GI++ == Focused Auto Programming?

Robert Feldt

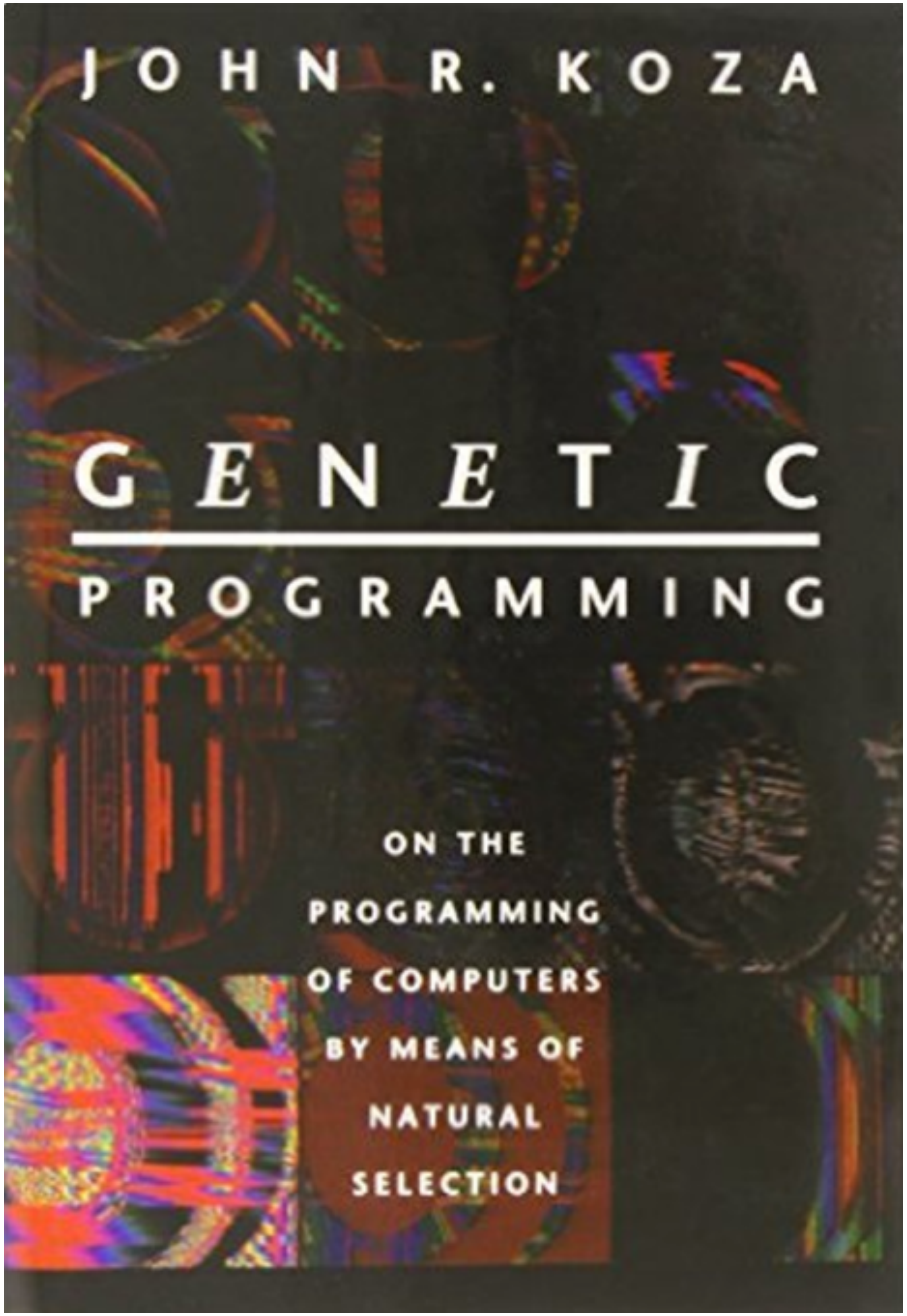
Chalmers University of Technology, Sweden

at the COW-50, UCL, London, 2017-01-31

@drfeldt

One view of SBSE: Ever-expanding Success!

A contrarian view of SBSE: Not quite there yet…


JOHN R. KOZA
GENETIC
PROGRAMMING
ON THE PROGRAMMING OF COMPUTERS BY MEANS OF NATURAL SELECTION

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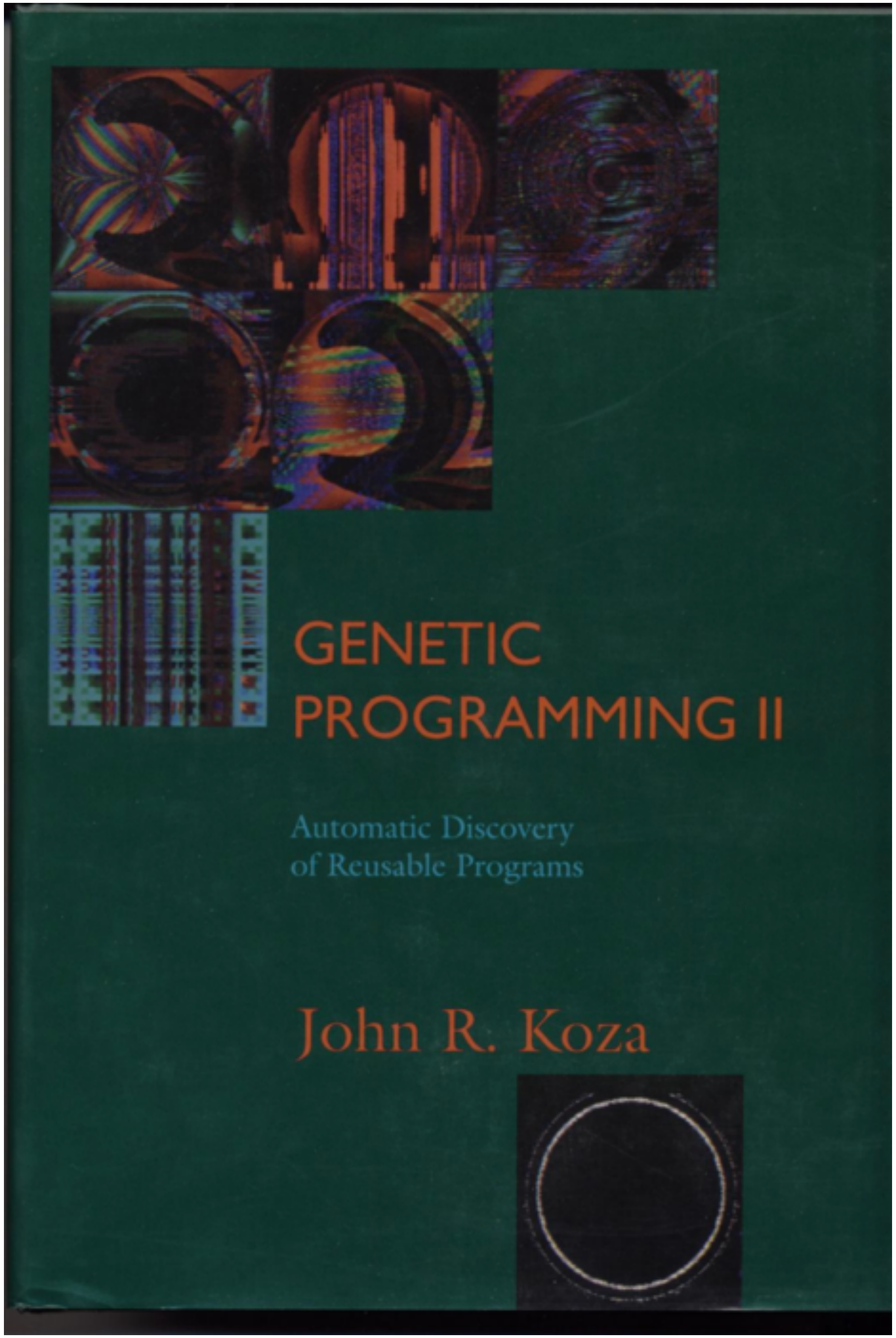

GENETIC PROGRAMMING II

Automatic Discovery of Reusable Programs

John R. Koza

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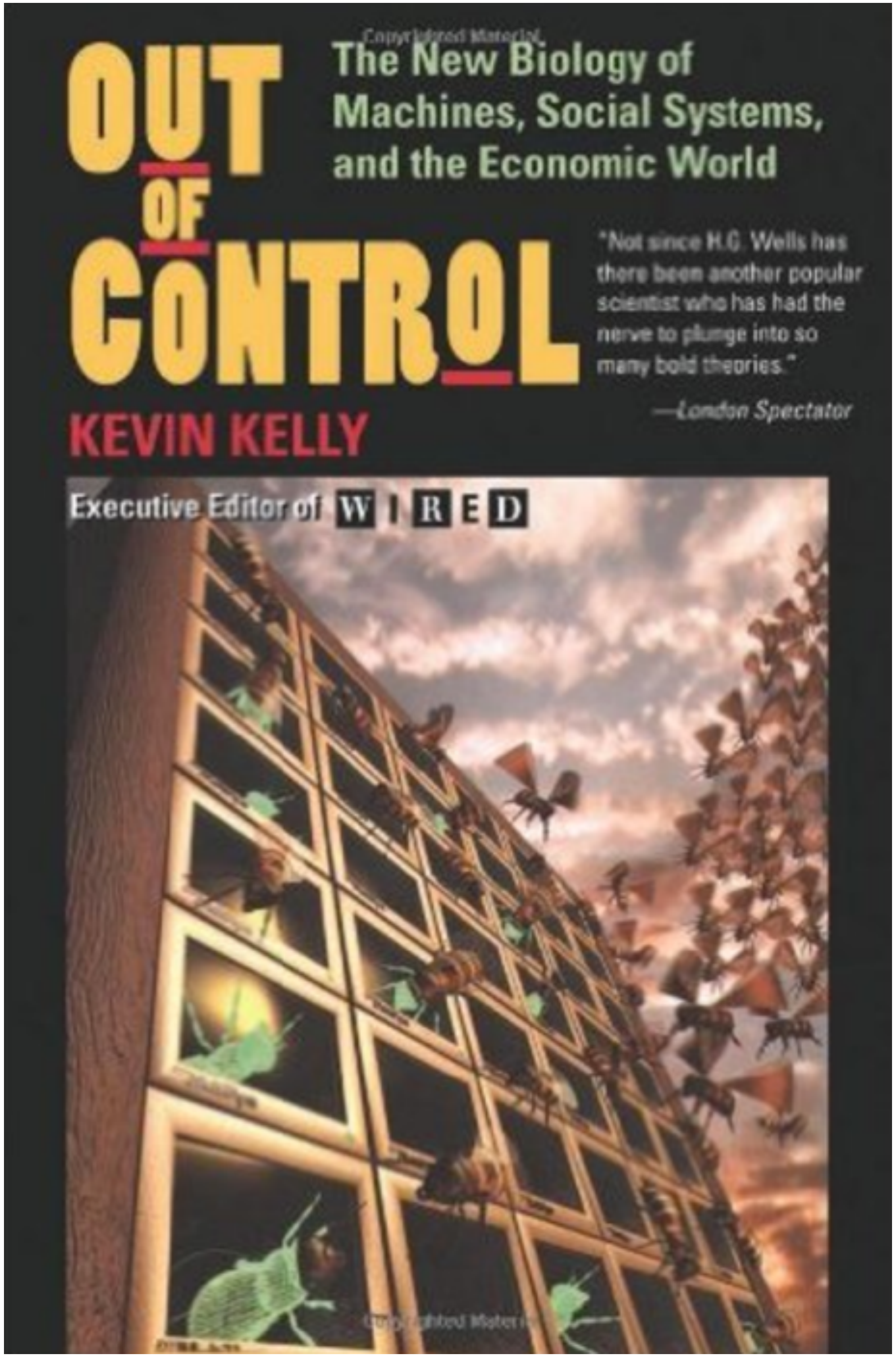
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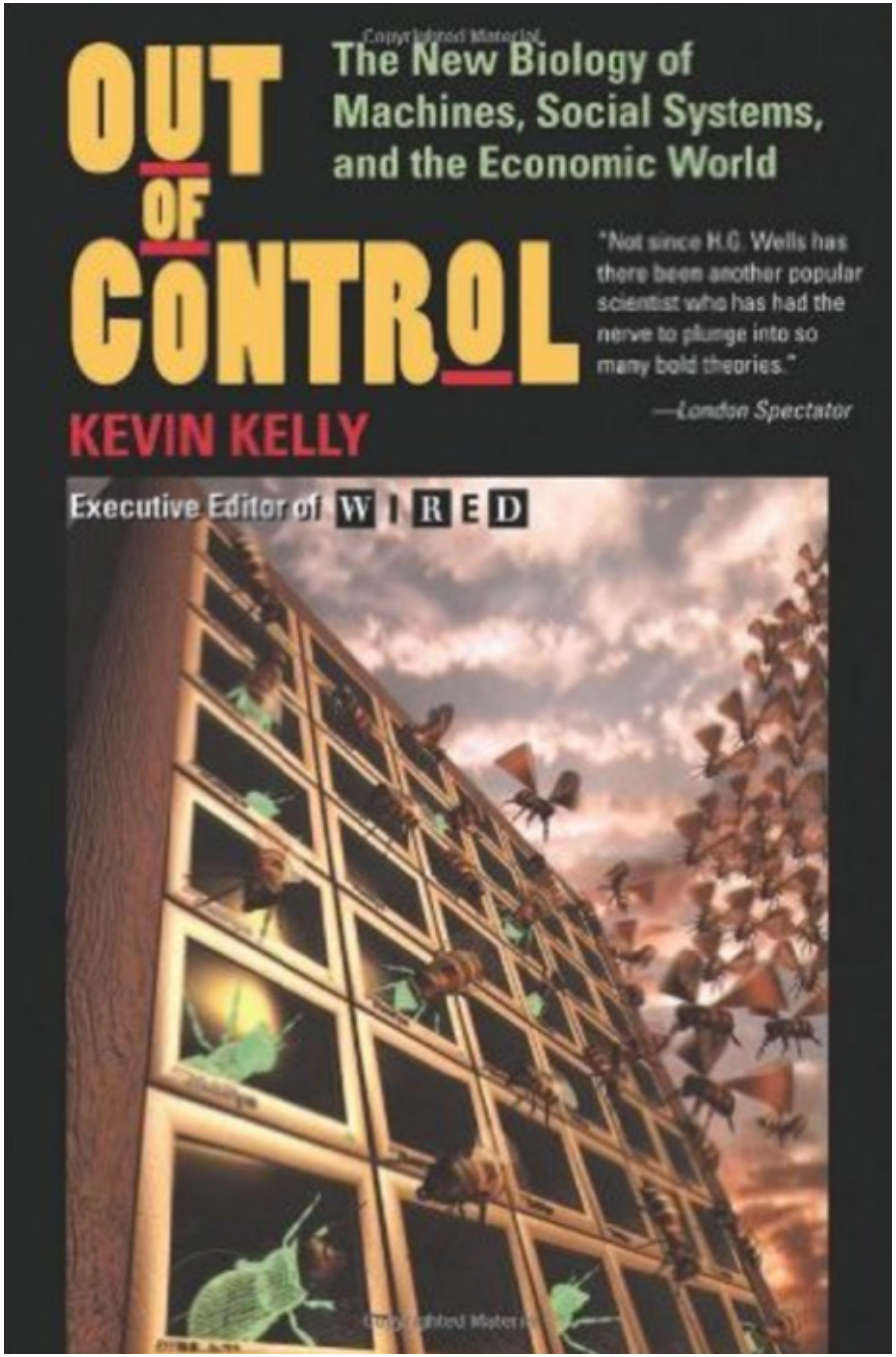
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"Evolution is the natural way to program" - Tom Ray

