CSCI 651

Algorithm Concepts

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College of Engineering and Computing Sciences

NEW YORK INSTITUTE OF TECHNOLOGY

Today's - Objectives

- 1st part
  - Getting to know each other
  - Introduction to the course
  - Requirements, assignments, quizzes, project, exams
  - Overview of topics to be covered
- 2nd part
  - Introduction to algorithms and data structures

About the Instructor

- Received the B.E. and M.Eng.Sc. degrees in electrical engineering and microelectronic design from the University College Cork, Ireland
- Received the Ph.D. degree in engineering science from Simon Fraser University (SFU), Canada (advisor: Prof. Ljiljana Trajković)
- Research assistant at Tyndall National Institute, Ireland (2011-2014); Research Assistant in the Communication Networks Laboratory at SFU (2015-2022).
- Postdoctoral fellow working on cybersecurity
  - development of fast machine learning (ML) algorithms
  - real-time system for detecting network anomalies
- Assistant Professor
  - College of Engineering and Computing Sciences, NYIT

About the Instructor

- Zhida Li, Assistant Professor, NYIT – Vancouver, Room 1814, Suite 180.
- Office hours: By appointment (zli74@nyit.edu)
- NYIT WWW: https://www.nyit.edu/bio/zli74 | Personal WWW: https://zhidali.me/
- LinkedIn: https://www.linkedin.com/in/zhidali/
- Google Scholar: https://scholar.google.com/citations?hl=en&user=t_hlHwQAAAAJ

Zhida Li

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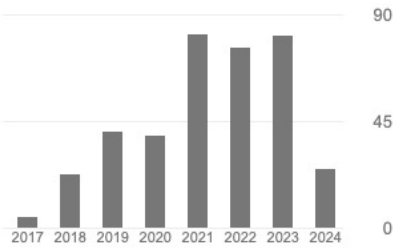
Communication networks cybersecurity machine learning intrusion detection systems

TITLE	CITED BY	YEAR
Machine learning techniques for classifying network anomalies and intrusions Z Li, ALG Rios, G Xu, L Trajković 2019 IEEE international symposium on circuits and systems (ISCAS), 1-5	74	2019
Detecting BGP anomalies using machine learning techniques Q Ding, Z Li, P Batta, L Trajković 2016 IEEE International Conference on Systems, Man, and Cybernetics (SMC …	47	2016
Machine learning for detecting anomalies and intrusions in communication networks Z Li, ALG Rios, L Trajković IEEE Journal on Selected Areas in Communications 39 (7), 2254-2264	34	2021

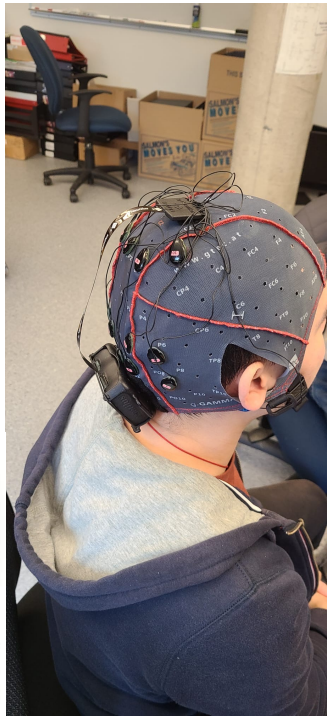
Cited by

	All	Since 2019
Citations	388	347
h-index	11	11
i10-index	13	11



About the Instructor (cont.)

- Network anomaly detection:
  - develop new algorithms (echo state networks, graph neural networks , and transformers) to enhance the model robustness for time series data
  - enhance BGPGuard
  - extract additional features based on network topology
- Blockchain:
  - Ethereum phishing detection based on transaction records and labels collected from Etherscan (https://etherscan.io)
- Brain-computer interface:
  - analyze electroencephalogram (EEG) benchmarks
  - develop new algorithms and approaches to analyze data from non-invasive collection of brain signals
- BCI & Neurotechnology, Virtual BR41N.IO Hackathon
  - https://www.br41n.io/Spring-School-2024
  - https://www.br41n.io/IEEE-SMC-2023



About the Instructor: External Service

- Secretary, Membership Development Committee, IEEE Canada
  https://www.ieee.ca/en/
- Secretary, IEEE Vancouver Section
  https://vancouver.ieee.ca/
- Chair, IEEE Circuits and Systems Society joint Chapter of the Vancouver/Victoria Sections
  https://vancouver.ieee.ca/cas/
- Counselor, IEEE NYIT-Vancouver Student Branch
  https://ieeenyit.org/

About the Teaching Assistants

- CSCI 651-VA2 (1539): Nora Liu, yliu157@nyit.edu
- Office Hours:
  - Monday, 12:00 PM to 1:00 PM (In-person) | Tuesday, 3:00 PM to 4:00 PM (Online)
  - In-person: Library, Suite 180, 2985 Virtual Way
  - Online: Zoom Meeting ID: 962 3240 6506

About You

- How many of you have not taken this course in undergrad?
- Have you ever used algorithm concepts in a project? Have you ever tried to optimize a code?

