
# “Mineração de repositórios do Github para construir Sistemas de Recomendação em Engenharia de Software”

Carlos Eduardo Dantas

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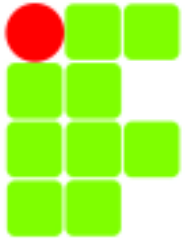
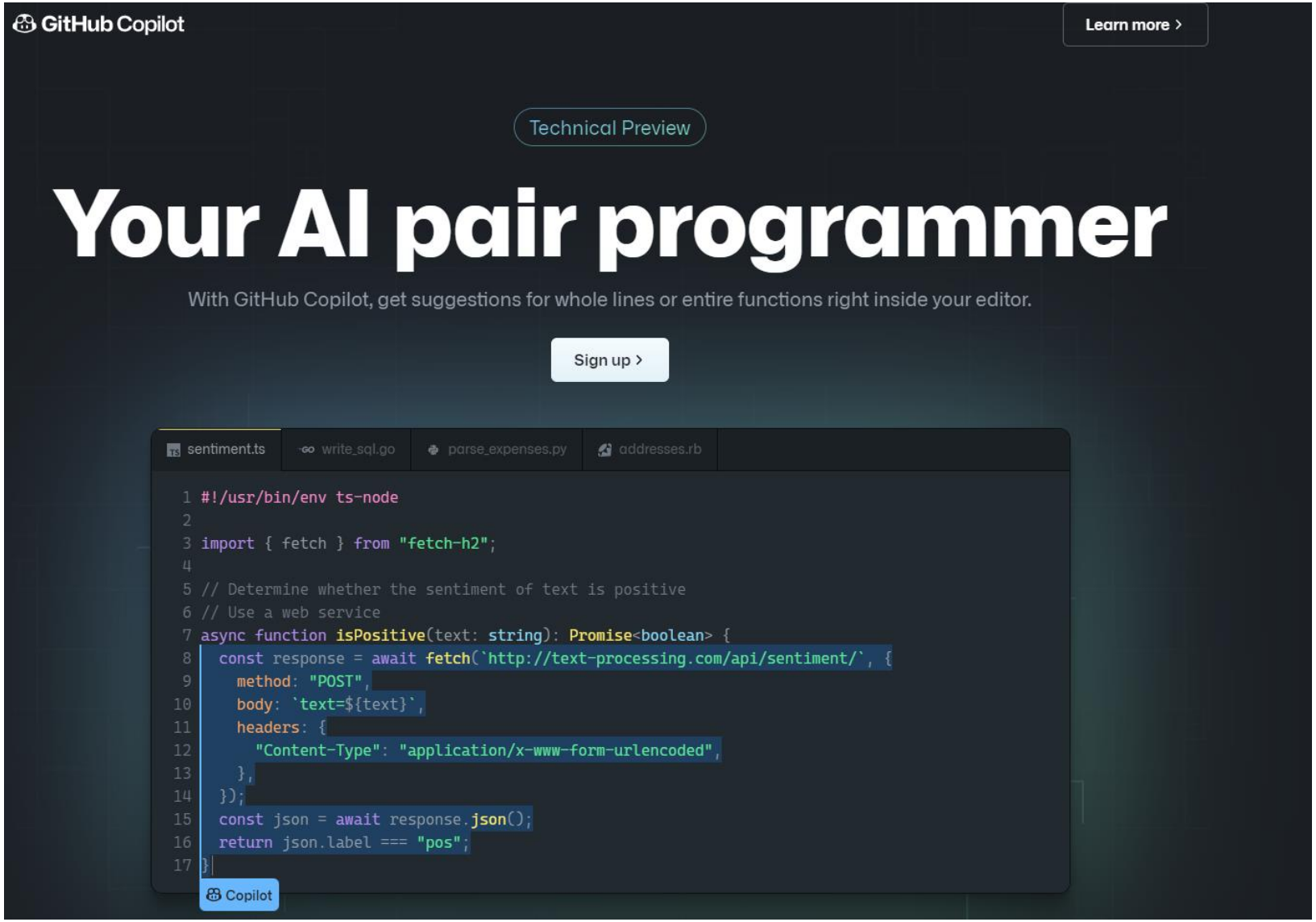
https://github.com/carloseduardoxp/Enacomp2021