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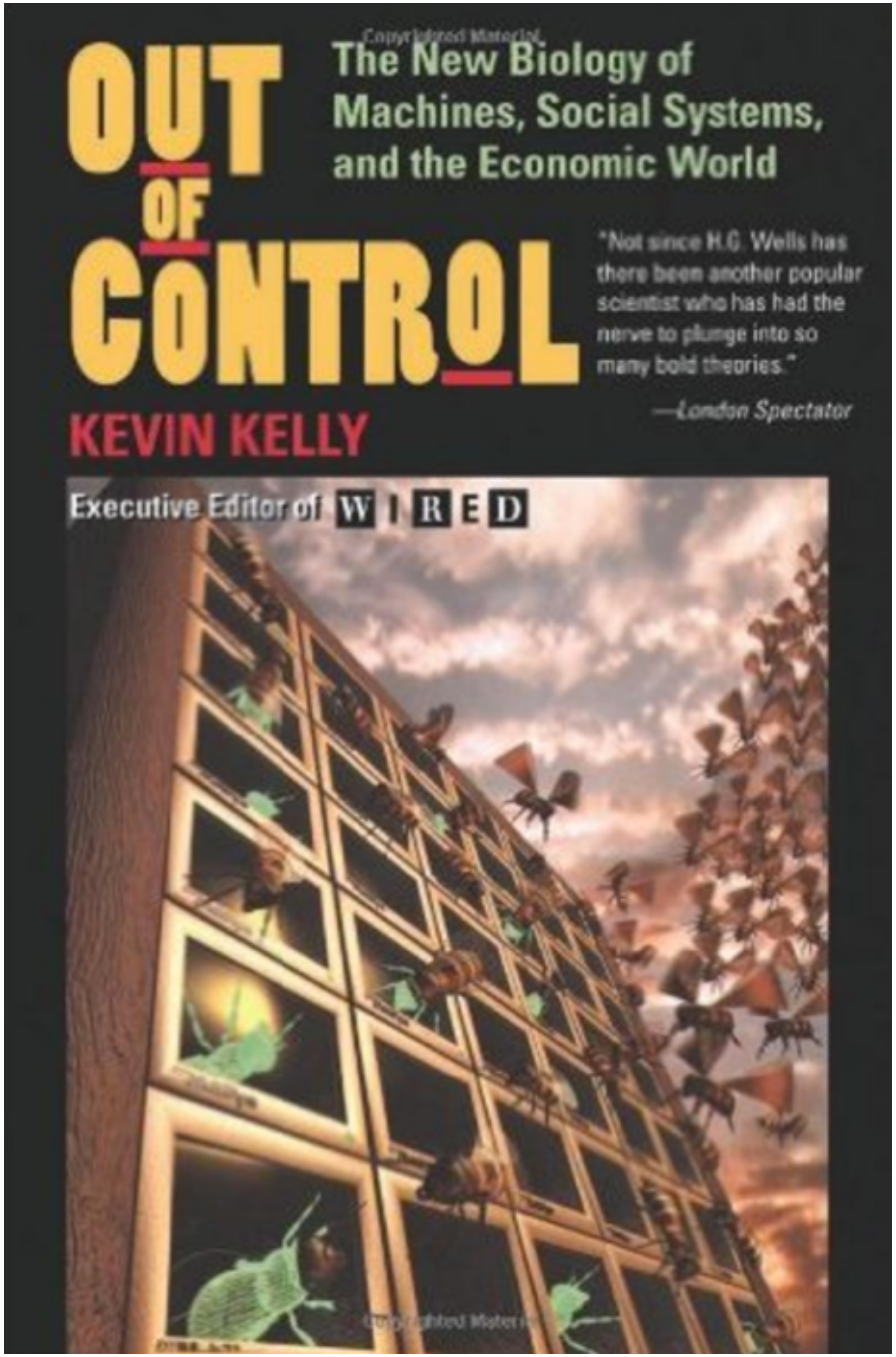
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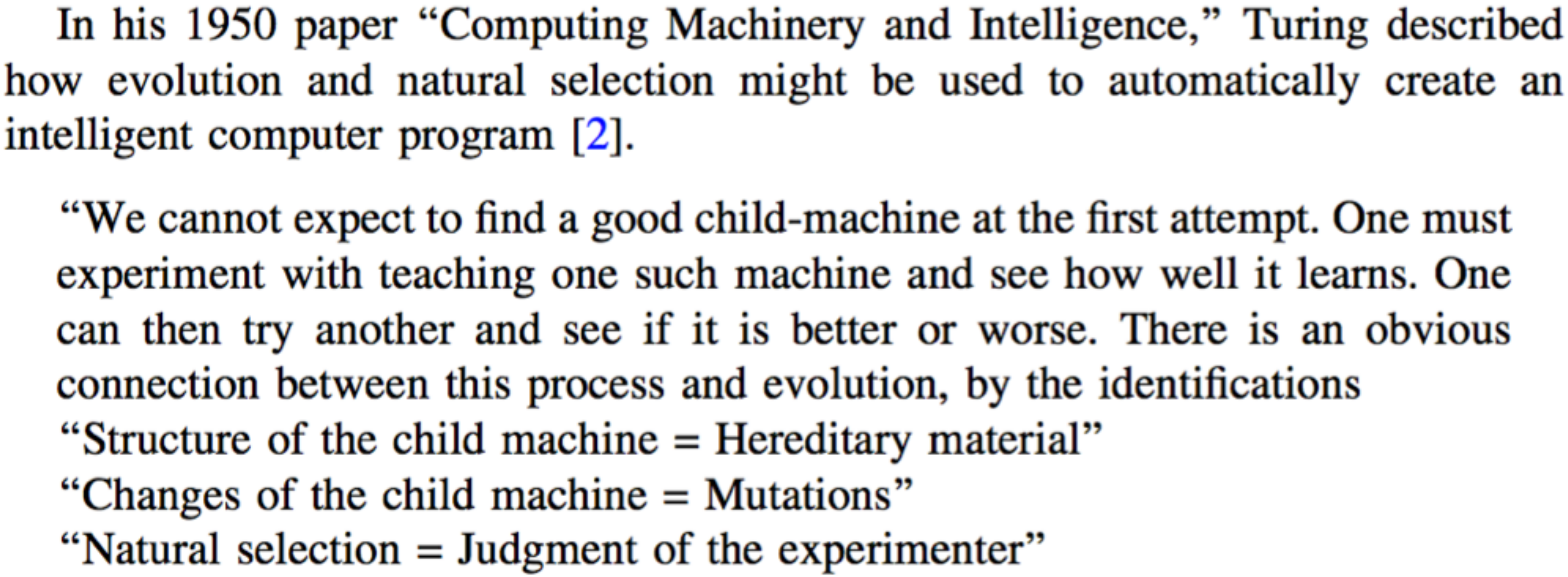
"I would rather fly on a plane running software evolved by a program like this, than fly on a plane running software I wrote myself," says Hillis, programmer extraordinaire.

Of course it all started much earlier (with Turing)… ;)



In his 1950 paper “Computing Machinery and Intelligence,” Turing described how evolution and natural selection might be used to automatically create an intelligent computer program [2].