What is this course all about?

CSCI 651-VA2 (1359): Monday and Friday, 9:00 AM - 12:00 PM (PT) in Room 4501, Suite 450, 2955 Virtual Way, BTC

- Algorithm concepts!
  - Computational complexity (efficiency in time and space)
  - Data structures and their applications
  - Methods to solve problems and design efficient algorithms
  - Theory and proofs!

Abstract Data Structures are reviewed.

The course covers the study of both the design and analysis of algorithms

Space and time complexity; performance evaluation; and NP-Hard and NP-Complete classes are also covered

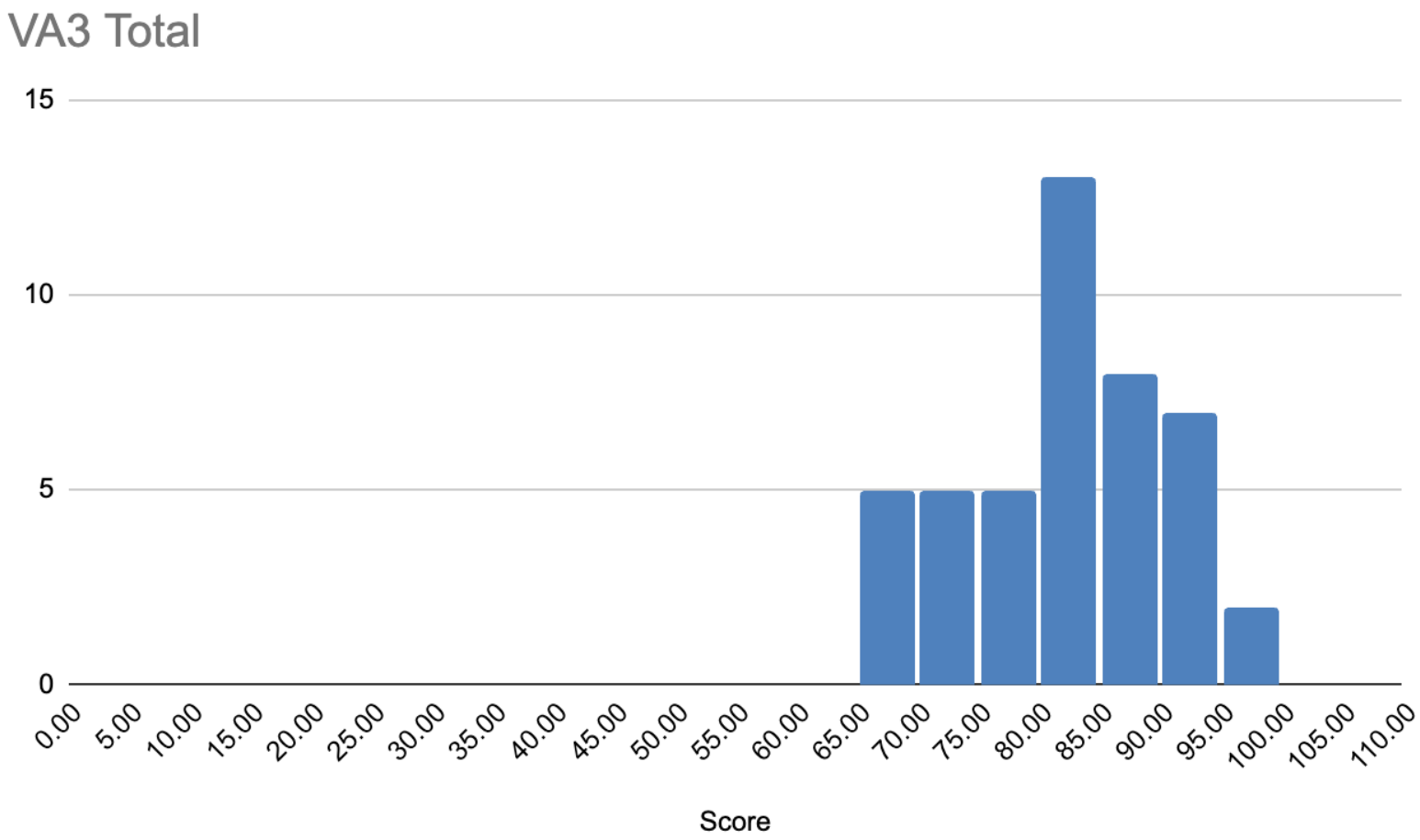
Why this course? Why Algorithms?

