COMP3251
Lecture 1: Introduction

Welcome to COMP3251

Instructor:

- HUANG, Zhiyi (zhiyi@cs.hku.hk)
- 423 Chow Yei Ching Building
- Tuesday, 4:00pm to 5:00pm
- Other time slots may be available **by appointment**

Tutors:

- LI, Dongchen (dongchen.li@connect.hku.hk)
- SUN, Enze (sunenze@connect.hku.hk)
- YANG, Peilin (peilinyang@connect.hku.hk)
- LG101 Chow Yei Ching Building
- Wednesday and Friday, 4:00pm to 5:00pm

What are algorithms?

An algorithm is a set of precise step-by-step rules for solving a specific computational problem.

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$$\begin{array}{lr} & 5\ 6\ 7\ 8 \\ \times & 1\ 2\ 3\ 4 \\ \hline \end{array}$$

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$$
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\times & 1\ 2\ 3\ 4 \\
\hline
 & 2\ 2\ 7\ 1\ 2
\end{array}
$$

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$$
\begin{array}{cccccc}
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\times & & 1 & 2 & 3 & 4 \\
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$$
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\times & & & 1 & 2 & 3 & 4 \\
\hline
 & & 2 & 2 & 7 & 1 & 2 \\
 & 1 & 7 & 0 & 3 & 4 & \\
1 & 1 & 3 & 5 & 6 & & \\
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\hline
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 & 1 & 7 & 0 & 3 & 4 & \\
1 & 1 & 3 & 5 & 6 & & \\
5 & 6 & 7 & 8 & & & \\
\hline
7 & 0 & 0 & 6 & 6 & 5 & 2
\end{array}
$$

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In primary school, we learnt this as "the correct way" of calculating the multiplication of two numbers.

```
          5 6 7 8
×         1 2 3 4
-----------------
        2 2 7 1 2
      1 7 0 3 4
    1 1 3 5 6
  5 6 7 8
-----------------
  7 0 0 6 6 5 2
```

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-----------------
        2 2 7 1 2
      1 7 0 3 4
    1 1 3 5 6
    5 6 7 8
-----------------
    7 0 0 6 6 5 2
```

In this course:

- How good is this algorithm?
- Can we do better?

An alternative multiplication algorithm

Examples: Multiplying two numbers, say, *1234* and *5678*.

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1) Partition *(1234)* into two numbers *(12)* and *(34)*.
2) Partition *(5678)* into two numbers *(56)* and *(78)*.

An alternative multiplication algorithm

Examples: Multiplying two numbers, say, *1234* and *5678*.

1) Partition *(1234)* into two numbers *(12)* and *(34)*.
2) Partition *(5678)* into two numbers *(56)* and *(78)*.
3) Multiply *(12)* and *(56)* and get *(672)*.

An alternative multiplication algorithm

Examples: Multiplying two numbers, say, *1234* and *5678*.

1) Partition *(1234)* into two numbers *(12)* and *(34)*.
2) Partition *(5678)* into two numbers *(56)* and *(78)*.
3) Multiply *(12)* and *(56)* and get *(672)*.
4) Multiply *(34)* and *(78)* and get *(2652)*.

An alternative multiplication algorithm

Examples: Multiplying two numbers, say, *1234* and *5678*.

1) Partition *(1234)* into two numbers *(12)* and *(34)*.
2) Partition *(5678)* into two numbers *(56)* and *(78)*.
3) Multiply *(12)* and *(56)* and get *(672)*.
4) Multiply *(34)* and *(78)* and get *(2652)*.
5) Multiply *(12)+(34)=(46)* and *(56)+(78)=(134)* and get *(6164)*.

An alternative multiplication algorithm

Examples: Multiplying two numbers, say, *1234* and *5678*.

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2) Partition *(5678)* into two numbers *(56)* and *(78)*.
3) Multiply *(12)* and *(56)* and get *(672)*.
4) Multiply *(34)* and *(78)* and get *(2652)*.
5) Multiply *(12)+(34)=(46)* and *(56)+(78)=(134)* and get *(6164)*.
6) Subtract the first two numbers from the third one and get *(6164)-(672)-(2652)=(2840)*.

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6) Subtract the first two numbers from the third one and get *(6164)-(672)-(2652)=(2840)*.
7) Sum up *(6720000)* (1st number padded with four 0's), *(2652)* (2nd number), and *(284000)* (4th number padded with two 0's), and get

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6) Subtract the first two numbers from the third one and get *(6164)-(672)-(2652)=(2840)*.
7) Sum up *(6720000)* (1st number padded with four 0's), *(2652)* (2nd number), and *(284000)* (4th number padded with two 0's), and get

(6720000) + *(2652)* + *(284000)* = *(7006652)*.

An alternative multiplication algorithm

Cannot make any sense?

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- That’s expected for now!

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Cannot make any sense?

- That’s expected for now!
- After a few classes, you will understand this alternative multiplication algorithm.
- By the end of the semester, you will be able to design algorithms like this one (and other fancy techniques too).

Why study algorithms?

