

FIT2004

Algorithms and Data Structures

Ian Wern Han Lim
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Referencing materials by
Nathan Companeze, Aamir Cheema, Arun Konagurthu and Lloyd Allison



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COMMONWEALTH OF AUSTRALIA

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Agenda

- Welcome
- Importance of ADS
- What is ADS?
- Learning Outcomes
- Topics of ADS for FIT2004
- About me...

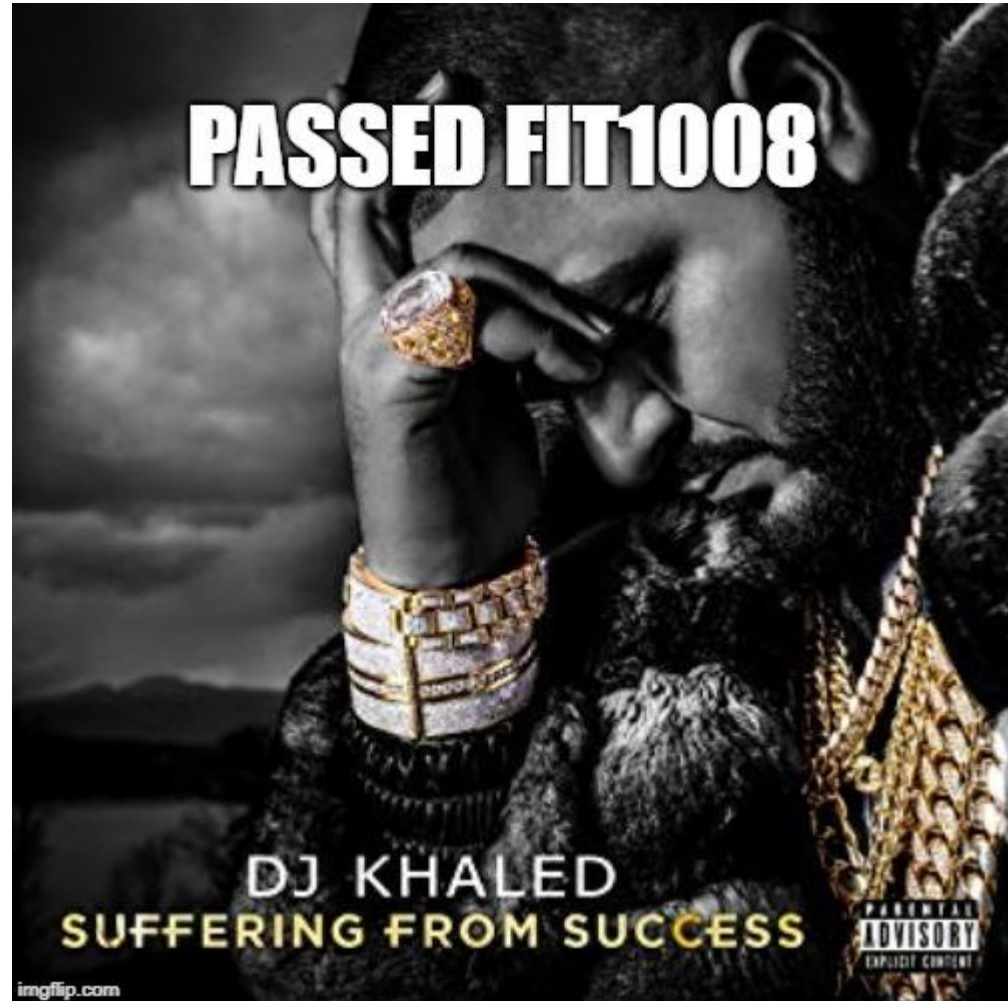
Let us begin...

- So what brings you to FIT2004?

Welcome to FIT2004

First timers...


- So what brings you to FIT2004?