> “We cannot expect to find a good child-machine at the first attempt. One must experiment with teaching one such machine and see how well it learns. One can then try another and see if it is better or worse. There is an obvious connection between this process and evolution, by the identifications
> “Structure of the child machine = Hereditary material”
> “Changes of the child machine = Mutations”
> “Natural selection = Judgment of the experimenter”

[Koza2010] in GPEM Anniversary issue

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Clear goal, small search space, less/short structure

A continuum of Automated Programming

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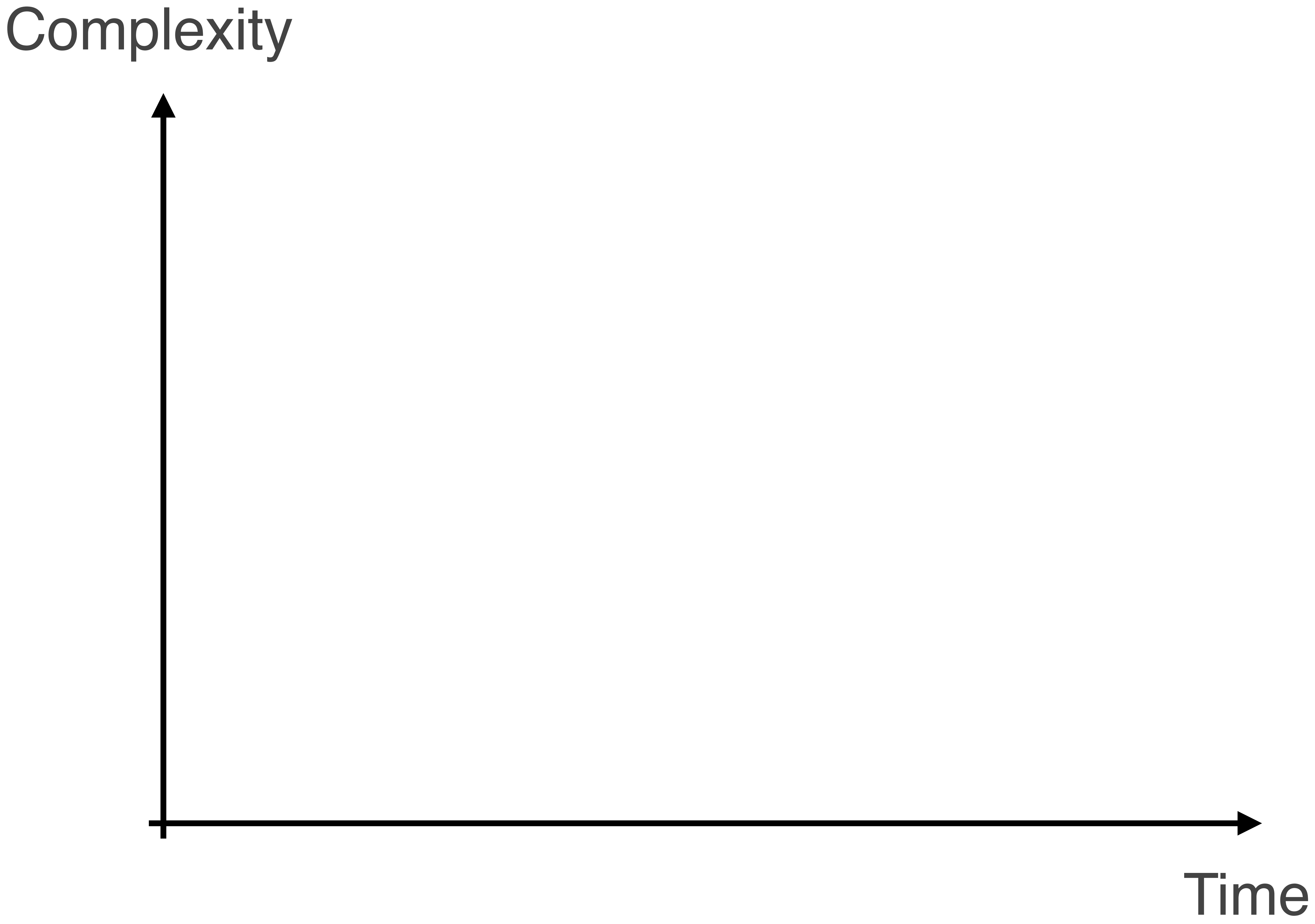

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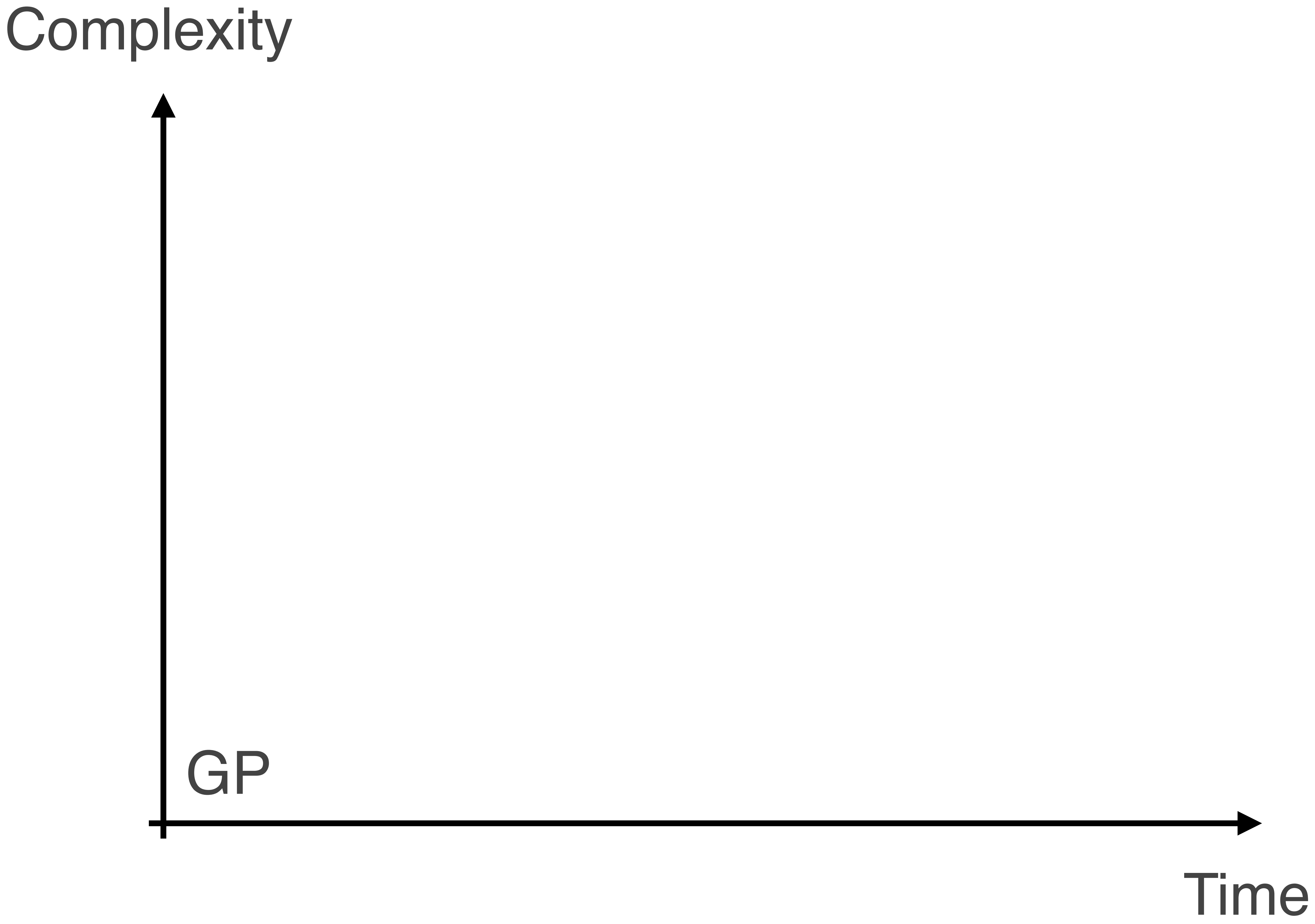

Complexity

GP

Time

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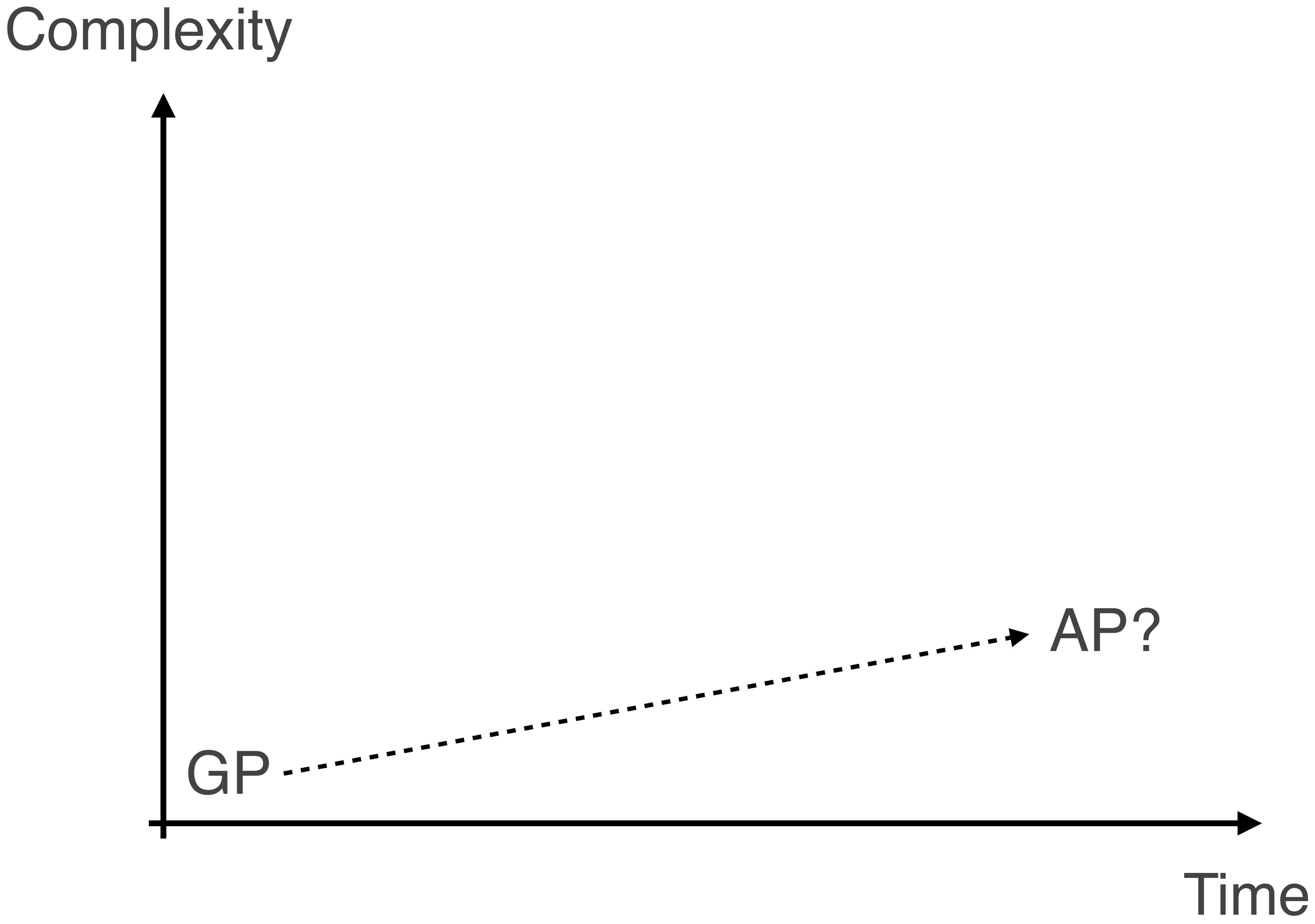