Useful for all areas in CS

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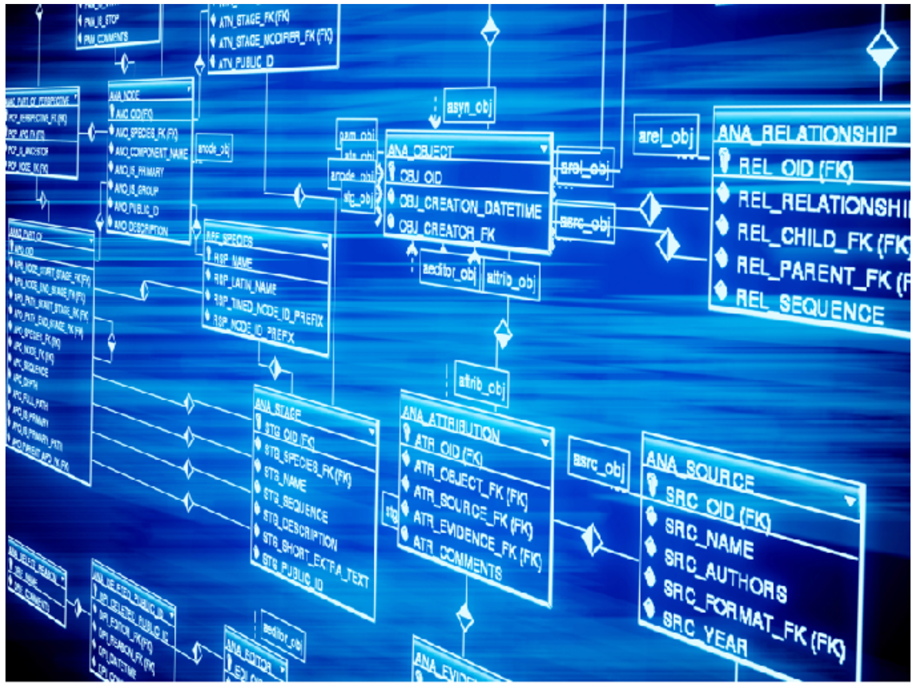
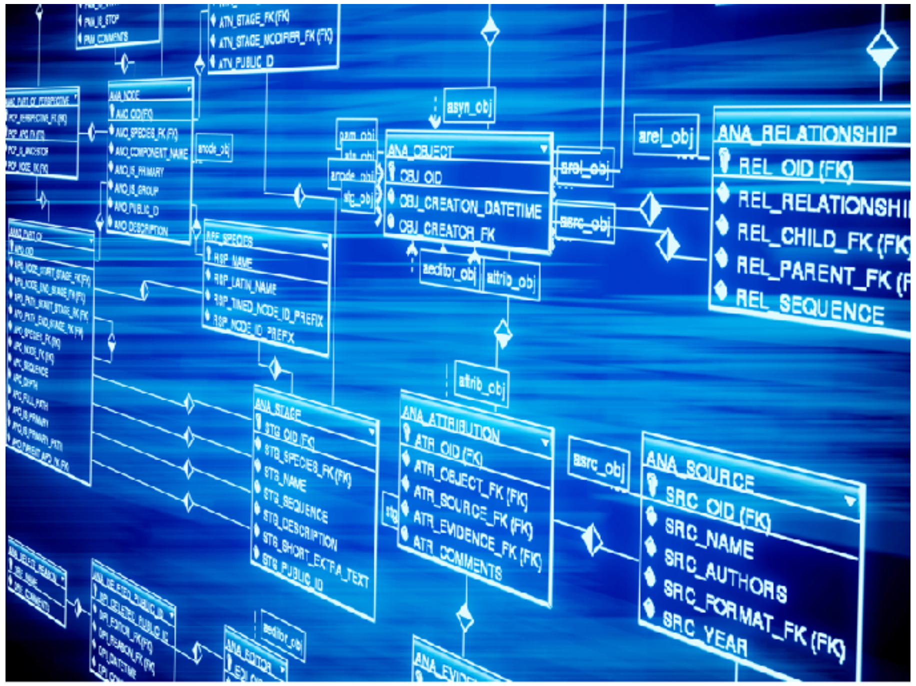


database

Useful for all areas in CS



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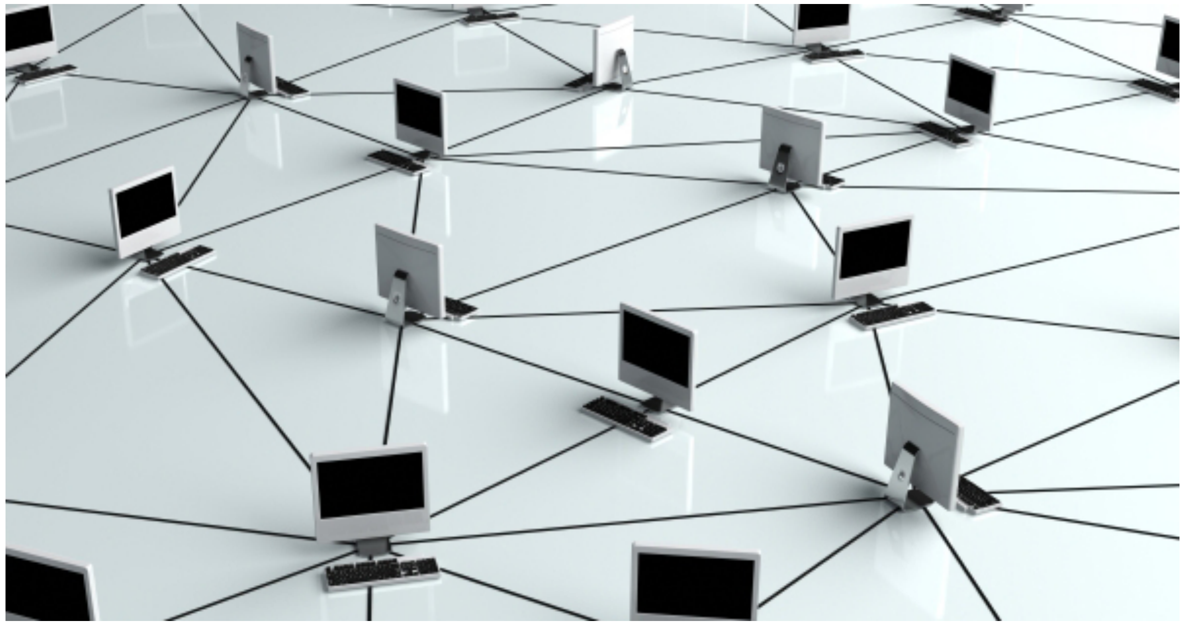
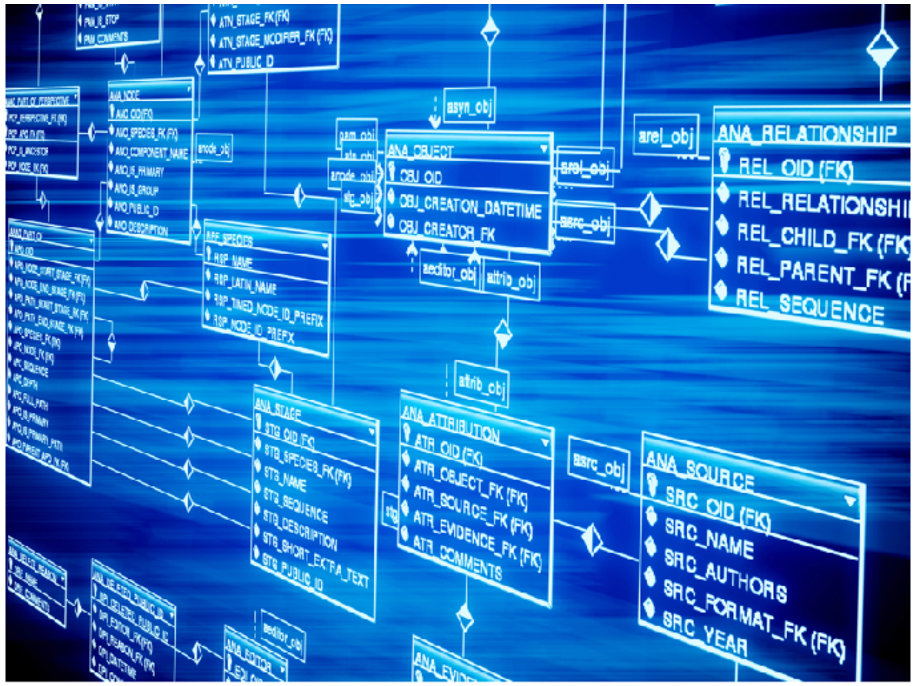


networking

Useful for all areas in CS



