

15:750
Algorithms in the Real World

Instructors:
Anupam Gupta and Rashmi Vinayak

Lecture 1

Course Staff

Instructors:

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Algorithms

Approximation Algorithms

Online and Stochastic Algorithms

Graph and Network Algorithms

Metric Spaces and Embeddings

Dimensionality and Dimension Reduction

Instructors

Rashmi Vinayak

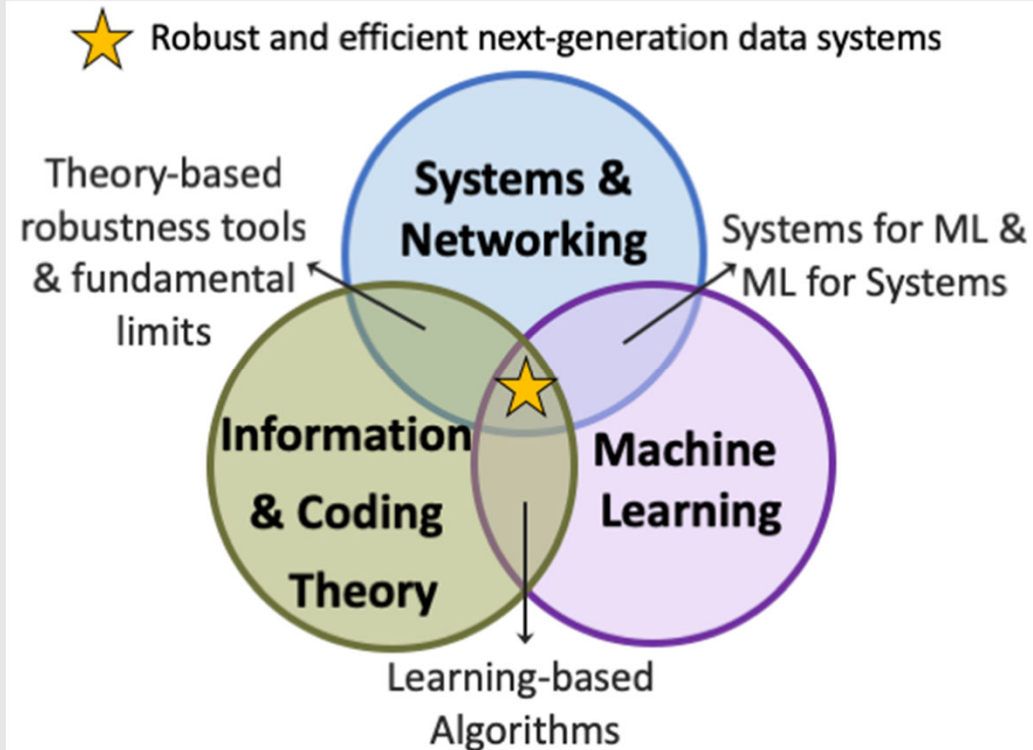
<http://www.cs.cmu.edu/~rvinayak/>

TheSys Lab

Research on both Theory and Systems

On Information & Coding Theory:

We formulate & solve theory problems based on real-world system challenges



Course content overview

Learning goals and Prerequisites

Goals: Cover algorithms and design principles that give students the ability to

- recognize which tool or method to apply to problems,
- to become reasonably proficient at using these tools, and
- to be able to reason about the correctness and performance of the resulting algorithms

More details on the course webpage

Prereqs:

Basic linear algebra and probability: E.g., matrix/vector operations, conditional probability

Basic algorithms: Any undergraduate level algorithms course

Course website has some resources



15-750 Schedule (Tentative) ☆ 📄 🌐

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	A	B	C	D	E	F	G
1	Date	Day	Lecture	Lecture Topic	HWs	HW topics	Lecture notes
2	1/18/2022	T	A	Introduction, Strassen's algorithm			
3	1/20/2022	R	A	Greedy algorithms (MST) and amortized analysis			
4	1/25/22	T	R	Hashing: basics (universal and pairwise independence..), constructions	Hw1 out	Hw1: First three lectures (including the fi	
5	1/27/2022	R	R	Hashing: cuckoo hashing, bloom filters			
6	2/1/2022	T	A	Shortest paths and more amortization			
7	2/3/2022	R	A	Dynamic programming	Hw1 in, Hw2 out		
8	2/8/22	T	R	Hashing: conc. bounds and load balancing (balls and bins)			
9	2/10/2022	R	R	Hashing: Streaming algorithms for big data, LSH			
10	2/15/2022	T	R	Algorithms for Coding			
11	2/17/2022	R	R	Algorithms for Coding (finite fields intro moved from hashing to here)	Hw2 in, Hw3 out		
12	2/22/22	T	R	Algorithms for Coding			
13	2/24/2022	R	R	Dimension Reduction: Random Projections			
14	3/1/2022	T		Midterm (no lecture)			
15	3/3/2022	R	R	Dimension Reduction: PCA, SVD			
16	3/8/22	T		Spring break!!			
17	3/10/2022	R		Spring break!!			
18	3/15/2022	T	R	Compression	Hw3 in, Hw4 out		
19	3/17/2022	R	R	Compression			
20	3/22/22	T	A	Optimization: Flows and Matchings			
21	3/24/2022	R	A	Optimization: Linear Programming, formulation and examples			
22	3/29/2022	T	A	Optimization: Linear Programming, duality, and algorithms			
23	3/31/2022	R	A	The Barriers to Optimization: NP hardness	Hw4 in, Hw5 out		
24	4/5/22	T	A	The Barriers to Optimization: Coping with Intractability (via Approximationsa)			
25	4/7/2022	R	A	Online Optimization: Making decisions online			
26	4/12/2022	T	A	Online Optimization: The Multiplicative Weights Framework			
27	4/14/2022	R		Carnival break, no classes	Hw5 in, Hw6 out		
28	4/19/22	T	A	Online/Continuous Optimization: the Gradient Descent framework			
29	4/21/2022	R	A	Random Walks and Sampling Algorithms			
30	4/26/2022	T	A	Spectral Graph Theory			
31	4/28/2022	R	R+A	Review Lecture: What we saw in the course	Hw6 in		
32				Final Exam (format TBD)			

Course logistics

Communication

Piazza: all course related communication

- All technical questions should be discussed via Piazza
- Pls don't use private messages unless necessary—very likely other students have same question as you! (You can be anonymous to other students, of course.)

Office hours

- Will be updated on the calendar on the course webpage
- Rashmi Vinayak's office hours by appointment:
 - Please send Rashmi an email along with a brief description of what you would like to discuss

Course materials

- No mandatory textbook
- We will provide lecture notes / reading from books / slides
- Course website lists some good books that you can use as reference
- If you use a resource that is useful in HWs, pls cite it!!

Evaluation

32% each for midterm (March 1)

32% for finals (date TBD)

32% for homeworks (~6 HWs, dates on schedule)

4% for attendance/class participation in lecture or Piazza

Homework policy

- Some HWs are collaborative, others solo.
- Need to write own solutions, no exchange of written material.
- Cite all sources!
- Submissions on Gradescope
- For each HW, you have a two-day (48 hours) **no-questions-asked** extension.
 - Can use this extension for any valid reason **without having to ask the instructors**.
 - No additional extensions (except for exceptional circumstances)

Questions?