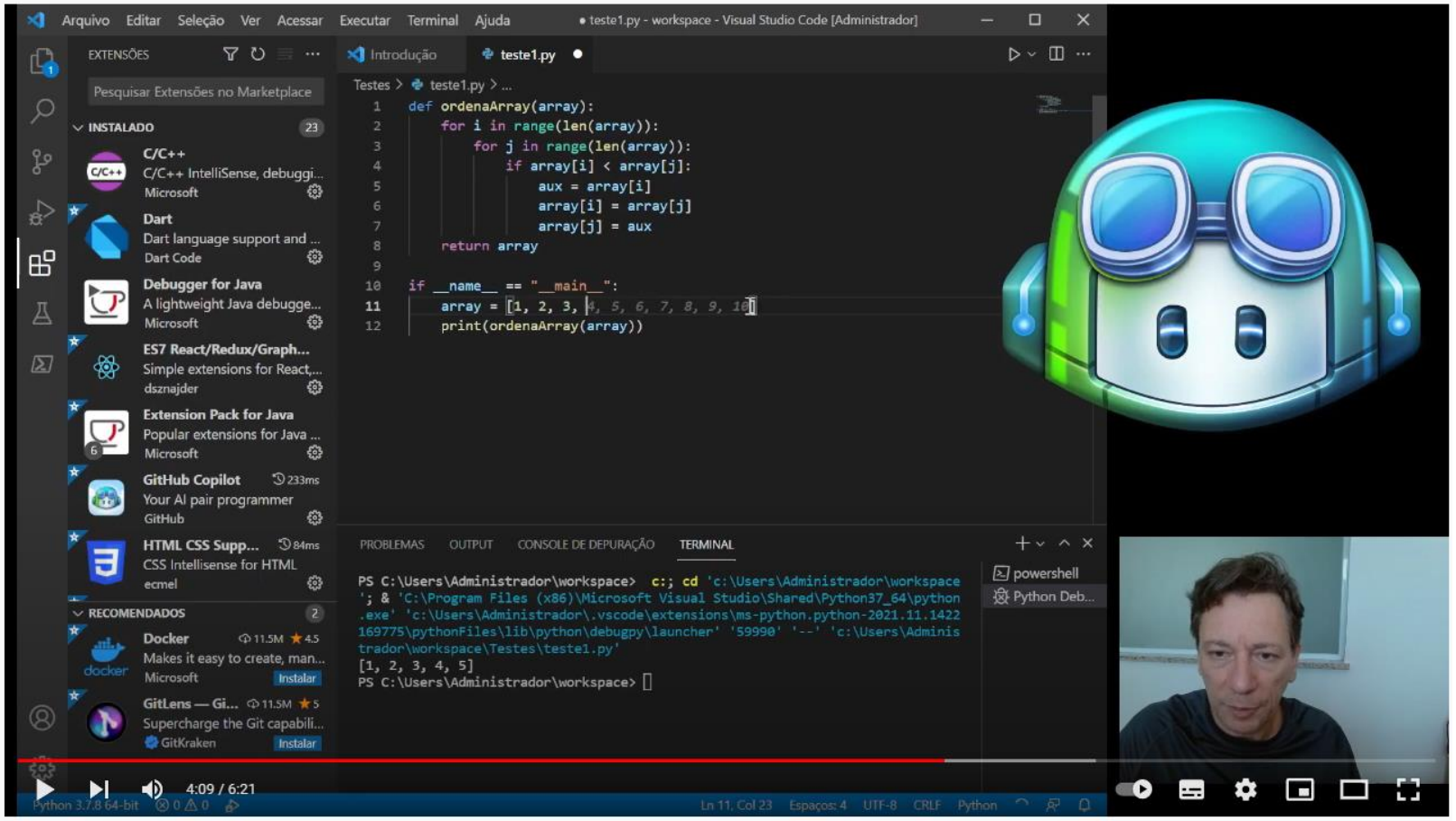


INSTITUTO FEDERAL DE
EDUCAÇÃO, CIÊNCIA E TECNOLOGIA
TRIÂNGULO MINEIRO
Campus Uberlândia Centro

# MOTIVAÇÃO


GitHub Copilot
Learn more >
Technical Preview
Your AI pair programmer
With GitHub Copilot, get suggestions for whole lines or entire functions right inside your editor.
Sign up >
sentiment.ts
write_sql.go
parse_expenses.py
addresses.rb
#!/usr/bin/env ts-node
import { fetch } from "fetch-h2";
// Determine whether the sentiment of text is positive
// Use a web service
async function isPositive(text: string): Promise<boolean> {
const response = await fetch(`http://text-processing.com/api/sentiment/`, {
method: "POST",
body: `text=${text}`,
headers: {
"Content-Type": "application/x-www-form-urlencoded",
},
});
const json = await response.json();
return json.label === "pos";
}
Copilot

# MOTIVAÇÃO




O poder de geração do GitHub Copilot.

