CPSC 421/501

Today: - Class Policy

- There are more (decision) problems than algorithms

Classes: (50 minutes of lecture / questions (this will be recorded)
(10-15 break / working in groups on older problems from previous homework & exams
(back together - questions, more material / pointers)

Material — roughly that of 2019 course.

This year - Pandemic

- CPSC 501 typically has 5-8 students
this year has 22 "

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CPSC 421 : Grading scheme

" 501 : 90% CPSC 421 + 10% Presentation

Last 2 Weeks Classes

reading 1 or more articles

This year: last 2 weeks of classes: - CPSC 501 Presentations
- Review for final

(No easier, but fewer topics)

CPSC 421 Grade:

10% max(final, midterm, homework)
+ 35% max(final, midterm)
+ 55% final [don't need to pass the final to pass the course...]

HW: You can work in teams, up to 4 people, but

- on some problems you can a single joint solution
- " " " you have to write up your own solution

Encouraging finding a team to work with
(you can change team at any time, you can work by yourself)

Piazza page: "Introduction" topic;
post brief bio, use this to help form teams

Homework due generally Wed nights, 11:59 pm

- All classes recorded
- These iPad notes or "board scans" posted
- All material covered in textbook and/or 2-3 handouts
- Piazza page will be monitored regularly
- Office hours start next week
- Some surveys submitted through canvas
  recordings accessed through canvas,
  Zoom lectures and office hours thru canvas
- HW thru Gradescope, but registering for
  Gradescope is done thru canvas

CPSC 320 algorithms

- CPSC 420 more algorithms
- CPSC 421 which problems can't be solved by:
  - any algorithm
  - probably by any "efficient" algorithm (e.g. polytime algorithm)

First topic: First handout,

Self-Referencing, Uncountability, and Uncomputability:

- Review parts of Chapter 0, notation on set theory (in Section 4.2 of the textbook)
- Upshot: There are more decision problems than algorithms (C program, Javascript, Turing machine, ...)

Break for 5 minutes

Textbook: Introduction to the Theory of Computing, by Sipser, 3rd edition

[Really almost the same course since early 1980's; a few additional topics. We will skip Ch 2, which is less relevant to us today...]

Some homework from there...

First topic: Handout on Self-referencing, uncountability, and uncomputability:

— Countably infinite versus uncountable set

von Neumann: roughly: "You don't understand mathematics. You just get used to it."

For me: "understand" = "see some examples" + "time"

(should give you an idea of what to expect, how much time the course will take for you, etc.)

— Application: more decision problems than algorithms

— "Russell's" Paradox, other paradoxes, similar to Cantor's thm, need for

We want to review set theory, and see the difference between - finite sets
- infinite sets

Review "decision problem" and "algorithm"

- Alphabet = finite set, e.g. $\Sigma = \{a, b\}$

  symbols / letters = elements of the alphabet

- A word in Σ, an alphabet, of length k, $k = 0, 1, 2, \ldots$, is a sequence of length k of elements of Σ.

e.g. $\Sigma = \{1, 2, 3\}$

$(1, 2, 2, 1, 3)$ is a word of length 5

usually write 12213 for $(1, 2, 2, 1, 3)$

$\Sigma^k = \{$ all words of length $k\}$

word = string

$\Sigma^* = \Sigma^0 \cup \Sigma^1 \cup \Sigma^2 \cup \ldots$

e.g. $\Sigma = \{a, b\}$

$\Sigma^1 = \{a, b\}$ (really $\{(a), (b)\}$)

$\Sigma^2 = \{aa, ab, ba, bb\}$ (really $\{(a,a), \ldots\}$)

$\Sigma^0 = ?$ answer: $\Sigma^0 = \{\varepsilon\}$

↑ string of length 0;

$|\Sigma^2|$, size of Σ^2 is $|\Sigma|^2$

$= (\text{size of } \Sigma)^2$

$|\Sigma^k| = |\Sigma|^k$

e.g. $\Sigma = \{a, b\}$, $|\Sigma^3| = 2^3 = 8$

$\Sigma^0 = |\Sigma|^0 = 1$ – a reason for $\{\varepsilon\} = \Sigma^0$

Concatenation:

$S_1 \circ S_2$ = write S_1, then S_2

$(aba) \circ (ab) =$ abaab

$(\varepsilon) \circ (ab) = ab$

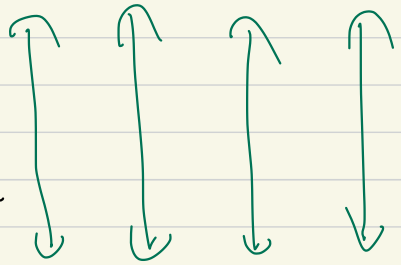
Note: Σ alphabet, finite set,

then Σ^* = "countable" in the following sense

e.g. $\Sigma = \{a, b\}$

$\Sigma^* = \{ \varepsilon, a, b, aa, ab, ba, bb, aaa, \cdots \}$

bijection
or
1-1 correspondence
to



$\mathbb{N} = \{1, 2, 3, 4, \cdots \}$

Next time:

decision problems $\longleftrightarrow$ languages over Σ

are "uncountable"