**Term 2: 24th Apr – 23rd Jun Online Lesson: Thurs 4.30-5pm**

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| **W** | **Date** | **Topic Overview** | **Work Required in VSV Online** |
| **1** | **12-16 Jun** | **4.1 Algorithm Analysis Tools**   * Summation notation for series/sequences. * Telescoping and Iteration on recurrences to a rule. * Fibonacci and Page Rank revision * Proof by induction revisited | 4.1A Exercises Summation Notation  4.1B Exercises Sequences Series  4.1C Exercises Inductive Proof  **4.1C Quiz Math Theory**  **4.1 Analysis Tools Homework (submit)** |
| **2** | **19-23 Jun** | **4.2 Big O Notation/Problem Classification**   * Counting operations in algorithms f(n) for n input size * Big O Notation, worst case time complexities * Indicators of combinatorial explosions solution space * Intro to problem classes P/NP/NP Complete/NP Hard | 4.2A Exercises Analysis of Algorithms  4.2B Algo Challenge Arabic2Roman  4.2C Exercises Combinatorial Explosions  **4.2C Quiz Big O Notation**  **4.2 Big O Homework (submit)** |
| **TERM Break 24th June – 9th July** | | | |

**Term 3: 10th Jul – 15th Sept**

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| **W** | **Week** | **Topic Overview** | **Work Required in VSV Online** |
| **3** | **10-14 Jul** | **4.3 Divide and Conquer**   * Binary Search algorithm, time complexity * Divide and Conquer advanced algorithm design pattern * Divide and Conquer, sorting Mergesort / Quicksort * Naïve to Divide and Conquer design pattern | 4.3A Exercises Binary Search  4.3B Exercises Mergesort  4.3C Exercises Divide and Conquer  **4.3C Quiz Recursion Divide & Conquer**  **4.3 Divide & Conquer Homework (submit)**  **Revision Ch 8,10 Textbook** |
| **4**  **SAT2** | **17-21 Jul** | **4.4 Master Theorem**   * Review Big O time/space complexity * Time complexity from first principles * Master Theorem for divide and conquer algorithms   T(n) = a \; T\!\left(\frac{n}{b}\right) + f(n)  \;\;\;\; \mbox{where} \;\; a \geq 1 \mbox{, } b > 1 | 4.4A Exercises Time Complexity  4.4B Exercises Master Theorem  4.4C Exercises Sorting Algorithms  **4.4C Quiz Time Complexity** |
| **5**  **SAT2** | **24-29 Jul** | **4.5 Dynamic Programming (DP)**   * Dynamic Programming using single array * Optimisation with DP: eg. Fibonacci, Coin Change * Naïve brute force to DP design patterns * DP time complexity analysis | 4.5A Exercises DP MinOP  **4.5A Quiz Time Complexity**  4.5B Exercises DP DannyJump  4.5C Exercises Dynamic Programming  4.5C Exercises SAT2 Practice  **SAT Part 2 due** |
| **6**  **SAT2** | **31 Jul – 4 Aug** | **4.6 Backtracking**   * Backtracking design pattern using problem constraints * Comparing efficiency Backtracking to naïve Brute force * Applications of backtracking algorithm design * Compare advanced algorithm design patterns for improving efficiency of naïve algorithms. | 4.6A Exercises Knights Tour  4.6B Exercises Rats Maze  4.6C Exercises Closest Pair of Points  4.6C Algo Challenge Golden Ratio  **4.6 Advanced Design Pattern Homework (submit)** |
| **7** | **7-11 Aug** | **4.7 Problem Classification/Heuristics**   * Classification of problems by efficient algorithms * Map Colouring, Travelling salesman, Knapsack 01 * Indicators that make problems difficult to solve. * Randomness and greedy design patterns in heuristics * Heuristics: Hill climbing, Simulated annealing, A\* | 4.7A Exercises Combinatorial Growth  **4.7A Quiz Classes of Problems**  4.7B Exercises Travelling Archeaologist  **4.7B Quiz TSP and Heuristics**  4.7C Exercises A\* Algorithm |
| **8**  **SAT3** | **14-18 Aug** | **4.8 SAT Analysis Task**  **SAT Part 3 – improving time complexity using advanced algorithm design patterns and/or heuristics** | 4.8B Exercises SAT Part 2 Practice |

**Term 3: 10th Jul – 15th Sept --- Online Lesson: Thurs 4.30-5pm**

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| **W** | **Week** | **Topic Overview** | **Work Required in VSV Online** |
| **9**  **SAT3** | **21-25 Aug** | **4.9 Computational Models**   * Turing Machine theoretical model of modern computers * Hilbert’s program, history of Computer Science * Church-Turing thesis on computability * “Entscheidungsproblem” (Decision problem) * Halting problem and Decision problems. | 4.9A Exercises Turing Machines  4.9A Algo Challenge Room Booking  4.9C Quiz Computational Models  4.9C Exercises Chapter 10 Textbook  **SAT Part 3 Due**  **4.9 Turing Machine Homework (submit)** |
| **10**  **SAT3** | **28 Aug – 1 Sep** | **4.10 Artificial Intelligence (AI)**   * Supervised machine learning with labelled training data * Neural Networks (NN), Perceptron neuron, layers in NN * Techniques for minimising NN prediction errors * Complexities of training multivariable NN | 4.10B Exercises Perceptrons  4.10C Exercises Neural Networks |
| **11** | **4-8 Sep** | **4.11 Machine Learning (ML)**   * Support Vector Machines (SVMs) maximum margin classifier, understanding how SVMs use parameters * SVM data transformations in higher dimensions * issues with SVMs that lead to decision errors * comparison of NN and SVMs supervised ML | 4.11B Exercises Training SVMS  4.11C Exercises SVM Errors  4.11C Exercises Chapter 11 Textbook  **4.11 Machine Learning Homework)** |
| **12** | **11-15 Sep** | **4.12 Ethics of Artificial Intelligence (AI)**   * Turing Test to identify Strong AI * History of AI and ML algorithms * Searle’s Chinese Room, arguments for/against Strong AI * Ethical issues around the use of AI in society | 4.12A Exercises Turing Test  4.12B Exercises Searles Chinese Rm  4.12C Exercises Ethics in AI  4.12 Quiz Artificial Intelligence |
| **Term Break 17th Sept-2nd October** | | | |

**Term 4: 2nd - 20th October**

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| **W** | **Week** | **Topic Overview** | **Work Required in VSV Online** |
| **13**  **SAC3** | **2-6 Oct** | **4.13 Revision Unit 3 & Unit 4**  **SAC3 U4 O3 Revision in 4.13 and Ch 10,11 Textbook** | 4.13 Exercises Revision  4.13 Quiz Revision  4.13 Algo Challenge  **SAC3 U4 Outcome 3** |
| **14** | **9-13 Oct** | **4.14 Revision & Practise Exams**   * Algorithm Challenges – random problems * VSV Trial Exams 2017-22 | 4.14 Exercises Revision  VSV Trial Exams 2017-22  VCAA Exam Solutions 2017-21 |
| **15** | **16-20 Oct** | **4.15 Revision & Practise Exams** |  |
| **VCAA Algorithmics Exam, NO reference permitted, 15 minutes reading, 2 hours writing** | | | |

**10th Nov 22 Activities TO BE CHECKED/DONE**

**Assessment**

* **SATs: 20% of total score**
* **SACs: 20% of total score**
* **End of year Exam 60% of total score.**

**Nov 2023 Algorithmics Exam (2 hours, scientific calculator permitted, no references)**