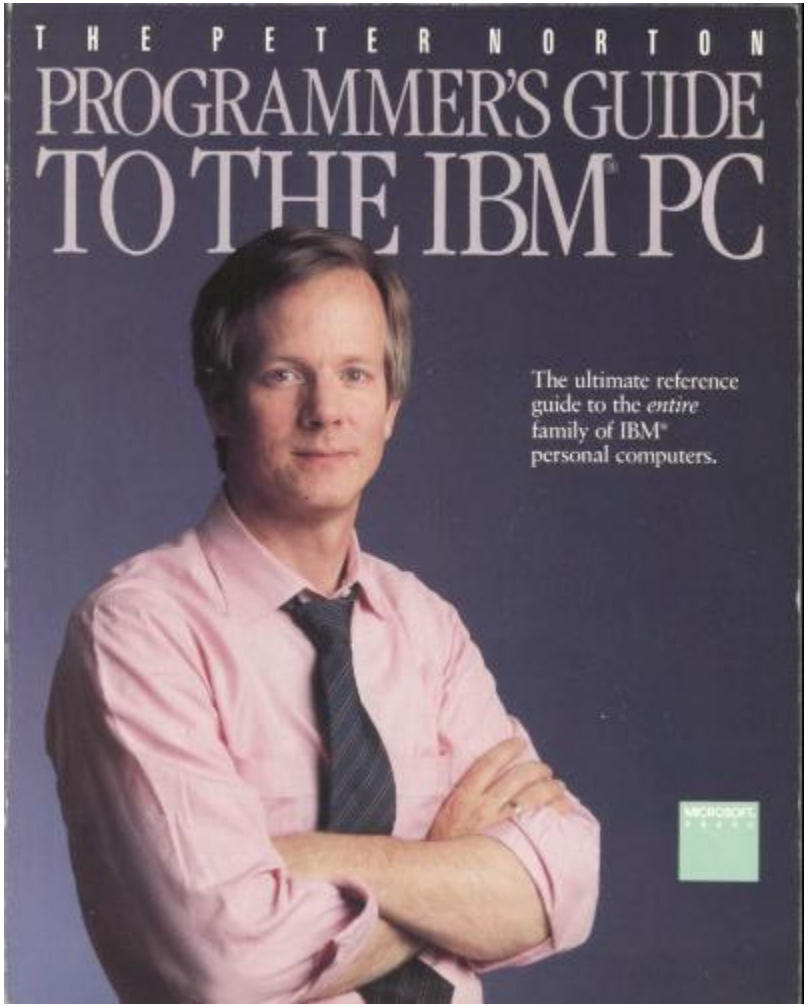
Unlocking insights hidden in software documentation

Christoph Treude
ARC DECRA Fellow and Senior Lecturer, University of Adelaide

THE UNIVERSITY of ADELAIDE

Software Documentation



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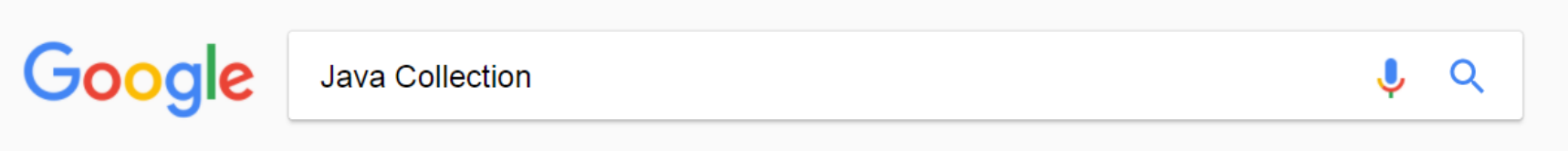
Software Documentation is everywhere



C. Treude and M. Aniche. Where does Google find API documentation? WAPI '18: Workshop on API Usage and Evolution, p. 19-22

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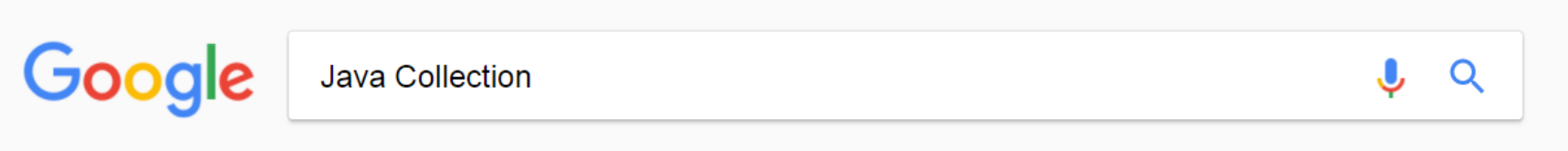

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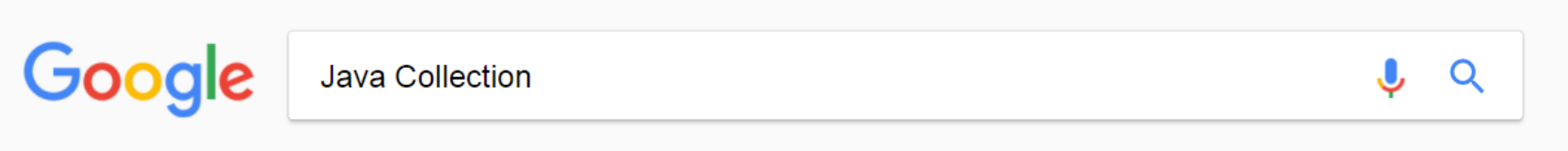

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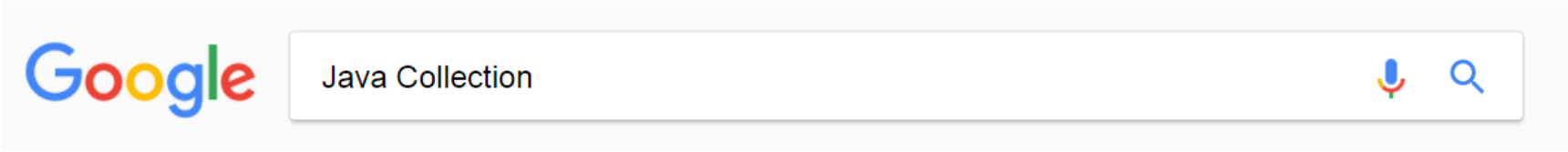

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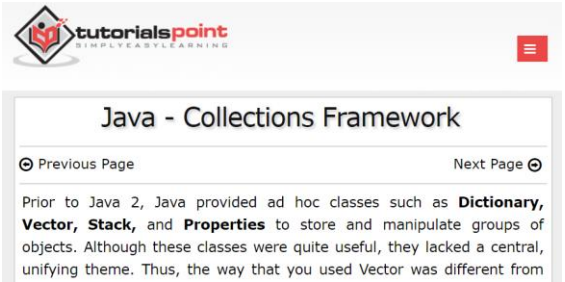

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162 different domains in the top 10 for 99 queries

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Software Documentation is everywhere

Tensorflow Python API: 309 different domains in the top 10 for 2,192 queries

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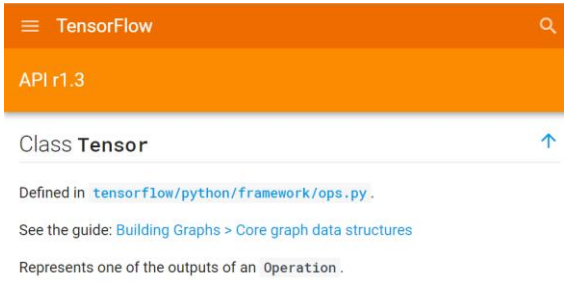

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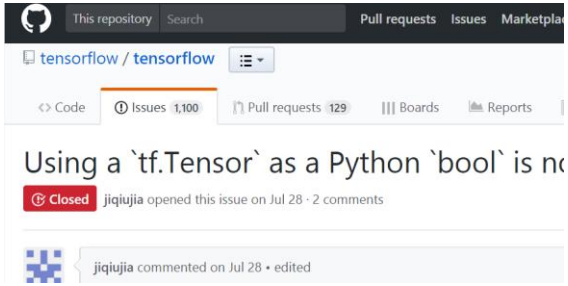

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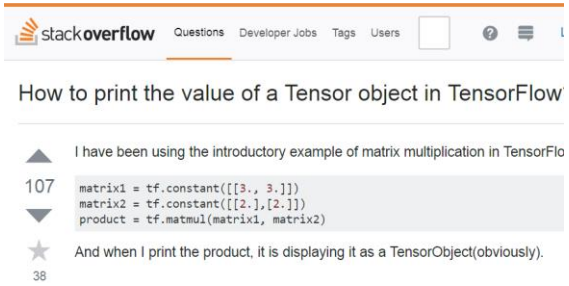

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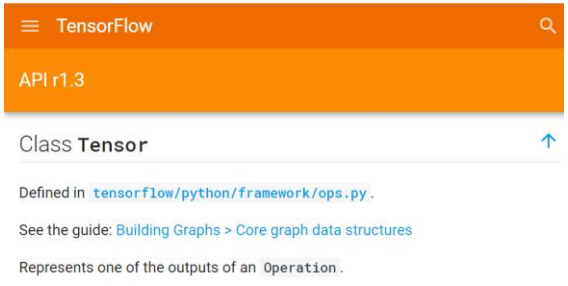

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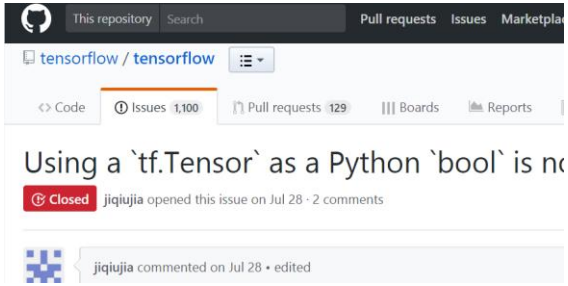

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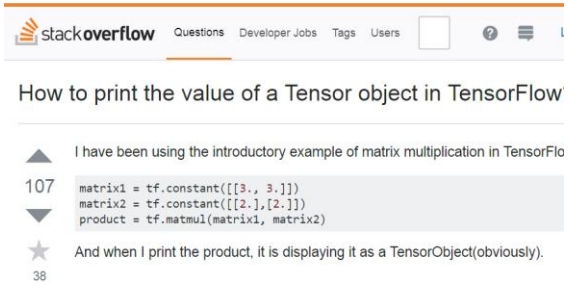

jQuery Event API: 75 different domains in the top 10 for 57 queries

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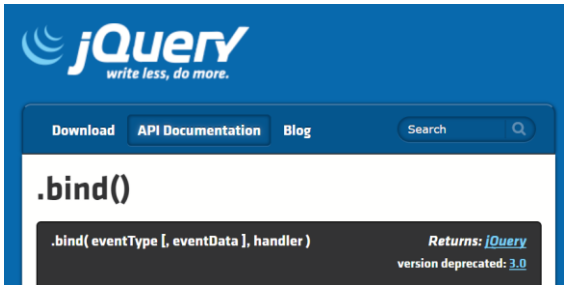

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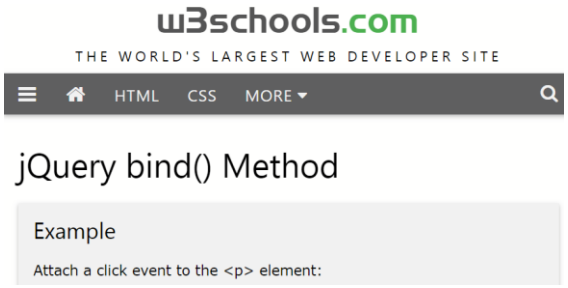

