COSC 221 - Introduction to Discrete Structures

Lecture - Course Information and Overview of Topics

Readings

- Chapter 2
- Computer Science Connections
  - Set Building in Languages (Section 2.3)
  - Clustering Datasets (Section 2.3)

Course Information

- Instructors and Meetings
- Resources
- Policy
- Evaluation
- R U Ready?

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- Lecture: MWF (12:00pm - 13:00pm)
- Seminar: M - F, one of 5 sessions
- Office Hours: 0.5 hour before each lecture

Seminar starts next week

Professor and TAs

- **Instructor:** Yong Gao
- **TAs:**
  Davit Abrahamyan (S1D)
  Ahmed Radwan (S1B, S1C, S1E, S1F)

Best Ways to Contact:

- office hours and class time
- email (yong.gao@ubc.ca)

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Resources

- Textbook and Slides
- Online Resources

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- *Connecting Discrete Mathematics and Computer Science* Cambridge Univ. Press, 2022. E-Book from Bookstore
- Lecture Slides/Notes: links on weekly schedule page

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- Canvas: COSC 221

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- Submission and Requirements
- Academic Integrity
- Late penalty and lifelines

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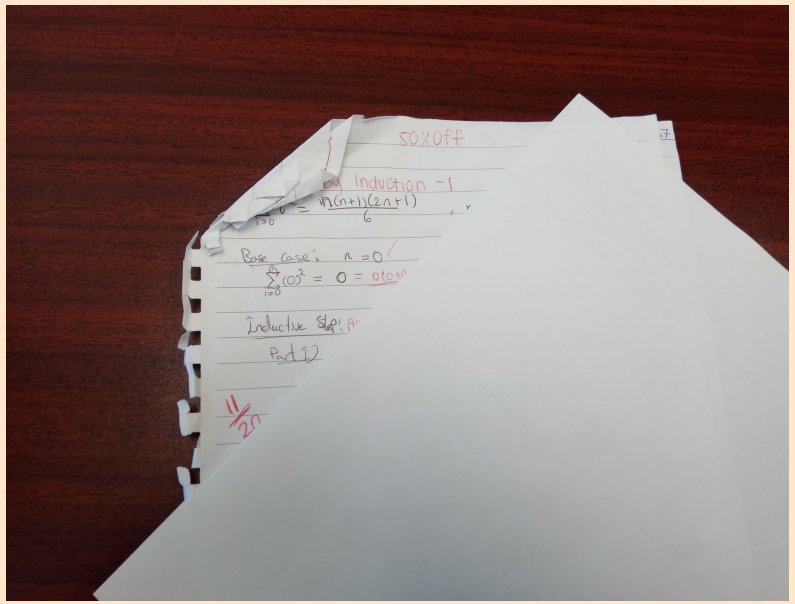

- Submission and Requirements
- Academic Integrity
- Late penalty and lifelines

  - Digital copy on Canvas
  - Type or write in legible handwriting
  - 10% deduction if you

Course Information

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- Be Professional and be Honest
- Acknowledge helps
- Talk to me before I talk to you
- **Details in Syllabus and UBC Webpage**

- Submission and Requirements
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- 0 -24 hours, 20%;
- 24 -48 hours, 40%;
- More than 48 hours, no mark

How to get a lifeline?

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Written Assignments (40%)

- Individual (20%)
- Seminar Questions (20%)

Tests (60%)

- Two Quizzes (10%)
- One Practice Midterm (0%)
- Final (30%)
- iClicker Quizzes (20%)

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- Team Size: 4 - 5 people
- Same marks for all participating members
- Form your own team, or ask TA for help

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Do the following before Friday's class

- Create an iClicker cloud account
- Sync it with COSC 221 on Canvas

Instructions at
https://lthub.ubc.ca/guides/iclicker-cloud-student-guide/

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Instruc
https nt-guide/

Q.1) Your instructor's first name is

A) Young
B) Yong
C) Gao
D) Yong and Gao

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Self-Check

- Chapter 2 of the Textbook. Do these words/phrases sound familiar?

  "variables, functions, sequences, Cartesian product"

- Computer Science Aspects. Feel comfortable to use these strange phrases?

  "for-loops, if-then-else, while-loops, ..."

Required Courses

- Prerequisites: One of MATH 101, MATH 142, APSC 173.
- Co-requisites: COSC 121

Q.2) Do you have COSC 121?