- It is one of the most important courses in computer science.
- Many questions in job interviews are coming from algorithmic concepts.
- It helps you in better understanding, analyzing, and problem solving. It is DIFFICULT but also very FUN.
- There is only a handful of classical problems with nicely designed algorithms. If you know how to solve a classical problem (e.g., the shortest-path problem), you can use it to do a lot of different things
  - Abstract ideas from the classical problems
  - Map your requirement to a classical problem
  - Solve with classical algorithms
  - …

Course-Level Learning Outcomes

1. Explain basic concepts related to the design and analysis of algorithms.
2. Describe classical algorithms and their complexity.
3. Design and analyze their own algorithms; and implement, experiment with, compare, and report on various algorithmic solutions to the same problem.
4. Compare and contrast the notions of NP-completeness and approximation algorithms.
5. Function effectively as a member of a team.
6. Communicate effectively via oral and written means.
7. Utilize machine learning to perform classification/regression.

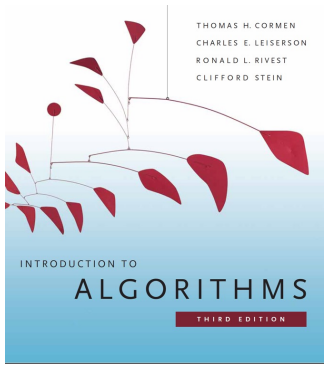
Total Score Distribution in SP 2024



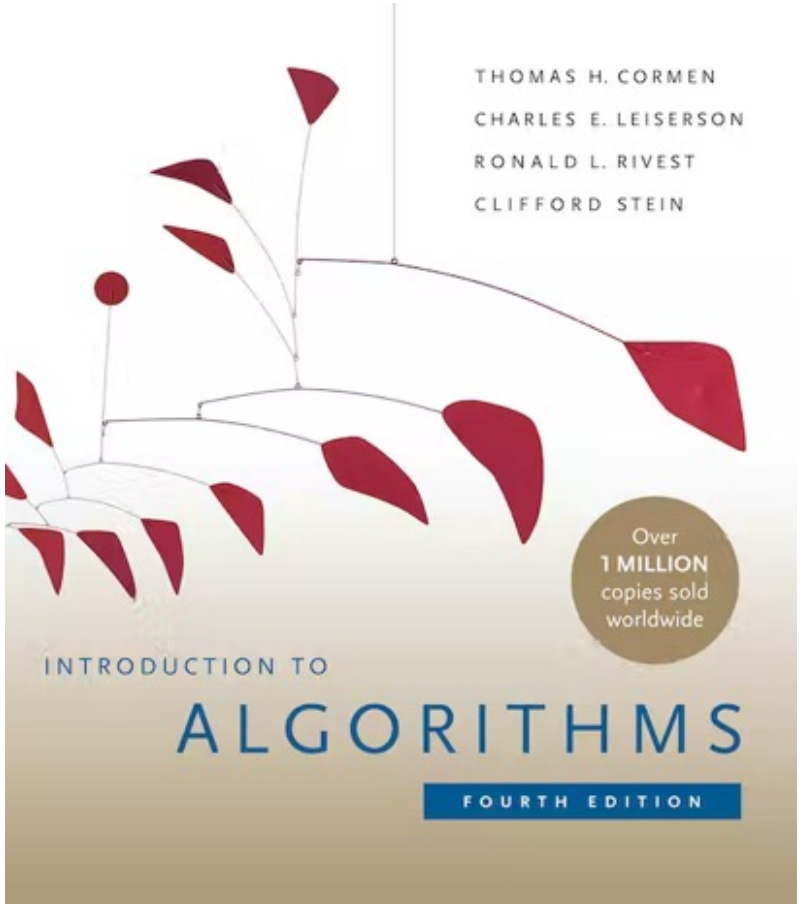
References

- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, *Introduction to Algorithms*, 4th edition, The MIT Press, 2022. (3rd edition is ok)
ISBN-13: 978-0262046305.