Welcome to FIT2004

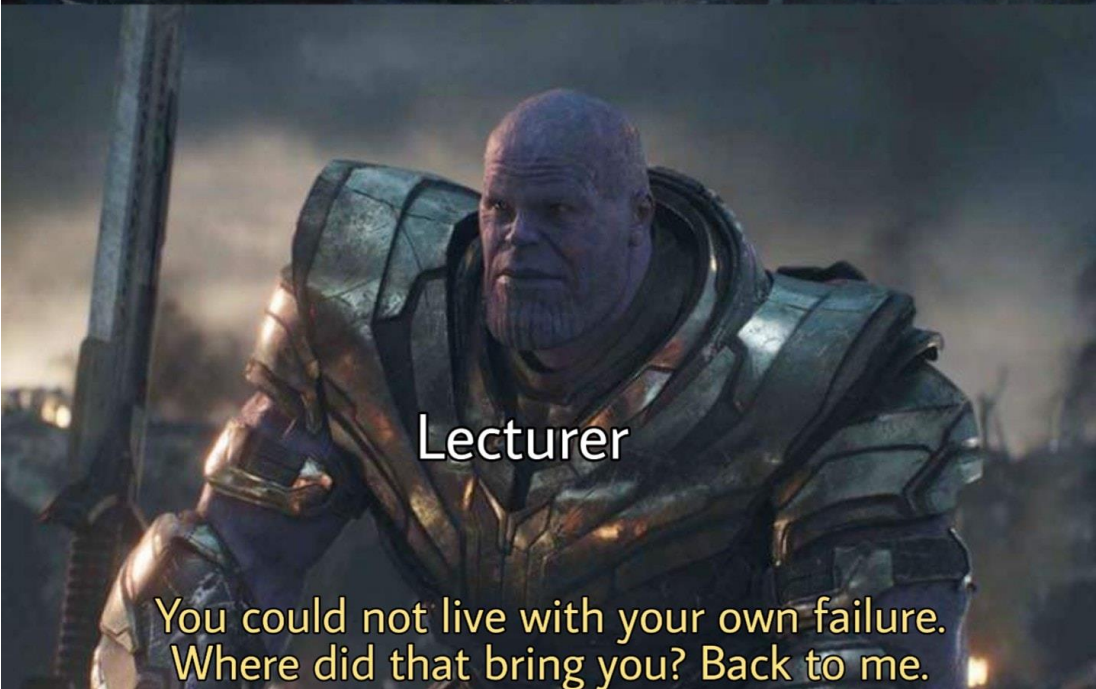
Returning students...

- As promised every semester



Students who
repeat the
subject

The same
lecturer teaching
same subject for
the new semester



Lecturer

You could not live with your own failure.
Where did that bring you? Back to me.

Questions?
Break...

- This is a very important unit

- This is a very very important unit

1 hour ago

@lan Lim (lecturer) forgot to mention that I finally realize just how important 2004 is haha. While interviewing for an internship, one of the companies actually gave me a similar question to the first assignment we did last sem. Just had to copy paste and change a bit 😊

- This is a very very very important unit
 - The **core** unit to computer science
 - “This is the **COREST of CORE** unit in your degree” – A/Prof Arun
 - Ex-course coordinate of the BCS
 - Ex-CE of the unit
 - CE of FIT3155 Advance Algorithms and Data Structures

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 - The **core** unit to computer science
 - Expect the **FANG** companies to interview you on the unit...
 - Facebook
 - Amazon and Apple
 - Netflix
 - Google
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Celestine Omin

@cyberomin

 Follow

I was just asked to balance a Binary Search Tree by JFK's airport immigration. Welcome to America.

12:26 AM - 27 Feb 2017 · Manhattan, NY

  8,754  7,447

Questions?
Break...

Algorithms and Data Structures

What is it?



Algorithms and Data Structures

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- Think of it as cooking...



Algorithms and Data Structures

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 - Simple
 - Clear
 - Step-by-step

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Algorithms and Data Structures

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Photo credits: 123rf



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 - And know which recipe to use when needed (**fast vs yummy**)

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 - Or even come up with your own recipe if you are good enough...