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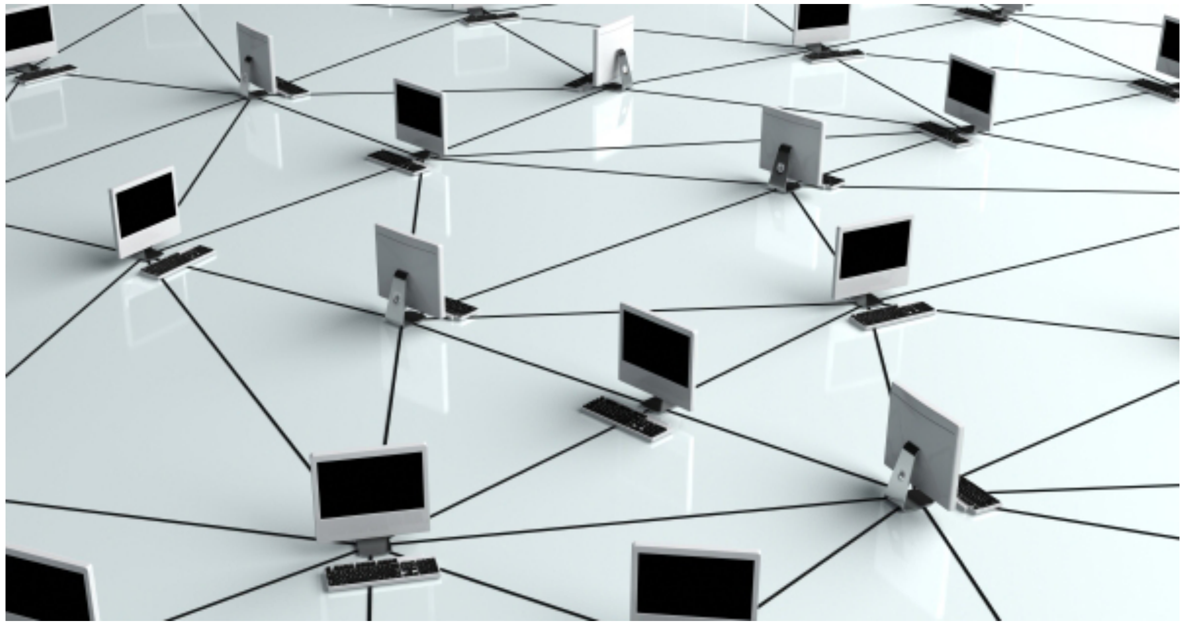
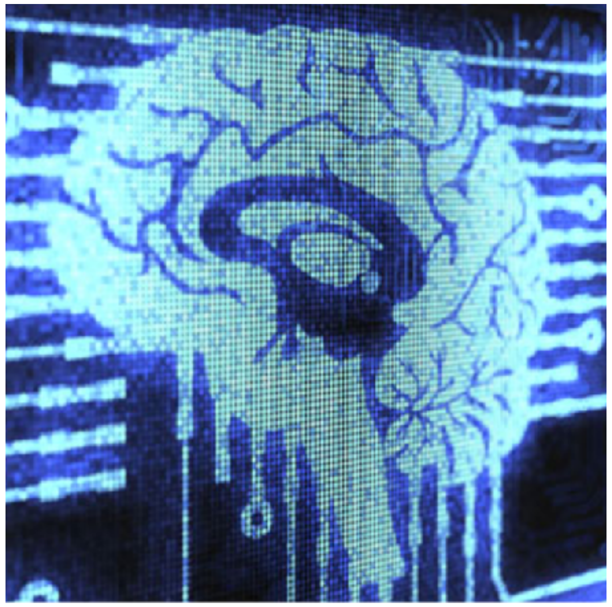
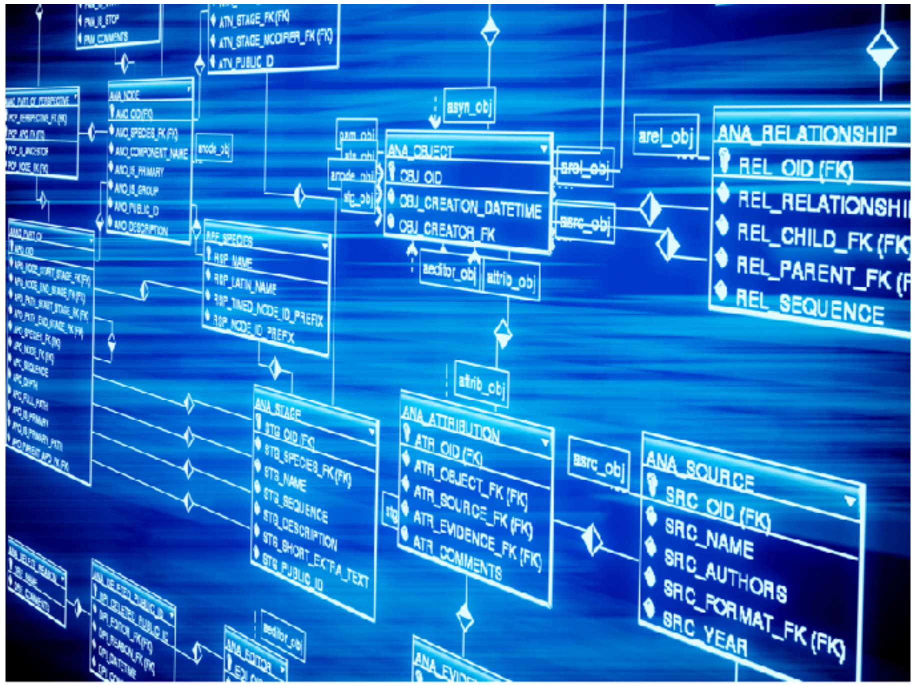


networking



machine learning

Useful for all areas in CS



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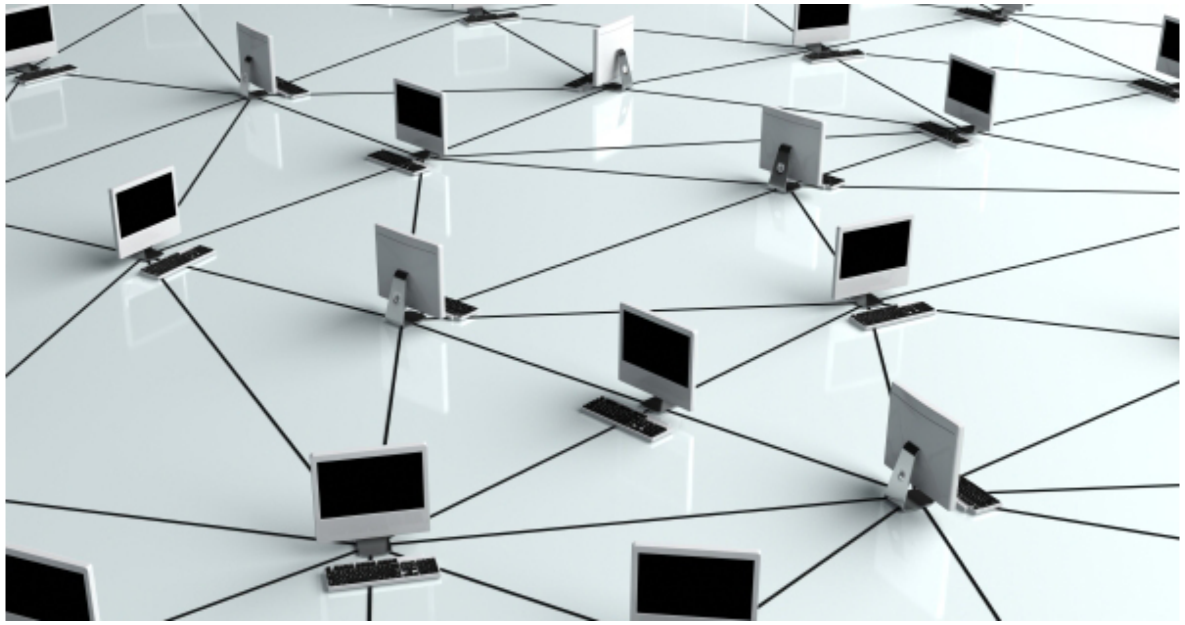

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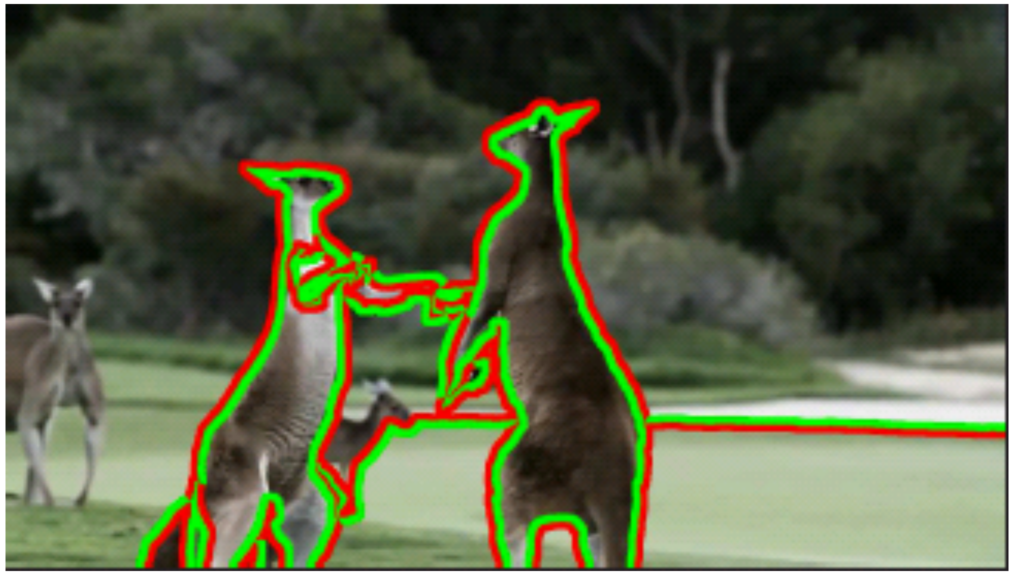