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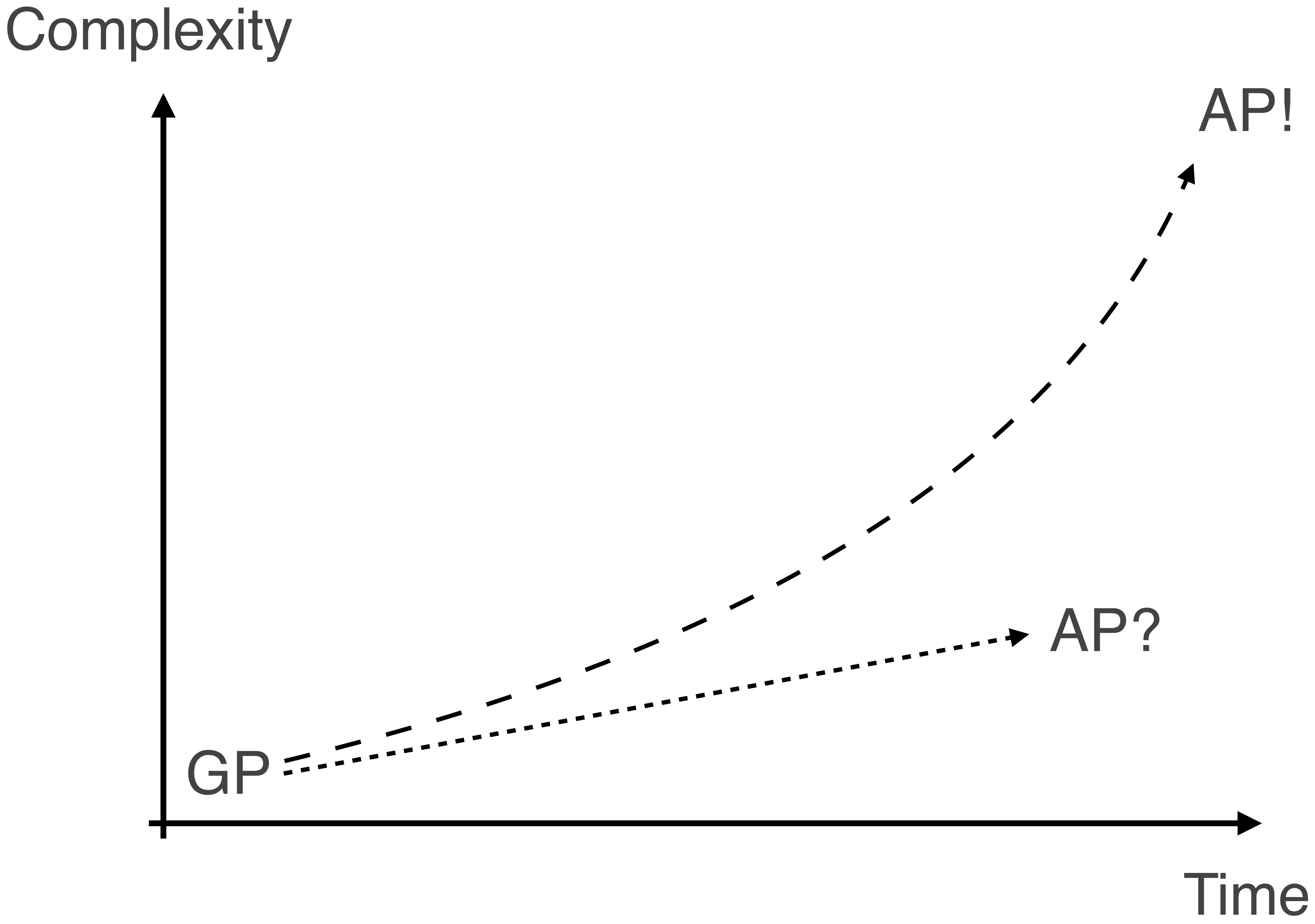

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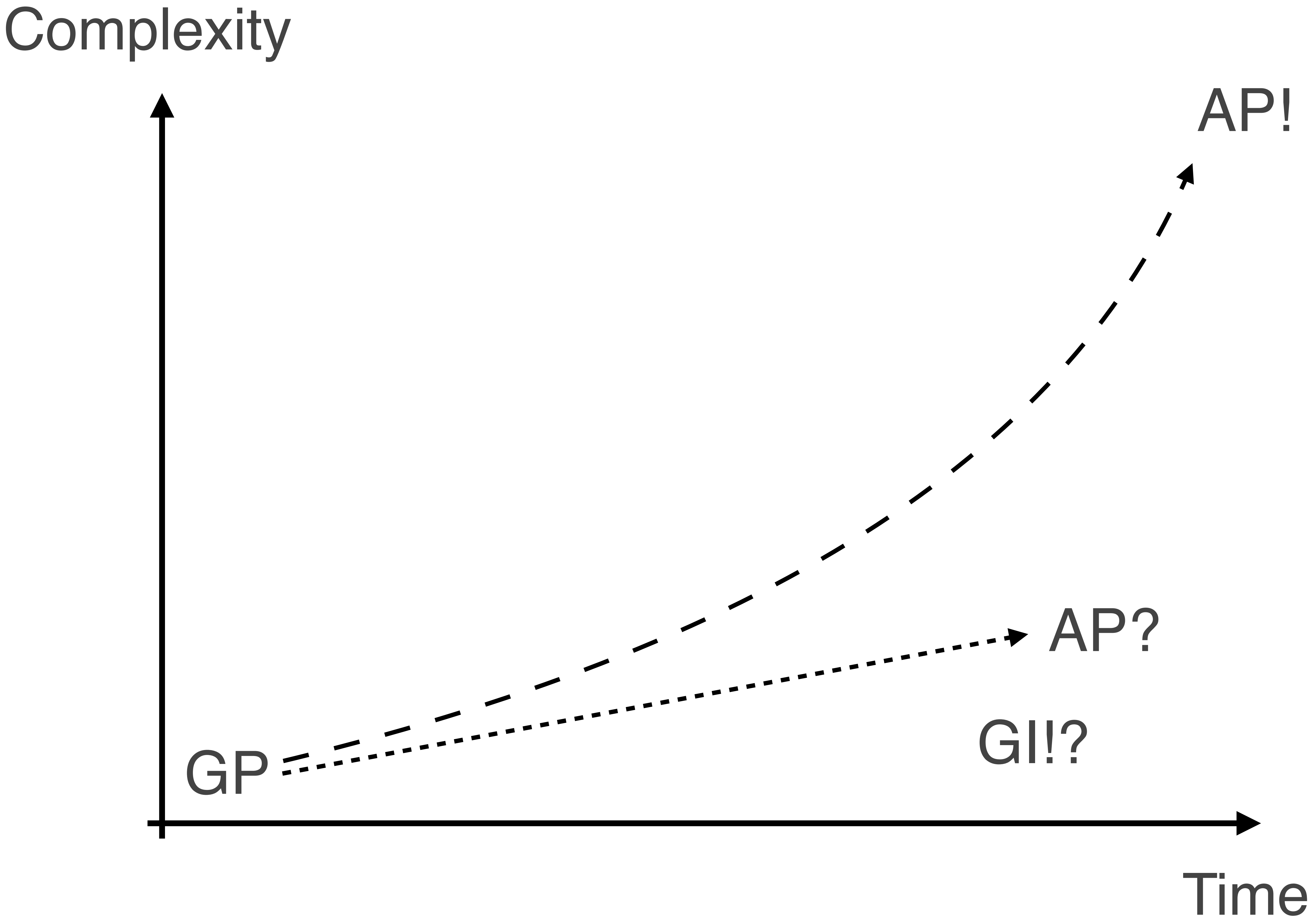

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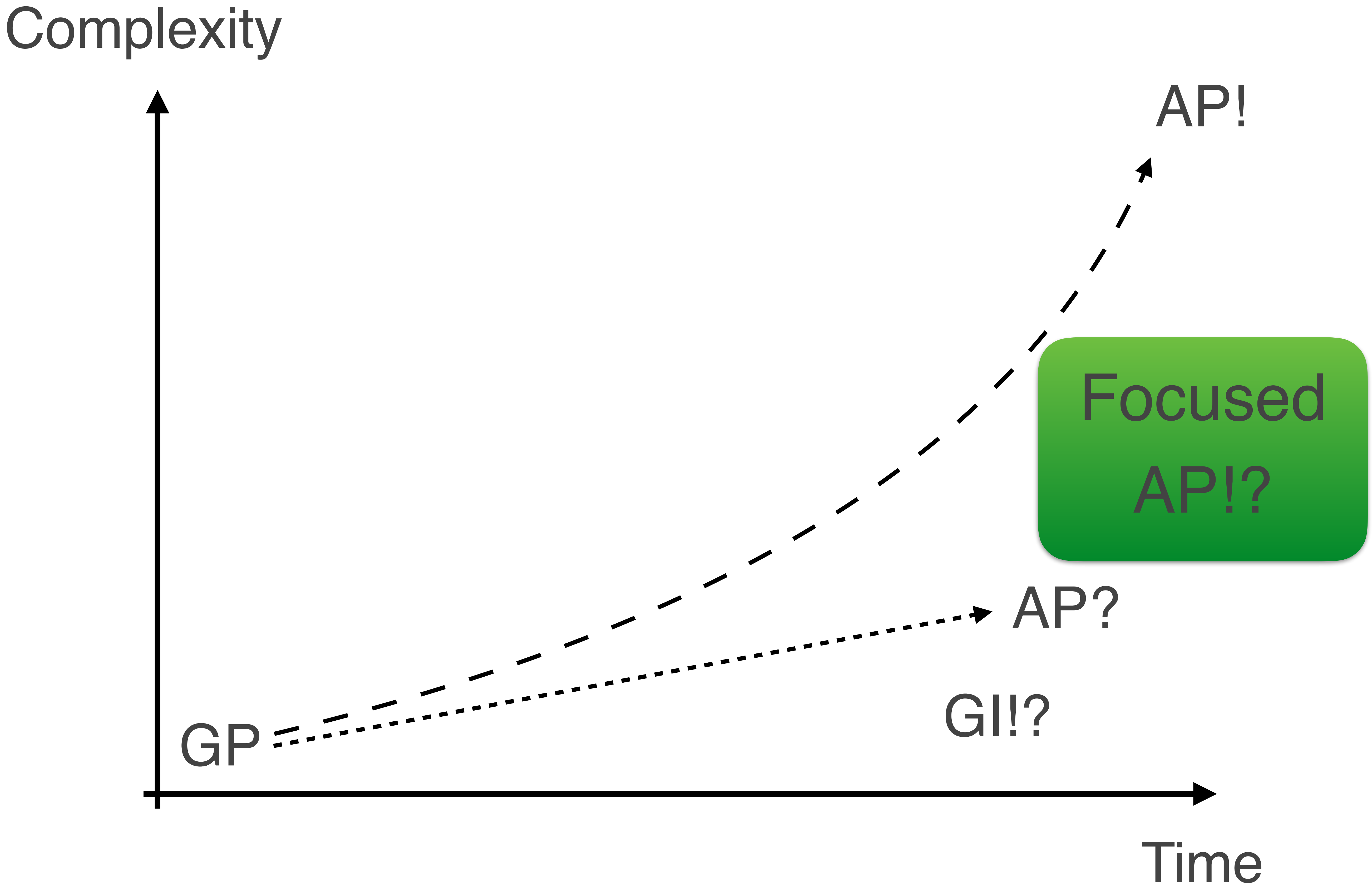

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- => we need ideas, intuition and methods/processes for how to use search/optimisation more actively in the software development process

Example: Web extraction library

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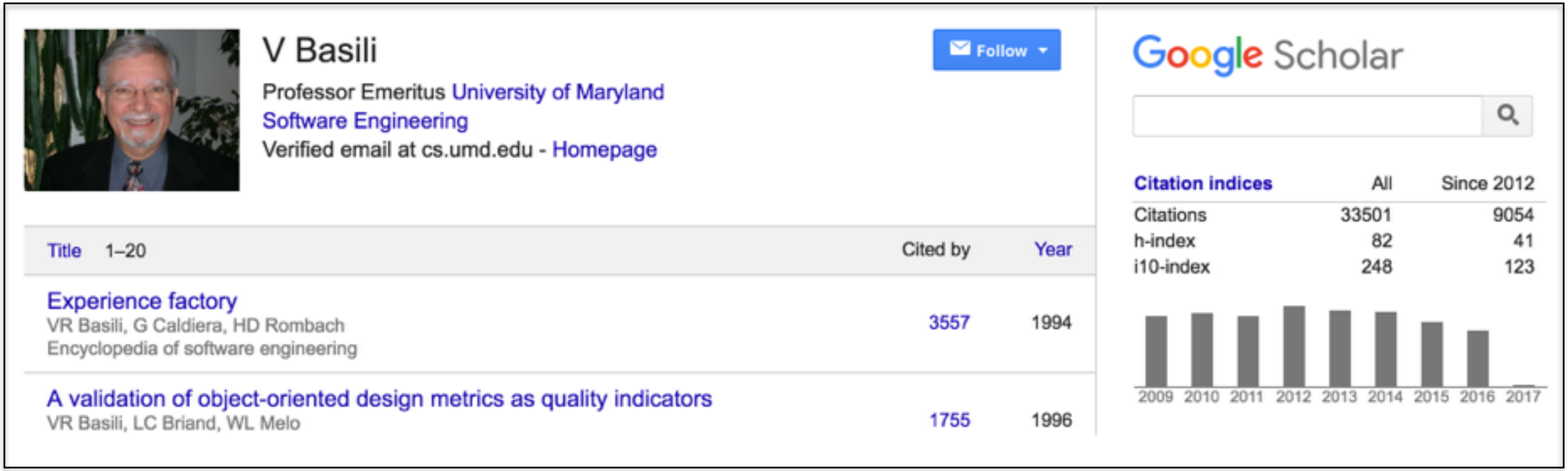