3rd edition

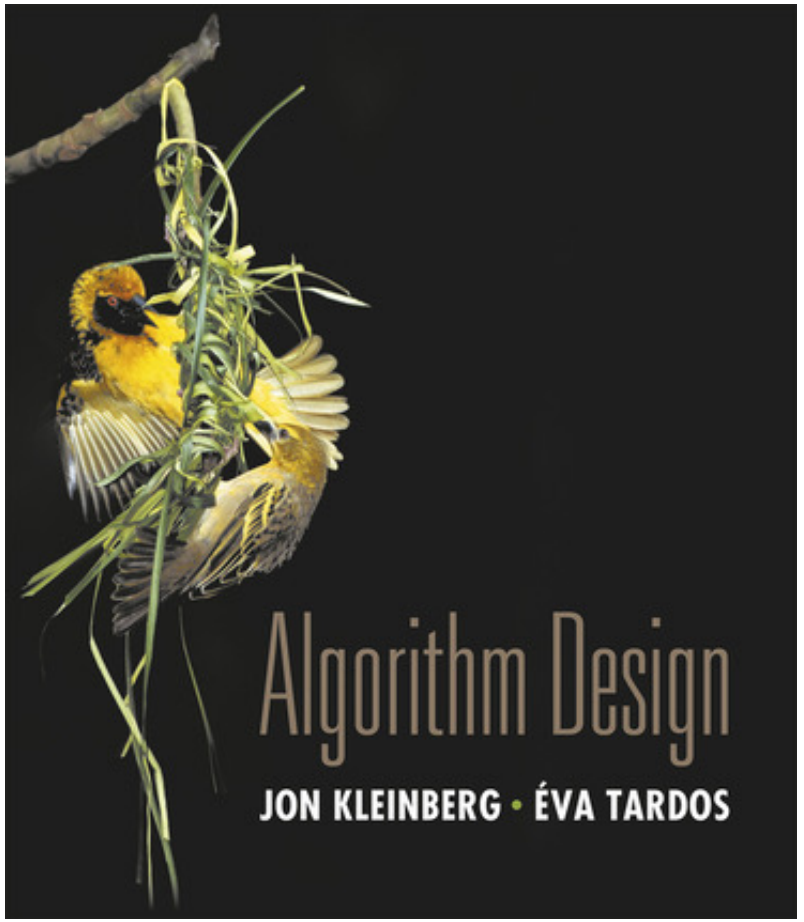


4th edition

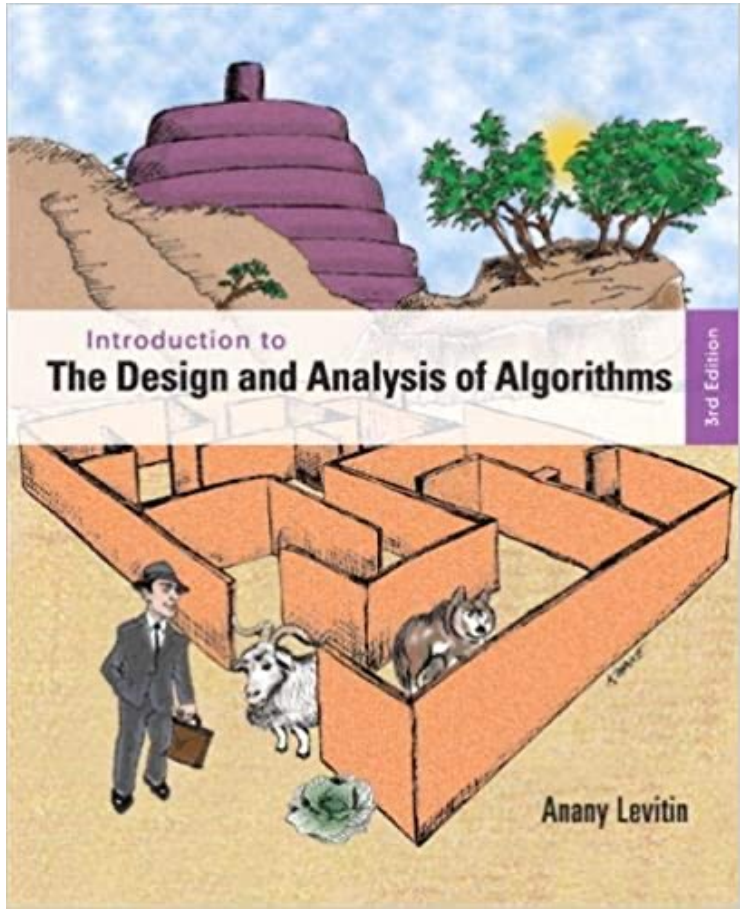


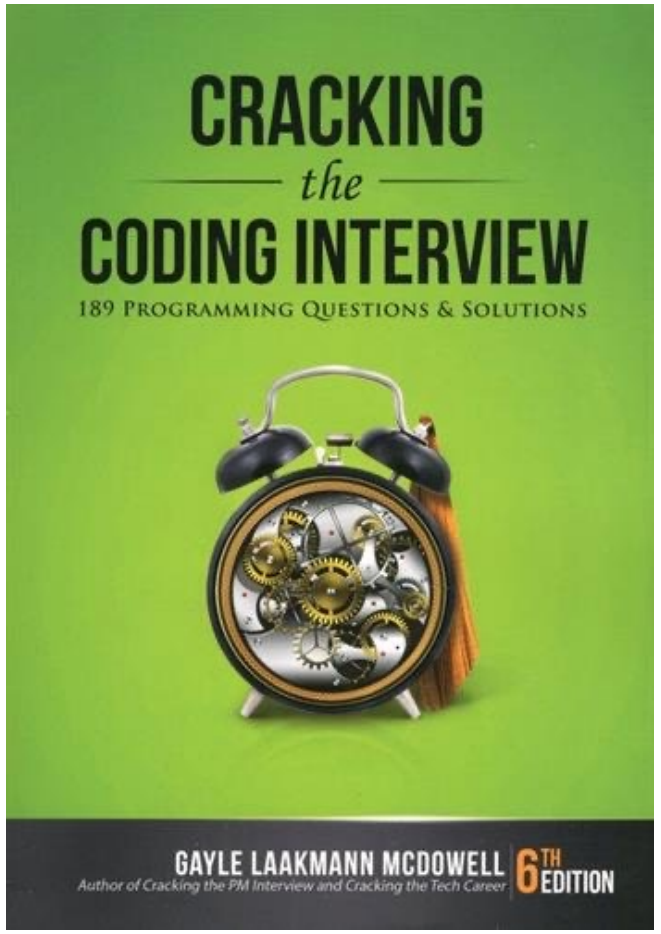
References

- Jon Kleinberg and Éva Tardos, *Algorithm Design*, 1st edition, Pearson, 2005. ISBN-13: 978-0321295354.



Other Resources





Other Resources (cont.)

- Jeff Erickson, *Algorithms*, 2019.
  ISBN-13: 978-1792644832.
  http://jeffe.cs.illinois.edu/teaching/algorithms/
- K. P. Murphy, *Probabilistic Machine Learning: An Introduction*. Cambridge, MA, USA: The MIT Press, 2022.
  ISBN-13: 978-0262046824.
  https://probml.github.io/pml-book/book1.html
- Christos Papadimitriou, Sanjoy Dasgupta, and Umesh Vazirani, *Algorithms*, McGraw Hill, 2006.
  ISBN-13: 978-0073523408.
- Aditya Y. Bhargava, *Grokking Algorithms,* Manning, 2016.
  ISBN-13: 978-1617292231.
- Gayle Laakmann McDowell, *Cracking the Coding Interview*, 6th Edition, 2015.
  ISBN-13: 978-0984782857.

Grading Guidelines

- Evaluation will be based on attendance, individual assignments, one group project (in groups of up to 3), one quiz, one midterm exam, and one final exam.

Item	Contribution to Total Grade
Attendance	5 %
Assignments	20 %
Project	10 %
Quiz	5 %
Midterm Exam	30 %
Final Exam	30 %
TOTAL	100 %

Grading Guidelines (cont.)