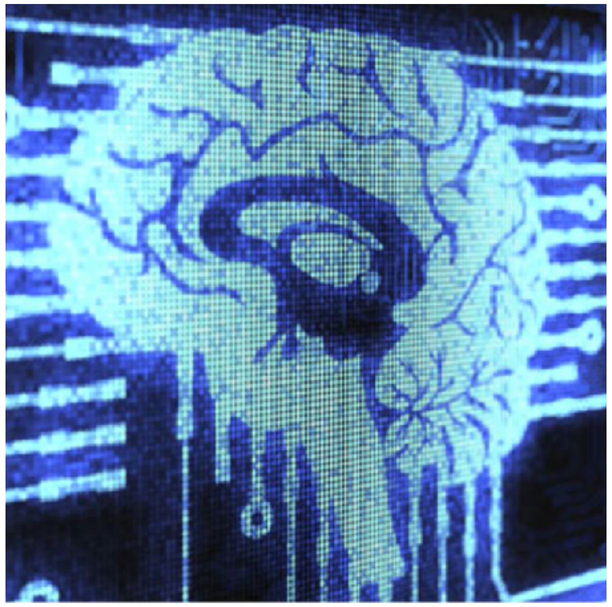
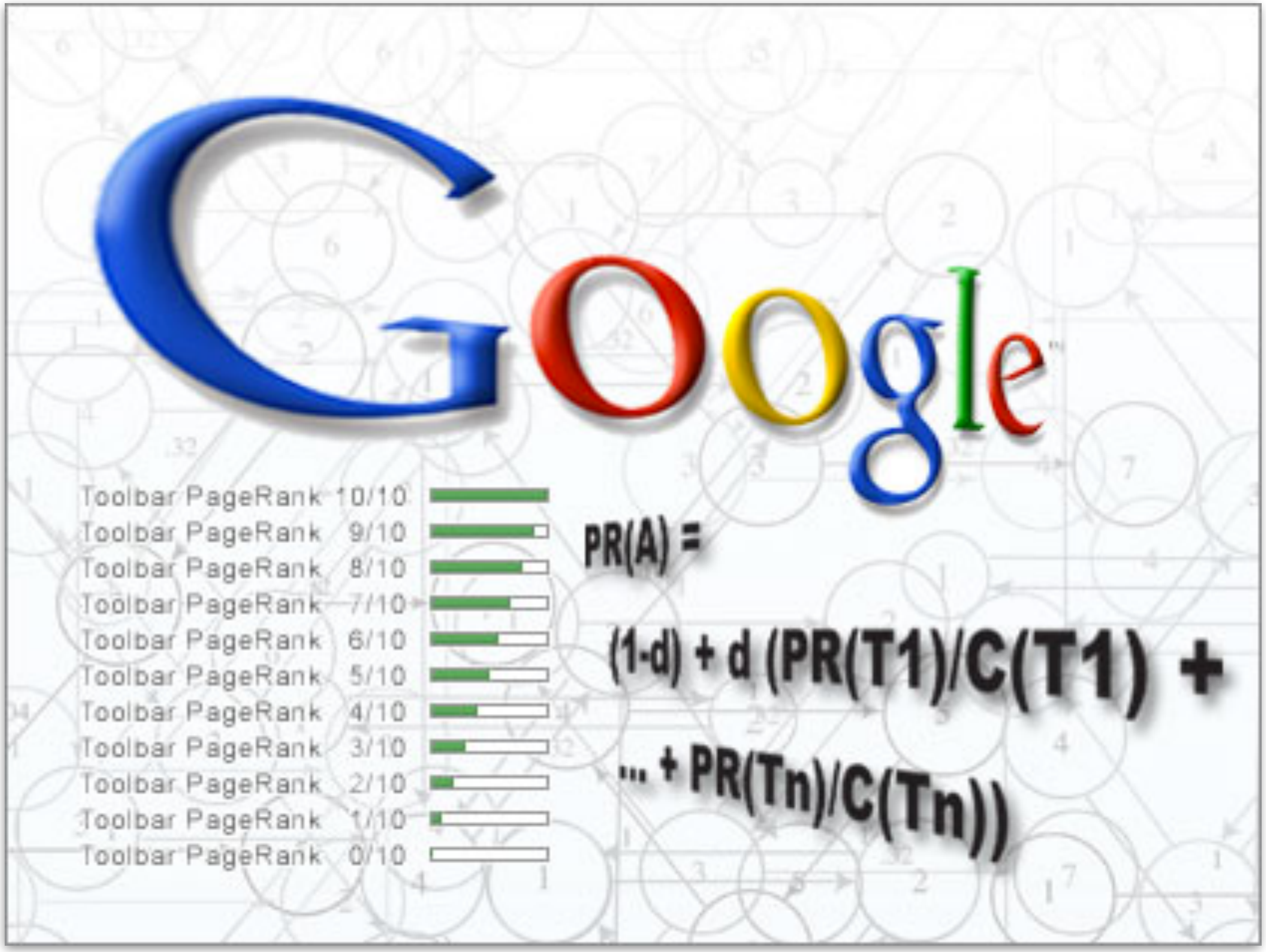


computer vision



machine learning

Algorithms that run the world



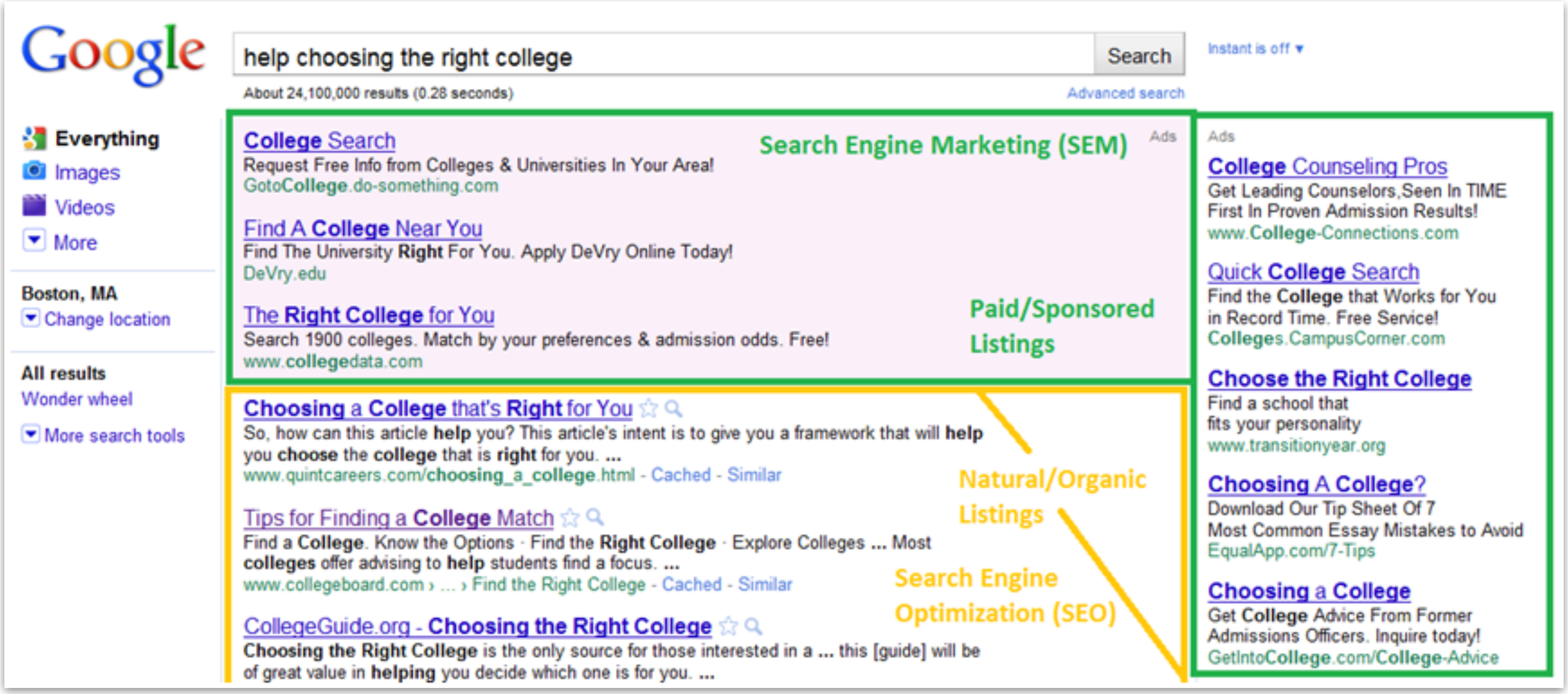
Page Rank

Algorithms that run the world

MOKO
新世紀廣場
Mong Kok
Olympian City Two
Nathan Rd
KING'S PARK
京士柏
Jordan Rd
Austin Rd
West Kowloon
Waterfront
Promenade
Gateway Tower Golden
Gateway Multiplex
iSQUARE
國際廣場
Hong Kong
Cultural Centre
香港文化中心
16 min
7.0 km
Victoria Harbour
維多利亞港
Island Pacific
Hotel Hong Kong
Jan 15 12:30pm
SHEK
TONG TSUI
石塘咀
The University
of Hong Kong
Fu Lam Rd
Lan Kwai Fong
蘭桂坊
CENTRAL
Hong Kong Convention
and Exhibition Centre
香港會議展覽中心
Premium Motors
2D
3
7C
7B
5
8A
8
1
6E
7D
6D
7A
6C
6A
2
4
12C
12A

Shortest Path Algorithms

Algorithms that run the world



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About 24,100,000 results (0.28 seconds)

Boston, MA

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Choosing a College that's Right for You
So, how can this article help you? This article's intent is to give you a framework that will help you choose the college that is right for you. ...