A) Yes

B) No

C) No, and I am not going to!

D) Do I have to?

Q.3) $A \subset B$ means that

A) A or B

B) A is a proper subset of B

C) A is less than B

D) A goes before B

Q.4) Let g be a function. $g(x)$ is read

A) "g of x"

B) "g followed by x"

C) "g with x"

D) "g"

Q.5) Set, Elements, and Subscripts

$$A = \{A_i \mid 3 * i, i \geq 1\}, \quad B = \{B_i \mid 2 * i, i \geq 1\}$$

The element $A_{B_{10}}$ equals

A) 30

B) 20

C) 60

D) None of the above

Additional Notes

Address me as

- ▷ Yong (Preferred)
- ▷ Prof/Dr Gao (More formal)
- ▷ Prof/Dr Yong (Never!)

Announcement 01: **Final Exam Question (5-10 points)**

- ▷ Describe/summarize ONE of the many "Computer Science Connections"
- ▷ A short paragraph suffices

Topics to be Covered

and why in computer science

- (Formal) Logic
- Proof Techniques
- Structures: Graph Theory
- Combinatorics: Counting
- (Discrete) Probability

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the science of valid reasoning

Calculus of Computing (Computer Science, ...)

- Propositional logic
- Predicate logic (calculus)
- ...

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Principles abstract, but applicable in any contexts

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Application: Artificial Intelligence (COSC 322)

- Knowledge Representation
- Automated Reasoning

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How to Play the Minesweeper Game?

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Other Applications

- Hardware and Software
- Theory of Computation

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Most Important Skills in Computing

- abstract thinking
- logic reasoning

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Problem Solving in Computing

- Model $\Rightarrow$ Ideas $\Rightarrow$ Algorithm (Impl.)
- Does it work?

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Proofs $\rightarrow$ New Ideas $\rightarrow$ Better Solutions

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Discrete Structure (or Structured Data)

- Objects
- Relationships

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Application: Artificial Intelligence - Games and Puzzles

- Game States - Objects
- Valid Moves - Relationship

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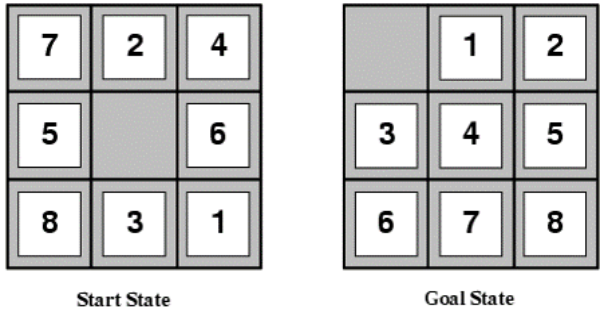
Sliding Puzzles



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Solution - Sequence of Valid Moves

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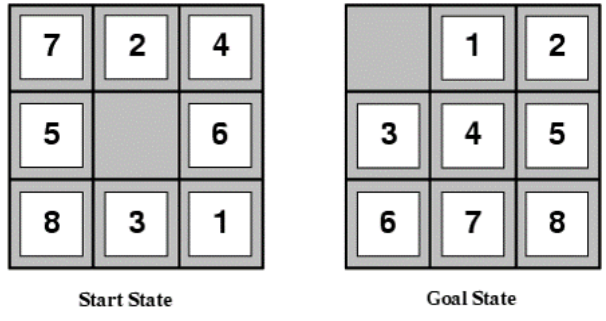

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Progress from 1990s to 2010s

- Deep Blue (Chess, 1997)
- AlphaGo (Go, 2016)

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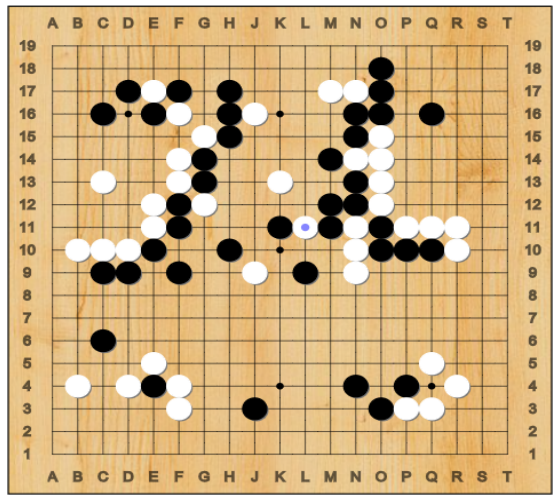