- Evaluation will be based on attendance, individual assignments, one group project (in groups of up to 3), one quiz, one midterm exam, and one final exam.

Item	Contribution to Total Grade
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Assignments	20 %
Project	10 %
Quiz	5 %
Midterm Exam	30 %
Final Exam	30 %
TOTAL	100 %

Lower Limit (%)	Grade
90	A
85	A-
80	B+
75	B
70	B-
65	C+
60	C
0	F

Explanation to Grade

Grade	Description	Quality Points	Used in GPA Calculation
A	Excellent quality and full mastery of the course material, extraordinary distinction	4.0	Yes
A-	Excellent quality and full mastery of the course material	3.7	Yes
B+	Good to excellent comprehension of the course material and the skills necessary to work with course material	3.3	Yes
B	Good comprehension of the course material and the skills necessary to work with course material	3.0	Yes
B-	Reasonably good comprehension of the course material and the skills necessary to work with course material	2.7	Yes
C+	Adequate and slightly above satisfactory comprehension of the course material and met the basic course requirements	2.3	Yes
C	Adequate and satisfactory comprehension of the course material and met the basic course requirements	2.0	Yes
F	Failure	0	Yes

Schedule

- Syllabus on Canvas.
- Updates from announcements.

Before We Start

Any questions?

Do you think this will be a hard class?