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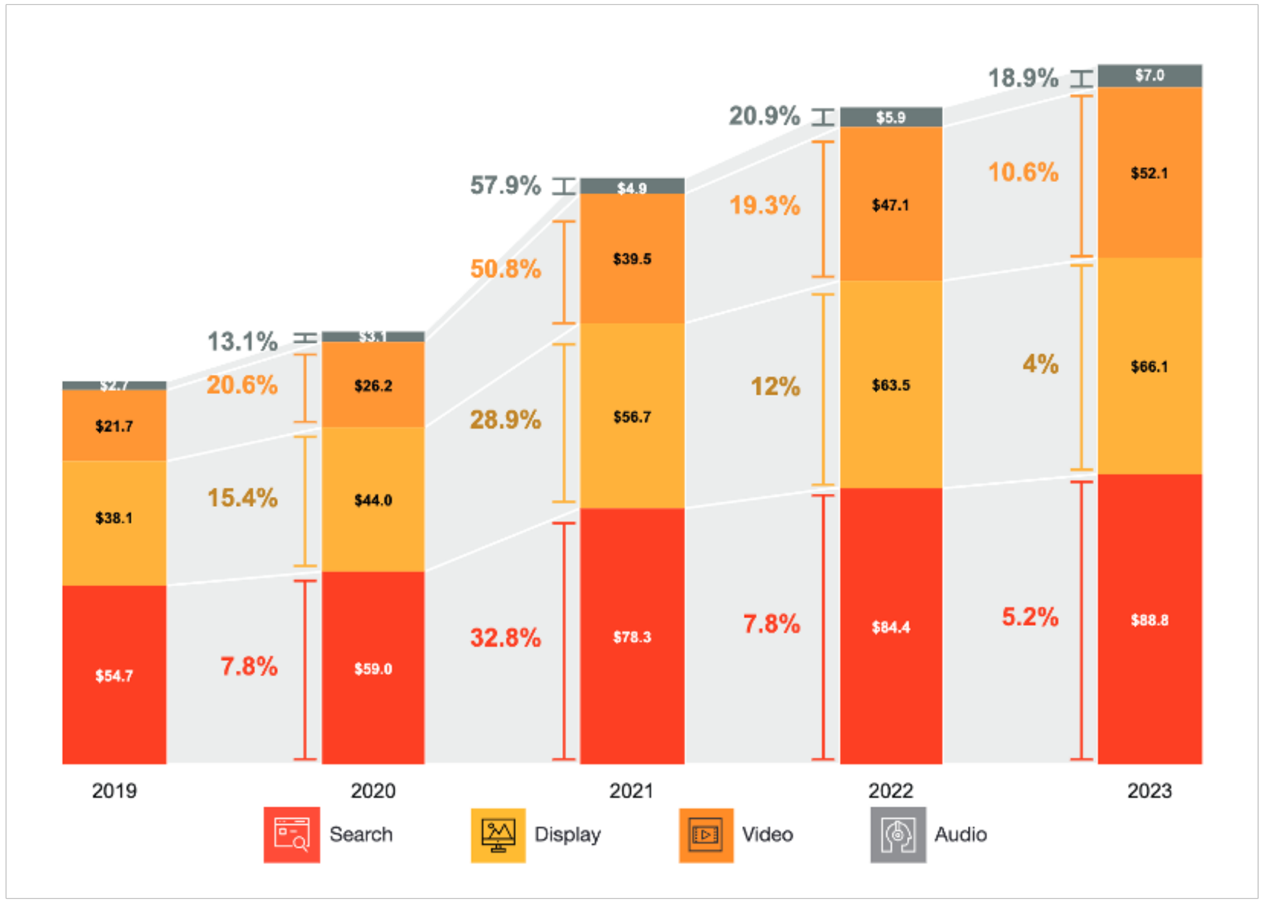
Online Advertisement

Online Advertisement is Big!



Source: IAB / PwC Internet Ad Revenue Report

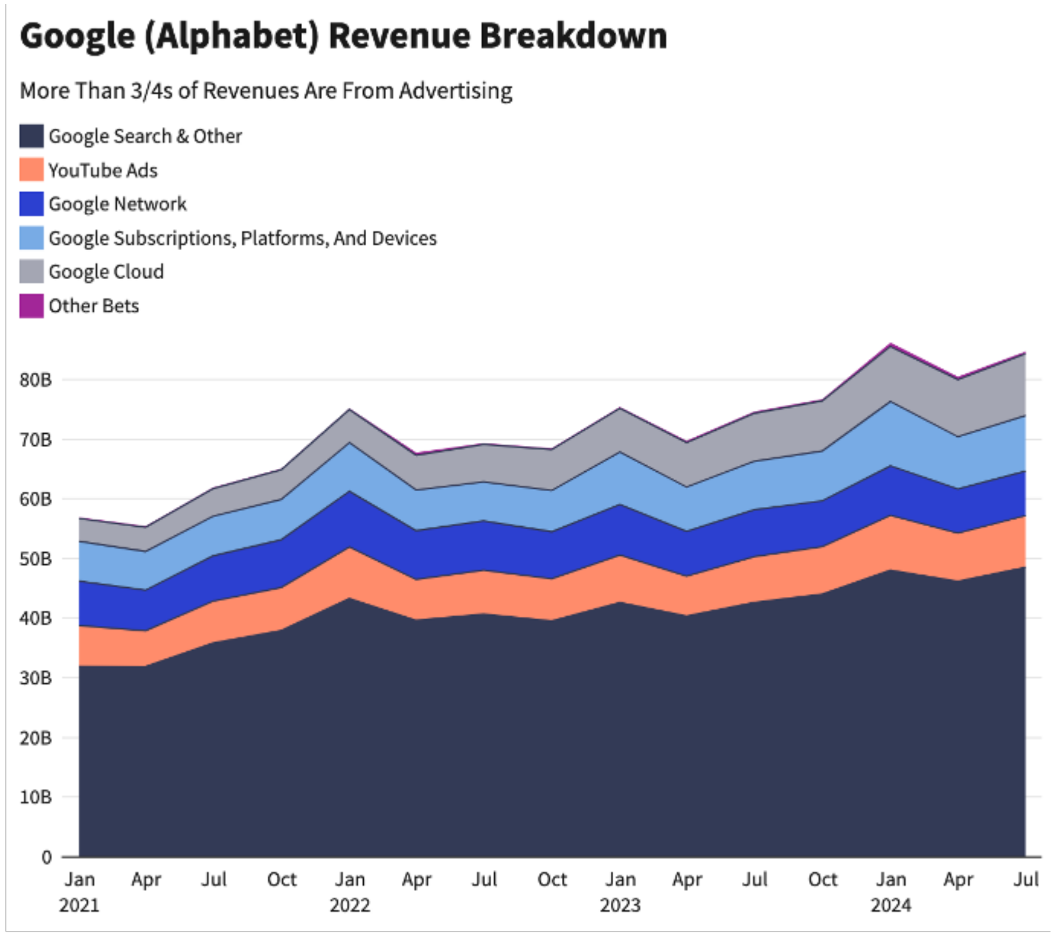
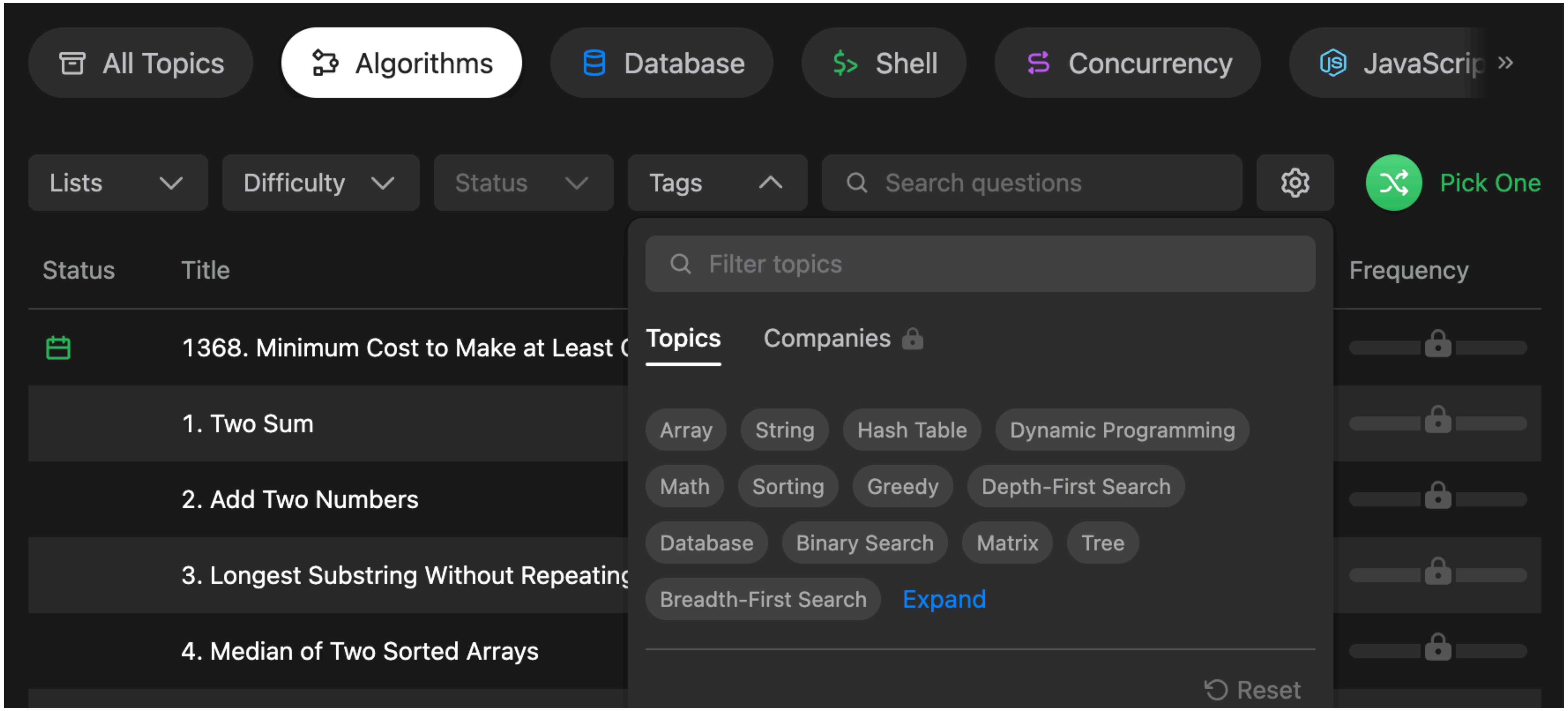


Chart: Investopedia/Peter Gratton
Source: Alphabet Inc.

LeetCode Prep Course?



1368. Minimum Cost to Make at Least (

1. Two Sum

2. Add Two Numbers

3. Longest Substring Without Repeating

4. Median of Two Sorted Arrays

What you will get from this course?

- Become a better programmer
- Sharpen your analytical and mathematical skills
- Ace the algorithm questions in your job interviews
- Think “algorithmically”

Textbook

Lecture notes:

- Self-contained
- Available on Moodle before each lecture

Textbook (required supplementary readings):

- *Algorithms*
  S. Dasgupta, C. H. Papadimitriou, and U. Vazirani

Other resources (optional):

- *Algorithm Design*
  E. Tardos and J. Kleinberg
- *Introduction to Algorithms*
  T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein
- Online course by Tim Roughgarden

Course Topics

Algorithm design paradigms:

- Divide and conquer (DPV Ch. 2)
- Greedy (DPV Ch. 5)
- Dynamic programming (DPV Ch. 6)

