Indexing Compressed Data for Fast Retrieval

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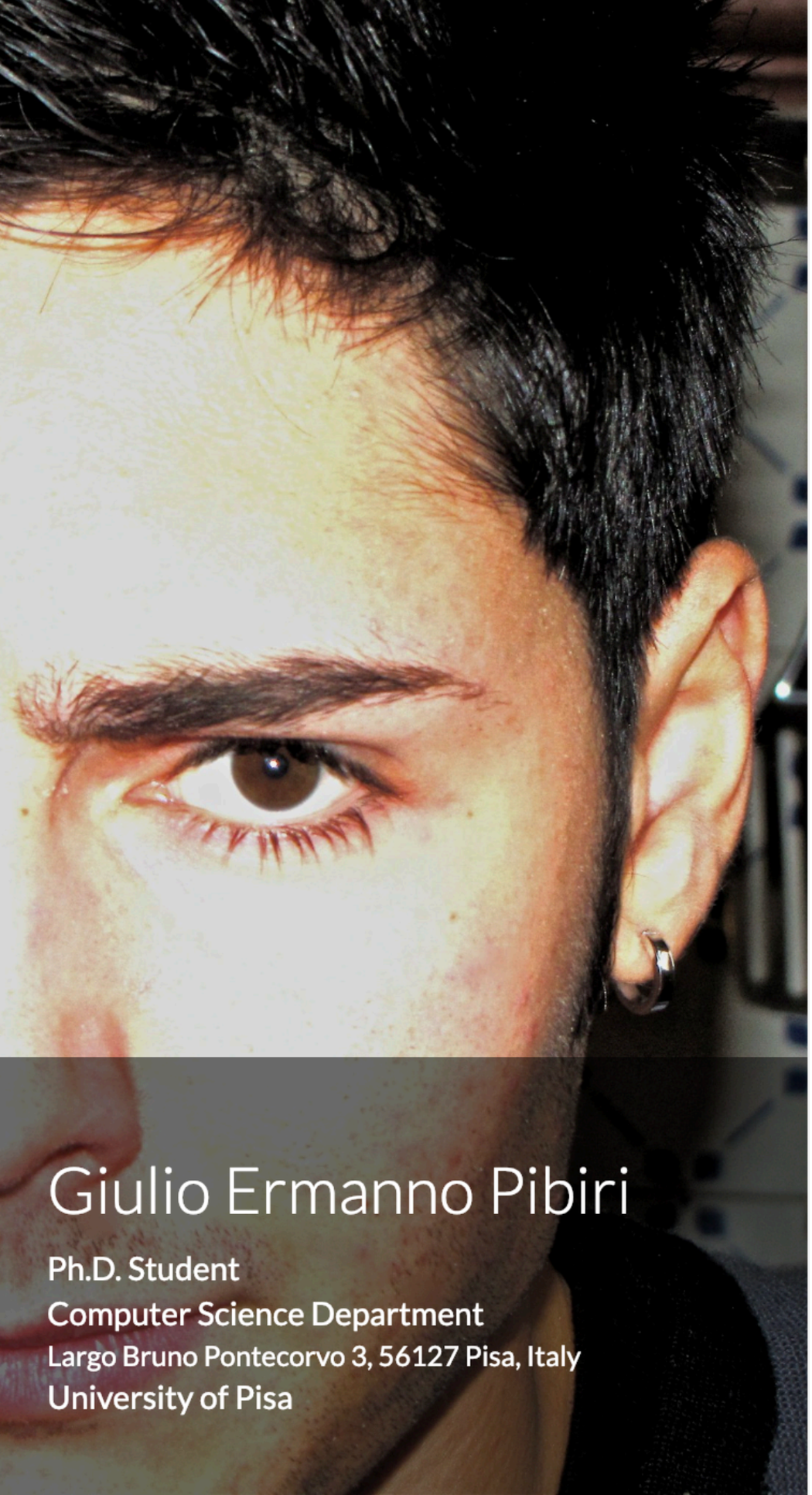
University of Pisa

01/02/2019



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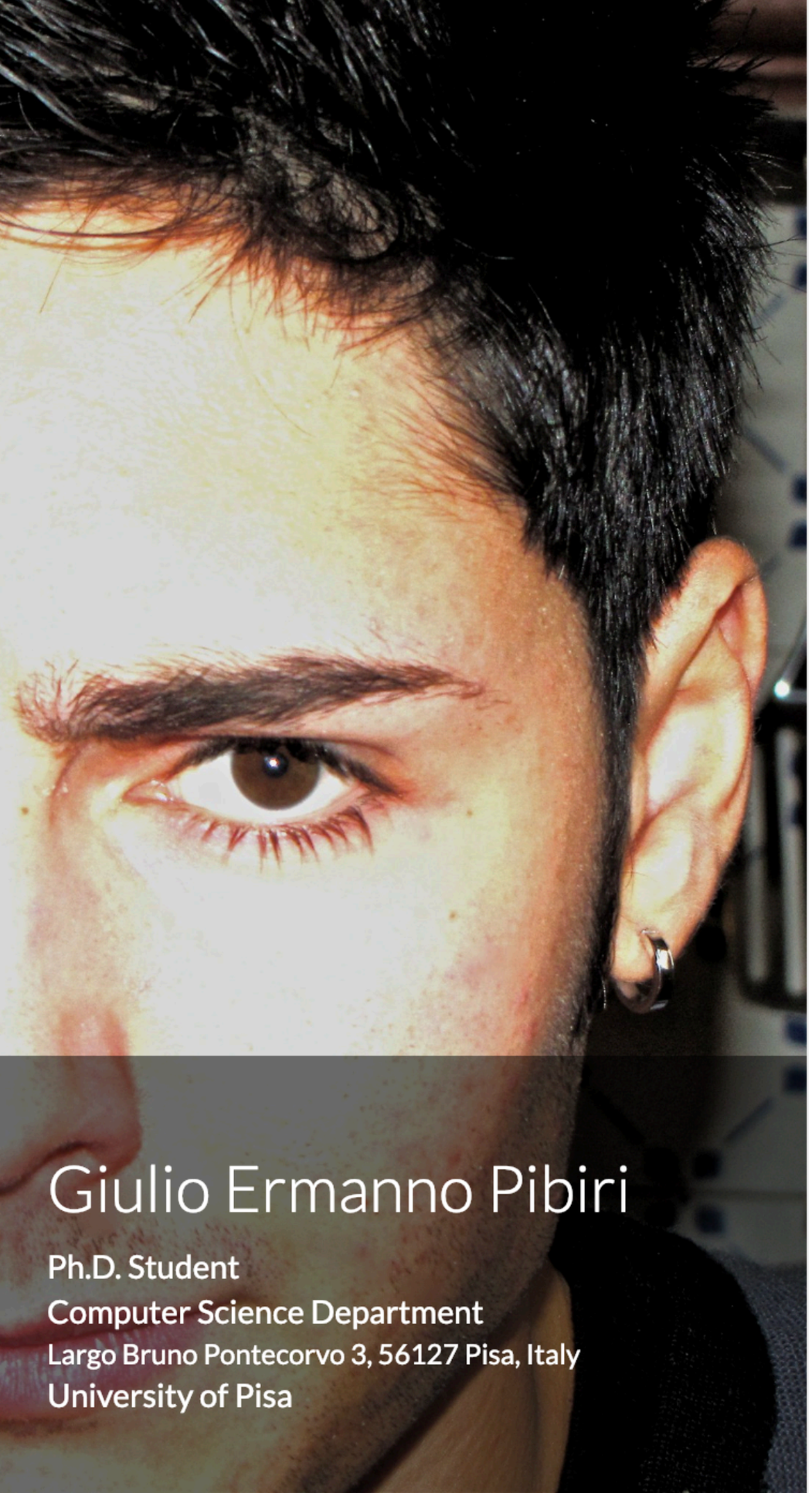