Algorithms and Data Structures

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 - And know which recipe to use when needed (**fast vs yummy**)
 - Or even come up with your own recipe if you are good enough...
 - Or to know what not to ever try...

Algorithms and Data Structures

What is it?



Why should I hire a software engineer if I can just copy and paste code from Stack Overflow?



Jessica Su, CS PhD student at Stanford



Answered Dec 28 · Upvoted by Rupak Hattikudur, Software Engineer @ L&T Infotech and Terry Lambert, Senior Software Engineer: Novell, Artisoft, IBM, Array Netw...

It's still worth the money. The breakdown is

- Copying code from StackOverflow: \$1
- Knowing which code to copy from StackOverflow: \$100000/year

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Because now you know what recipe to look for and make sense

Questions?
Break...

Learning Outcomes

At the end of the unit...

Learning Outcomes

At the end of the unit...

1. Analyze general problem-solving strategies and algorithmic paradigms, and apply them to solving new problems;
2. Prove correctness of programs, analyze their space and time complexities;
3. Compare and contrast various abstract data types and use them appropriately;
4. Develop and implement algorithms to solve computational problems.

Learning Outcomes

At the end of the unit...

1. Analyze general **problem-solving strategies** and algorithmic paradigms, and apply them to solving new problems;
2. Prove **correctness** of programs, analyze their **space and time complexities**;
3. **Compare** and **contrast** various abstract data types and use them appropriately;
4. **Develop** and **implement algorithms** to solve computational problems.

Learning Outcomes

At the end of the unit...

- Materials are designed to achieve the learning outcome
- Measured in and mapped to all your assessment
 - Assignment
 - Exam

Questions?