174 visualizações • Estreou em 11 de nov. de 2021

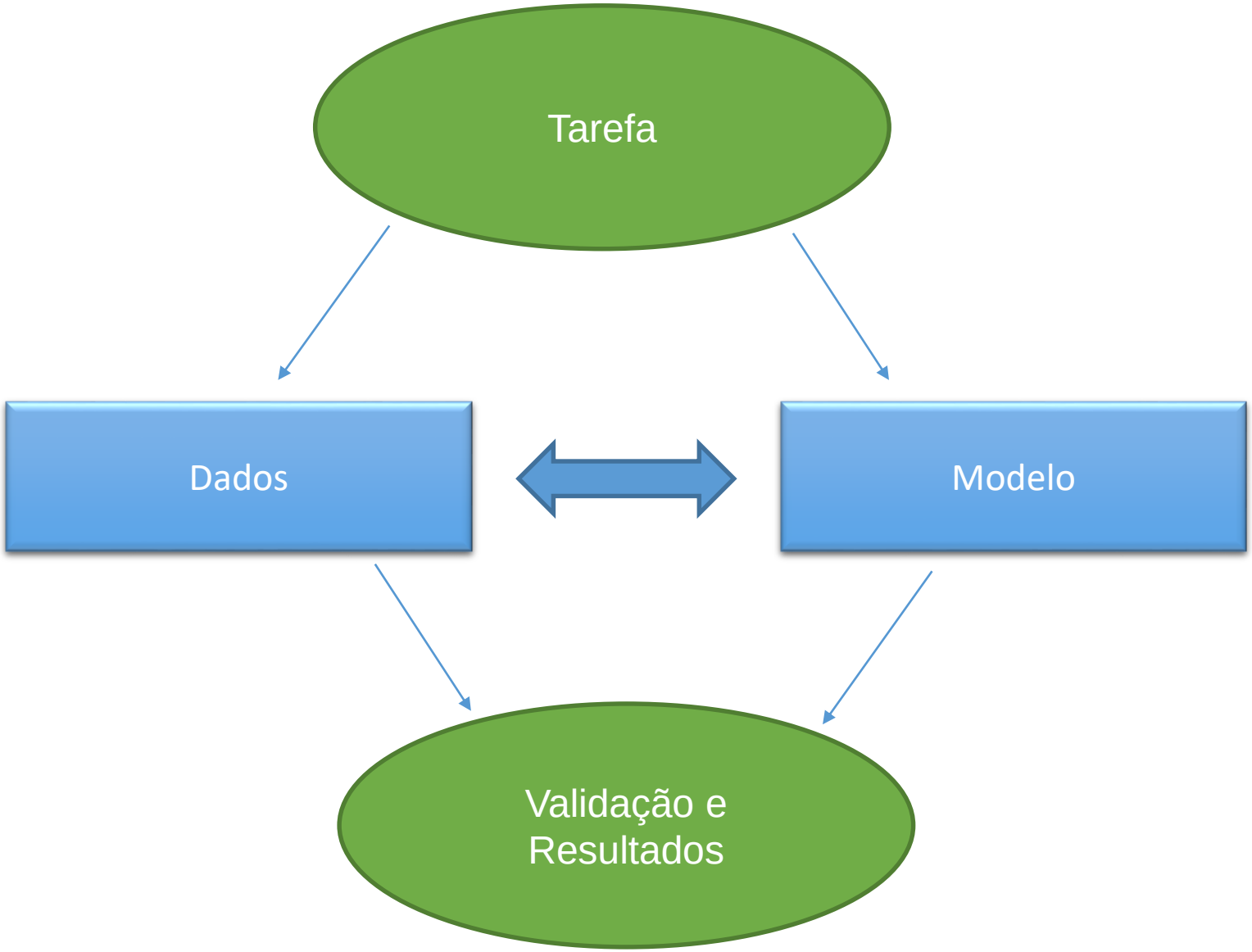
23 NÃO GOSTEI COMPARTILHAR SALVAR ...