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Ph.D. Thesis

Space and Time-Efficient Data Structures for Massive Datasets

by

Giulio Ermanno Pibiri

Supervisor

Rossano Venturini

Referee

Daniel Lemire

Referee

Simon Gog

2018

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HPC laboratory

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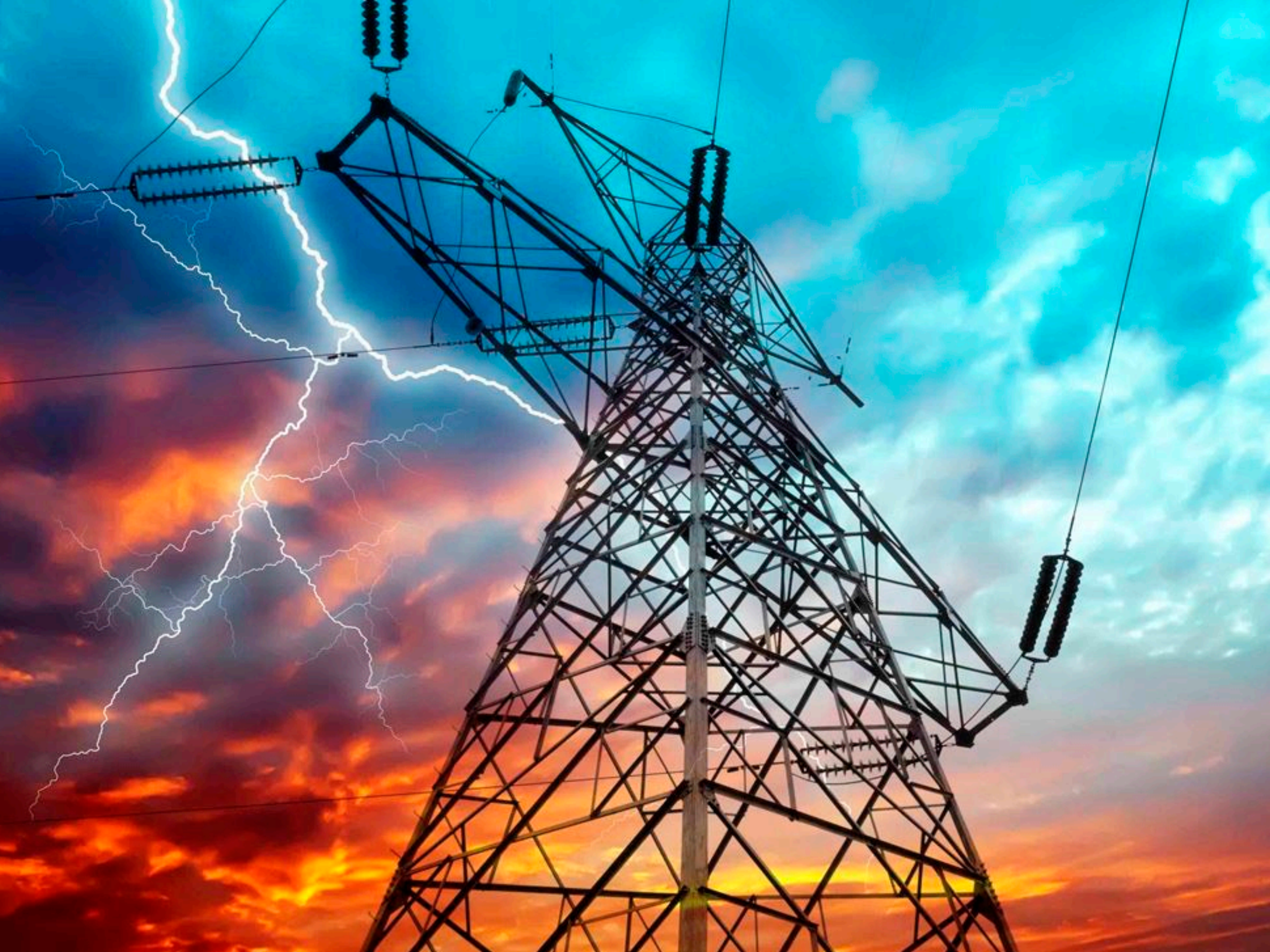
Raffele Perego


Statistics
Progress
Statistical
Analysis



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Compilers · Structure of a program · Variables and types · Classes