Introduction

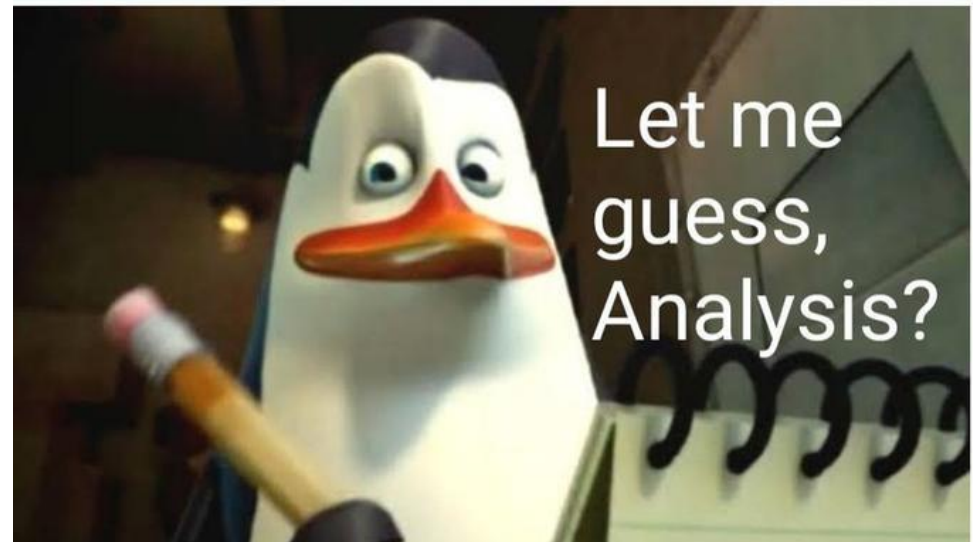
The Topics

- Now let us go through the topic one by one

Introduction

The Topics

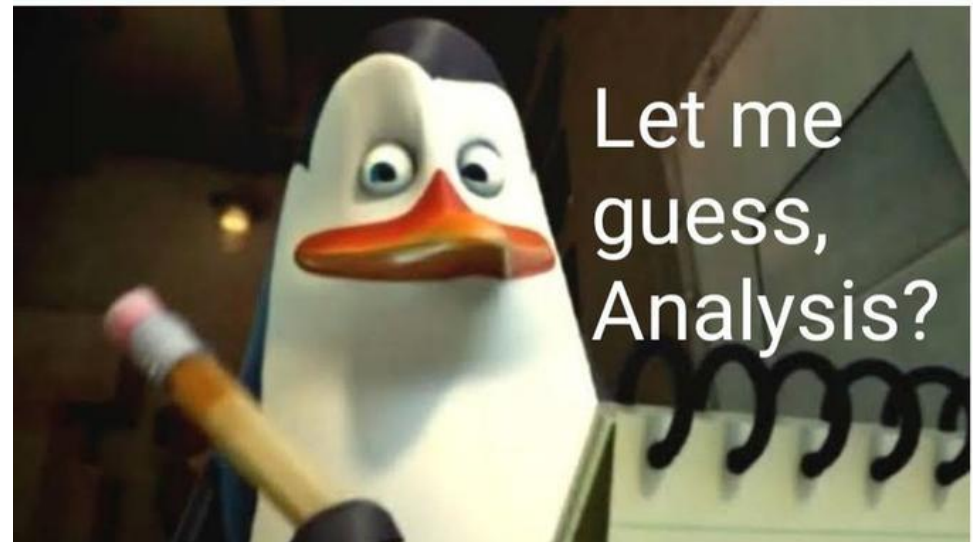
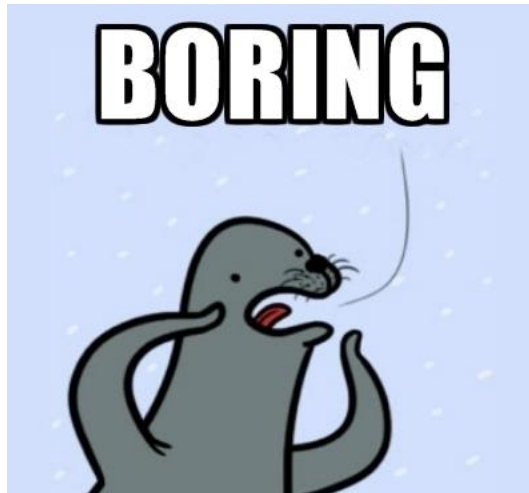
- Analysis of algorithms
 - Correctness
 - Complexity
 - Finding
 - Proving



Introduction

The Topics

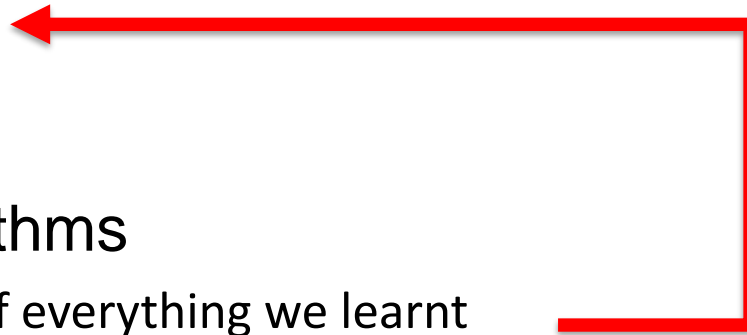
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Introduction

The Topics

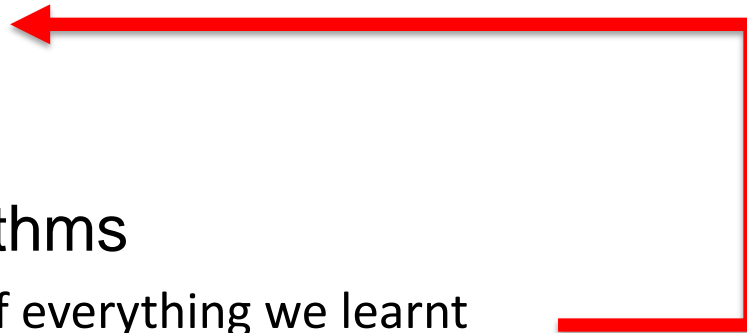
- Analysis of algorithms
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 - Complexity
- Sorting algorithms
 - Quick recap of everything we learnt



