



# Theory of Computation

## Lambda Calculus (LC)

Dr Shekhar “Shakes” Chandra

V1.0

“Computing Science is no more about computers than Astronomy is about telescopes.”

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- Edsger W. Dijkstra

(1930-2002)

# Getting Help

Post questions on [Piazza](#)  
[Signup here](#)

**All lecturers and most tutors are monitoring this forum!**

If it is a private matter or related to a personal issue

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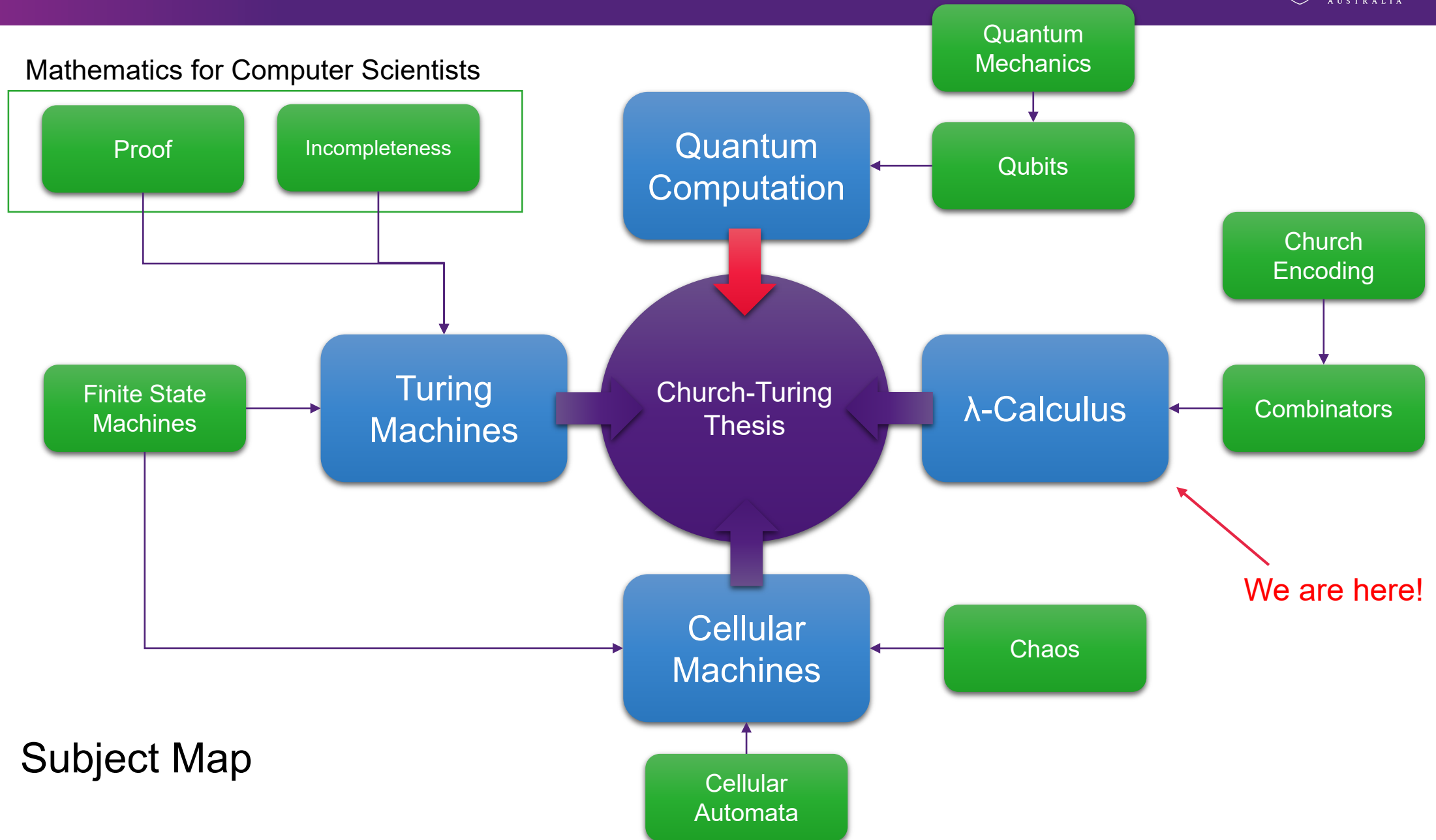
Code for Piazza: Godel

# Overview

- Previous Module Summary
- Subject Map
- Relevant Chapters
- What is required of You!
- Upon completion ...

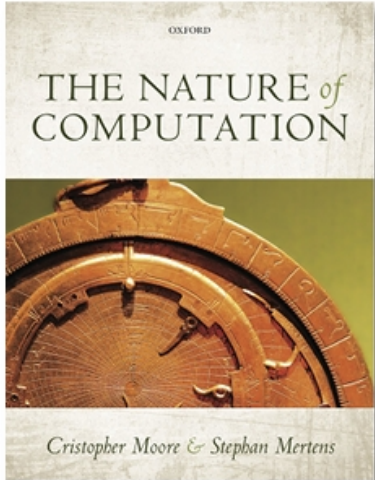
# What did we do last time?

- We saw how chaotic systems create fractals
- We saw how cellular automation produces chaotic behaviour
- We then covered different cellular automations including the Game of Life (GoL)
- We found that it is possible to create a Turing machine based on the GoL by constructing a kind of circuitry out of the gliders and spaceships within GoL



Subject Map

# Prescribed & Recommended Texts



Cristopher Moore and Stephan Mertens (2011).

*The Nature of Computation*

Oxford University Press.

[eBook – UQ Library]

**Chapter 7**

Raul Rojas (2015).

A Tutorial Introduction to the Lambda Calculus

[arxiv.org]

Shakes Chandra (????).

Modern Computation

Chapter 5

[See Blackboard]

# What is required of You!

- Read Shakes' Notes on Lambda Calculus (~60 mins)
- Read Rojas' Introduction to LC (~60 mins)
- Read Moore and Mertens Chapter 7, section 7.4 (~ 2-3 Hours)
- Review the demonstrations and examples conducted during the lectures. (~15 mins each lecture)
- Attempt the tutorial and notebook demos

## Upon completion, you should be able to:

- Beta reduce lambda expressions
- Explain Church encoding and describe how to build
  - Boolean algebra in LC
  - Numbers in LC
  - Counting in LC
  - Arithmetic in LC
- Define what a combinator is and describe the role and form of the various special combinators covered in the course.
- Understand and explain the Y combinator, especially in the context of Turing completeness and in implementing the factorial function in LC



# What's Next?

Next we will see what the future of computation holds for us! Can we use the quantum realm, the science of the very tiny ( $<10^{-10}\text{m}$ ), to create bizarre computers that can function over large distances faster than light or break RSA encryption nearly instantly?!



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AUSTRALIA

CREATE CHANGE

# Thank you

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