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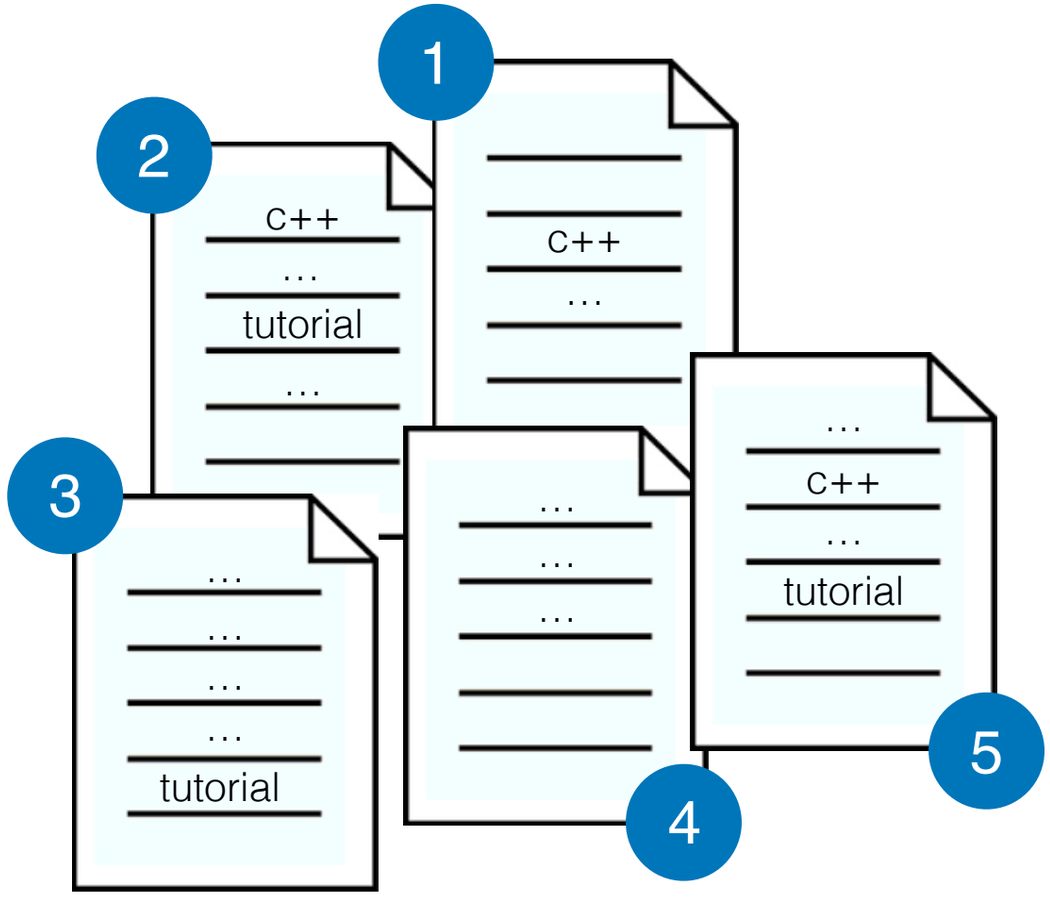
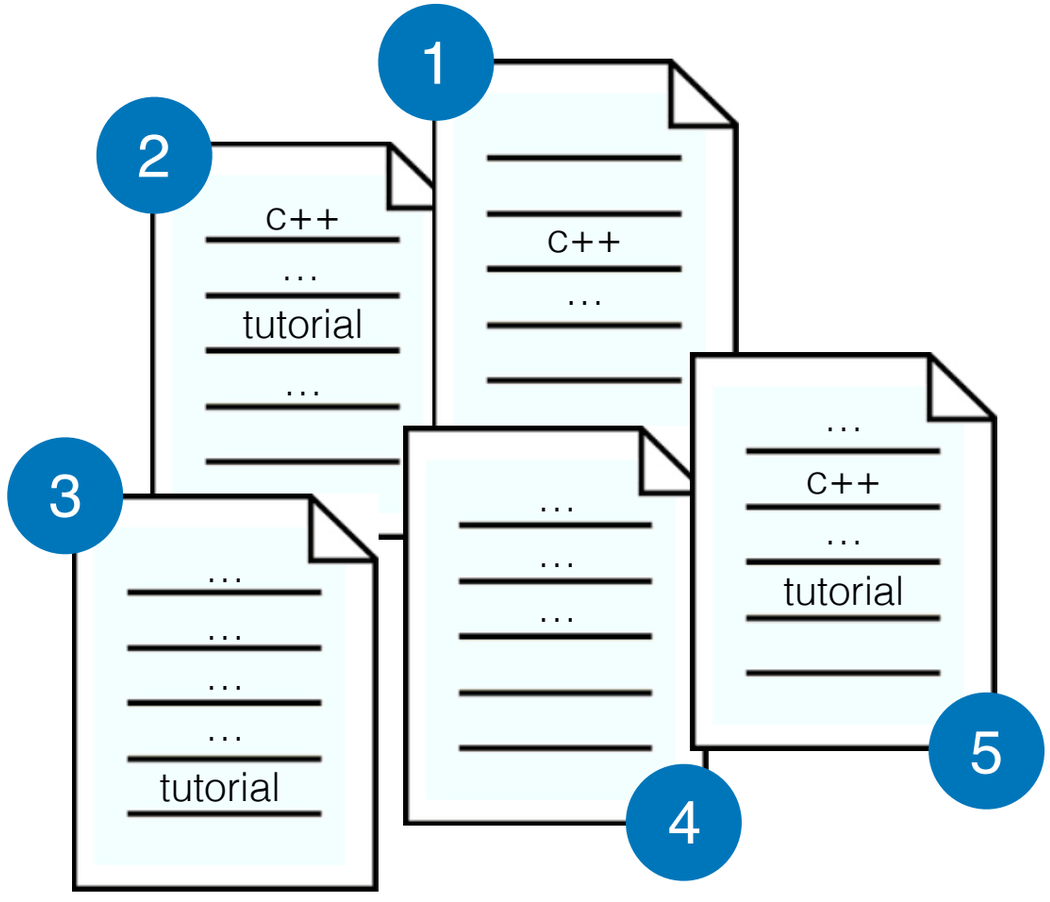
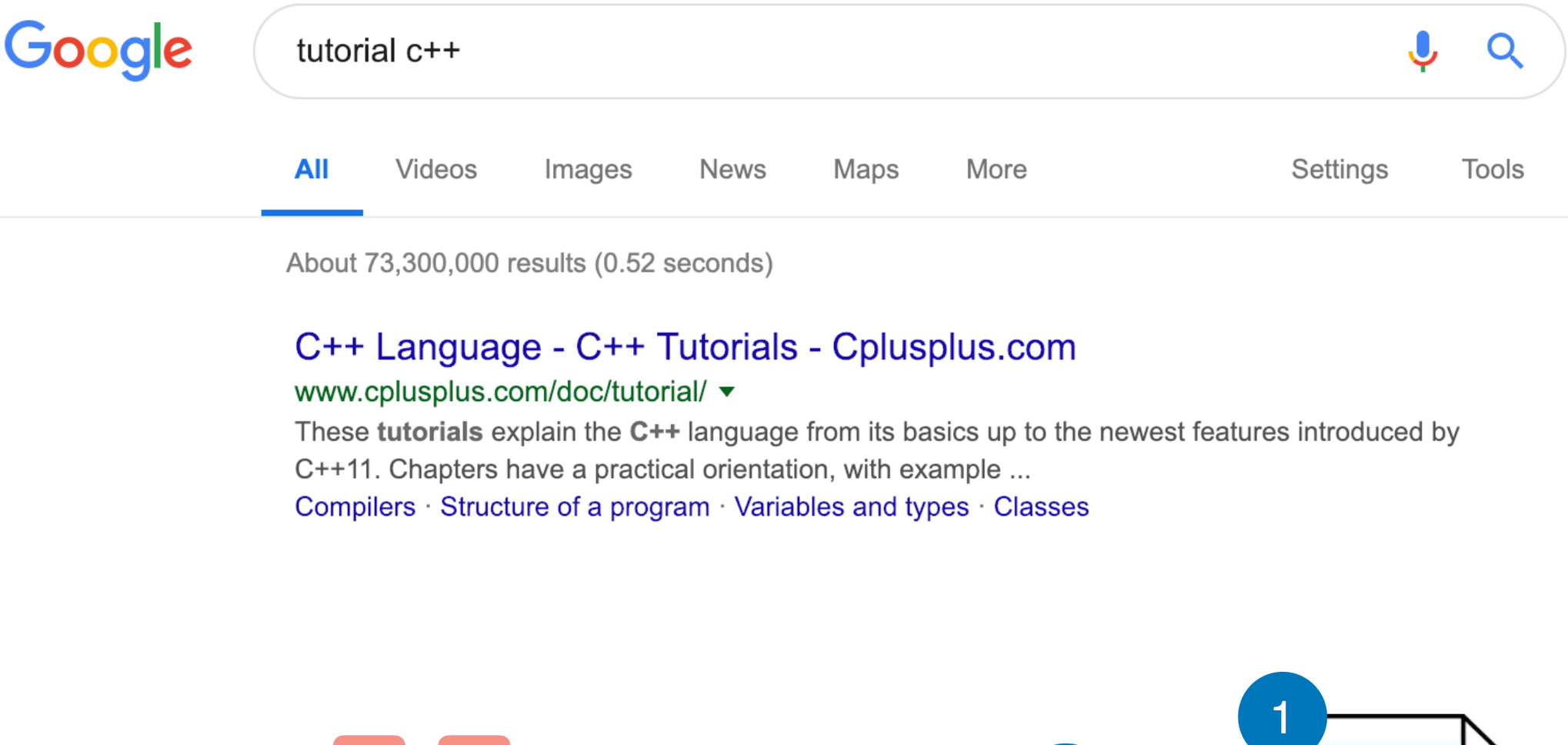