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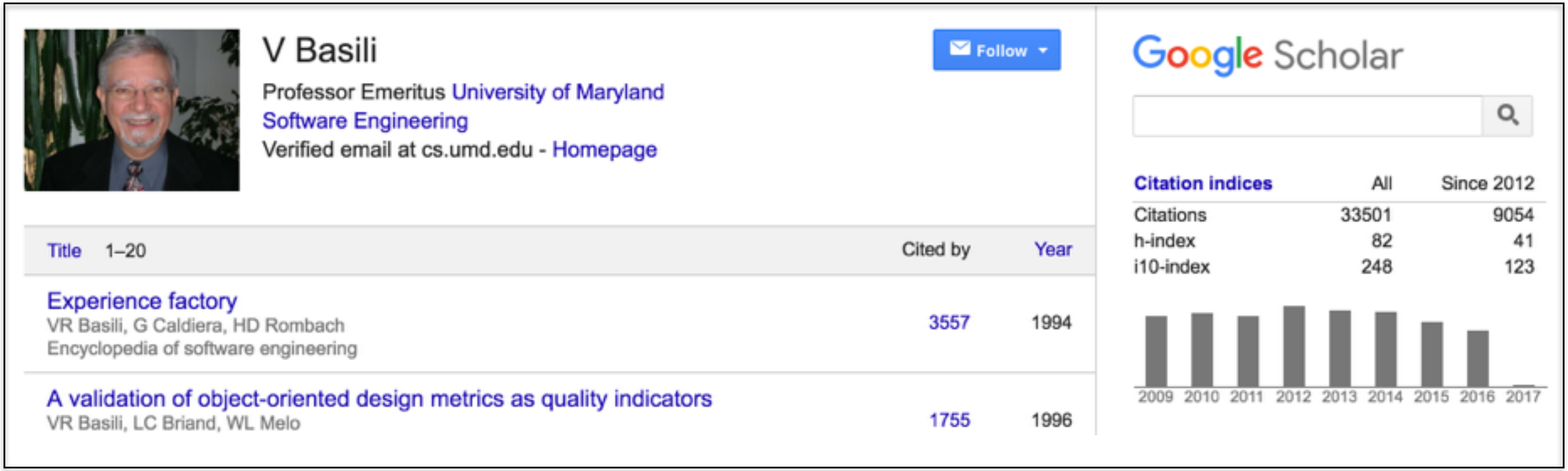

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Web extraction, traditional solution vs AdaptiLib

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WebGet Lib +

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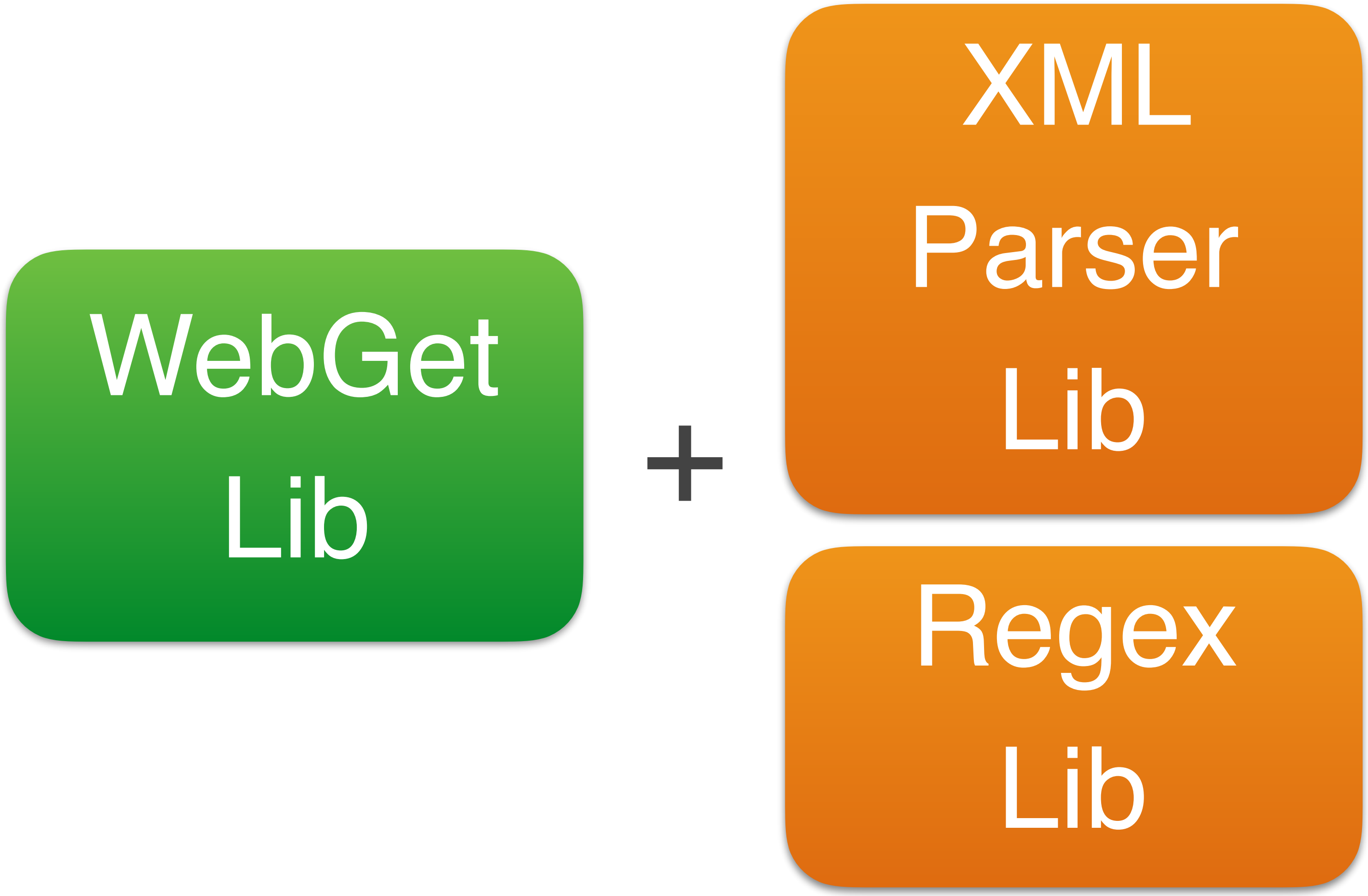

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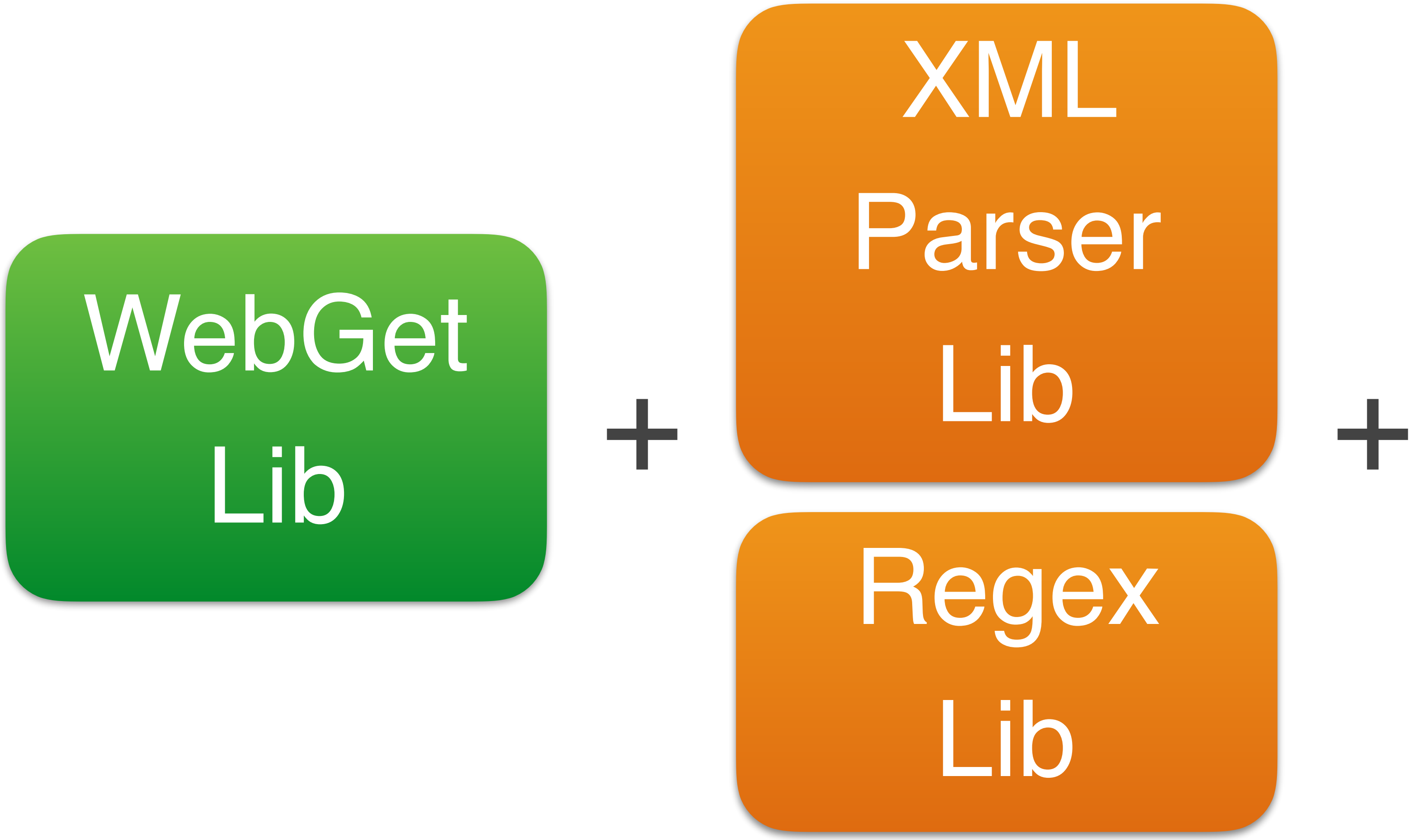

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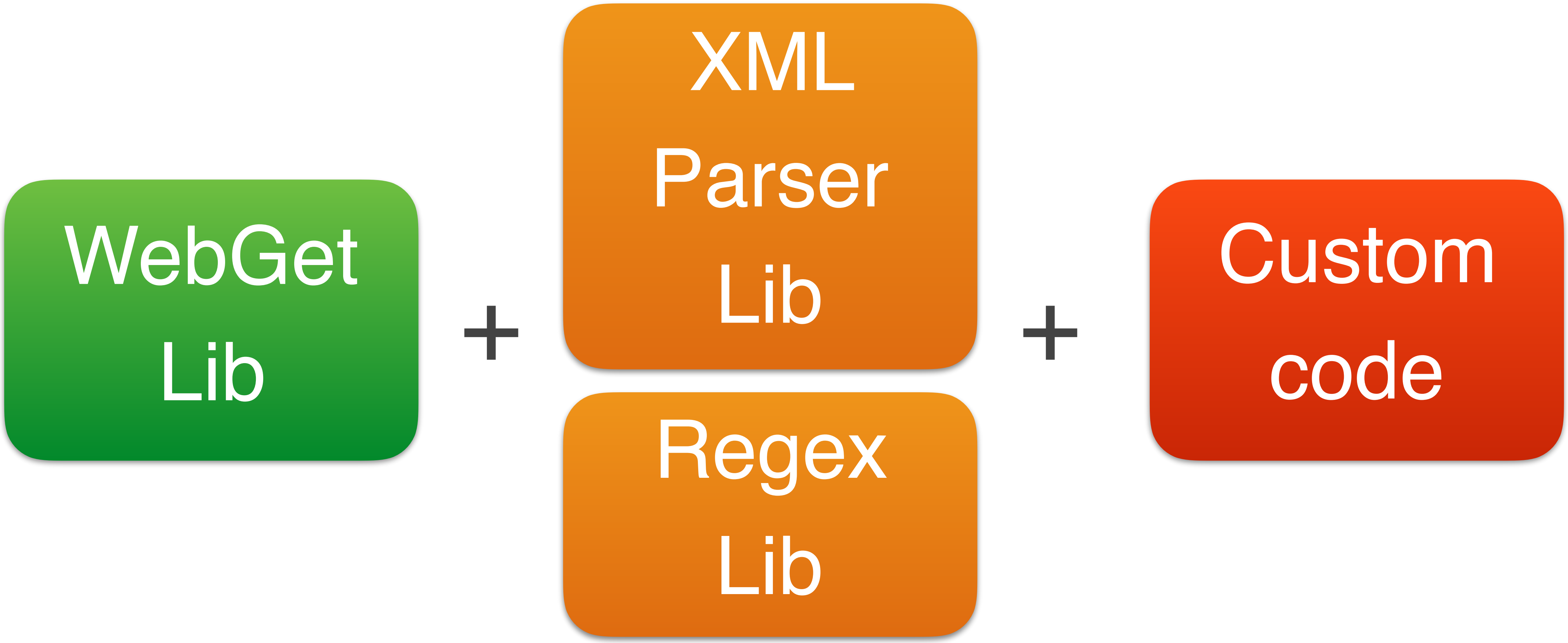

