
بسم الله الرحمن الرحيم

Theory of Computer Science

Ali Shakiba

Vali-e-Asr University of Rafsanjan

ali.shakiba@vru.ac.ir

What we are going to discuss?

Theory of Computation

Complexity Theory

another topic ...

- Mining Massive Datasets
- Computational Learning Theory
- Parameterized Algorithms

Theory of Computation

- Church-Turing thesis, Turing machine & its variations
- exploring the limits of algorithmic solvability
- reducibility as a key method to prove unsolvability
- recursive/partial recursive functions
- decidability in terms of recursion
- arriving at Turing machines
- decidability of logical theories
- Turing reducibilities

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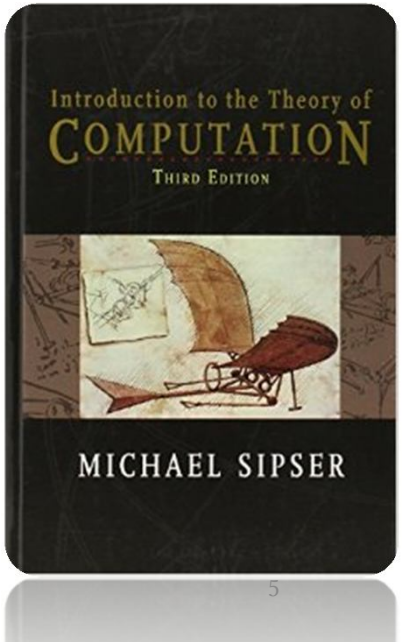

[S12] Sipser, Michael. **Introduction to the Theory of Computation**, 3rd edition. Cengage Learning, 2012. (Chapters 3 to 6)

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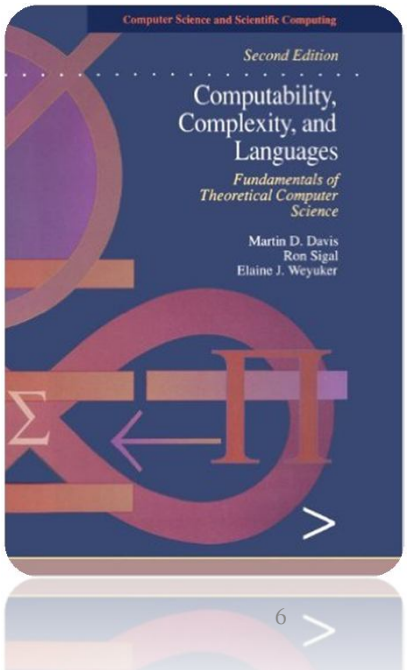

[DSW94] Davis, Martin, Ron Sigal, and Elaine J. Weyuker. **Computability, Complexity, and Languages: Fundamentals of Theoretical Computer Science**. Newnes, 1994. (Chapters 2 to 6)

Complexity Theory

- time complexity
- P, NP, NP-completeness and P vs. NP problem
- space complexity
- PSPACE, PSPACE-completeness, L, NL and NL-completeness
- Intractability, relativization and circuit complexity

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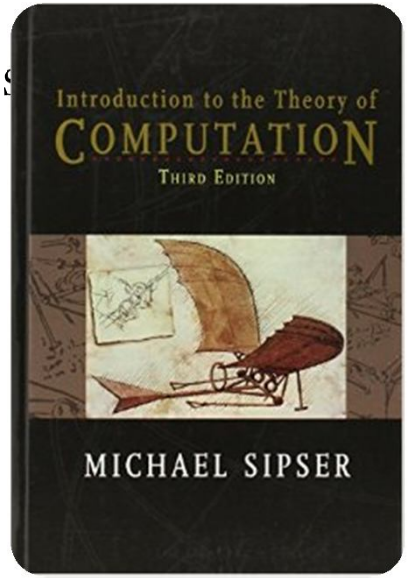

[S12] Sipser, Michael. **Introduction to the Theory of Computation**, 3rd edition. Cengage Learning, 2012. (Chapters 7 to 9)

You choose which one …

Mining Massive Datasets

- MapReduce, communication cost model and complexity theory for MapReduce
- theory of local sensitive hash functions and applications
- data streams, Bloom filters, count distinct problem, moments, queries in window
- frequent items and algorithms
- much much more depending on our time ...

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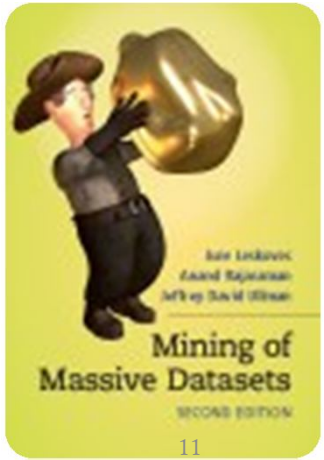

Leskovec, Jure, Anand Rajaraman, and Jeffrey David Ullman. **Mining of massive datasets**. Cambridge University Press, 2014.