Marcelo Maia
33 inscritos

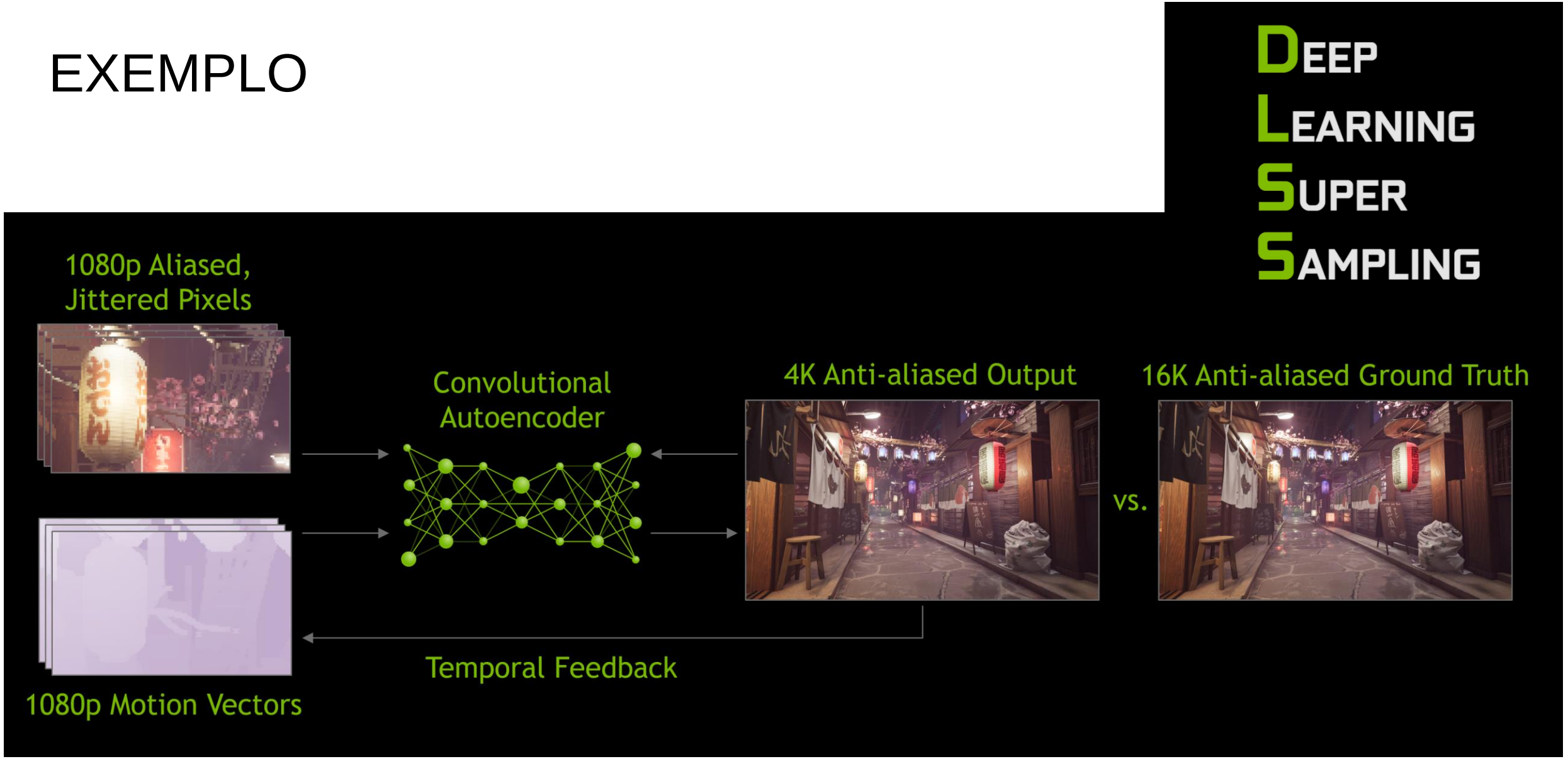
INSCRITO

https://youtu.be/a5ViPnDKfNg

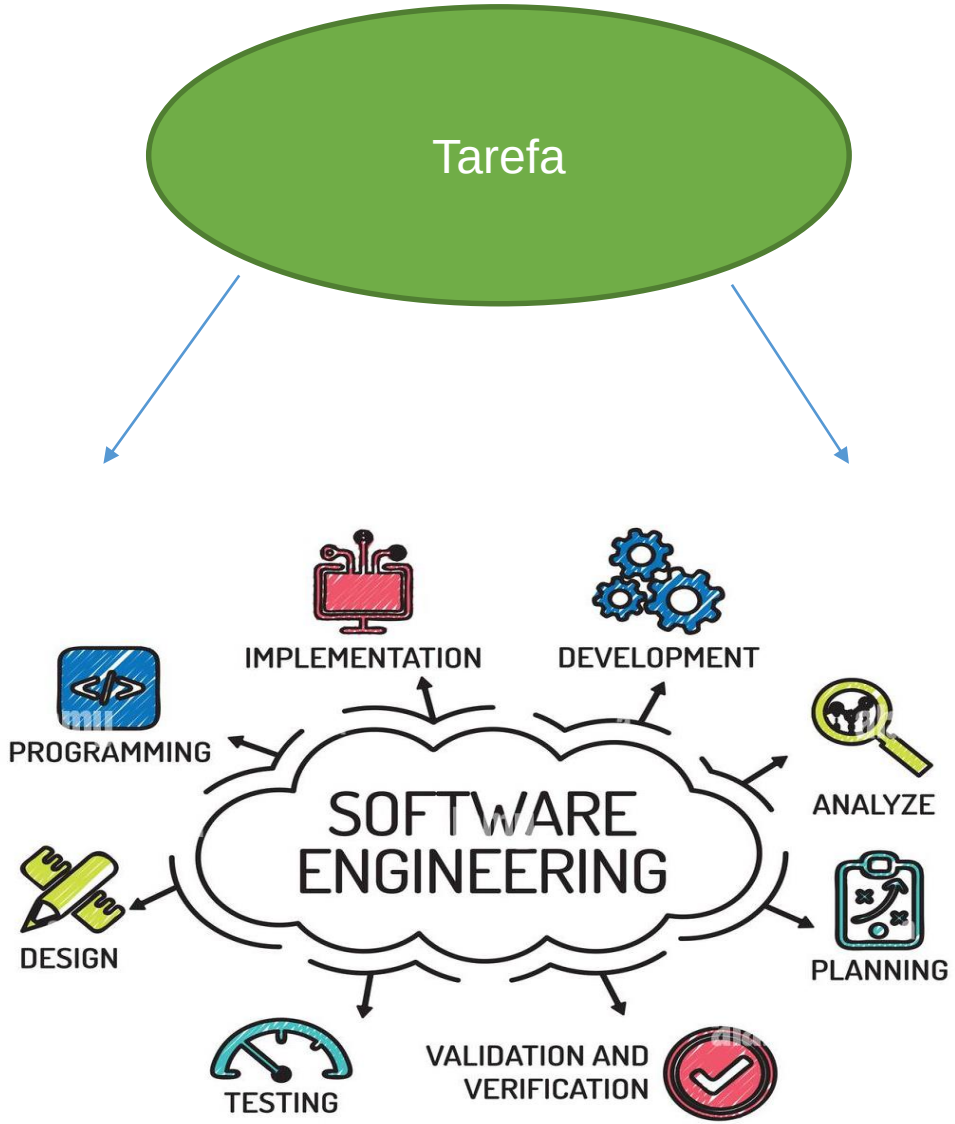
# DESIGN



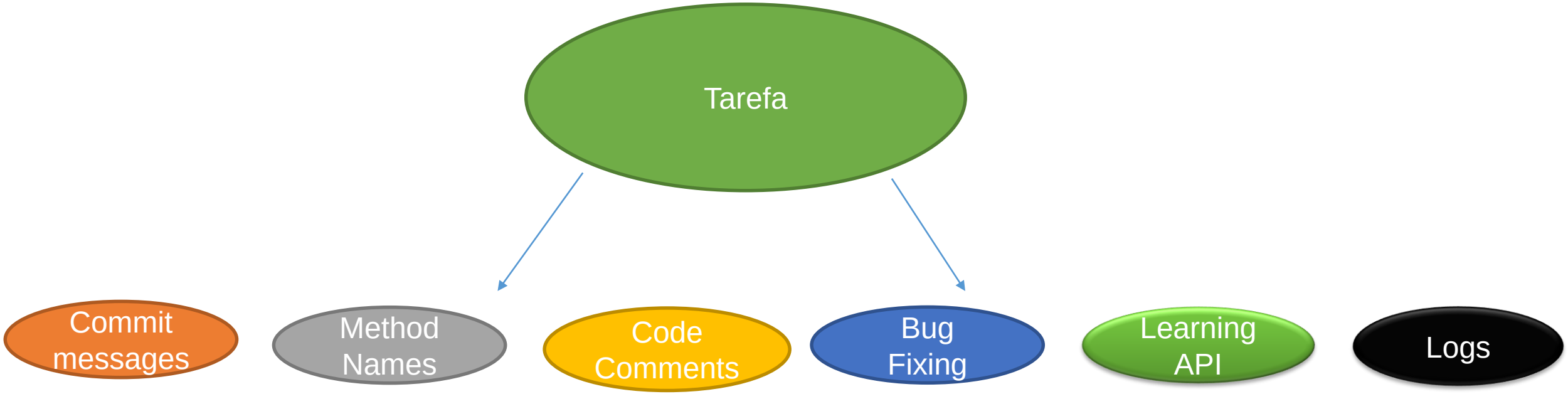
# EXEMPLO


DEEP LEARNING SUPER SAMPLING
1080p Aliased, Jittered Pixels
Convolutional Autoencoder
4K Anti-aliased Output
16K Anti-aliased Ground Truth
vs.
Temporal Feedback
1080p Motion Vectors

# TAREFA

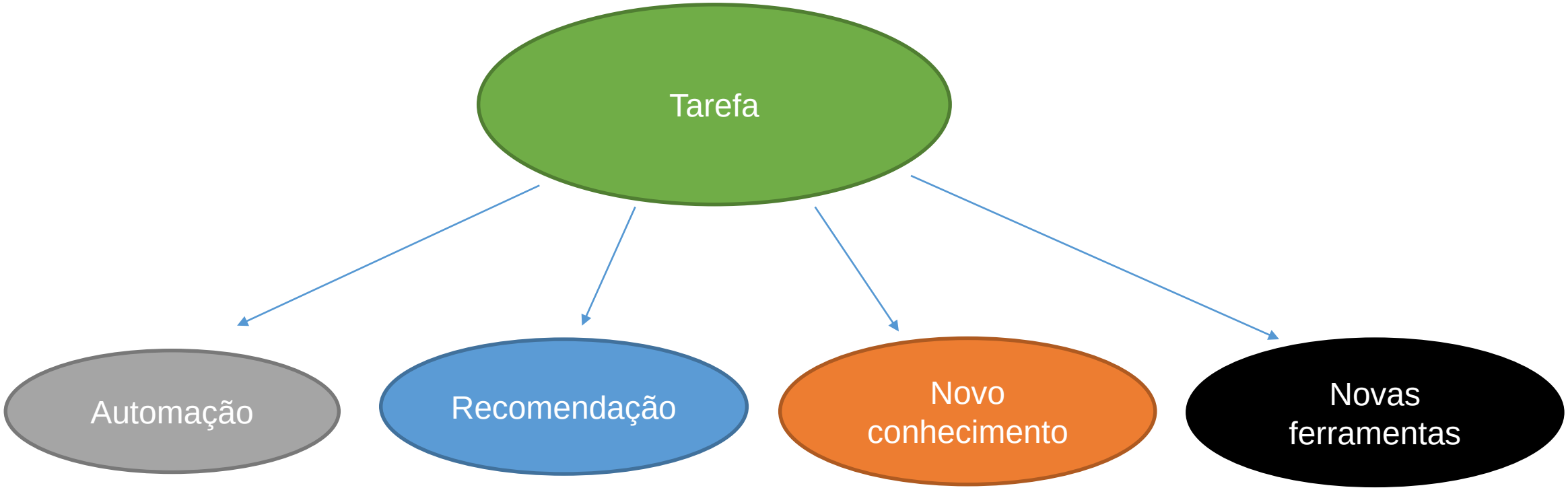

Tarefa
IMPLEMENTATION
DEVELOPMENT
PROGRAMMING
ANALYZE
SOFTWARE ENGINEERING
DESIGN
PLANNING
TESTING
VALIDATION AND VERIFICATION

# TAREFA




AND MANY OTHERS

# TAREFA


Tarefa
Automação
Recomendação
Novo conhecimento
Novas ferramentas

# TAREFA

Recomendação

## Detecting Architecturally Relevant Classes Using Dynamic Analysis

Liliane do Nascimento Vale[1,2] and Marcelo de Almeida Maia[1]
[1]Faculty of Computing - Federal University of Uberlândia, Uberlândia – MG – Brazil
[2]Computer Science Department - Federal University of Goiás, Catalão – GO – Brazil
Email: liliane.ufg@gmail.com, marcelo.maia@ufu.br

## AutoComment: Mining Question and Answer Sites for Automatic Comment Generation

Edmund Wong, Jinqiu Yang, and Lin Tan
University of Waterloo, Waterloo, Ontario, Canada
{e32wong, j223yang, lintan}@uwaterloo.ca