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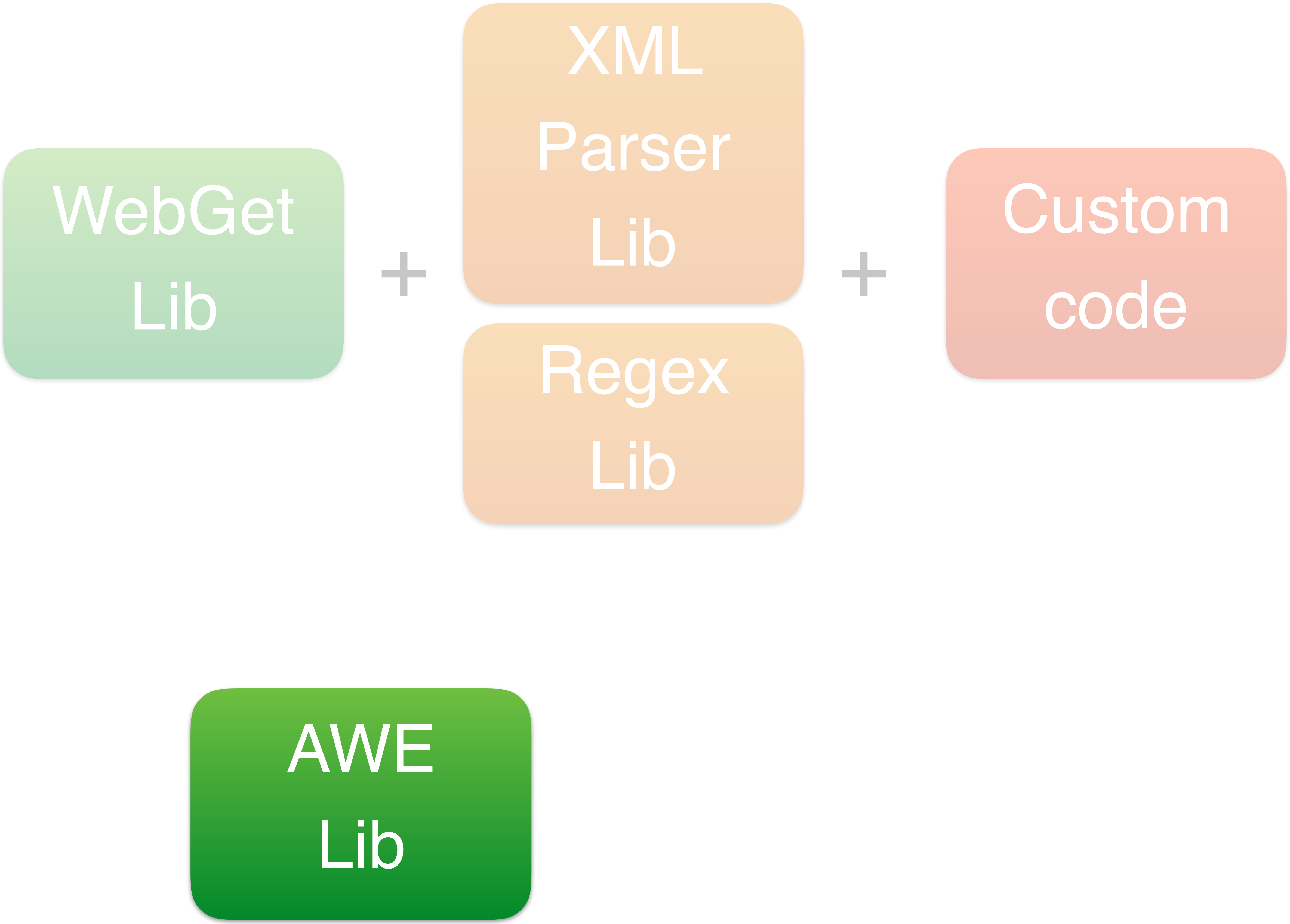

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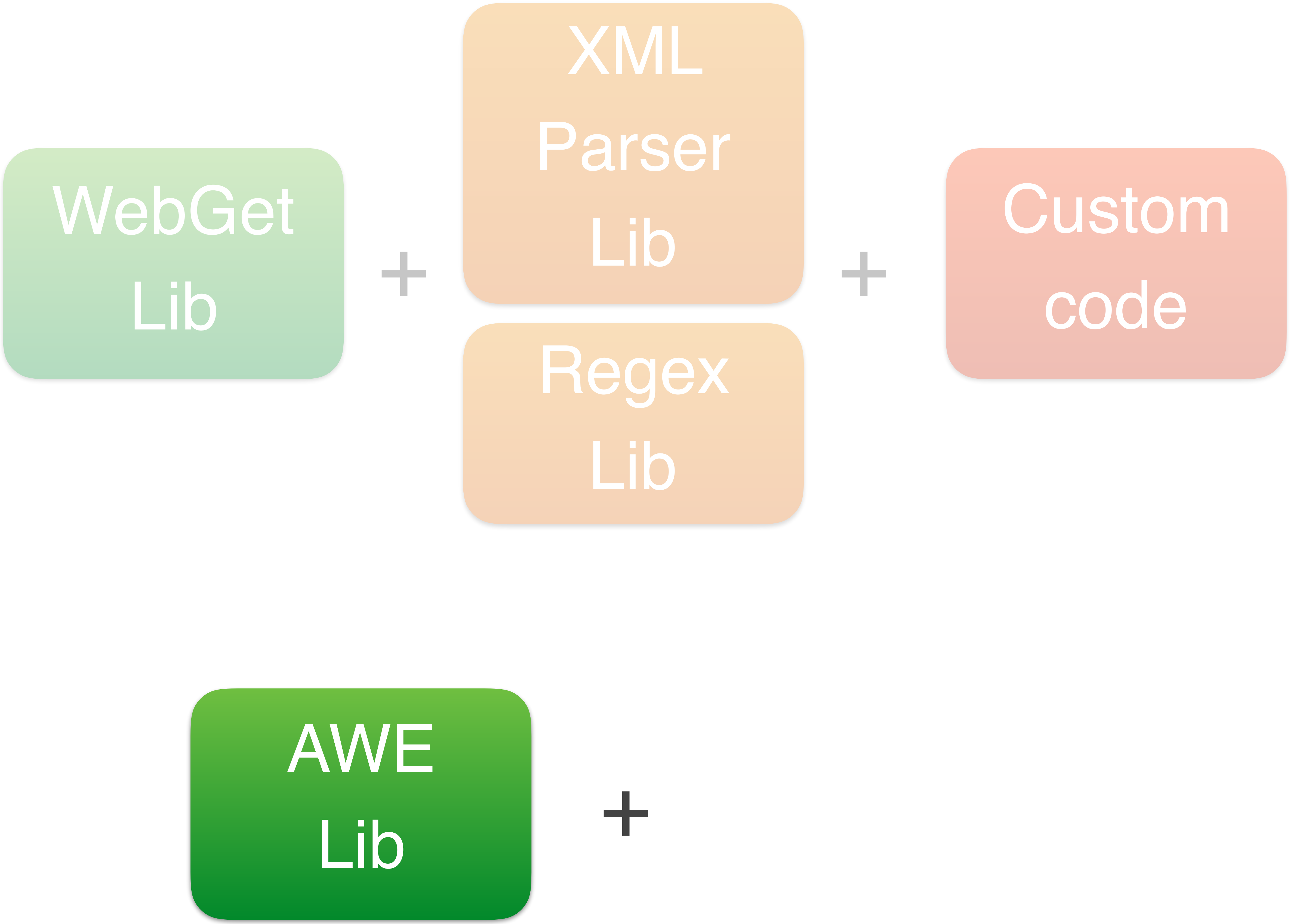

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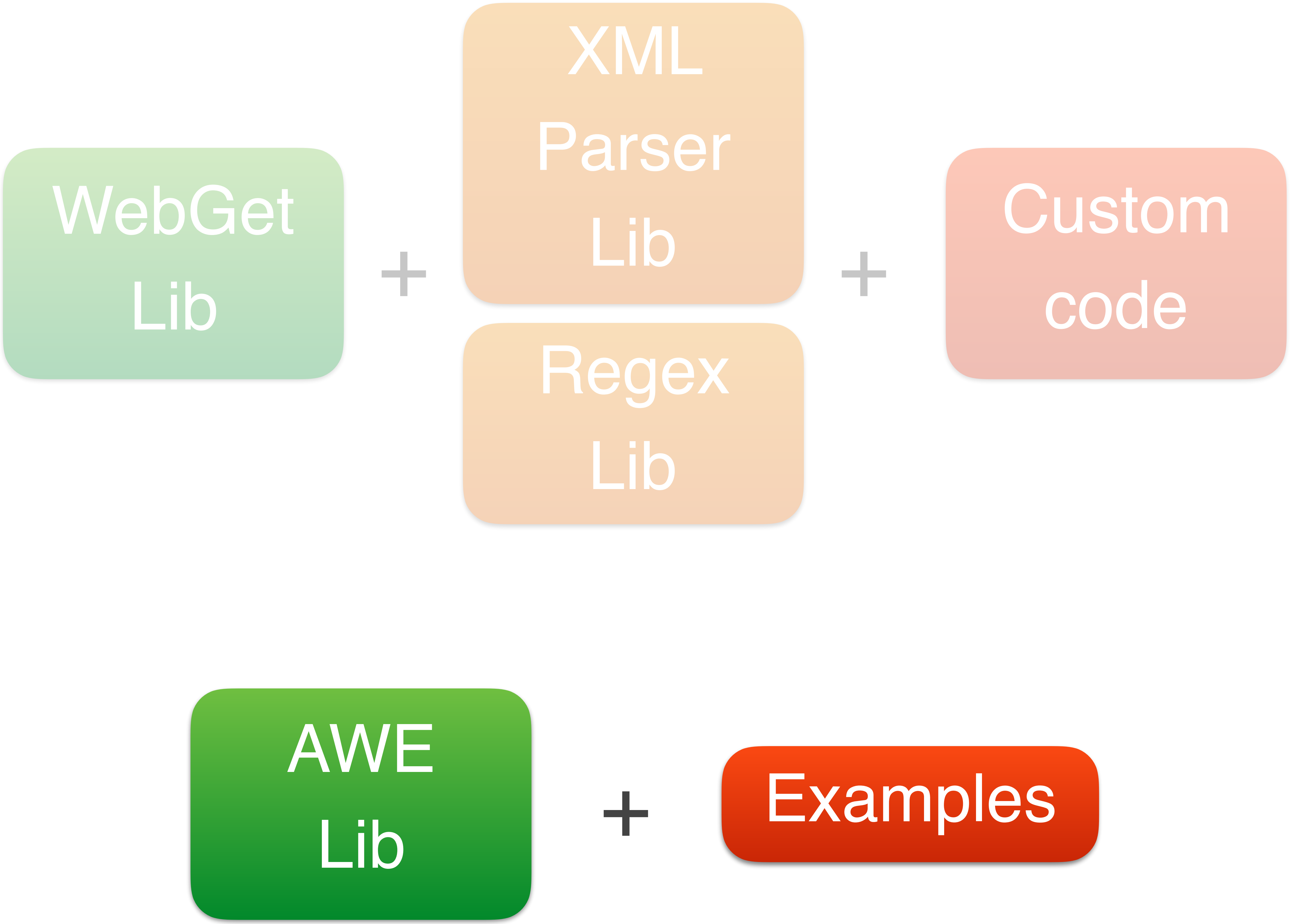

