outcome 3.

**Phil Feain** - And I guess people too need to understand being a study, that is a Higher Education Scored Study, this is an equivalent first year university standard study, even though some of this content does go into second and third year, we're looking at it about first year content. Would you agree Georgia?

**Georgia Gouros** - Well not having been to university for a very long time. I did do Computer Science back in the day, but the computers weren't very powerful then there wasn't a lot of machine learning. Yes, some of the topics definitely from the Unit 3 and the Unit 4 definitely tertiary level topics. Definitely. Especially the applied algorithms and discussion of things like advanced algorithm design patterns, certainly and heuristics and of course, machine learning, that we're doing here.

**Phil Feain** And it's also still the only study of its type in Australia.

**Georgia Gouros** - I think they are their focus too, with the SVMs. The students mathematical understanding at high school level may not be able to grasp the full complexities of the mathematical applications for SVMs and for the multi-level neural networks. I don't know maybe your school, the kids are really bright, but in general, most students will have done Maths Methods and Specialist Maths and those concepts are not in those studies.

**Phil Feain** - Okay it's gone fairly quiet. I guess we'll just do the last call for any questions.

**Georgia Gouros** - Yes, some of the stuff is in second year Computer Science. I saw that too, especially the heuristic stuff. I think that's quite advanced.

**Phil Feain** - Okay well, ... we'll wrap it up at that point. Thanks very much everyone for attending tonight. And we'll let you know as things are published. But between now and then good luck for the rest of the school year and no doubt will be speaking to you in the not-too-distant future. Thanks everyone.

[Copyright Victorian Curriculum and Assessment Authority](https://www.vcaa.vic.edu.au/Footer/Pages/Copyright.aspx) 2022