## Suggesting Accurate Method and Class Names

Miltiadis Allamanis[†] Earl T. Barr[‡] Christian Bird[⋆] Charles Sutton[†]
[†]School of Informatics
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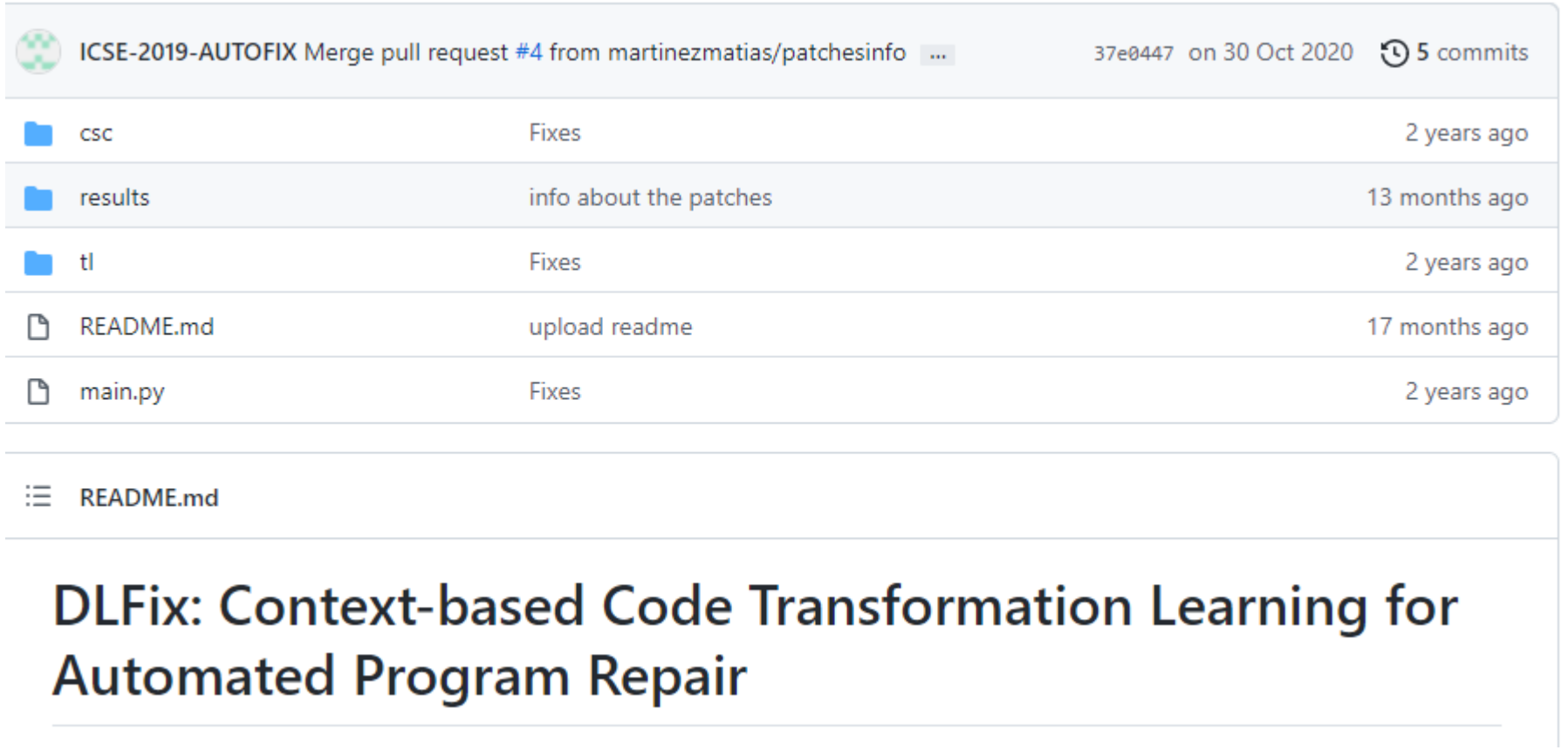
{m.allamanis, csutton}@ed.ac.uk
[‡]Dept. of Computer Science
University College London
London, UK
e.barr@ucl.ac.uk
[⋆]Microsoft Research
Microsoft
Redmond, WA, USA
cbird@microsoft.com

## Commit Message Generation for Source Code Changes

**Shengbin Xu**[1], **Yuan Yao**[1], **Feng Xu**[1], **Tianxiao Gu**[2], **Hanghang Tong**[3] and **Jian Lu**[1]
[1]State Key Laboratory for Novel Software Technology, Nanjing University, China
[2]Alibaba Group, USA
[3]Arizona State University, USA
kingxu@smail.nju.edu.cn, {y.yao, xf, lj}@nju.edu.cn, tianxiao.gu@gmail.com, hanghang.tong@asu.edu

# TAREFA

Automação



ICSE-2019-AUTOFIX Merge pull request #4 from martinezmatias/patchesinfo ... 37e0447 on 30 Oct 2020 5 commits

| | | |
|---|---|---|
| csc | Fixes | 2 years ago |
| results | info about the patches | 13 months ago |
| tl | Fixes | 2 years ago |
| README.md | upload readme | 17 months ago |
| main.py | Fixes | 2 years ago |

README.md

## DLFix: Context-based Code Transformation Learning for Automated Program Repair

# TAREFA

Novo conhecimento

## When and Why Your Code Starts to Smell Bad

Michele Tufano*, Fabio Palomba†, Gabriele Bavota‡, Rocco Oliveto§,
Massimiliano Di Penta¶, Andrea De Lucia†, Denys Poshyvanyk*
*The College of William and Mary, Williamsburg, VA, USA - †University of Salerno, Fisciano (SA), Italy
‡Free University of Bozen-Bolzano, Italy - §University of Molise, Pesche (IS), Italy
¶University of Sannio, Benevento, Italy