Graph algorithms:

- Graph decomposition (DPV Ch. 3)
- Shortest path (DPV Ch. 4)
- Max flow (DPV Ch. 7.2, supplementary materials will be available on Moodle)

Complexity theory:

- NP-completeness and reduction (DPV Ch. 8)

Assessment

- Homework assignments (40%)
  - 5 assignments
  - Count **best 4** out of 5
  - **No late submission:** If you happen to be extremely busy before one of the deadlines, that's your worst 1 out of 5
  - About 4 problems in each assignment
- Midterm (10%)
  - 90 min, semi-open book (2 sheets of A4), in class
  - Most likely in the week after the reading week
- Final (50%)
  - 3 hours, 4-5 questions, semi-open book (2 sheets of A4)

Collaboration Policy for Homework Assignments

YES: Discuss with friends, ask ChatGPT, acknowledge them, **write your own solutions**.

NO: Copy solutions word-for-word or with minor modifications (from your friends, from the Internet, from past-year, etc.)

Note: I strongly recommend that you try to complete the homework assignments on your own.

3251 (Regular Class) vs. 3252 (Advanced Class)

- COMP3251 focuses on
  - How basic algorithms work
  - Applications of algorithms
- COMP3252 emphasizes more on
  - Problem solving skills
  - Mathematical proofs