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  - (2b) And allow fuzzy mapping of user needs to tasks

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# returns:
# {“name”: “Barbara Ann Kitchenham”,
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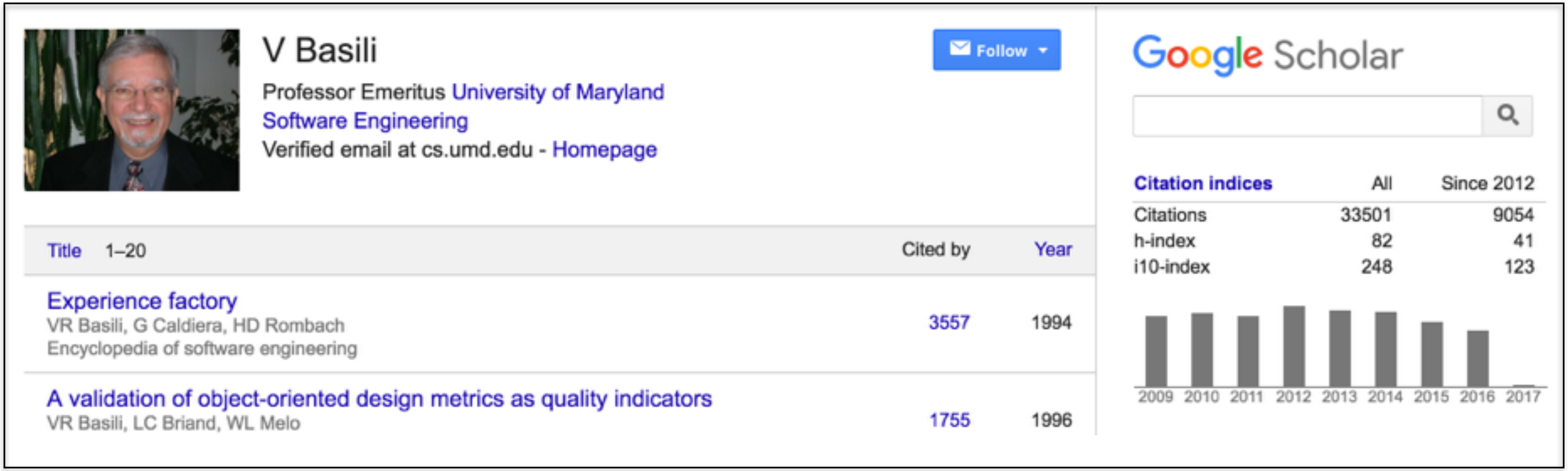
```

Big benefits with semantically similar task



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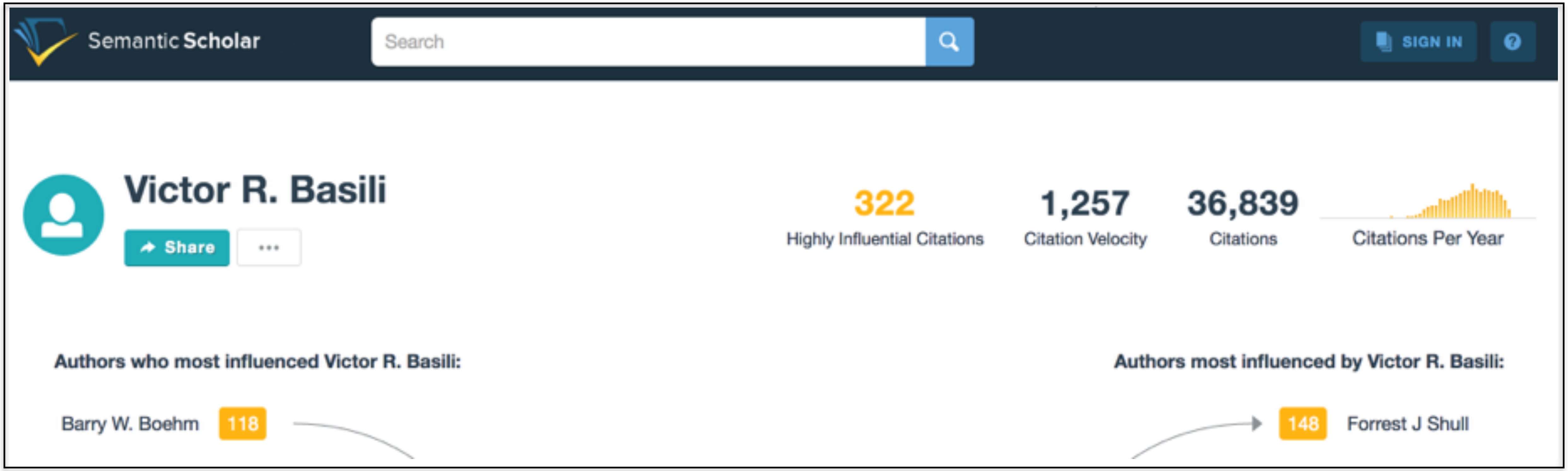

Victor R. Basili

322 Highly Influential Citations

1,257 Citation Velocity

36,839 Citations

Citations Per Year

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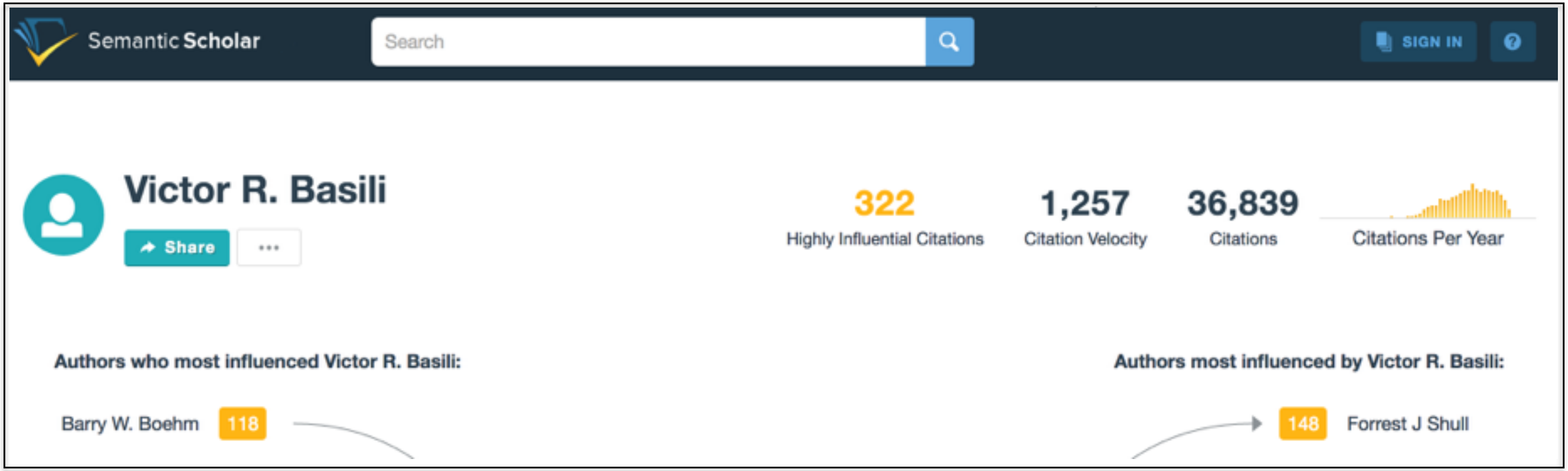

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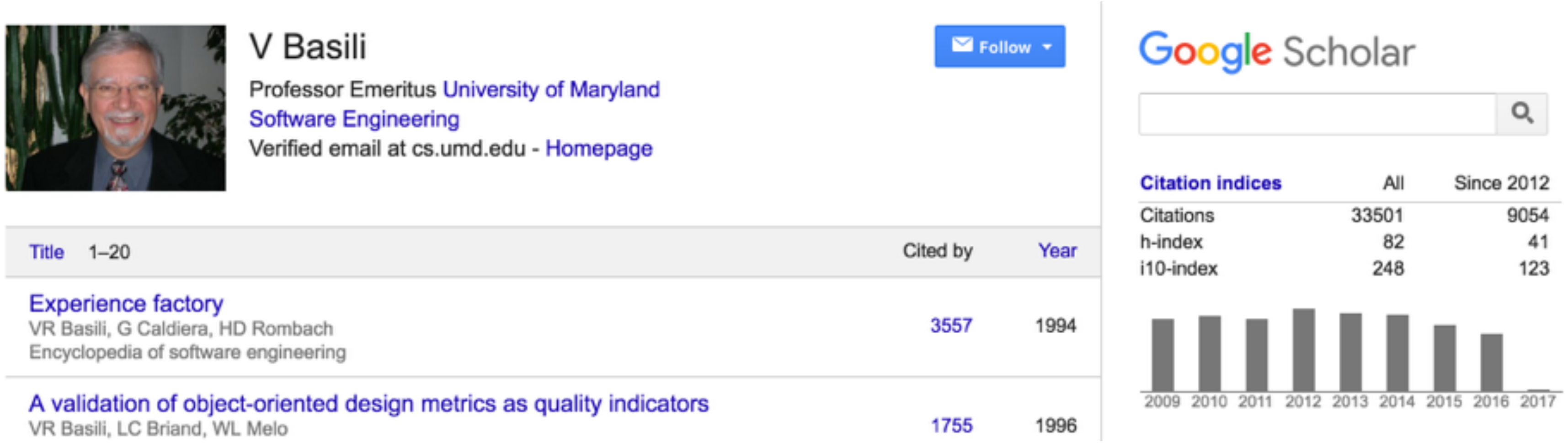
Only change 2 I/O examples & re-adapt!

GI would not help: Only semantic, not syntactic similarity



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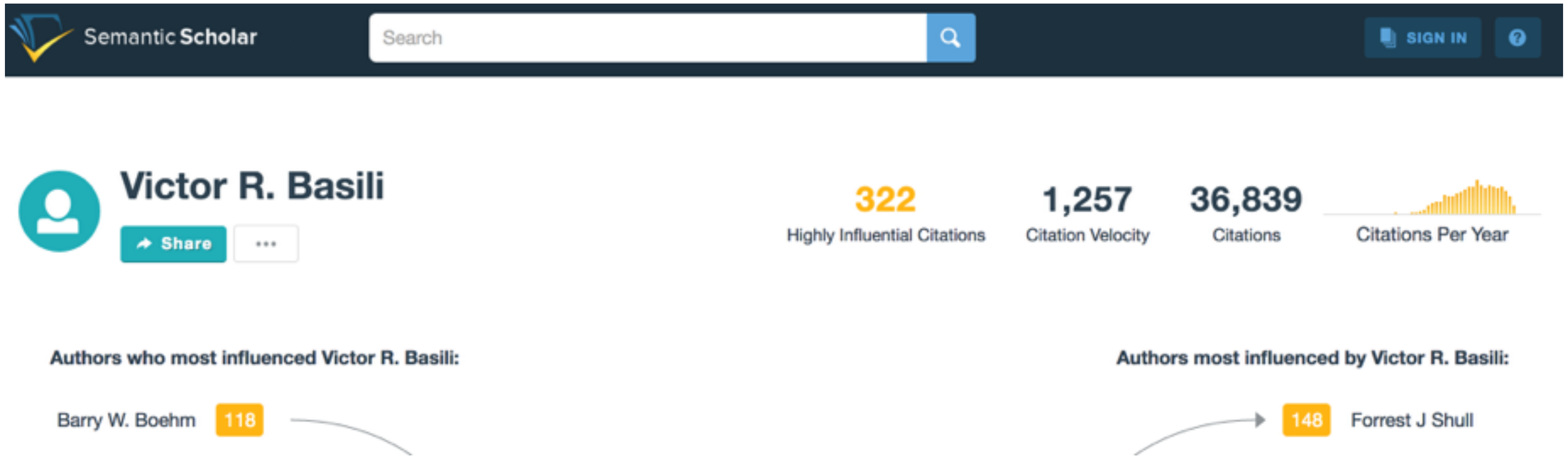

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    - 5. Full/free search (search from atoms & up, warn dev)

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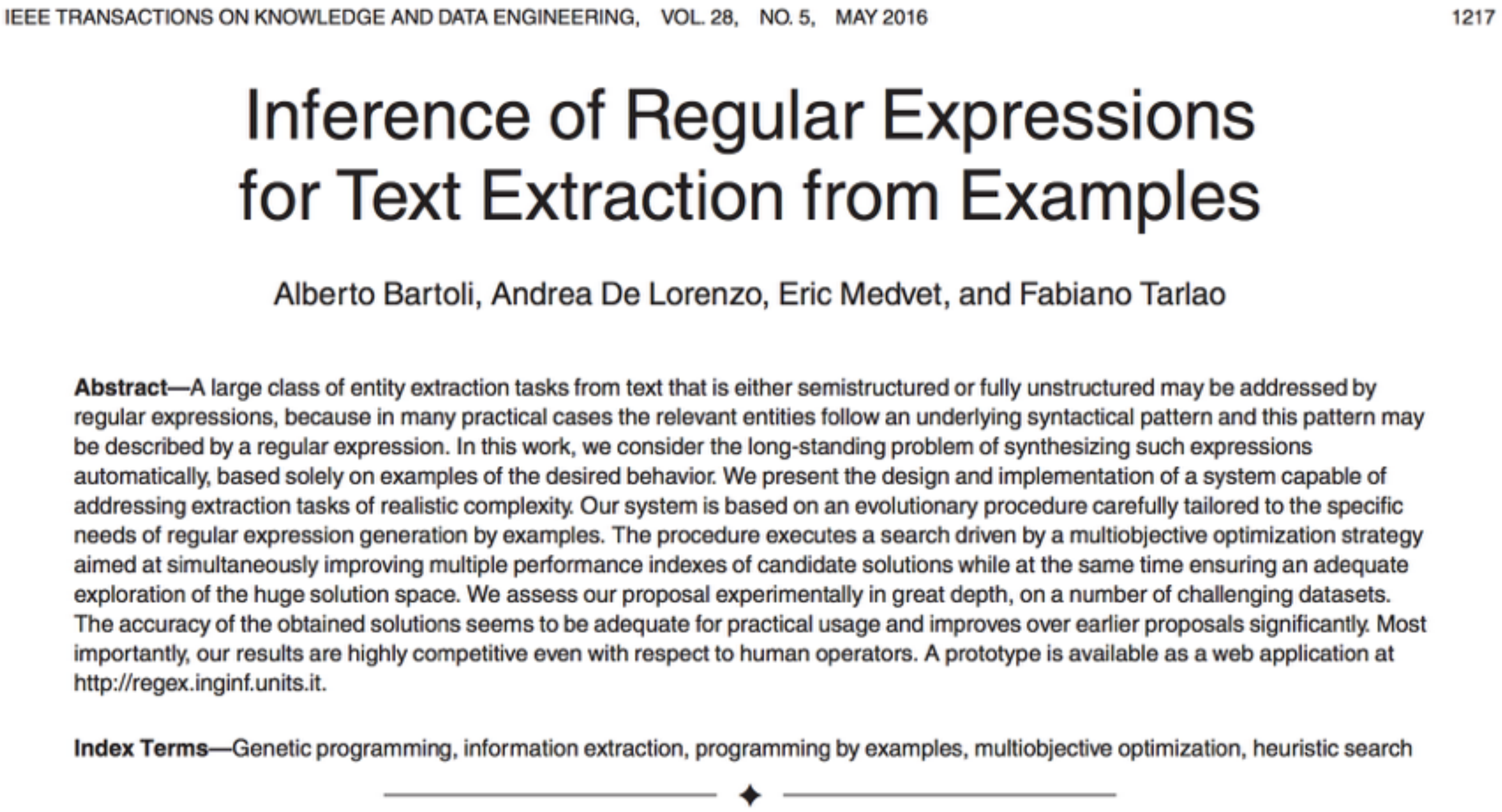
    - with brute force and flexibility of search, only wh. needed

Thank you!

robert.feldt@chalmers.se

@drfeldt

But what about Bartoli et al?!



IEEE TRANSACTIONS ON KNOWLEDGE AND DATA ENGINEERING, VOL. 28, NO. 5, MAY 2016 1217

Inference of Regular Expressions for Text Extraction from Examples

Alberto Bartoli, Andrea De Lorenzo, Eric Medvet, and Fabiano Tarlao

Abstract—A large class of entity extraction tasks from text that is either semistructured or fully unstructured may be addressed by regular expressions, because in many practical cases the relevant entities follow an underlying syntactical pattern and this pattern may be described by a regular expression. In this work, we consider the long-standing problem of synthesizing such expressions automatically, based solely on examples of the desired behavior. We present the design and implementation of a system capable of addressing extraction tasks of realistic complexity. Our system is based on an evolutionary procedure carefully tailored to the specific needs of regular expression generation by examples. The procedure executes a search driven by a multiobjective optimization strategy aimed at simultaneously improving multiple performance indexes of candidate