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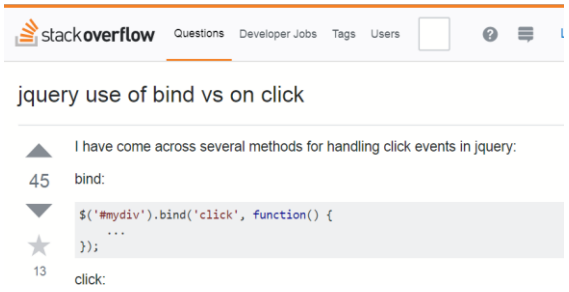

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Navigating documentation is not trivial

C. Treude, M. P. Robillard, and B. Dagenais. Extracting Development Tasks to Navigate Software Documentation. IEEE Trans. on Software Engineering, 41, 6, p. 565-581, 2015

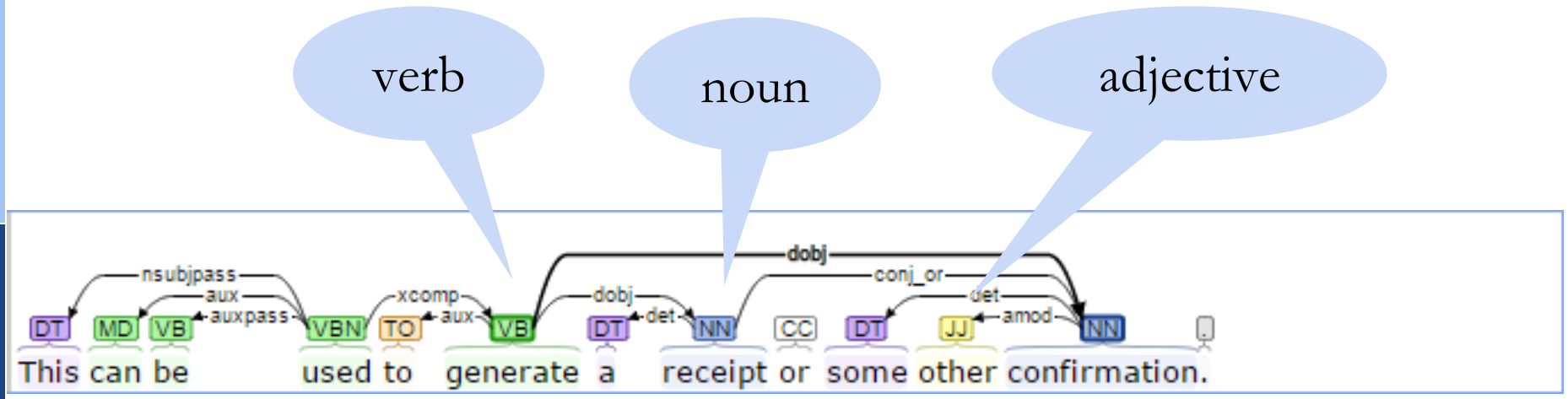
Navigating documentation is not trivial

Common Tasks

	Link
	Link
	Link
	Link
	Link
	Link
	Link
	Link

C. Treude, M. P. Robillard, and B. Dagenais. Extracting Development Tasks to Navigate Software Documentation. IEEE Trans. on Software Engineering, 41, 6, p. 565-581, 2015

Extracting tasks from documentation



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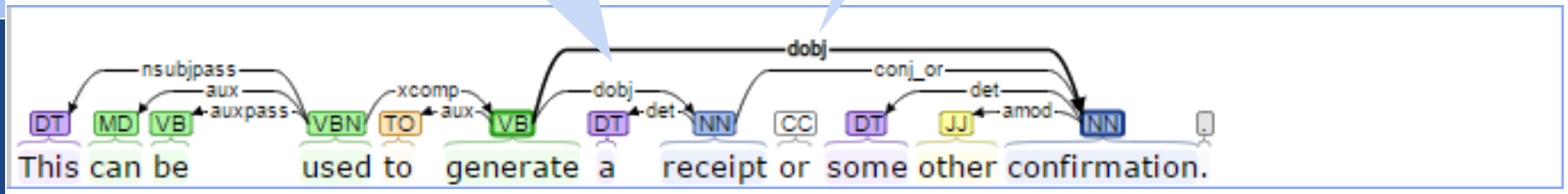
Grammatical dependencies

direct object:
generate
confirmation

direct object:
generate receipt



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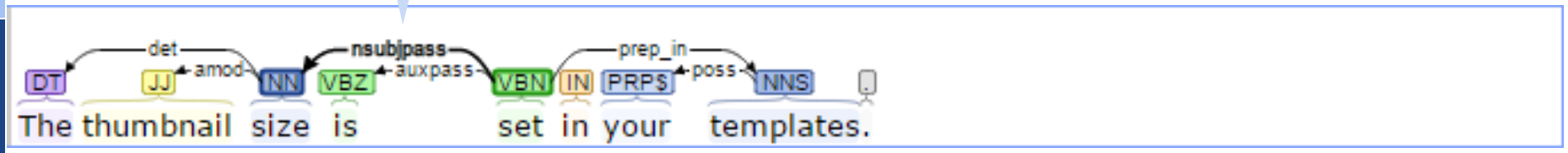
Grammatical dependencies

passive nominal subject: set size



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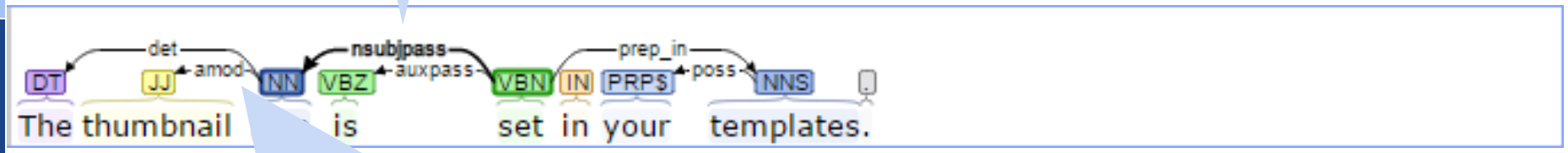

adjective modifier: set thumbnail size

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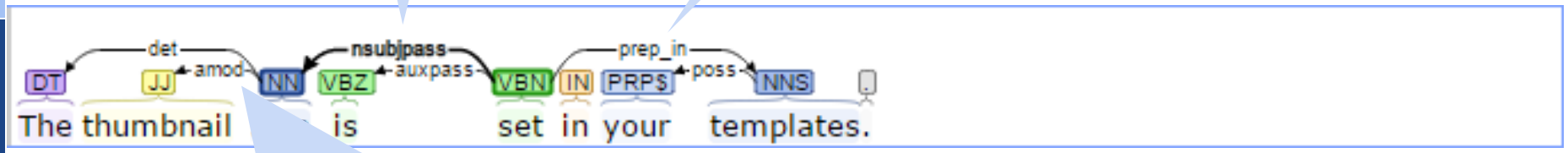
Grammatical dependencies

preposition:
set thumbnail size in templates

passive nominal subject: set size



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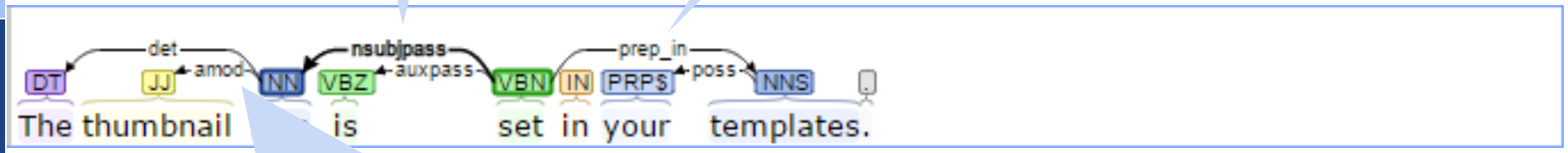
Grammatical dependencies

preposition:
set thumbnail size in templates

passive nominal subject: set size

online demo:
http://task-phrases.herokuapp.com/



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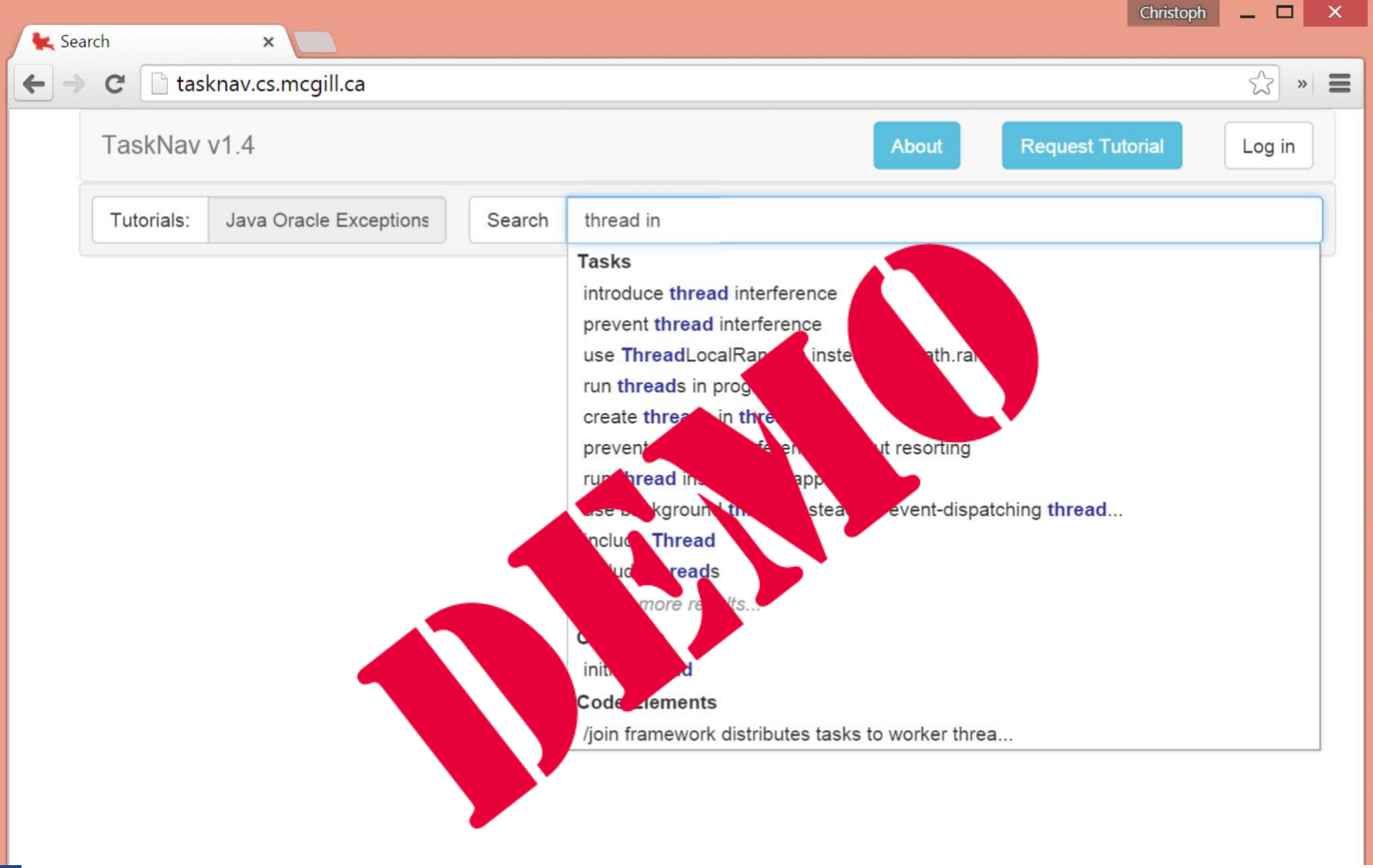
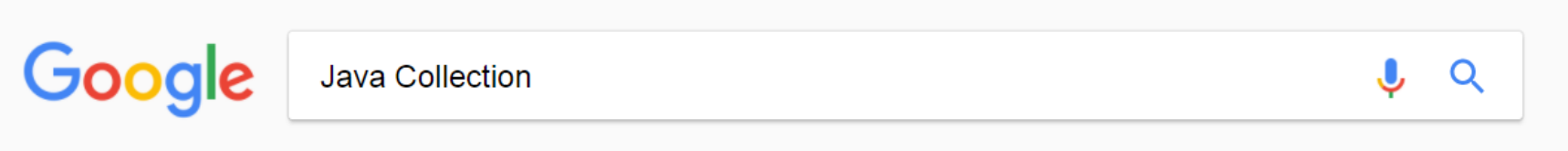