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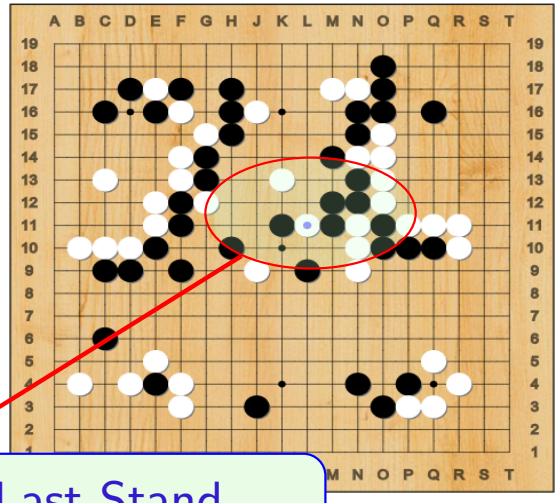

Game Four Human Players' Last Stand

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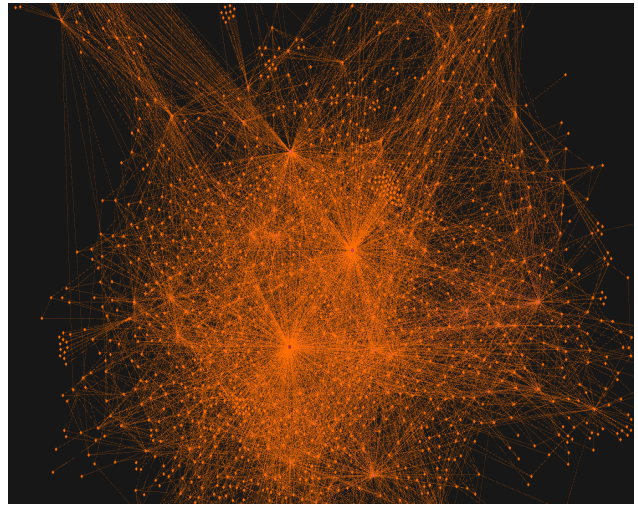
Application: Network Science

- TikTok, WeChat, LinkedIn, Twitter
- WWW, Routers, Mobile Devices
- Protein-Protein Interaction, ...



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- WWW, Routers, Mobile Devices
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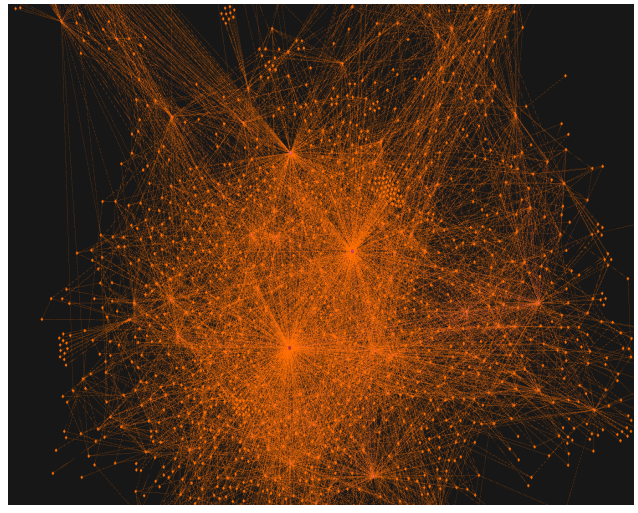
Pairwise Relations $\Rightarrow$ Local/Global Properties



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Graph Theory in Computer Science and Mathematics

- Deep Questions
- Beautiful Theories
- Algorithmic Problems

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- Graph Minor Theorem (1985, 500 pages of proof)
- Four Color Theorem (1976, 1997, computer-assisted proof)
- Strong Perfect Graph Theorem
  (Conjectured in 1961, proof in 2002, published in 2006)

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Challenging, but of Practical Importance

- Shortest Paths
- Graph Coloring

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Combinatorics

Analytical Properties of

- Sets, Lists, Strings, Trees.

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- Counting, Enumerating, and Searching
- Applications in combinatorial optimization, geometry, coding theory (information theory), linguistics, biology, ...

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Applications in Computer Science

- Randomized Algorithms
- Probabilistic Models for Social Networks
- Reasoning Under Uncertainty (AI)

References I