Computational Learning Theory

- what is learning?
- probably approximately correct, PAC, learning
- Occam's razor
- Vapnik-Chervonenkis dimension
- weak and strong learning
- learning in the presence of noise
- inherent unpredictablity
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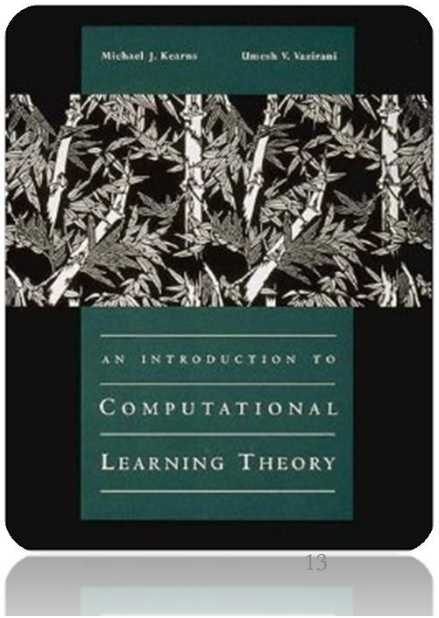

Kearns, Michael J., and Umesh Virkumar Vazirani. **An introduction to computational learning theory**. MIT press, 1994.

Parameterized Algorithms

- parameterized complexity theory
- the art of problem parameterization
- data reduction or kernelization technique
- bounded search trees
- dynamic programming
- tree-width and tree decomposition
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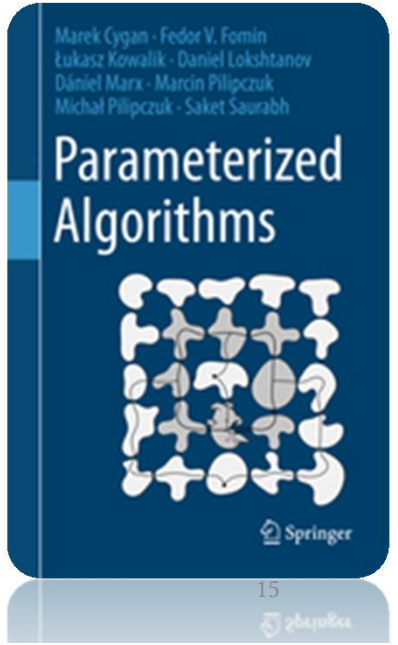


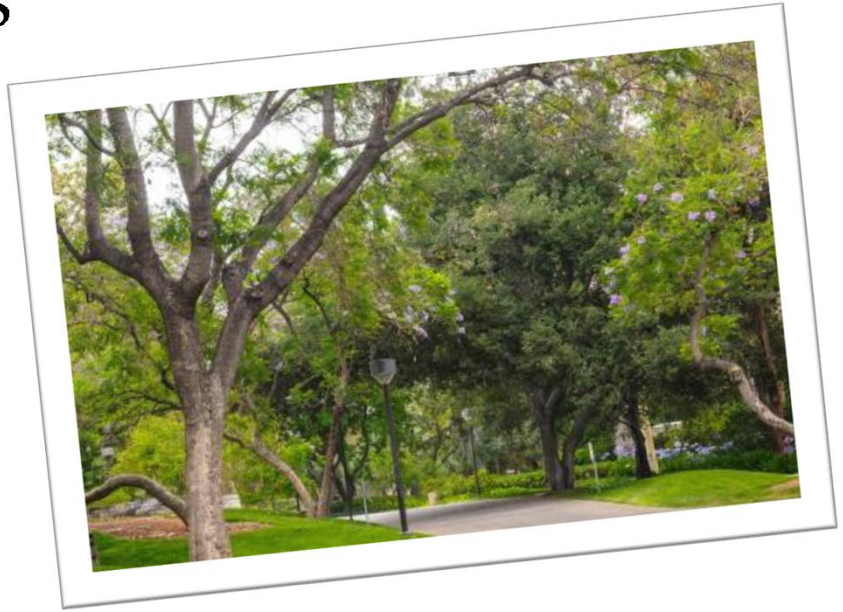
Cygan, Marek, et al. **Parameterized algorithms**. Vol. 4. Switzerland: Springer, 2015.

Evaluation

Title		Grade	Description
Exercises		5	At least 10 series, weekly
Project	Written Report	3	
	Presentation	2	
Written Exams	Mid-1	2	Monday, Aban, 3rd 1395 (Ch. 3-5 [S12]
	Mid-2	2	Monday, Azar, 1st 1395 (Ch. 2-6 [DSW94])
	Mid-3	2	Monday, Day, 6th 1395 (Ch. 6-9 [S12])
	Final	4	Consult GOLESTAN
Excellence		+2	
Total		20 + 2	

Engineers Teach Machines to Recognize Tree Species

Engineers from Caltech have developed a method that uses data from satellite and street-level images, such as the ones that you can see in Google maps, to create automatically an inventory of street trees that cities may use to better manage urban forests.



http://vision.caltech.edu/registree/

http://www.caltech.edu/news/engineers-teach-machines-recognize-tree-species-52122

No Comments

Theorem 6.3. The minimum degree of a simple planar graph is at most five.

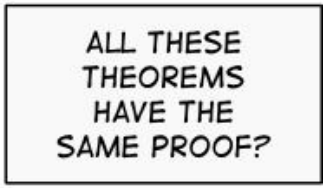
Proof. The proof is identical to that of Theorem 4.7.

Theorem 4.7. A simple graph is hamiltonian if and only if its closure is hamiltonian.

Proof. The proof is identical to that of Theorem 2.2.

Theorem 2.2. A connected graph has at least one spanning tree.

Proof. The proof is identical to that of Theorem 1.4.



Theorem 1.4. Let G be a simple graph of order n. Then the number of edges of G is at most n(n-1)/2.

Proof. The proof is trivial.