tutorial ⟶ **[2, 3, 5]**

c++ ⟶ **[1, 2, 5]**





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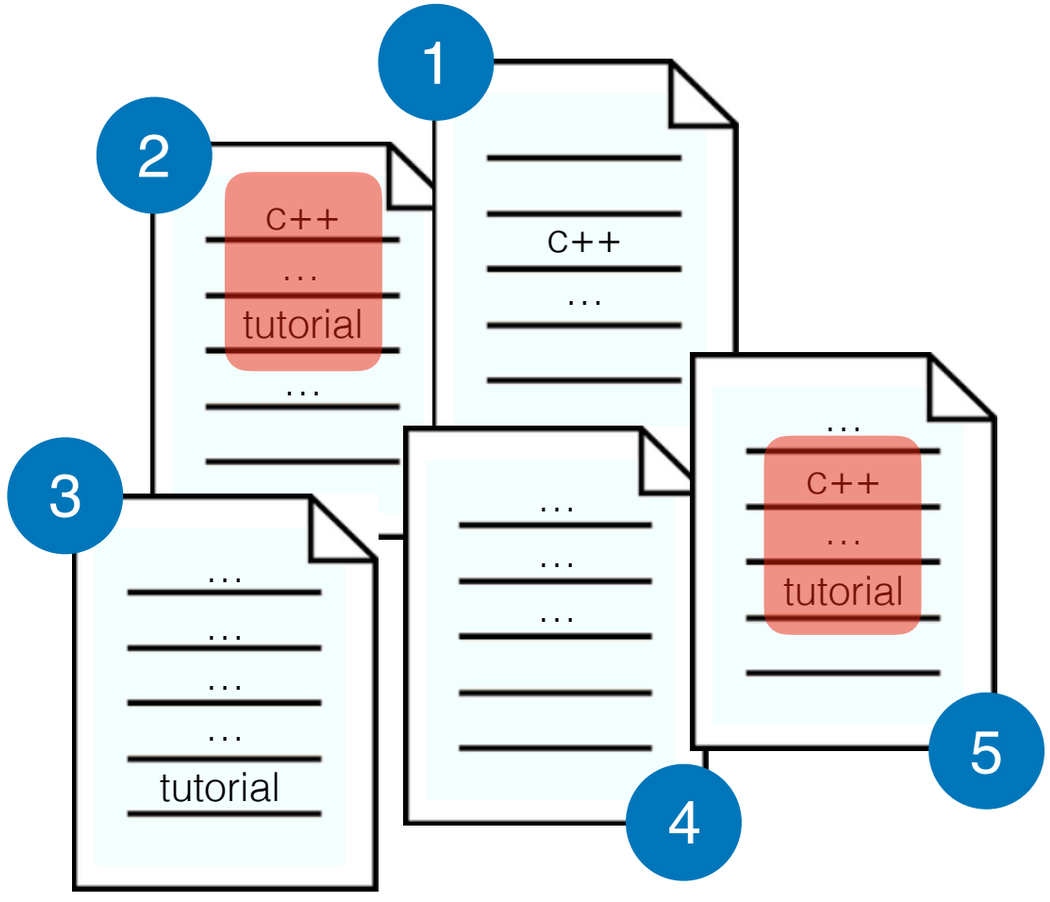
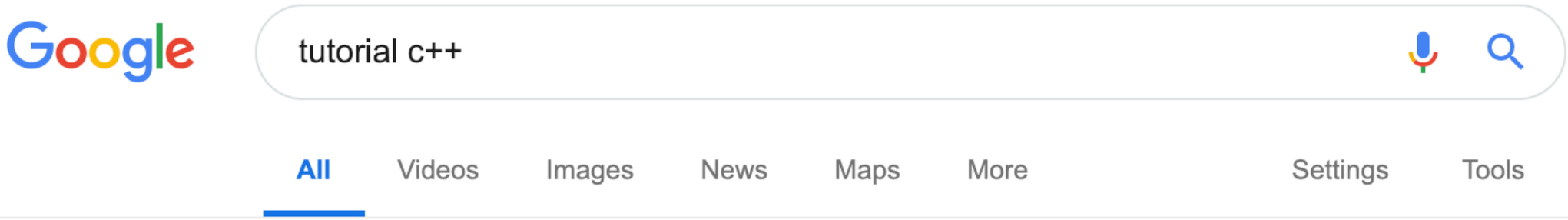
c++ → **[1, 2, 5]**

