CSPC-206 Discrete Structures

Module 0: Introduction to the Course

Welcome to CSPC-206

Instructor In-Charge

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- Text Book: Kenneth Rosen, "Discrete mathematics and its applications", 7th Edition, McGrawHill.
- For Study Material
  - Refer the text book (Slides will not be shared)

What is Discrete Mathematics?

- A part of mathematics devoted to the study of discrete (as opposed to continuous) objects.

- Examples of discrete objects:
  - integers,
  - steps taken by a computer program,
  - distinct paths to travel from point A to point B on a map along a road network,
  - ways to pick a winning set of numbers in a lottery.

Discrete vs. Continuous Mathematics

Discrete Mathematics

It considers objects that vary in a discrete way.

Example: digital wristwatch.

On a digital watch, there are only finitely many possible different times between 1:25 P.M. and 1:27 P.M. A digital watch does not show split seconds: - no time between 1:25:03 and 1:25:04. The watch moves from one time to the next.

Integers --- *core of discrete mathematics*

Discrete mathematics --- models and tools for analyzing real-world phenomena that change discretely over time and therefore ideal for studying computer science – computers are digital! (numbers as finite bit strings; data structures, all discrete! Historical aside: earliest computers were analogue.)

Why is it computer science? (example 1)

- NITJ plans to admit B.Tech. students based on aggregate marks of three tests–Test1, Test2 and Test3. Each test is of 100 marks. A student is eligible for the Admission counseling for NITJ subject to following conditions:
- Marks in Test1 >=70
- Marks in Test2 >=65
- Marks in Test3 >=65
- Total marks in all tests >= 230 OR

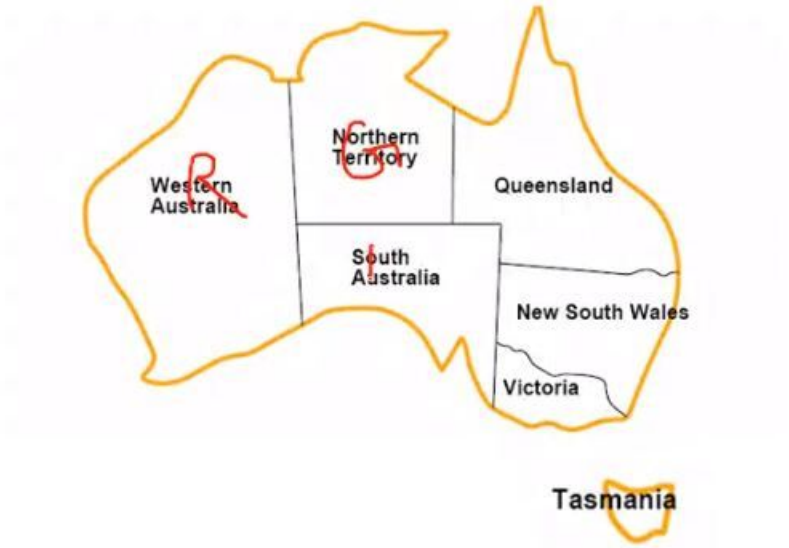
  Total marks in Test2 and Test3 >=150
- If an eligible student scores more than 260 marks in the three tests, he/she is eligible for scholarship otherwise he/she will be eligible for normal admission.

Why is it computer science? (example 2)

- The router can send packets to the edge system only if it supports the new address space.
- For the router to support the new address space it's necessary that the latest software release be installed.
- The router can send packets to the edge system if the latest software release is installed.
- The router does not support the new address space.

How to write these specifications in a rigorous / formal way? ***Use Logic***

Example: Coloring a Map



How to color this map so that no two adjacent regions have the same color?

Kinds of Problems Solved Using Discrete Mathematics

- How many ways can a password be chosen following specific rules?
- How many valid Internet addresses are there?
- What is the probability of winning a particular lottery?
- Is there a link between two computers in a network?
- How can I identify spam email messages?
- How can I encrypt a message so that no unintended recipient can read it?
- How can we build a circuit that adds two integers?

Kinds of Problems Solved Using Discrete Mathematics

- What is the shortest path between two cities using a transportation system?
- Find the shortest tour that visits each of a group of cities only once and then ends in the starting city.
- How can we represent English sentences so that a computer can reason with them?
- How can we prove that there are infinitely many prime numbers?
- How can a list of integers be sorted so that the integers are in increasing order?
- How many steps are required to do such a sorting?
- How can it be proved that a sorting algorithm always correctly sorts a list?