C. Treude, M. Sicard, M. Klocke, and M. P. Robillard. TaskNav: Task-based Navigation of Software Documentation. ICSE '15: 37th Int'l. Conf. on Software Engineering, p. 649-652

Software Documentation is everywhere



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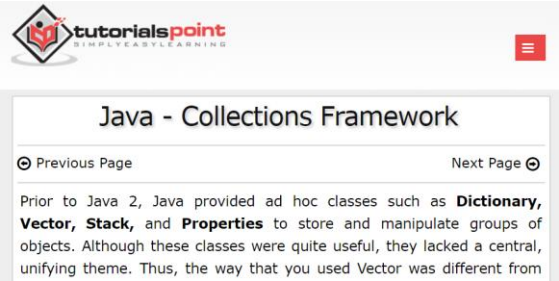

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DataSource and DriverManager on J2SE

2

1

I'm interested in developing a desktop application that connects to a MySQL DB. After reading this java tutorial on DB connection (and several others) I have a question. Using DataSource seems popular on J2EE while DriverManager is a common choise for desktop applications. Is it still possible to use DataSource on a desktop application? If yes, is it a better choice over DriverManager?

java mysql java-ee connection datasource

share edit

asked Jun 3 '12 at 7:58

RedBaron

13 ● 2

add a comment

2 Answers

active oldest votes

2

I'll quote the javadoc:

> An alternative to the DriverManager facility, a DataSource object is the preferred means of getting a connection.

Normally you use `DriverManager` when you just want a connection for one time while with `DataSource` you get other features such as connection pooling and distributed transactions.

Hope this helps.

add a comment

C. Treude and M. P. Robillard. Augmenting API Documentation with Insights from Stack Overflow. ICSE '16: 38th Int'l. Conference on Software Engineering, p. 392-403

insight sentence

a sentence from Stack Overflow that is related to a particular API type and that provides insight not contained in the API documentation of that type

	A	B	C	D	E
1	sentence	answer_i	type	sentence	meaningful?
816	2817	234	DriverManager	Most applications these days use the DataSource interface and do not interact with the DriverManager like this.	y
817	32	3	AudioClip	Most media formats (sound, image, video etc.) are what is known as 'container formats'	y
818	1654	123	String	Most random number generators are, in fact, "pseudo ran	
819	891	83	Serializable	My guess would be the possibility to consistently extend th	
820	1834	149	String	My opinion, and it's only that, is that as soon as you start s	
821	3687	314	JPanel	My suggestion is to go through the Oracle Swing Tutorial a	
822	1866	155	String	NB: the compare is done on 'usuario' because that's guara	
823	3733	319	JPanel	Neither cardsPanel1 nor cardsPanel2 (dark gray) have an	
824	286	14	Image	Next I extend JLabel:	
825	286	14	JPanel	Next I extend JLabel:	
826	3408	287	ArrayList	No, ArrayList of ArrayLists cannot contain other elements	
827	3719	316	JPanel	None of these panels will be visible unless you add them t	
828	2707	224	DriverManager	Normally you do not need to implement it, use the class fr	
829	2848	237	DriverManager	Normally you use DriverManager when you just want a co	
830	1000	101	Serializable	Not just Serializable.	
831	736	67	PropertyChange	Not likely 3, but 3.1.	
832	275	13	Image	Not really a problem when loading from the application jar	
833	275	13	JPanel	Not really a problem when loading from the application jar	
834	1650	122	String	Not too shabby.	
835	3360	279	ArrayList	Not with my solution!	
836	969	95	Serializable	Note that all non-static non-transient fields of A and B mus	
837	102	7	AudioClip	Note that Class.getResource doesn't take a full file name	
838	1842	151	String	Note that in Java SE 7 and later you can use a String obje	
839	850	77	Serializable	Note that it still invokes defaultWriteObject for the "easy" f	
840	1015	105	Serializable	Note that Serializable is just a marker interface.	
841	1864	155	String	Note that string constants are usually "interned" such that	
842	3125	247	ArrayList	Note that the returned type for asList() is a List using a co	
843	1575	112	String	Note that the second parameter (i.e. Charsets.	
844	466	39	Image	Note that you can find the background color component b	

Coding Guide for "Meanin

The following kinds of s … being meaningful on their own:

- The sente … e to another sentence.
  Example: … *nutable list.*
- The … "it", "this", "that", etc., which are not resolved wit…
  … *ce a [n][3]-Matrix.*

coding guide

… acing a code snippet (often indicated by a colon).
… *create a factory method:*

… s grammatically incomplete.
… *yes, ArrayList.*

… tence contains communication between Stack Overflow users.
… e: *Thanks to the comments I have to update my answer.*

… he sentence references code elements that come from user examples rather than the API.
Example: *You might be surprised to find out that in your sample code, s1 == s2 returns true!*

- The sentence references specific Stack Overflow users.
  Example: *Like EJP said the key part is to save in a byte array.*
- The sentence only contains a link.
  Example: *http://www.jmagick.org/index.html.*
- The sentence contains a reference to something that is not an obvious part of the API ("block" in the example)
  Example: *The block size is parameterized for run-time performance optimization.*
- The sentences starts with "but", "and", "or" etc.
  Example: *And then another instance of string with content Hello world.*
- The sentence is a generic statement that is unrelated to the API type.
  Example: *Most random number generators are, in fact, pseudo random.*
- The sentence contains a comparison that is incomplete (i.e., one part of the comparison is missing).
  Example: *char[] is less vulnerable.*
- The sentence resulted from a parsing error.
  Example: *Because the java.io.*
- The sentence requires another sentence to be complete.
  Example: *First, you have to know the encoding of string that you want to convert.*
- The sentence contains an explicit reference to a piece of context that's missing.
  Example: *What you're trying to do here is rather unusual, to say the least.*

Other sentences are considered meaningful.

C. Treude and M. P. Robillard. Augmenting API Documentation with Insights from Stack Overflow. ICSE '16: 38th Int'l. Conference on Software Engineering, p. 392-403

Supervised Insight Sentence Extractor

1	cosine similarity between sentence and most similar sentence in API documentation	11	question age
2	average cosine similarity between sentence and all sentences in API documentation	12	sentence starts with noun followed by verb in present tense, third person singular
3	question user acceptance rate	13	number of tokens in sentence
4	answer age	14	position of API element in sentence
5	answer time difference to question	15	number of occurrences of API element in sentence
6	question score	16	answer score
7	question favorites	17	answer size
8	question user reputation	18	number of nouns in sentence
9	question views	19	sentence starts with noun
10	number of nouns followed by verb in present tense, third person singular in sentence	20	number of characters that are code
		21	number of occurrences of the verb "be" in sentence

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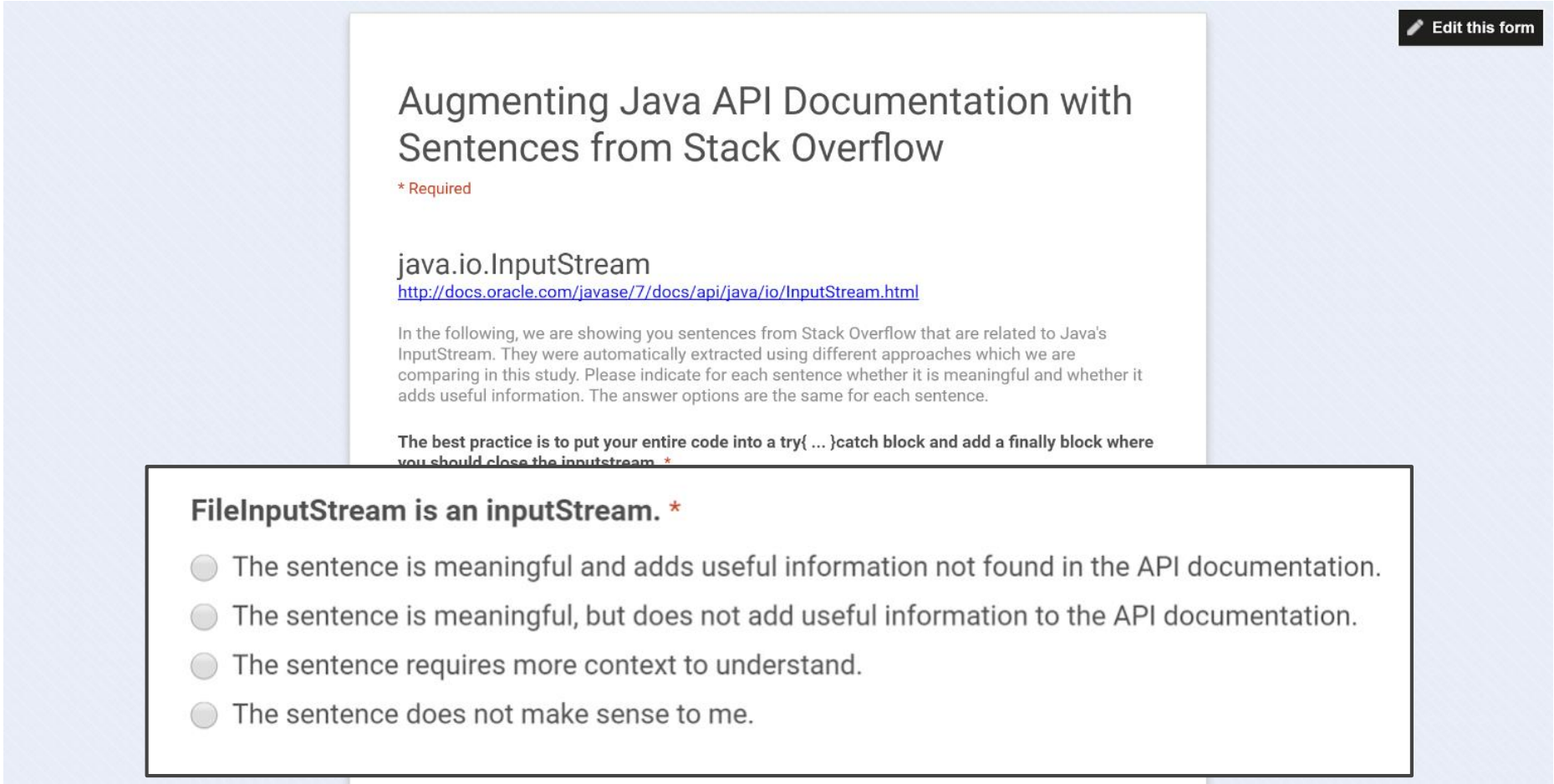
Comparative Study



