Course Introduction

Dr Patrick Chan

School of Computer Science and Engineering

South China University of Technology

Discrete Mathematics is...

- ## Mathematics
  - ### Study of numbers?
    - Number is just a kind of *well-defined concept*
  - ### Mathematics is the study of any truth regarding well-defined concepts

Discrete Mathematics is…

- **Discrete**
    - Distinct, separable (in contrast to continuous)
    - Example
        - Integer number
        - State
        - Digital Computer

Discrete Mathematics is…

- **Discrete Mathematics** is the study of any truth regarding discrete entities

- Discrete math is the foundation for the rigorous understanding of computer systems

- So, what is it really?

A Discrete Problem: Sudoku

- What are the rules of Sudoku?

- Write down an algorithm for solving Sudoku

- Does your algorithm always solve the puzzle? How can you prove it?

- How long does your algorithm take to finish in the worst case?

Why Discrete Mathematics?

- It's the basic **language** in sciences
  - It's a **gateway** to more advanced courses in sciences, not only in computer systems

- **Enhance your mind**
  - It's a **toolbox** full of the problem-solving techniques
  - You will use it over and over in your life

Applications in Computer System

- Circuit design

- Computer architecture

- Computer networks

- Operating systems

- Programming: algorithms and data structures

- Programming languages

- Computer security, encryption

- Error correcting codes

- Graphics algorithms, game engines

- . . .

Syllabus

- Ch01: Logic and Proof

- Ch02: Set

- Ch09: Relation

- Ch06: Counting

- Ch08: Advanced Counting

- Ch10: Graph

- Abstract Algebra   * most contents are not covered by the textbook

Ch01: Logic and Proof

- **Basic principle** in our life

- All about Correct / Wrong (True / False)

- Most people think they are logical, but…

- Is the conclusion correct?
  Clever student can pass this subject.
  You cannot pass this subject.
  You are not clever.

Ch02: Set

- A set is a **collection** of something
  - Number, Character, Collection, Anything

- Set operators

- A function
  - One-to-one
  - Onto
  - Inverse
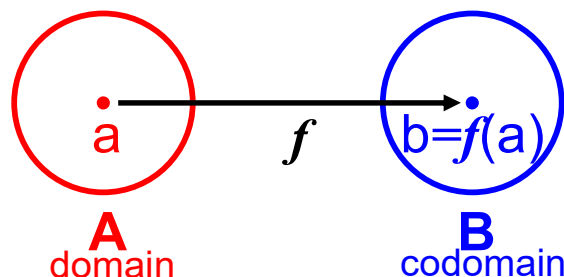
Ch09: Relation

- Similar to function but more general
  - Function: 1 object maps to 1 object
    E.g.   f(x) = x +1
  - Relation: 1 object maps to 0 or more objects
    E.g.   (A, B): A likes B
              (A, B, C): A is larger than B
   but smaller than C

Ch06: Counting

- Play an important role in many applications
  - Hacking: how many times we should try at most for the password of a Ali payment?
  - Experimental Study: how many experiments should be carried out if 5 different variables are considered and each variables contains 10 values?
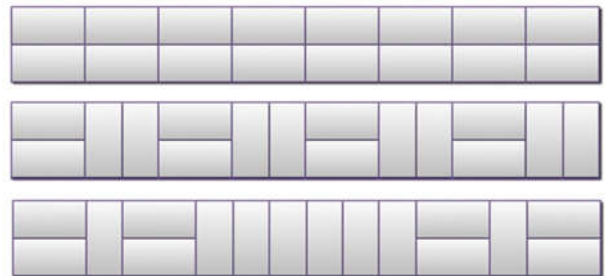
Ch08: Advanced Counting

- **Recursive Problem**
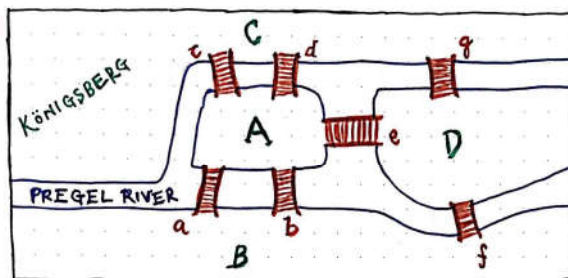   - How many triangles in the layer 2? the layer n?
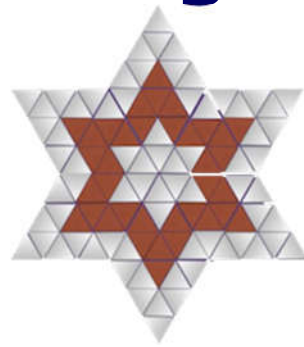
    - The area to be tiled is 2 x 16 and the tiles are each 1 x 2. How many different ways are there to cover the area with tiles?