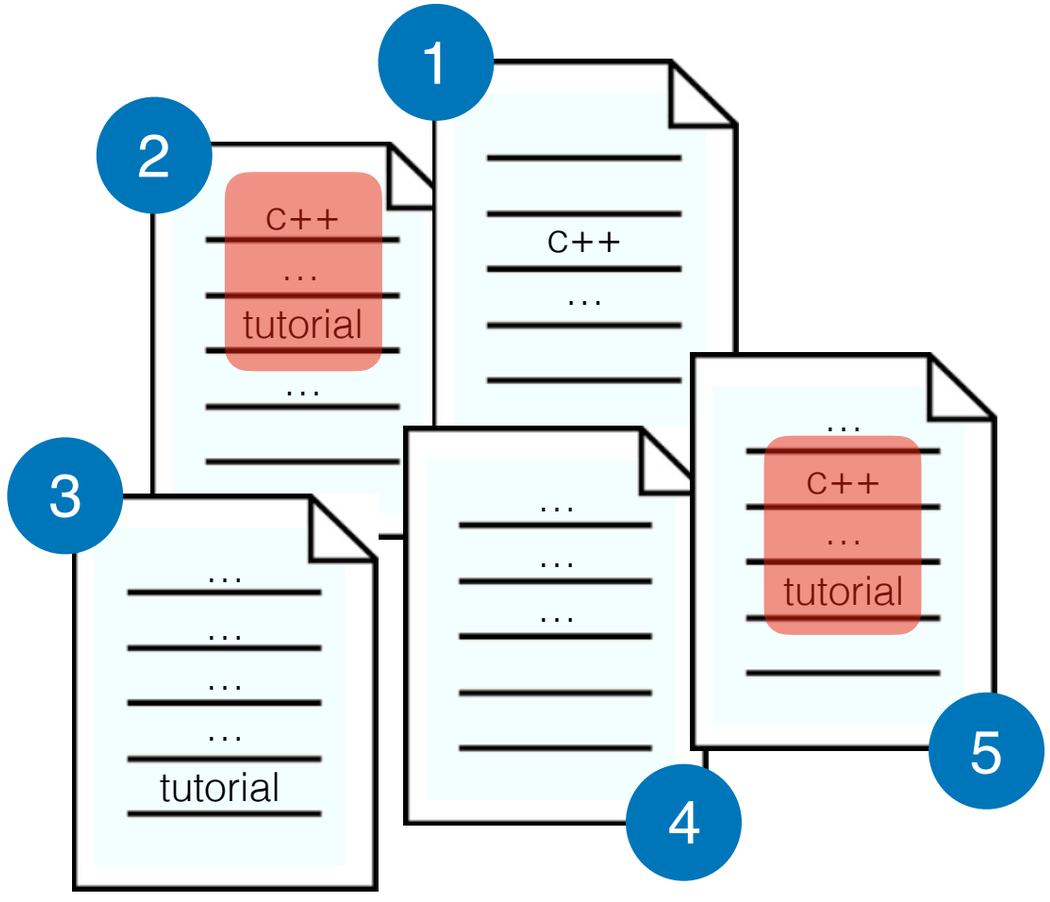


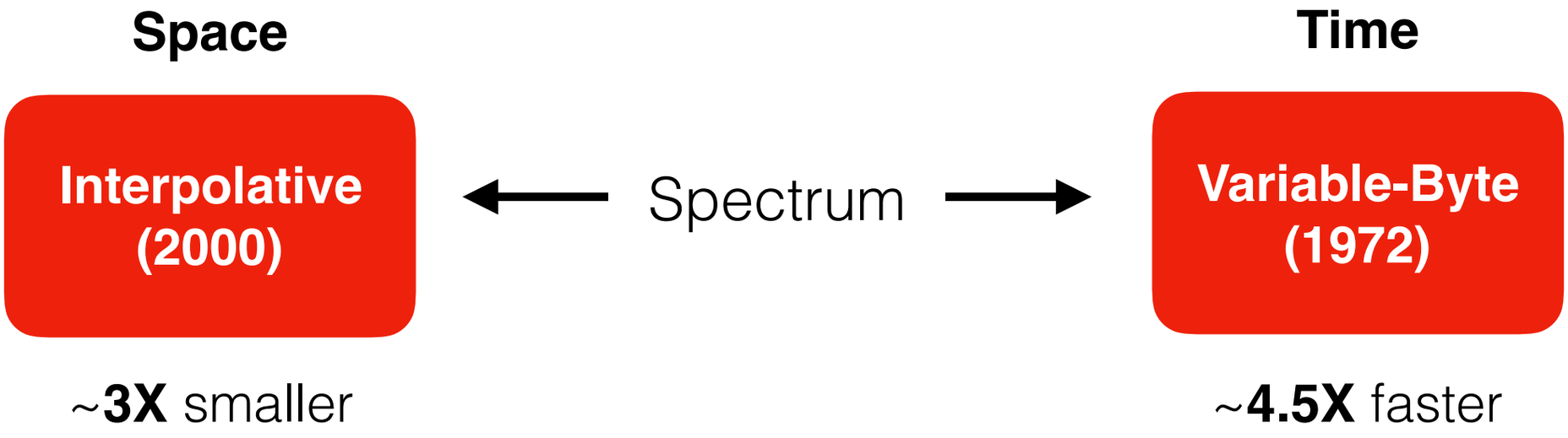


tutorial → [2, 3, 5]

c++ → [1, 2, 5]

Inverted Index




Space
Time
Interpolative (2000)
Spectrum
Variable-Byte (1972)
~3X smaller
~4.5X faster

Space

Time

Interpolative (2000) ⟵ Spectrum ⟶ **Variable-Byte (1972)**

~**3X** smaller

~**4.5X** faster

As small as Interpolative and **much faster**?