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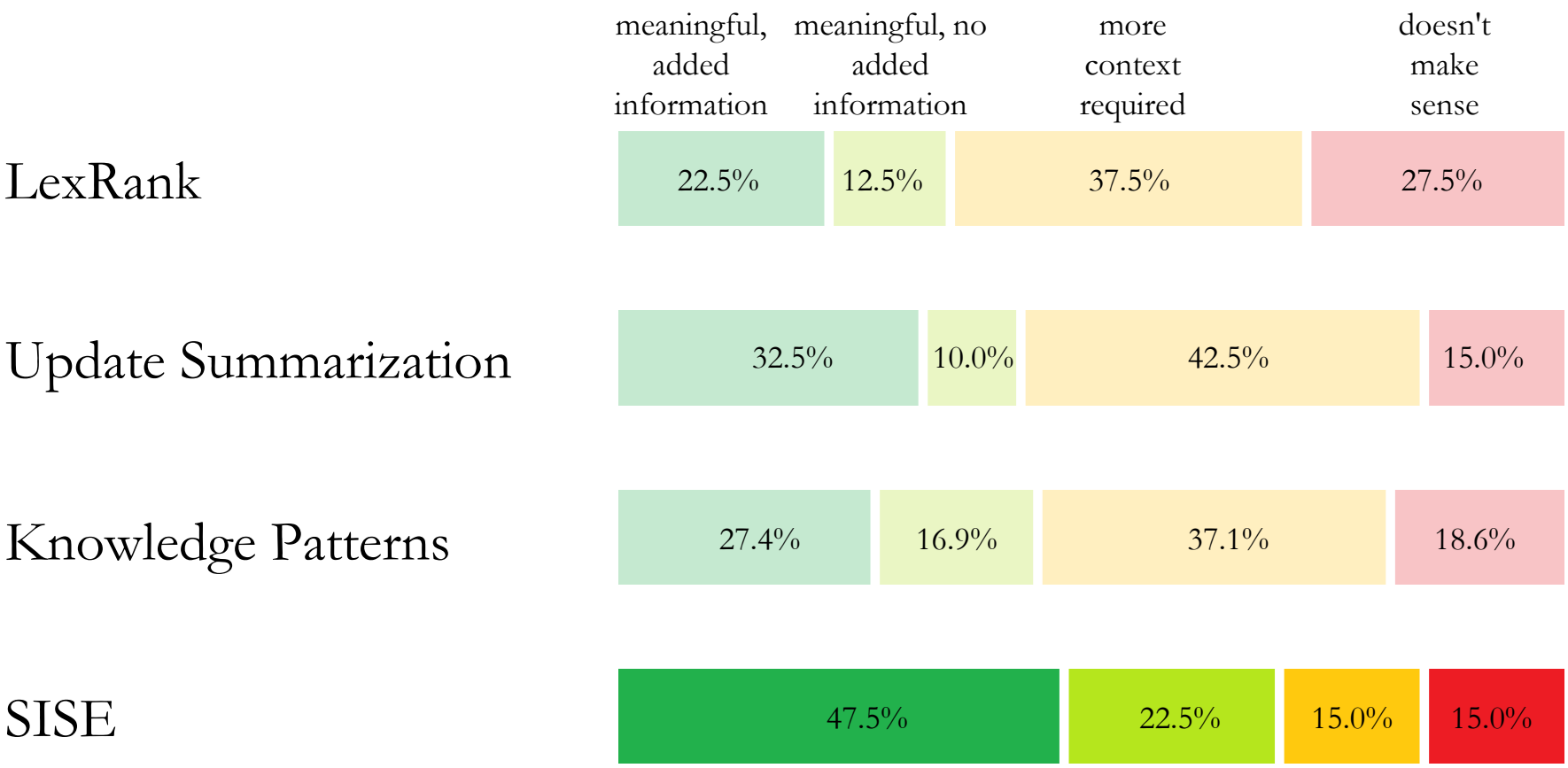

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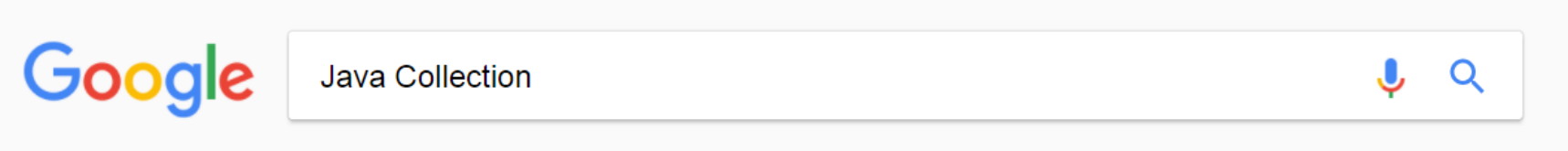

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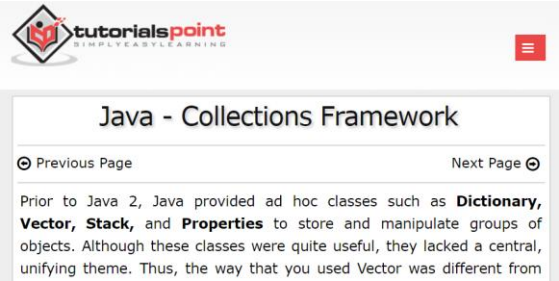

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37%

What is this thing? (Witt)

javascript × 1672211

JavaScript (not to be confused with Java) is a high-level, dynamic, multi-paradigm, weakly-typed language used for both client-

763 asked today, 5021 this week

java × 1451316

Java (not to be confused with JavaScript or JScript or JS) is a general-purpose object-oriented programming language designed to

523 asked today, 3312 this week

c# × 1237935

a high level, object-oriented programming language that is designed for building a variety of applications that run on the .NET

436 asked today, 2607 this week

android × 1129817

Google's mobile operating system, used for programming or developing digital devices (Smartphones, Tablets, Automobiles, TVs,

476 asked today, 2762 this week

python × 1012032

a dynamic, strongly typed, object-oriented, multipurpose programming language, designed to be quick (to learn, to use, and to

776 asked today, 4942 this week

jquery × 924833

a popular cross-browser JavaScript library that facilitates Document Object Model (DOM) traversal, event handling, animations,

203 asked today, 1261 this week

c++ × 582841

a general-purpose programming language. It was originally designed as an extension to C, and keeps a similar syntax, but is now a

169 asked today, 1112 this week

ios × 574313

the mobile operating system running on the Apple iPhone, iPod touch, and iPad. Use this tag [ios] for questions related to

177 asked today, 1139 this week

css × 550605

a representation style sheet language used for describing the look and formatting of HTML (Hyper Text Markup Language), XML

207 asked today, 1328 this week

55,899 tags in total

M. Nassif, C. Treude, and M. P. Robillard. Automatically Categorizing Software Technologies. To appear in IEEE Transactions on Software Engineering, 2018

What is this thing? (Witt)

sentinel2 × 4

created Jul 17 at 14:05

drake-r-package × 4

The drake R package (https://github.com/ropensci/drake) is a Make-like pipeline toolkit. Its purpose is to

created Jul 17 at 13:56

select-onchange

created Jul 17 at 13:35

oos

created Jul 17 at 11:42

office-web-app × 2

created Jul 17 at 11:42

react-native-sentry × 6

created Jul 17 at 9:58

kintohub

created Jul 17 at 5:54

ruby-on-rails-5.3

created Jul 17 at 5:42

ruby-2.4.4

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graniteui

created Jul 16 at 16:54

coral3

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pagesource × 4

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created Jul 16 at 15:13

55,899 tags in total

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What is this thing? (Witt)

sentinel2 × 4

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Hypernym discovery:

Discovery of the more general concept in a is-a relationship

created Jul 17 at 5:54

created Jul 17 at 5:42

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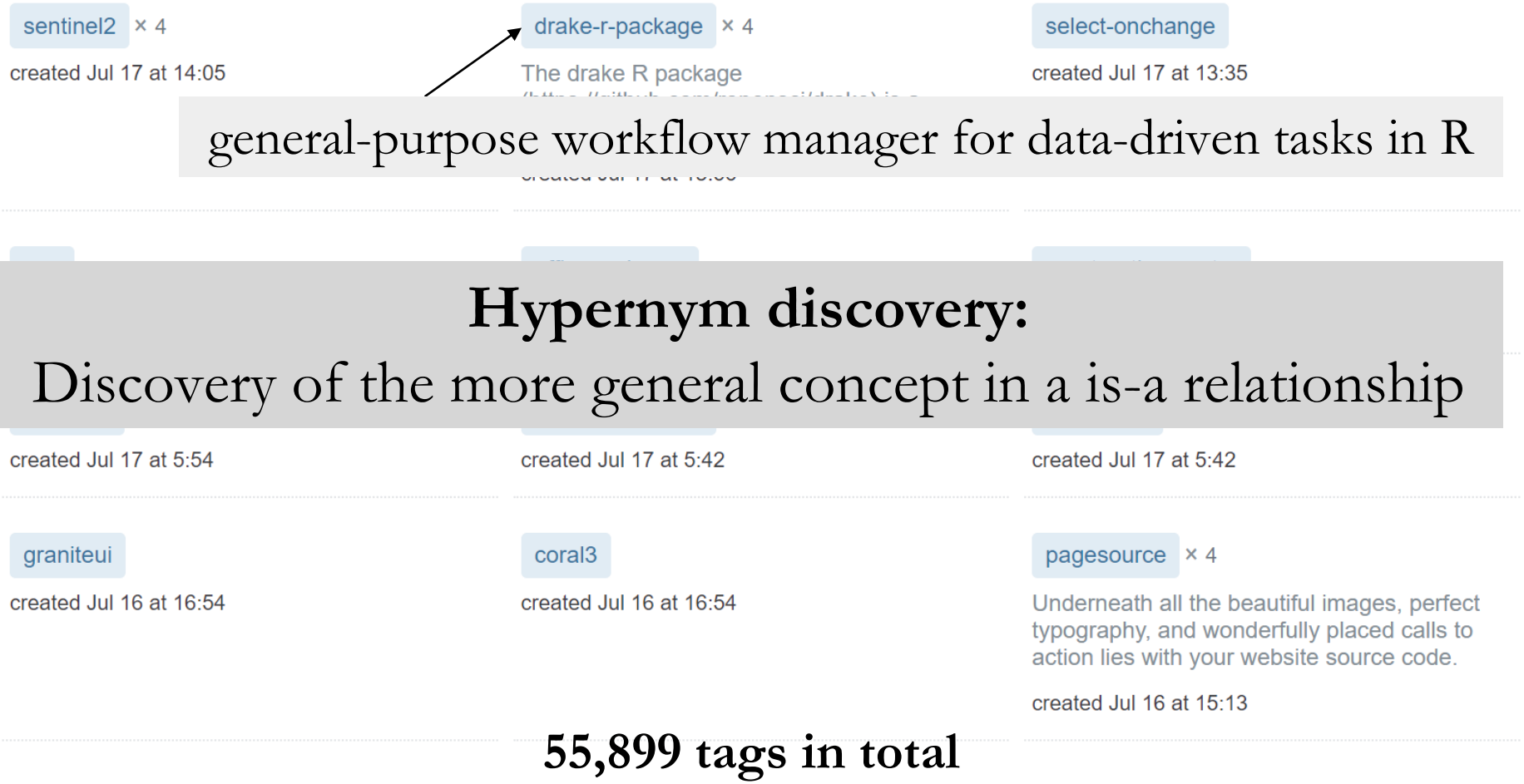

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Hypernyms

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Hypernyms

html	markup language
python	imperative and functional programming language
objective-c	general-purpose programming language
objective-c	object oriented programming language
ruby	general-purpose open-source dynamic object oriented reflective programming language
java	open-source, dynamic, reflective, object oriented, general-purpose programming language
java	class-based, object oriented, strongly typed, reflective language and run-time environment
silverlight	run time environment and multimedia framework
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stackoverflow