Introduction

The Topics

- Analysis of algorithms
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- Sorting algorithms
 - Quick recap of everything we learnt
 - Also new better ones



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 - Counting sort
 - Radix sort

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 - More **analysis of Divide and Conquer ones like Quick Sort**
 - Also new better ones
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Introduction

The Topics

- Analysis of algorithms
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Quiz

Introduction

The Topics

- Traversal and shortest distance

- Traversal and shortest distance
 - The Graph data structure

Introduction

The Topics

- Traversal and shortest distance
 - The Graph data structure
 - A lot of algorithms here...

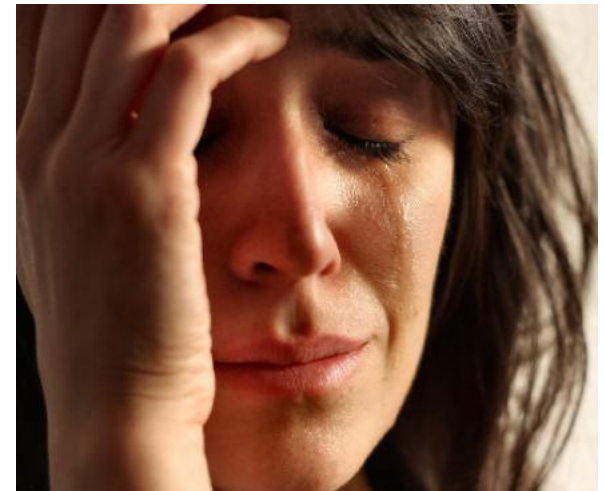


Introduction

The Topics

- Traversal and shortest distance
 - The Graph data structure
 - A lot of algorithms here...

Assignment



- Traversal and shortest distance
 - The Graph data structure
 - A lot of algorithms here...
 - And somehow, we can make trees from graph!
called Minimum Spanning Tree (MST)

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- ... all of the algorithms above uses all sort of techniques
 - Greedy
 - Dynamic programming
 - ... and many more

- Traversal and shortest distance
 - The Graph data structure and **networks**
 - **A lot of algorithms** here...
 - And somehow, we can **make trees** from graph!
called Minimum Spanning Tree (MST)
 - And we can build networks and optimize the flow!

- ... all of the algorithms above uses all sort of **techniques**
 - Greedy
 - Dynamic programming
 - ... and many more

Introduction

The Topics

- Dynamic programming
 - Analyzing it from time/ space complexity

Introduction

The Topics

- Dynamic programming
 - Analyzing it from time/ space complexity
 - This is your **Assignment** as well

Introduction

The Topics

- Dynamic programming
 - Analyzing it from time/space complexity
 - This is your **Assignment** as well
 - Also useful in the future...

← SH Shawn Hoong ... typing

> Need to spend company's reward points of 100 points 15:40

> Can claim steam codes with cost/value 6, 12, 24, 60 15:40

> Can claim razer gold to steam code of 10 points to rm 10 razer, razer rm 11.60 to steam rm 10 15:41

online 0/1 Knapsack problem solver

Using dynamic programming with javascript [Read about it on wikipedia](#) [Youtube video](#)

capacity items	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
no items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
value=60 weight=60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
value=12 weight=12	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	12	12	12	12	12	12
value=24 weight=24	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	12	12	12	12	12	12
value=6 weight=6	0	0	0	0	0	0	6	6	6	6	6	6	12	12	12	12	12	12	12	18	18	18
value=6.6 weight=10	0	0	0	0	0	0	6	6	6	6	6	6	12	12	12	12	14.6	14.6	18	18	18	18