## Why We Refactor? Confessions of GitHub Contributors

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tsantalis@cse.concordia.ca

Marco Tulio Valente
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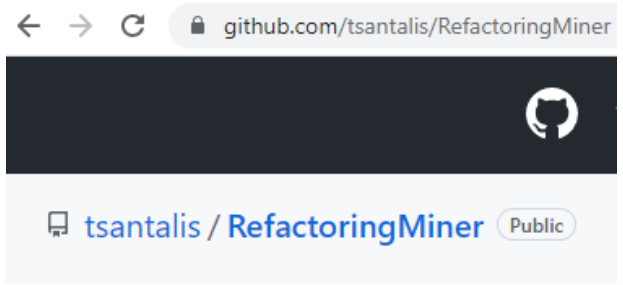
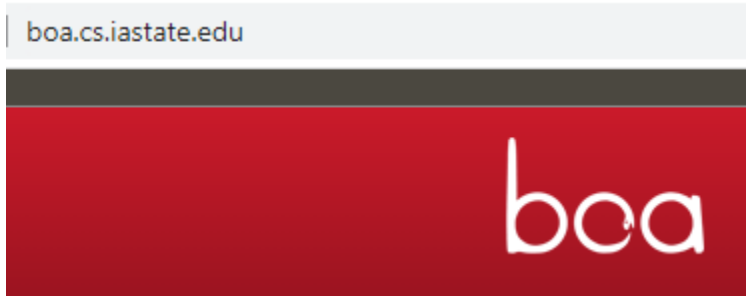
mtov@dcc.ufmg.br

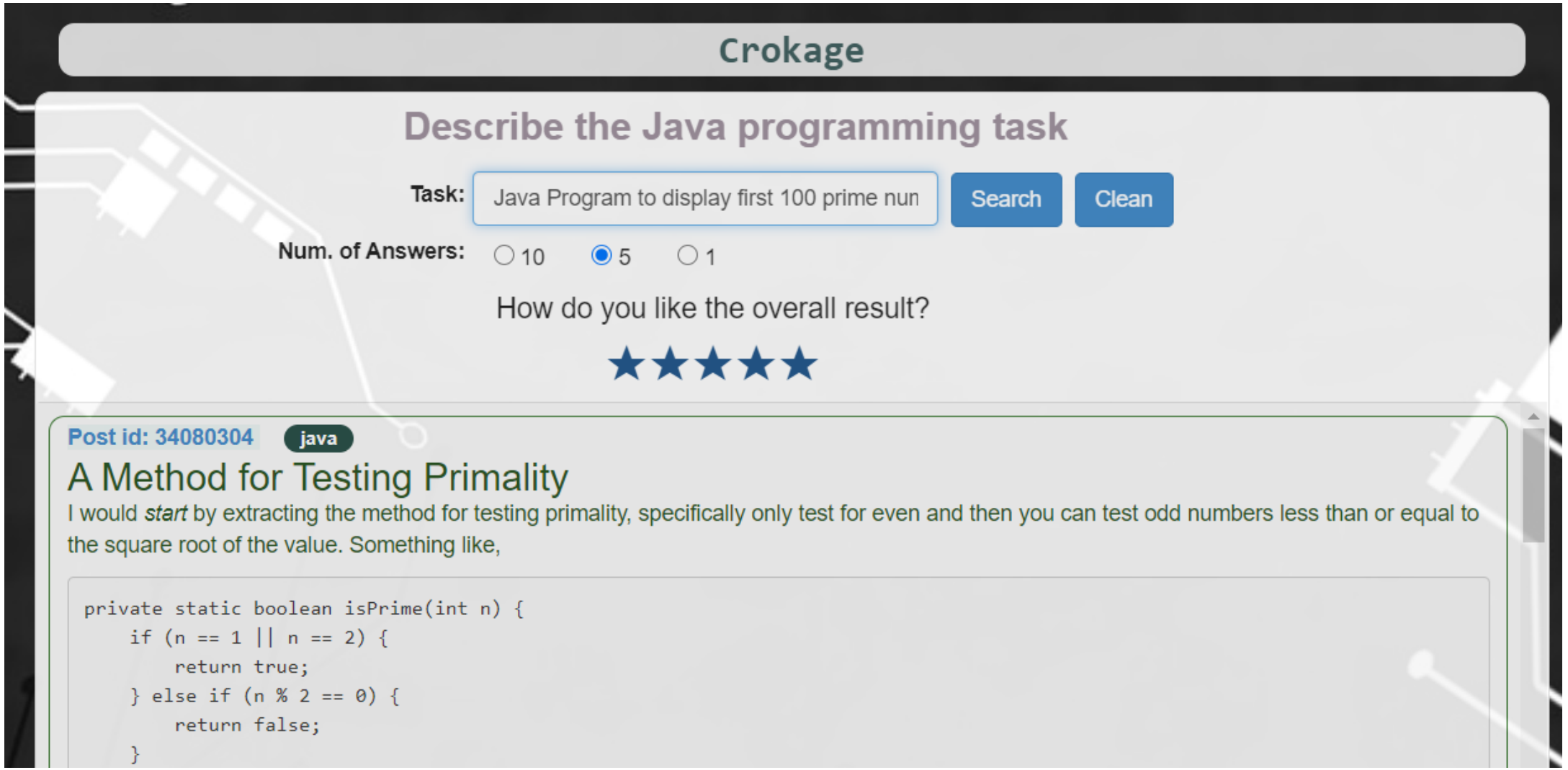
# TAREFA

Novas ferramentas



# TAREFA


Crokage
Describe the Java programming task
Task:
Java Program to display first 100 prime nun
Search
Clean
Num. of Answers:
10
5
1
How do you like the overall result?
Post id: 34080304
java
A Method for Testing Primality
I would start by extracting the method for testing primality, specifically only test for even and then you can test odd numbers less than or equal to the square root of the value. Something like,
private static boolean isPrime(int n) {
if (n == 1 || n == 2) {
return true;
} else if (n % 2 == 0) {
return false;
}

# TAREFA

Benjamin Popper · 3º

Director of Content at Stack Overflow

Brooklyn, Nova York, Estados Unidos · 346 conexões · Informações de contato

stackoverflow.blog/2019/08/14/crokage-a-new-way-to-search-stack-overflow/

THE OVERFLOW

Essays, opinions, and advice on the act of computer programming from Stack Overflow.