WIKIPEDIA
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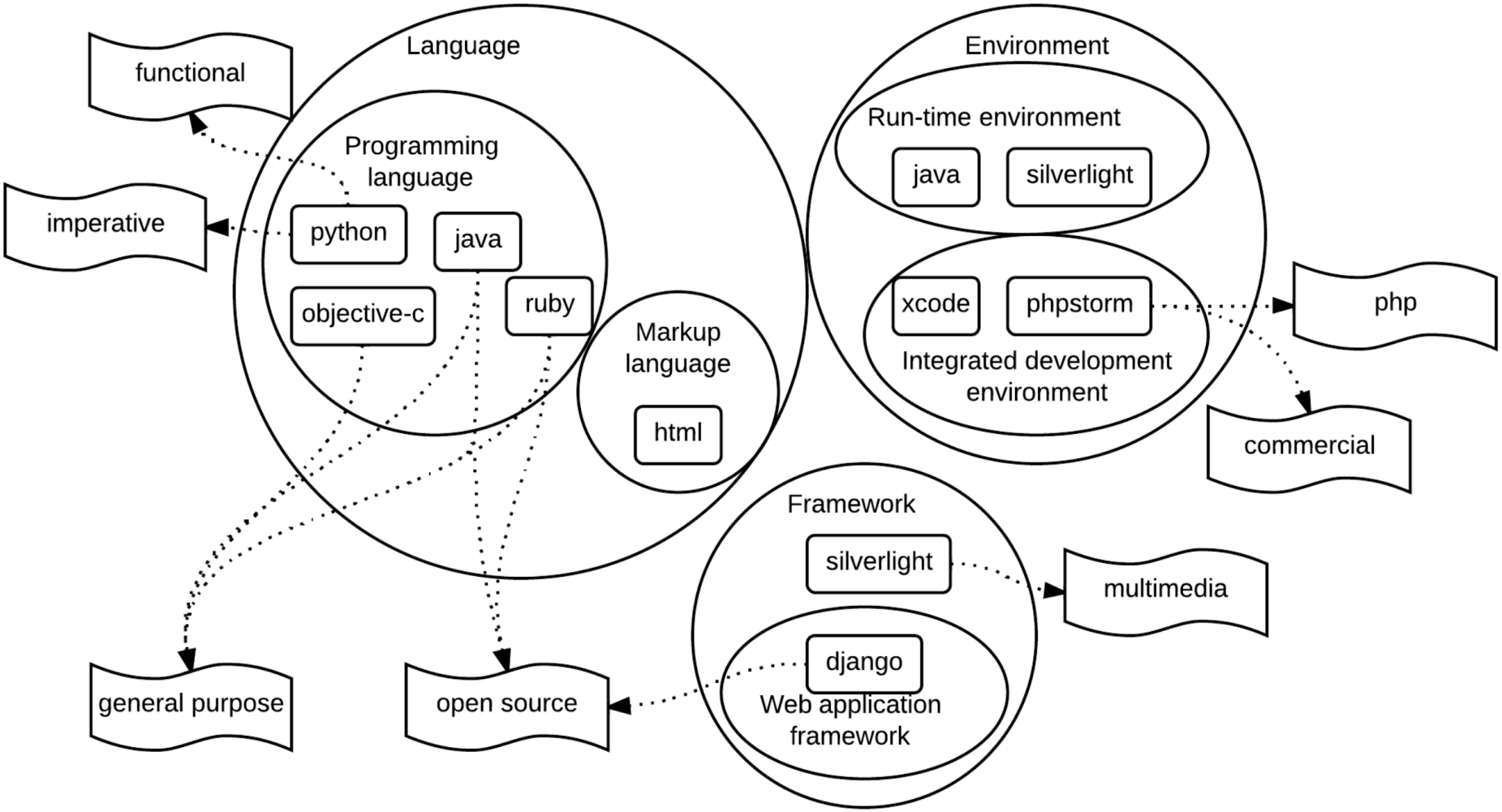
Attributes and Categories



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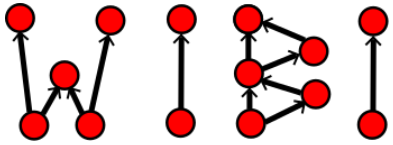
Evaluation

Witt

WordNet
A Lexical Database for English



WebIsA Database

Google

Targeted Hypernym Discovery

DBpedia Spotlight

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Evaluation

	A	B	C
1	**Tag**	**Hypernym**	**Correct hypernym in the sense of software technology: Y/N**
2	google-chrome-extension	Software add-ons	y
3	windows	gap	n
4	midori	stellar renowned artist	n
5	vector	virus	n
6	ruby-on-rails	open source full-stack web application framework	y
7	normalizing	harden	n
8	root-node	widely-used abstract data-type data-structure	n
9	windows-phone-7	Cloud clients	n
10	bloodhound	large tracker dog	n
11	reporting-services	Goods	n
12	x12	major edus edus standard	n
13	i18n-gem	Britpop musicians	n
14	ancestor	Morehead City, North Carolina	n
15	install-sequence	Installation software	n
16	array-initialize	Arrangement	n
17	camera	device	y
18	sqlx	great tool	n
19	orm	computer programming	n
20	reference	Reference	n
21	wordpress-plugin	framework	n
22	n2o	Industrial hygiene	n
23	pp	Pascal	n
24	bing	Artificial hills	n
25	syncdb	system	n
26	ora-20000	People from Pristina	n
27	active-directory	Organisation	n

Witt

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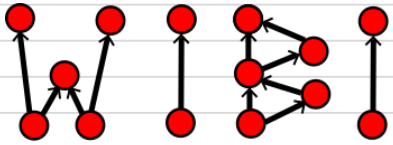

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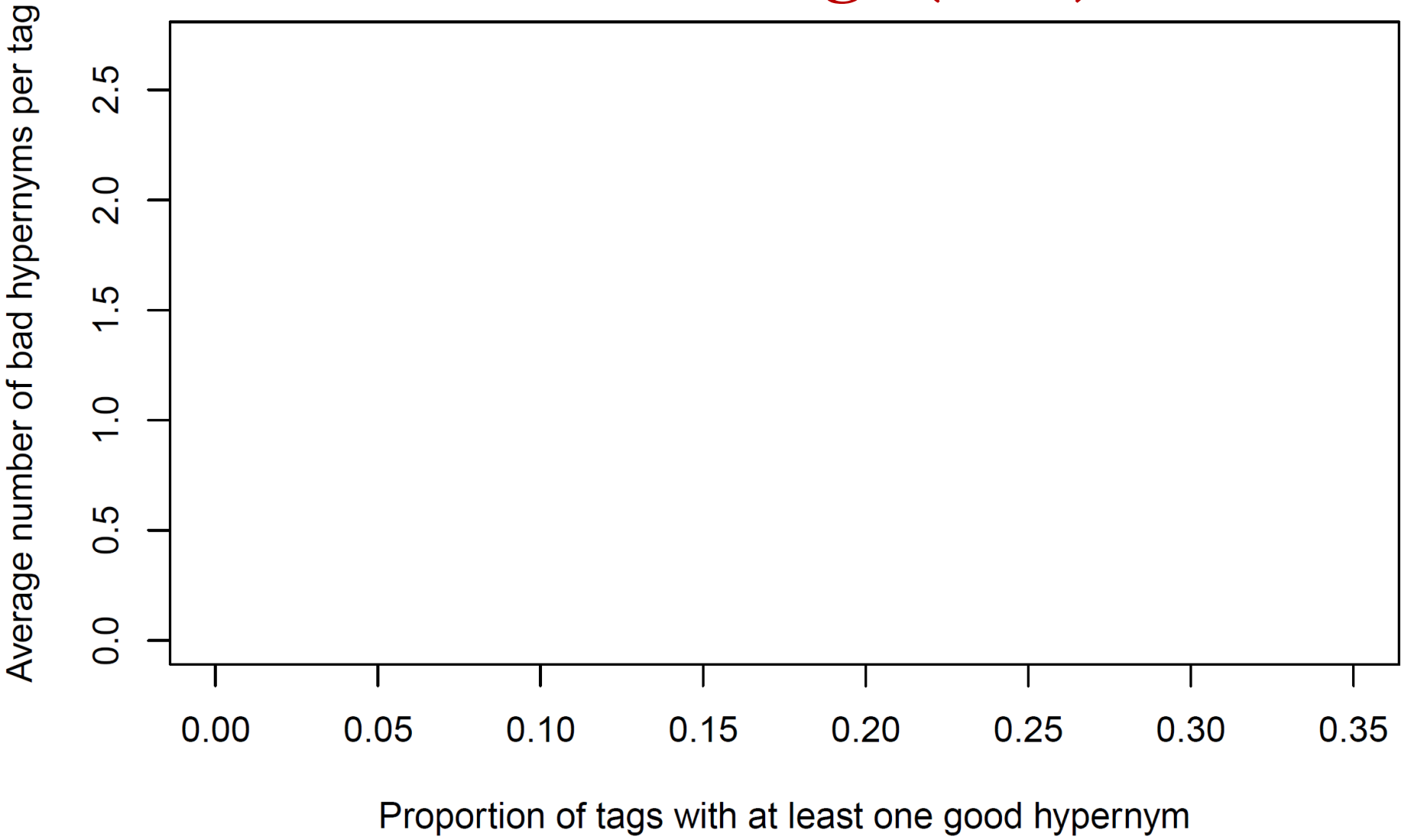

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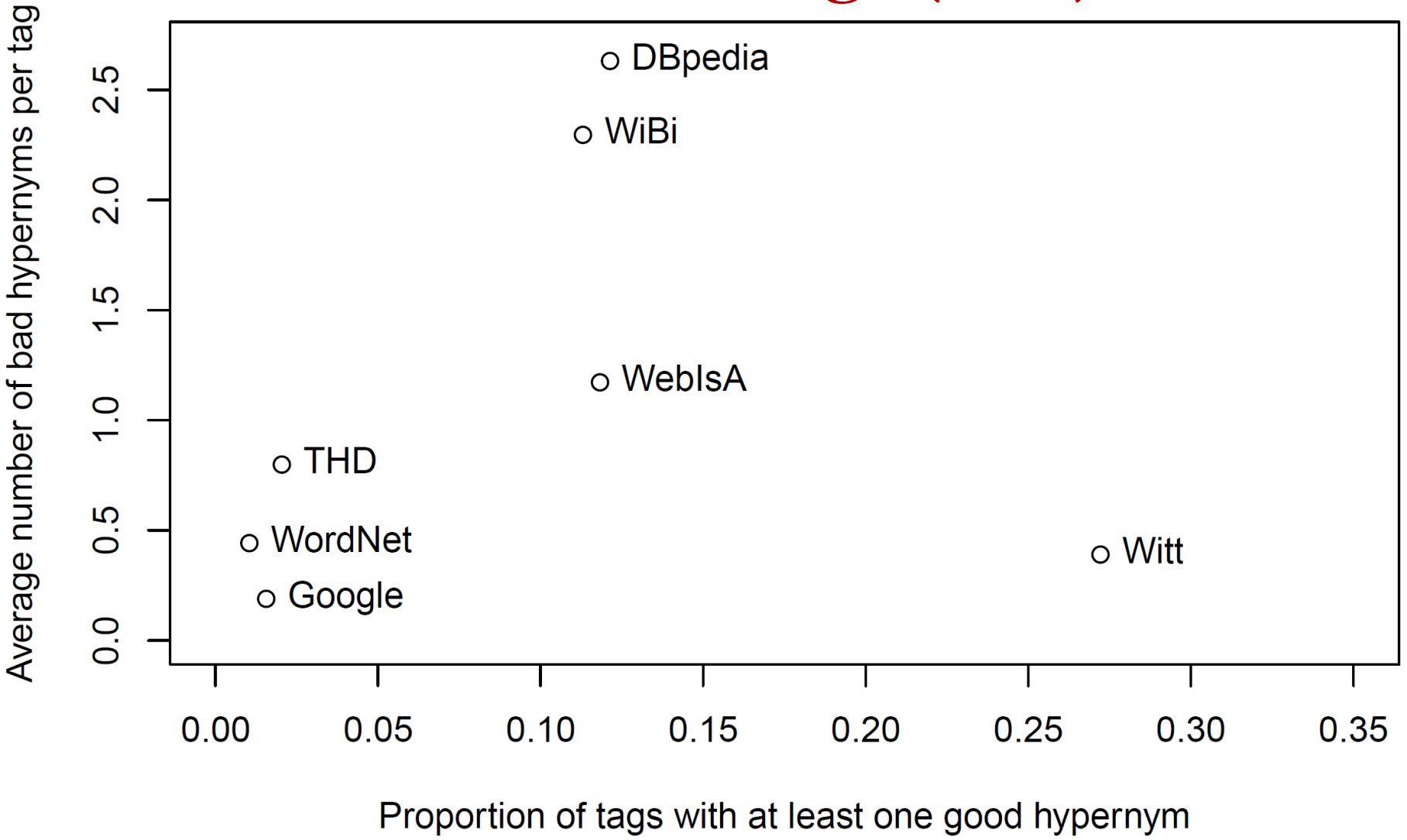