Items in solution:
val=6.6 w=10
val=6 w=6
val=24 w=24
val=60 w=60
solution: 98.6

Add Item
Value: 10
Weight: 10
OK

Delete all Items
delete

Reload demo items
reload

New capacity
Knapsack size:
100
OK

> Use online knapsack problem solver 15:42

GIF

Thanks Monash Computer Science program 15:43

Introduction

The Topics

- Efficient lookup structure
 - How to search for item quickly (via key)

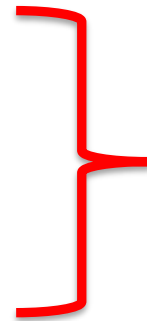
Introduction

The Topics

- Efficient lookup structure
 - How to search for item quickly (via key)
 - Hash tables
 - Binary Search Tree (BST)

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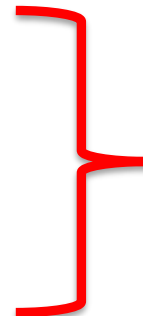
Real world focus

- Efficient lookup structure
 - How to search for item quickly (via key)
 - Hash tables
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 - Cuckoo hashing
 - Binary Search Tree (BST)
 - AVL tree

- Pattern matching

- Efficient lookup structure
 - How to search for item quickly (via key)
 - Hash tables
 - Making good hash function
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 - AVL tree

- Pattern matching
 - Tries
 - Suffix Arrays



Assignment
(popular in exam)

- Every topic is important
- Every topic is examined
 - Quiz
 - Assignment
 - Exam

Questions?
Break...

Introduction

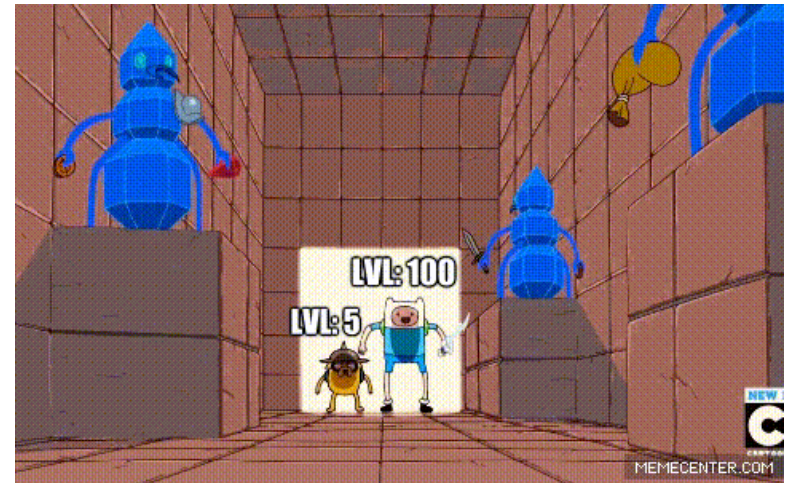
About me?

- Wern Han LIM, just call me Ian
- lim.wern.han@monash.edu
- Room 2-4-21
- BCS graduate 2009
- Gone through this before
(before the unit was nerfed)

Introduction

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- **Feel free to contact me**
(more on that later)
- BCS graduate 2009
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- Tutor for the unit since 2014 when it was redeveloped
- Lecturer for the unit since 2018
- Been packaged to MUA k-times for marking

- Also had experienced in algo units
 - FIT 1008 Introduction to Computer Science
 - FIT 3155 Advanced Algorithms and Data Structures
- ... and other units
 - FIT 2014 Theory of Computation
 - FIT 3140 Advanced Programming
 - FIT 3152 Data Analytics

- Do have speech impairment, so please do interrupt me
 - Ask me to repeat
 - Ask me to spell
 - Ask me to write
- Faculty teaching award 2017
- Monash Student Association (MSA in MUA) 2018 teaching award (Faculty of IT)
- Faculty teaching excellence 2019
- PVC teaching excellence 2020

Questions?
Break...

Thank You