1

ACM TOIS 2017

Space

Time

Interpolative (2000) ⟵ Spectrum ⟶ **Variable-Byte (1972)**

~**3X** smaller

~**4.5X** faster

1

As small as Interpolative and **much faster**?

ACM TOIS 2017

2

As fast as Variable-Byte and **much smaller**?

IEEE TKDE 2019
(to appear)

Space

Interpolative (2000)

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Spectrum

Time

Variable-Byte (1972)

~**4.5X** faster

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1

ACM TOIS 2017

As fast as Variable-Byte and **much smaller**?

2

IEEE TKDE 2019
(to appear)

What about **both** objectives at the same time?!

3

ACM WSDM 2019

Space

Interpolative (2000)

~**3X** smaller

Spectrum

Time

Variable-Byte (1972)

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As small as Interpolative and **much faster**?

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ACM TOIS 2017

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2

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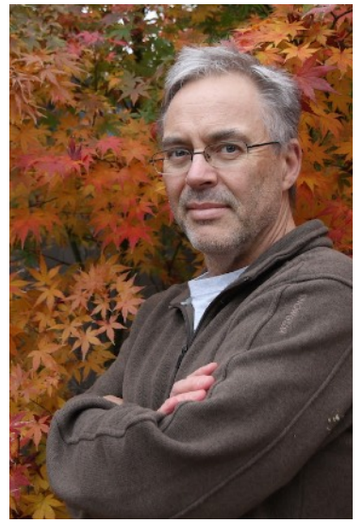
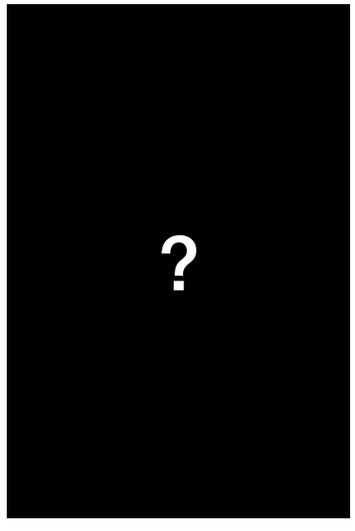
What about **both** objectives at the same time?!

3

ACM WSDM 2019



Alistair Moffat



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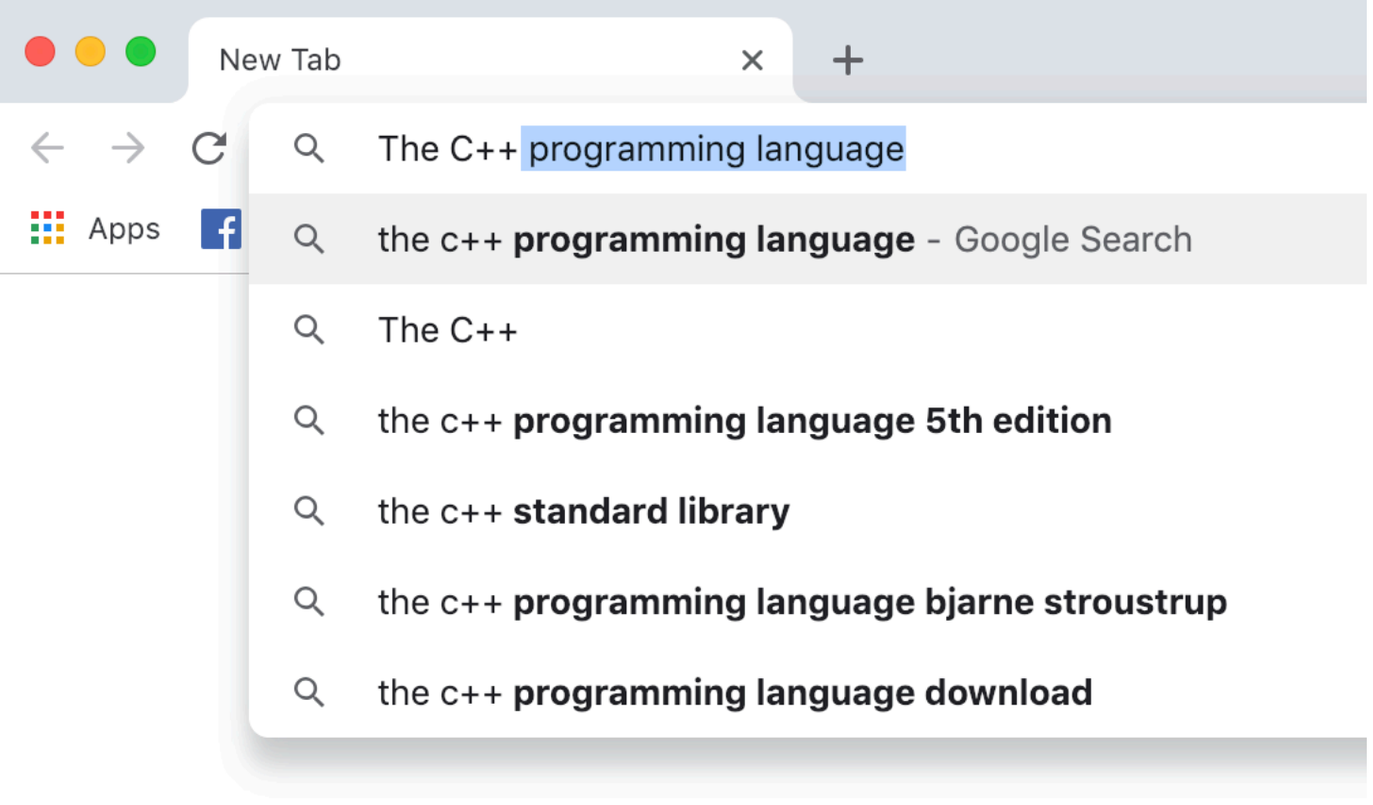
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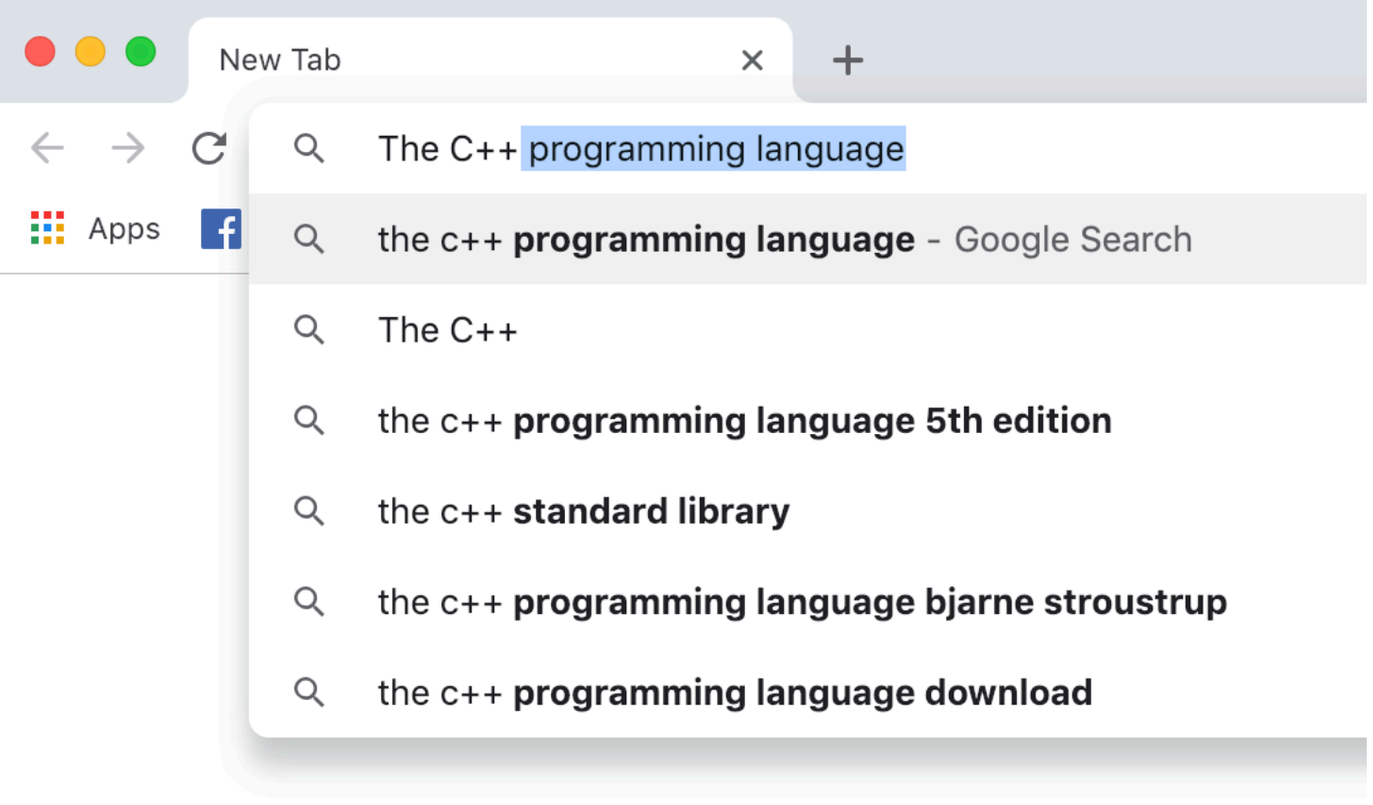