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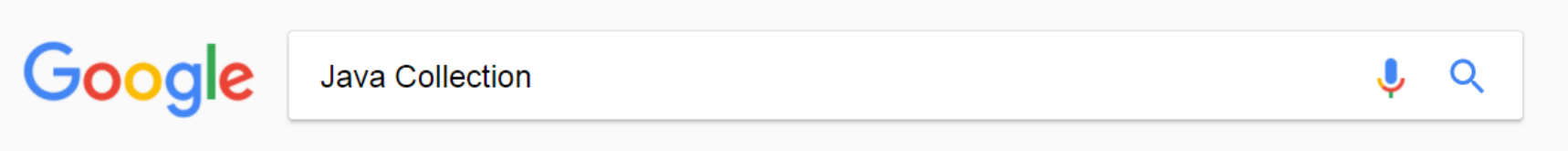
Software Documentation is everywhere



100%

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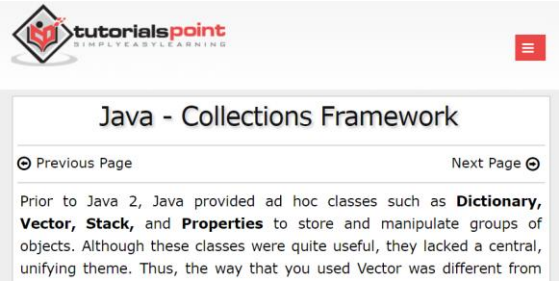

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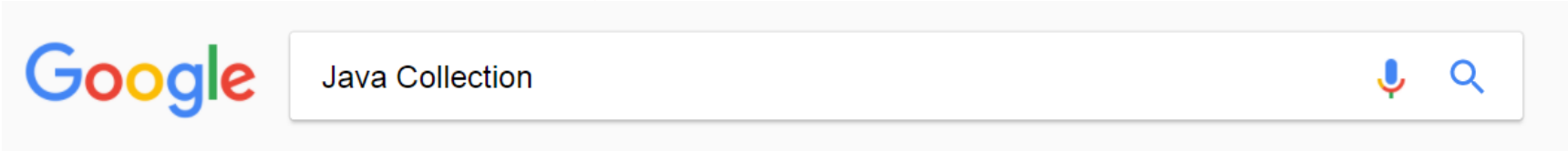
Challenges for Newcomers



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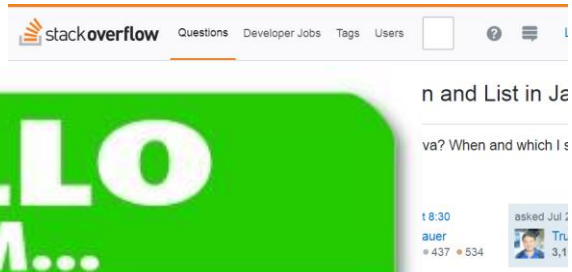

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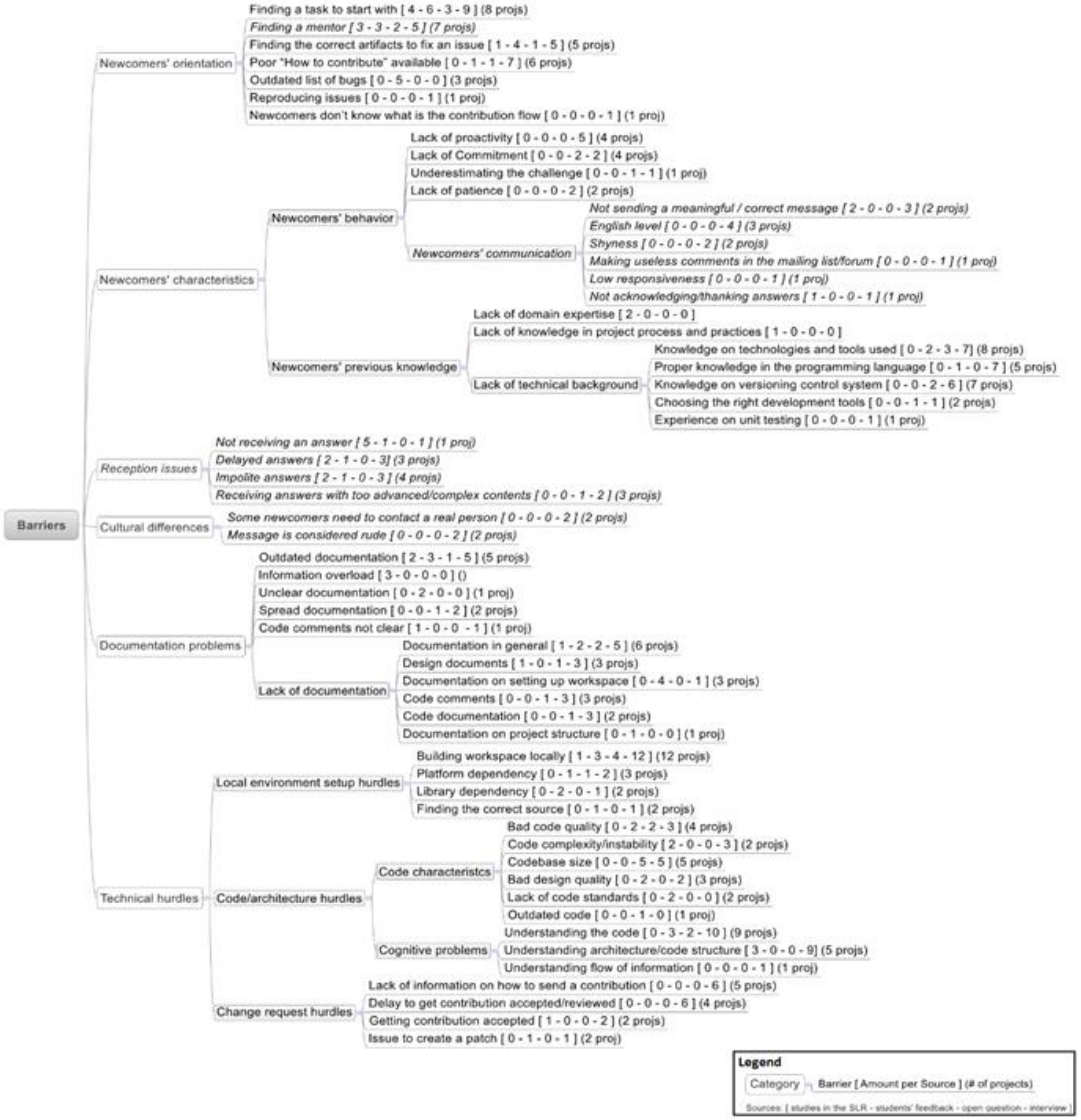
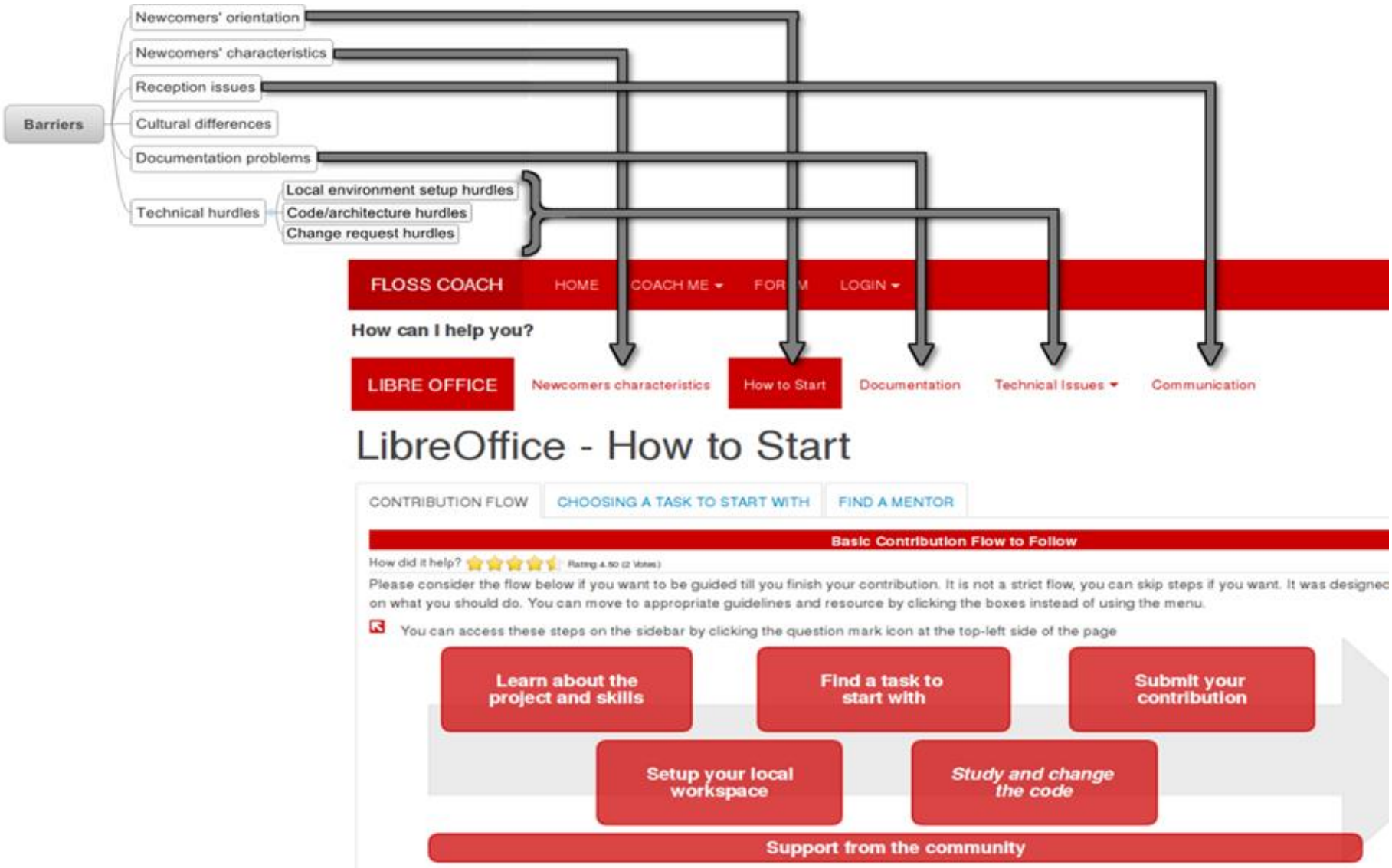
Barriers for Newcomers to OSS projects



I. Steinmacher, T. U. Conte, M. A. Gerosa, and D. Redmiles. Social barriers faced by newcomers placing their first contribution in open source software projects. CSCW '15: 18th Conf. on Comp. supported coop. work & social computing, p. 1379-1392

