

# Course summary

and your future study of algorithms

# Tools in your algorithmic toolbox

- ADTs and Data structures
- Exhaustive search and optimizations
- Greedy algorithms
- Divide and conquer
- Dynamic Programming
- Randomized algorithms [touched upon]
- String algorithms
- Graph algorithms
- NP-completeness and Reductions [touched upon]

# Tools in your algorithmic toolbox

- ADTs and Data structures: *Hash Map, UNION-FIND*
- Exhaustive search and optimizations: *BFS, DFS*
- Greedy algorithms: *Scheduling, Huffman codes*
- Divide and conquer: *Sorting, Inversions*
- Dynamic Programming: *Knapsack, Edit distance*
- Randomized algorithms [touched upon]: *Quicksort*
- String algorithms: *KMP, Hirschberg*
- Graph algorithms: *Topological sorting, Strongly connected components, Min spanning trees, Shortest paths*
- NP-completeness and Reductions [touched upon]: *Vertex-cover, Clique*

Five important topics  
we did not cover

# I. Max flows, min cuts, bipartite matchings, linear programming

Second course in algorithms by Tim Roughgarden – video playlist:

- <https://www.youtube.com/playlist?list=PLEGCF-WLh2RJh2yDxlJJjnKswWdoO8gAc>

# II. Better algorithms for NP-complete problems

Example: better algorithm for Vertex Cover:

video links (Stanford course):

- <https://youtu.be/9eLvyM0gTWO>
- <https://youtu.be/aj7WT49y-qE>
- <https://youtu.be/yy3meMHpk10>

# III. Approximation algorithms for hard problems

Example: approximate solution to knapsack problem using greedy and dynamic programming heuristics:

video links (Stanford course):

- <https://youtu.be/FE413JeEBts>
- <https://youtu.be/QFZ7E3qgNwM>
- <https://youtu.be/KB-ueY1VNTU>
- <https://youtu.be/GVrltG08knU>
- <https://youtu.be/tOuAvsCvPvg>
- [https://youtu.be/5heXe\\_tMSi8](https://youtu.be/5heXe_tMSi8)

# IV. Randomized algorithms

- Stanford course by Tim Roughgarden

(with video links):

- <http://timroughgarden.org/f19/f19.html>



# V. Algorithms and data structures for different memory hierarchies

MIT course by Erik Demaine (with video links)

- <https://courses.csail.mit.edu/6.851/spring12/lectures/>