solutions while at the same time ensuring an adequate exploration of the huge solution space. We assess our proposal experimentally in great depth, on a number of challenging datasets. The accuracy of the obtained solutions seems to be adequate for practical usage and improves over earlier proposals significantly. Most importantly, our results are highly competitive even with respect to human operators. A prototype is available as a web application at http://regex.inginf.units.it.

Index Terms—Genetic programming, information extraction, programming by examples, multiobjective optimization, heuristic search

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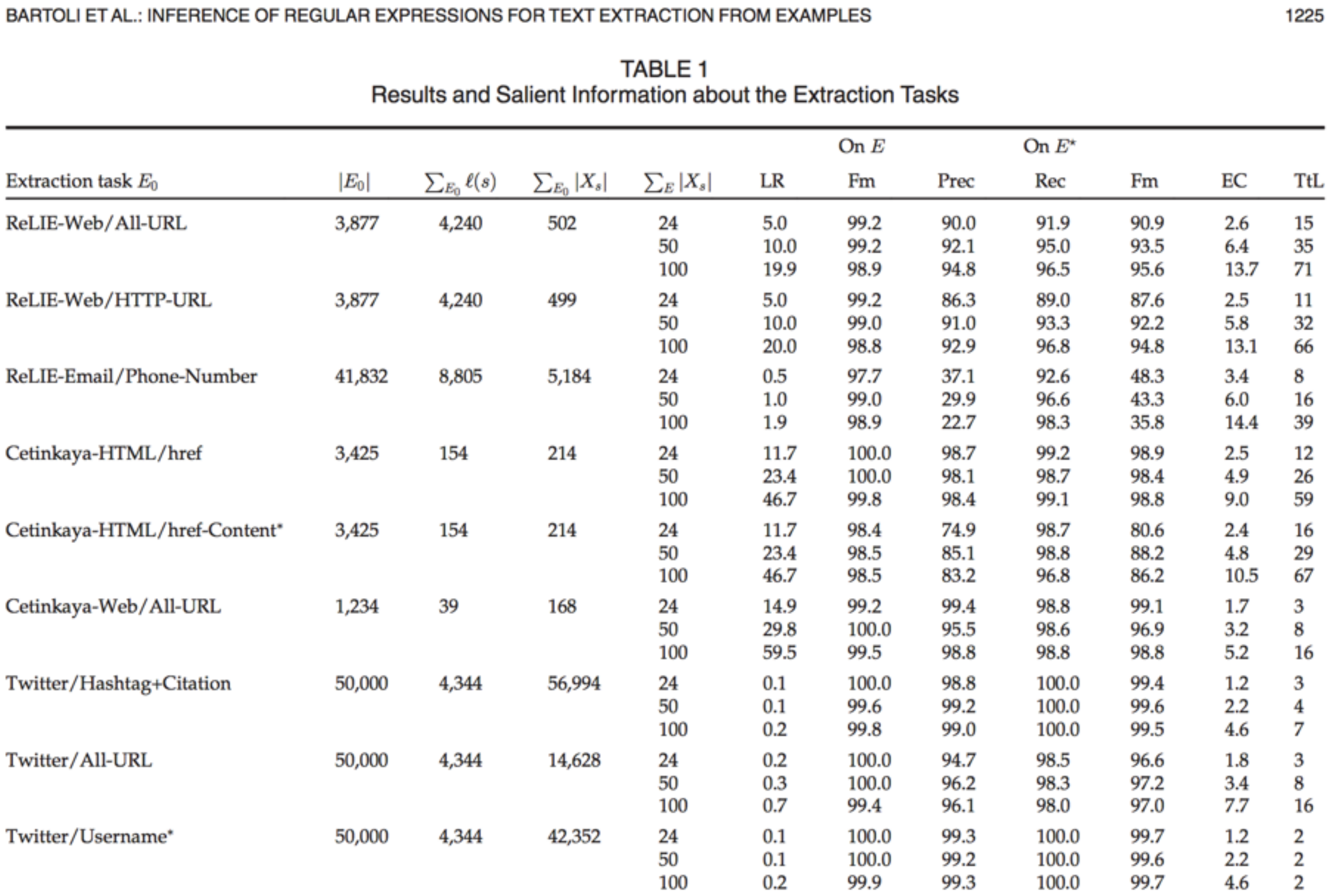

BARTOLI ET AL.: INFERENCE OF REGULAR EXPRESSIONS FOR TEXT EXTRACTION FROM EXAMPLES 1225

TABLE 1
Results and Salient Information about the Extraction Tasks

						On E	On E^*				
Extraction task E_0	$\lvert E_0 \rvert$	$\sum_{E_0} \ell(s)$	$\sum_{E_0} \lvert X_s \rvert$	$\sum_{E} \lvert X_s \rvert$	LR	Fm	Prec	Rec	Fm	EC	TtL
ReLIE-Web/All-URL	3,877	4,240	502	24	5.0	99.2	90.0	91.9	90.9	2.6	15
				50	10.0	99.2	92.1	95.0	93.5	6.4	35
				100	19.9	98.9	94.8	96.5	95.6	13.7	71
ReLIE-Web/HTTP-URL	3,877	4,240	499	24	5.0	99.2	86.3	89.0	87.6	2.5	11
				50	10.0	99.0	91.0	93.3	92.2	5.8	32
				100	20.0	98.8	92.9	96.8	94.8	13.1	66
ReLIE-Email/Phone-Number	41,832	8,805	5,184	24	0.5	97.7	37.1	92.6	48.3	3.4	8
				50	1.0	99.0	29.9	96.6	43.3	6.0	16
				100	1.9	98.9	22.7	98.3	35.8	14.4	39
Cetinkaya-HTML/href	3,425	154	214	24	11.7	100.0	98.7	99.2	98.9	2.5	12
				50	23.4	100.0	98.1	98.7	98.4	4.9	26
				100	46.7	99.8	98.4	99.1	98.8	9.0	59
Cetinkaya-HTML/href-Content*	3,425	154	214	24	11.7	98.4	74.9	98.7	80.6	2.4	16
				50	23.4	98.5	85.1	98.8	88.2	4.8	29
				100	46.7	98.5	83.2	96.8	86.2	10.5	67
Cetinkaya-Web/All-URL	1,234	39	168	24	14.9	99.2	99.4	98.8	99.1	1.7	3
				50	29.8	100.0	95.5	98.6	96.9	3.2	8
				100	59.5	99.5	98.8	98.8	98.8	5.2	16
Twitter/Hashtag+Citation	50,000	4,344	56,994	24	0.1	100.0	98.8	100.0	99.4	1.2	3
				50	0.1	99.6	99.2	100.0	99.6	2.2	4
				100	0.2	99.8	99.0	100.0	99.5	4.6	7
Twitter/All-URL	50,000	4,344	14,628	24	0.2	100.0	94.7	98.5	96.6	1.8	3
				50	0.3	100.0	96.2	98.3	97.2	3.4	8
				100	0.7	99.4	96.1	98.0	97.0	7.7	16
Twitter/Username*	50,000	4,344	42,352	24	0.1	100.0	99.3	100.0	99.7	1.2	2
				50	0.1	100.0	99.2	100.0	99.6	2.2	2
				100	0.2	99.9	99.3	100.0	99.7	4.6	2