FLOSSCoach



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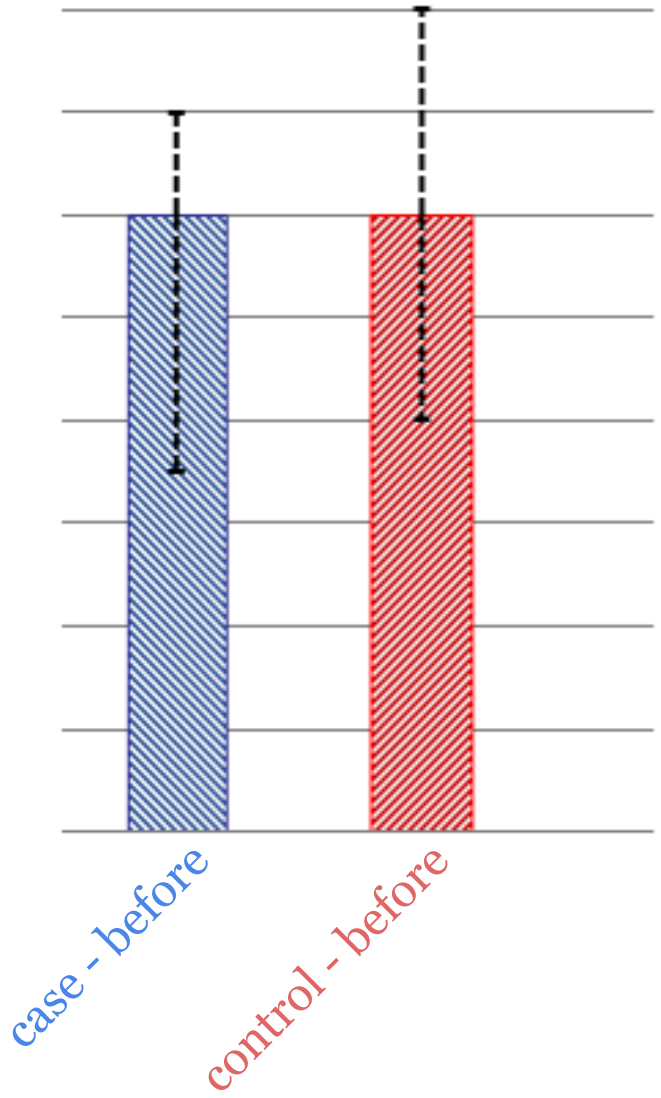
Self-efficacy:

"I feel comfortable with the process of contributing to an Open Source project"



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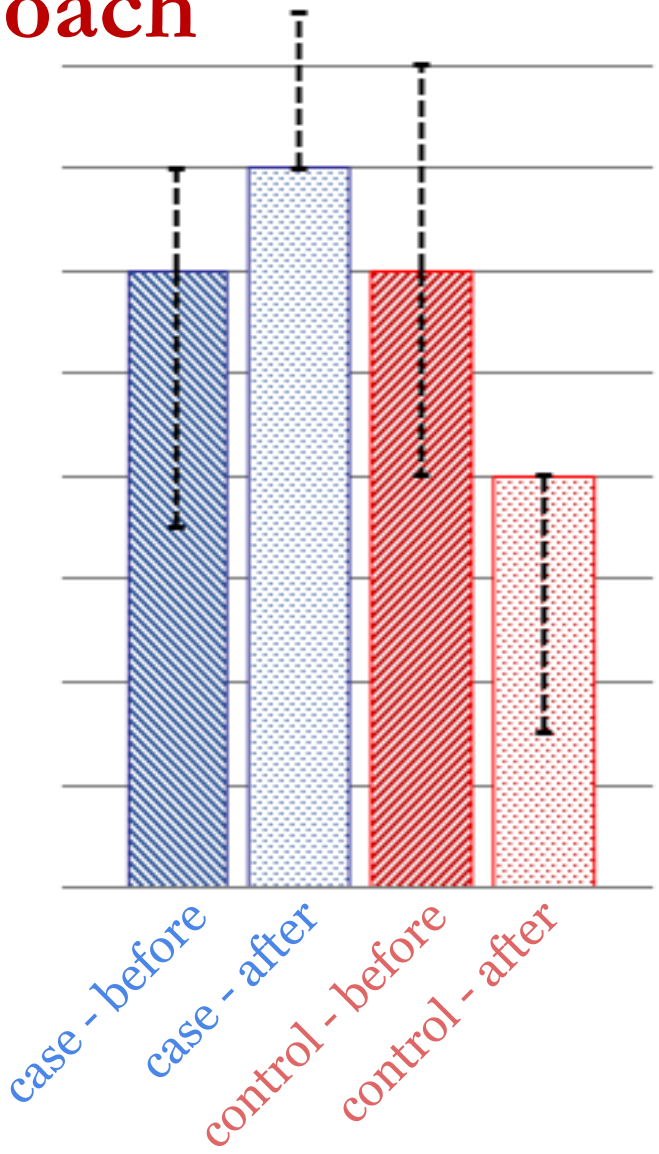

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Bimodal software documentation

Insert elements from one array to another array in Java

1

I'm trying to identify multiples of 3 from an input array and insert those multiples in to output array.Using a count variable I can declare the output array. But then how can I insert multiples in to output array?.