N-gram lookup

Hey Siri

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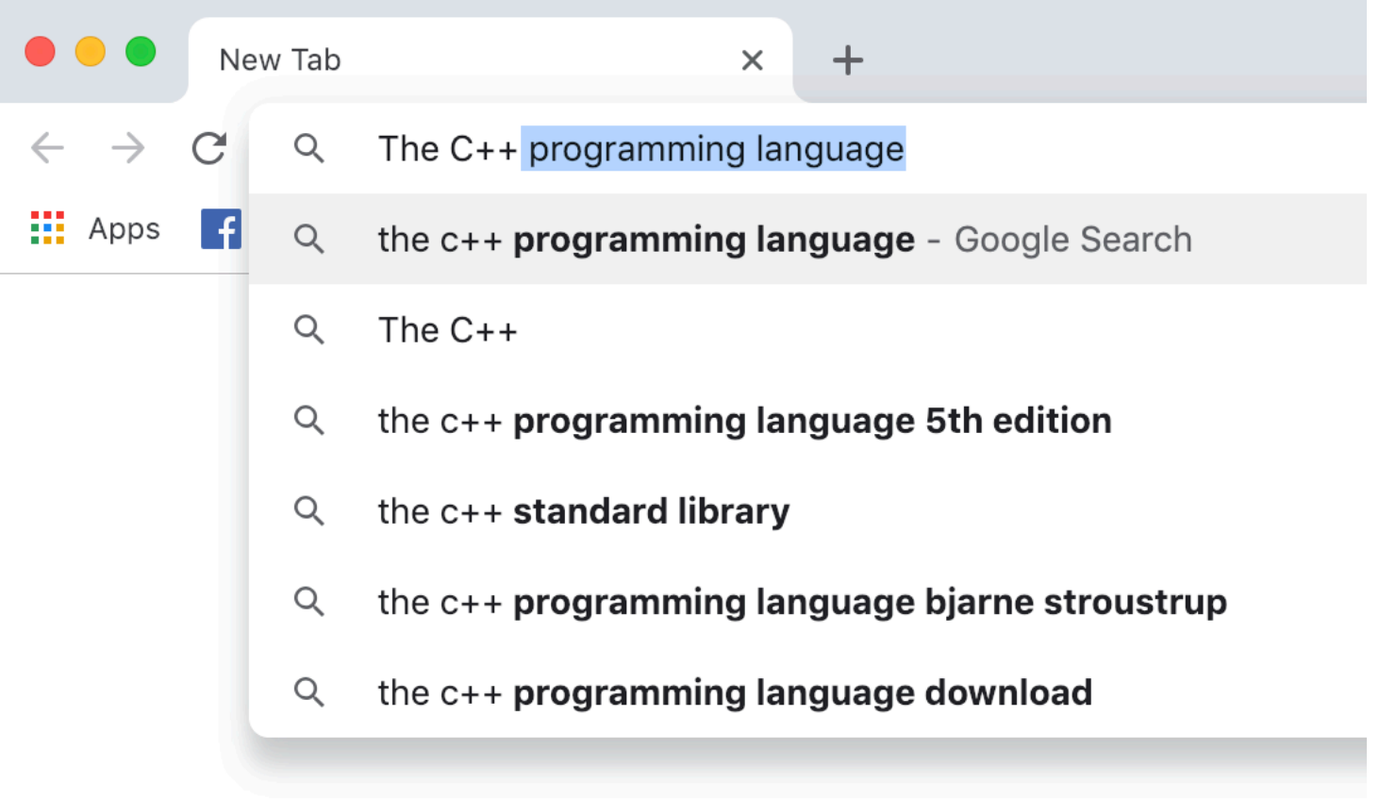