Ch10: Graph
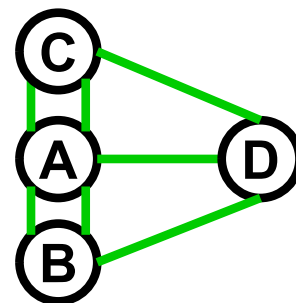
- A model which represent pairwise relations between objects

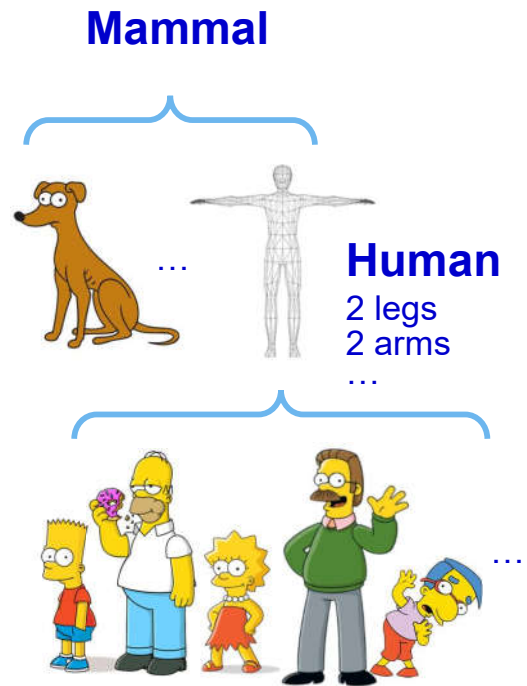# Abstract Algebra

- Advanced topic

- Study the characteristics of structures rather than the usual number systems
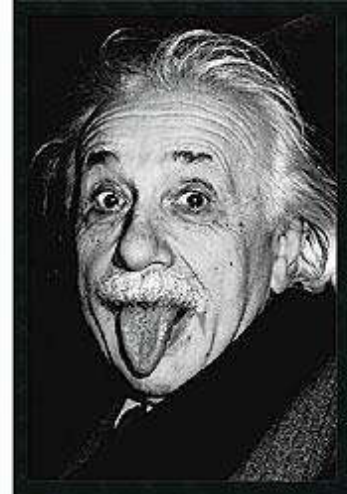
- Study something you do not know what it is

Mammal

Human
2 legs
2 arms
…

Syllabus

- Ch01: Logic and Proof ☺

- Ch02: Set ☺ ☺

- Ch09: Relation ☹

- Ch06: Counting ☺

- Ch08: Advanced Counting ☹☹☹

- Ch10: Graph ☹
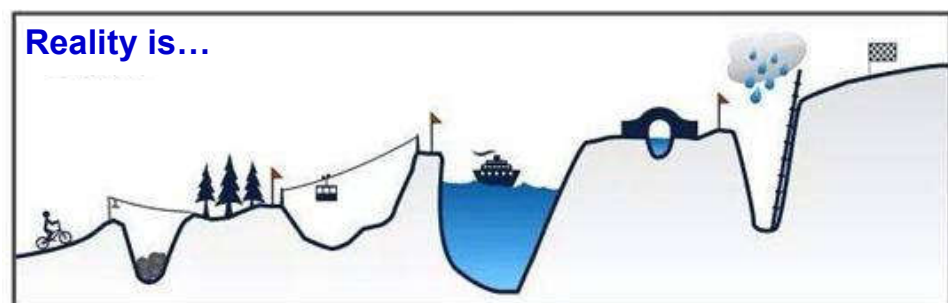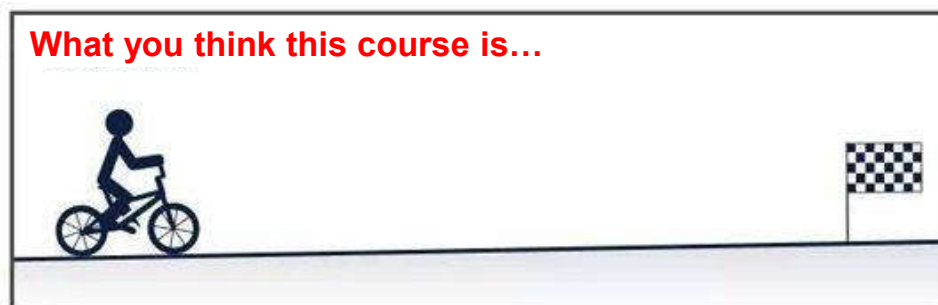
- Abstract Algebra 💀💀💀💀💀💀 …

My Teaching Philosophy

- I never teach my pupils; I only attempt to provide the conditions in which they can learn

Albert Einstein

Work Hard, Don't Wait

What you think this course is...

Reality is...

Advices...

- **Enjoy** each lesson

- **Think** more

- **Ask** questions

- **Smile** ☺ *(even you fail)*

- Read in advance

- Do the exercise

- Form a study group

Pain is inevitable
Suffering is optional

Good Luck!