java arrays

share edit

asked Jun 15 at 15:56

Kaveen

10 • 4

add a comment

2 Answers

active oldest votes

0

```
public class MultipleOfThreeInAnArray {
    public static void choseMultiplesOfThree(int[] input) {
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Challenges in Analyzing Documentation

vs

F. N. A. Al Omran and C. Treude. Choosing an NLP Library for Analyzing Software Documentation: A Systematic Literature Review and a Series of Experiments. MSR '17: 14th Int'l. Conf. on Mining Software Repositories, p. 187-197

Comparing NLP libraries

CoreNLP

SyntaxNet

spaCy

NLTK

Only between 60% and 71% of tokens from Stack Overflow, GitHub, and the Java API Documentation were assigned the same part-of-speech tag by all four libraries.

1. different tokenization

2. general part of speech

3. specific part of speech

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Bimodal software documentation

1/3 of all posts edited

edit to code → edit to text

edited post → more comments

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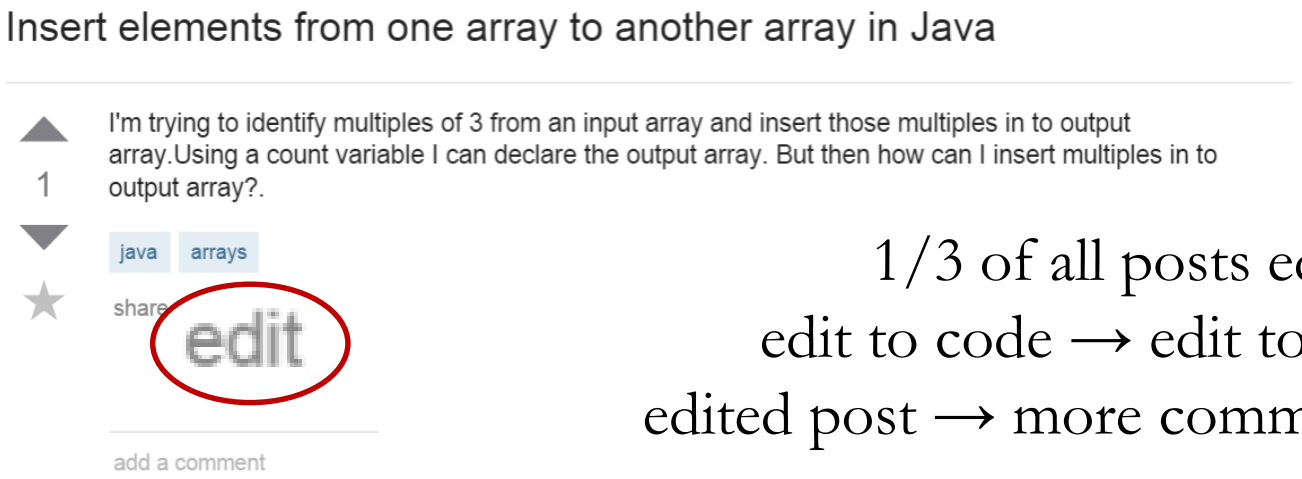

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MSR Challenge 2019: SOTorrent

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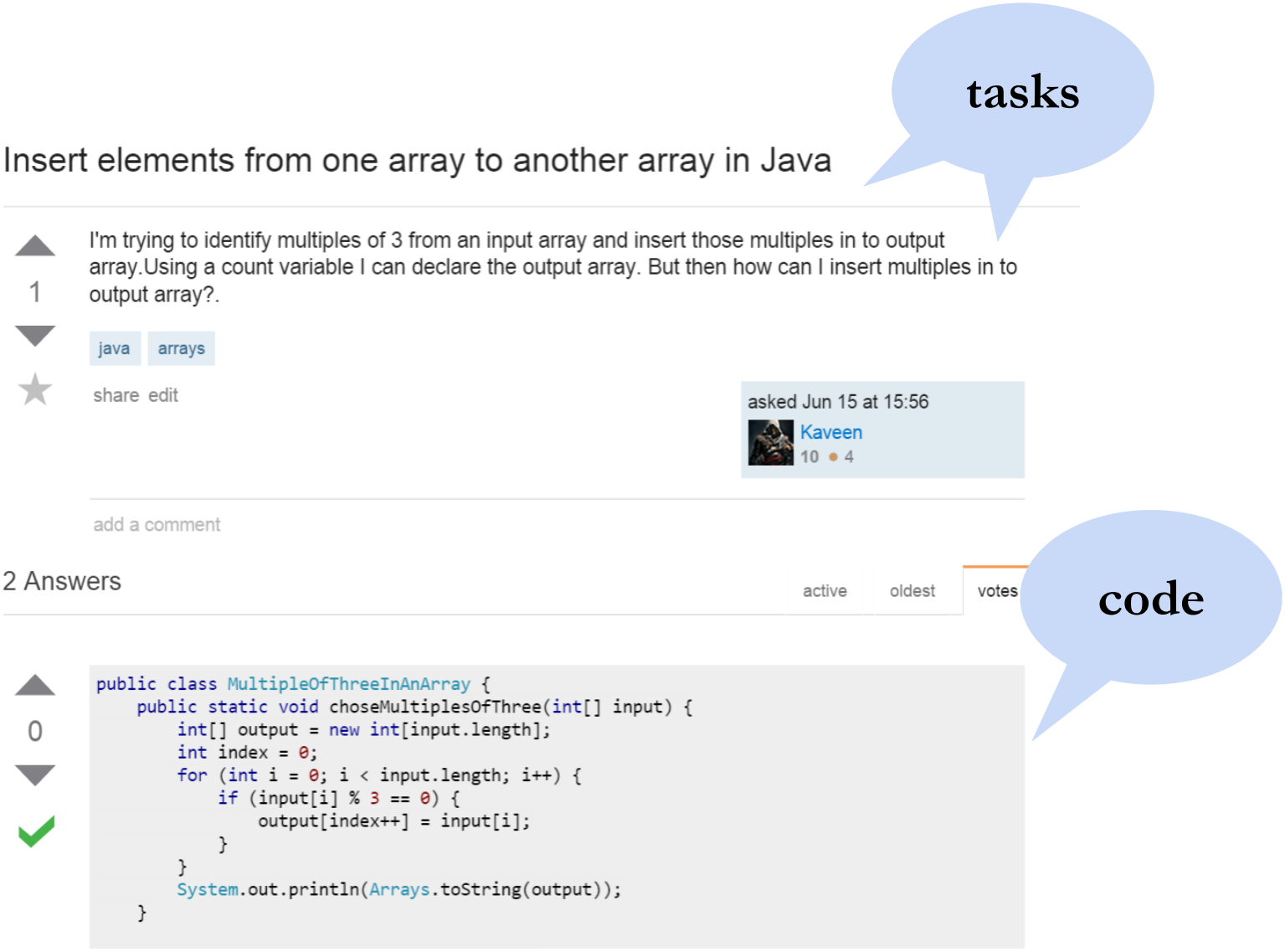

B. A. Campbell and C. Treude. NLP2Code: Code Snippet Content Assist via Natural Language Tasks. ICSME '17: 33rd Int'l. Conf. on Software Maintenance and Evolution, p. 628-632

Code Snippet Content Assist

tasks

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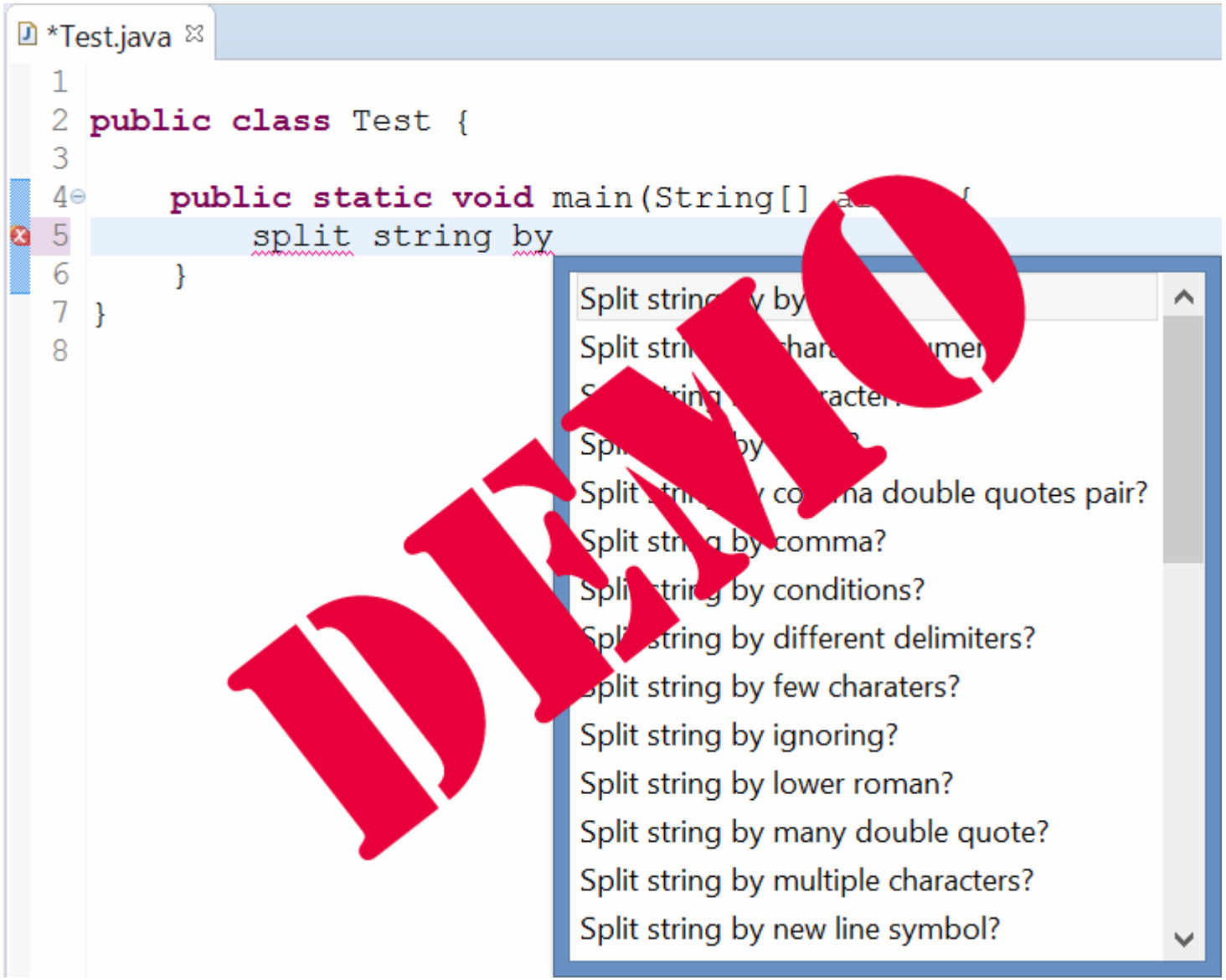
https://github.com/ctreude/nlp2code



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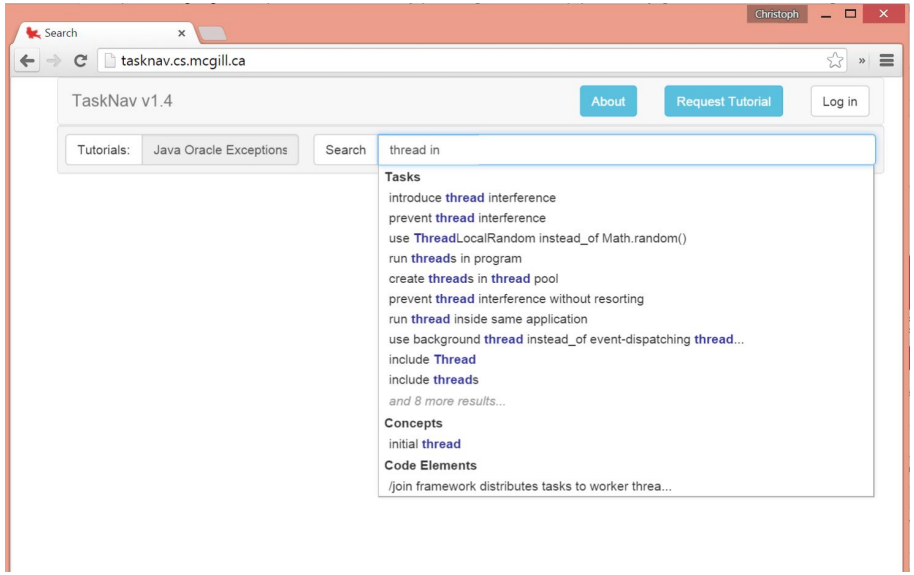

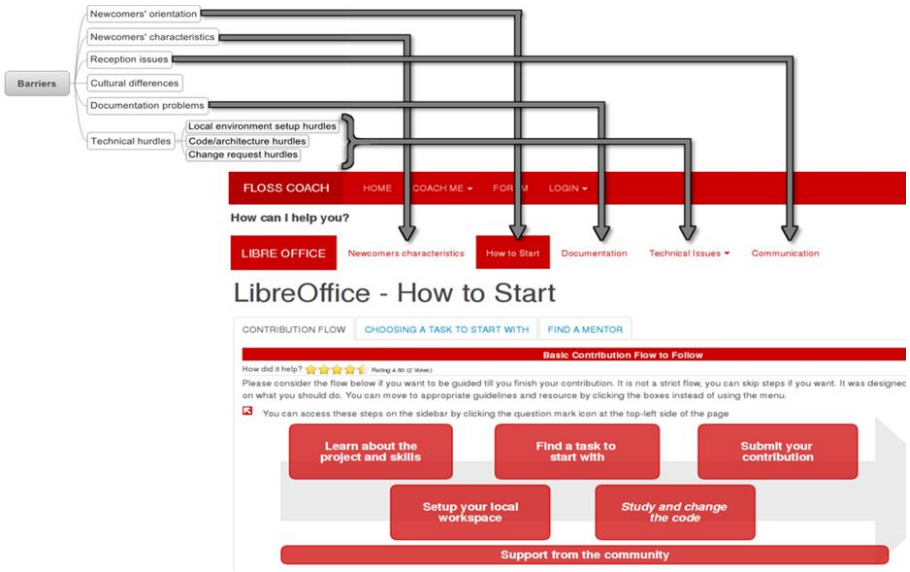

we're working on getting it to them where and when they need it.

Acknowledgements

Bart Dagenais,
Resulto,
Canada

Gregorio Robles,
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Spain

Martin Robillard,
McGill,
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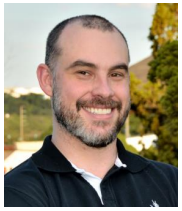

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McGill,
Canada

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            }
        }
        System.out.println(Arrays.toString(output));
    }
```
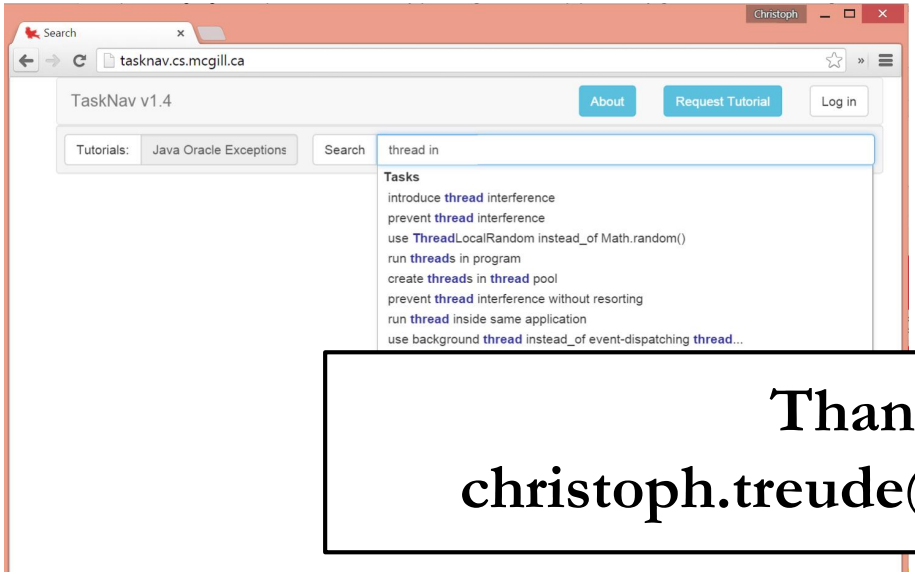
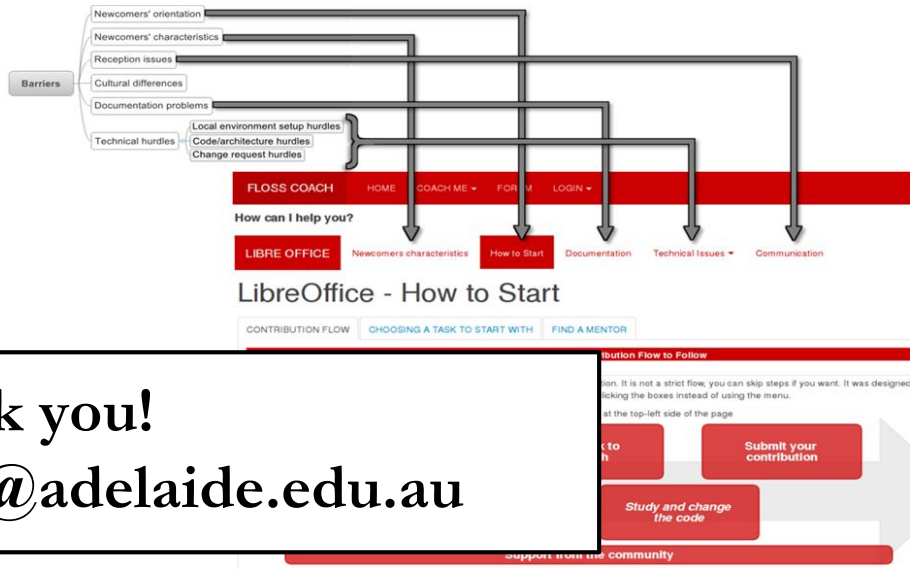

Most information needed by developers already exists somewhere,





Thank you!

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we're working on getting it to them where and when they need it.