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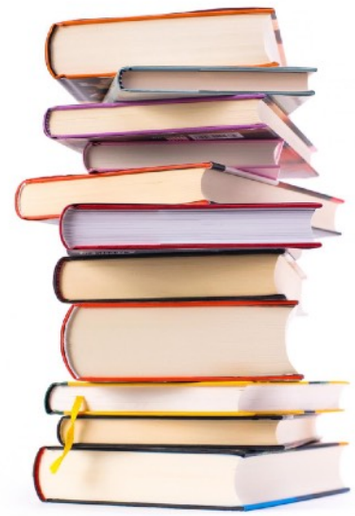
~6% of the books ever published
More than 11 billion N-grams!



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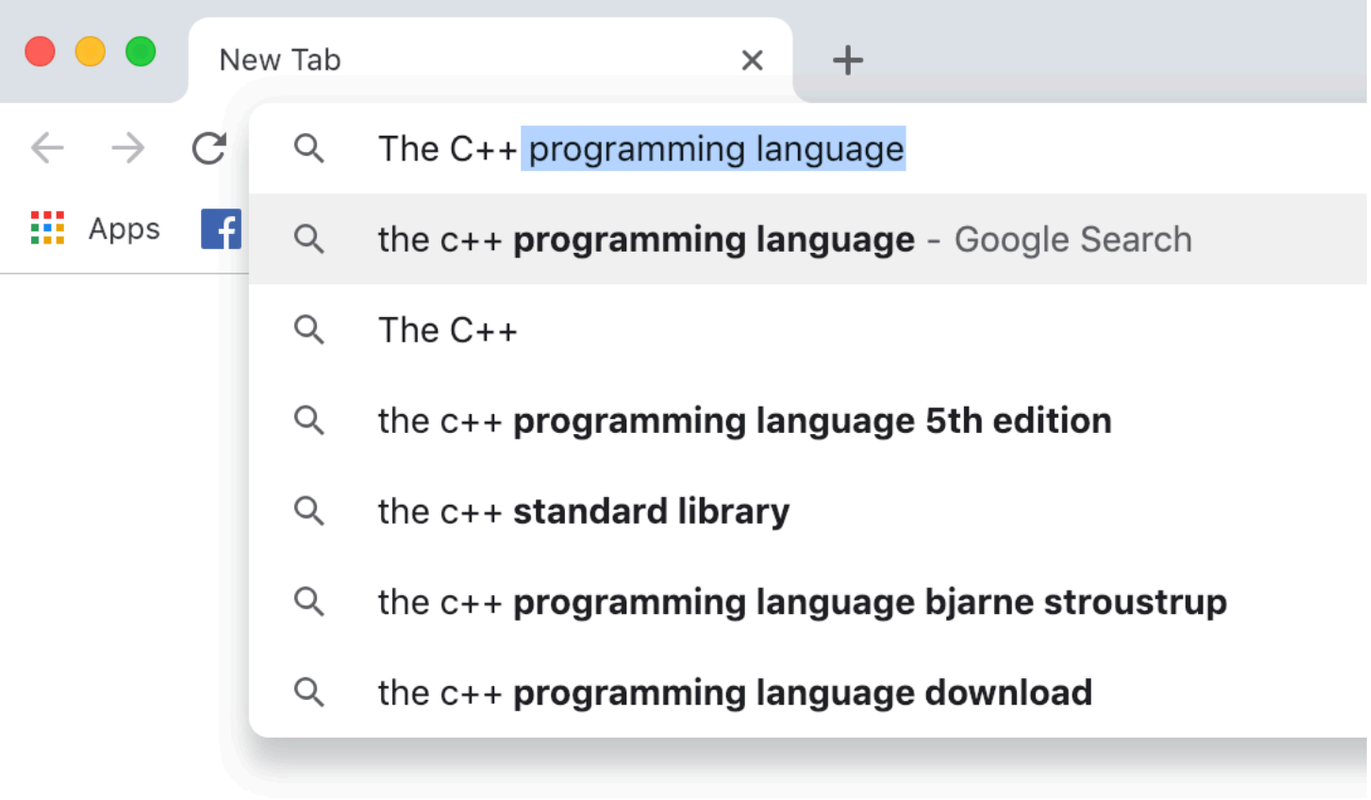
N-gram lookup

Hey Siri

Google Translate



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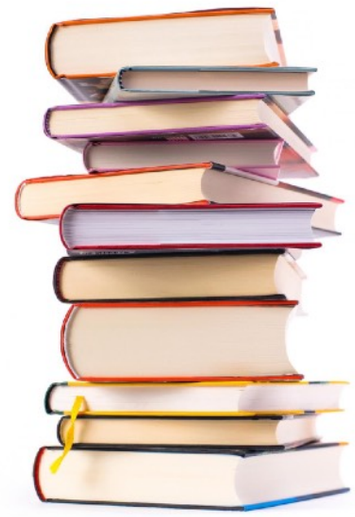

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~29GB

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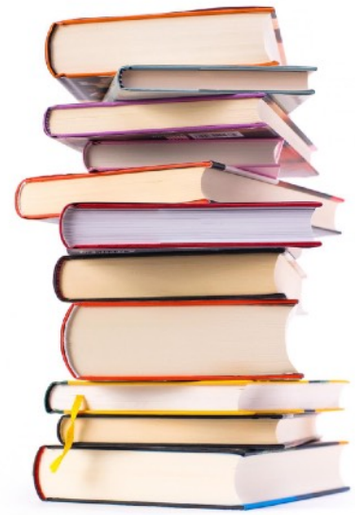

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~29GB

Indexing? 1

ACM TOIS 19

(to appear)

Estimation? 2

Efficiency to deliver better services by using less resources.

Impact is far reaching and implies substantial economic gains.

Do not underestimate the impact of efficient software:
do not (just) rely on hardware.

My resources are publicly available:

http://pages.di.unipi.it/pibiri

https://github.com/jermp

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Thanks for your attention, time, patience!