Latest Newsletter Podcast Company

code-for-a-living AUGUST 14, 2019

## CROKAGE: A New Way to Search Stack Overflow

One of the most powerful attributes of Stack Overflow (SO) is the accumulation of developers' knowledge over time. Community members have contributed more than 18 million questions and 27 million answers. When a developer is stuck on a coding problem, they search through this vast trove of information to see if a solution to their…

**Ben Popper**
Director of Content

# TAREFA

## APISonar: Mining API usage examples

**Andre Hora**

Department of Computer Science, Federal University of Minas Gerais, Belo Horizonte, Brazil

**Correspondence**
Andre Hora, Department of Computer Science, Federal University of Minas Gerais, Belo Horizonte, Brazil.
Email: andrehora@dcc.ufmg.br

**Abstract**

Developers spend a significant part of their time searching for code examples on the web. Often, they look for Application Programming Interface (API) usage examples, that is, how to use APIs provided by libraries and frameworks. For this purpose, several programming websites are available. Some programming websites provide manually created examples: unfortunately, as millions of APIs are available nowadays, they do not cover the majority of the APIs. To alleviate this limitation, other programming websites focus on automatically mining API usage examples from code repositories. To the best of our knowledge, however, these solutions are still very limited: they often present poor, duplicated, and similar API usage examples. In this article, we propose an approach, APISonar, to automatically mine API usage examples from code repositories. Our approach aims to overcome the limitations of current solutions: we focus on presenting readable and reusable API usage examples. We analyze millions of source files provided by 4486 software projects hosted on GitHub. Based on this data, we extract 11 million API usage examples about 1.5 million distinct APIs. We evaluate APISonar by assessing its quality and usage. We show that APISonar is a competitive solution, providing the best API examples in terms of readability and reusability, as compared with popular programming websites. Moreover, despite being a novel website, APISonar attracted a significant amount of users in a short period (3.7K users from 119 countries during 5 months). APISonar is available at www.apisonar.com.

apisonar.com

**API**Sonar

Search API examples

try: java, android, Log, math, json...

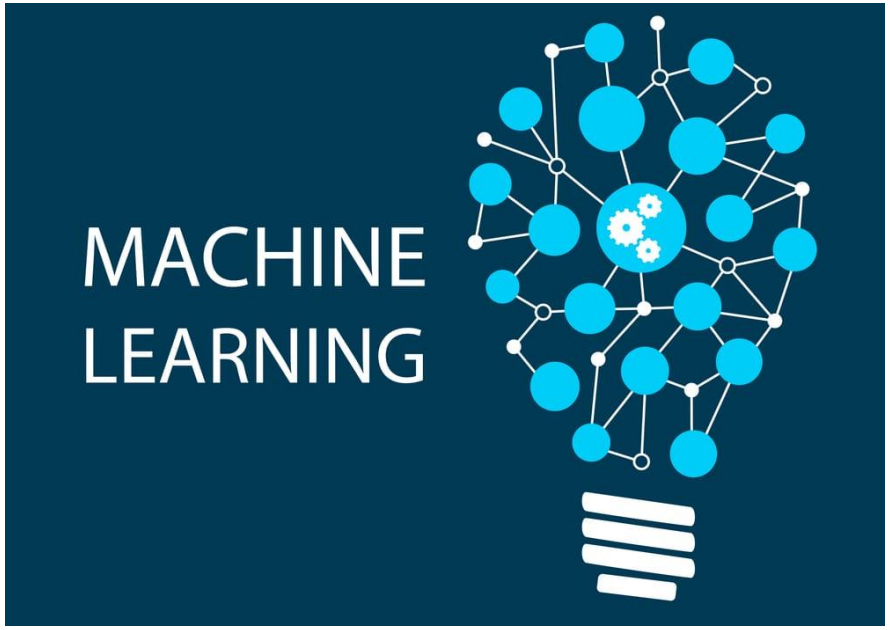
# TAREFA

# Learning to Spot and Refactor Inconsistent Method Names

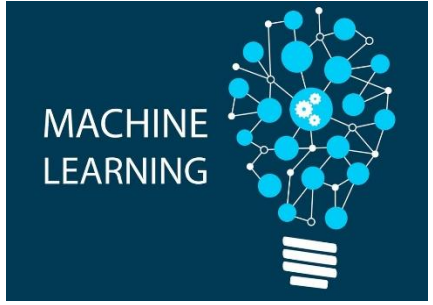
Kui Liu[†], Dongsun Kim[†], Tegawendé F. Bissyandé[†], Taeyoung Kim[‡], Kisub Kim[†], Anil Koyuncu[†], Suntae Kim[‡], Yves Le Traon[†]
[†]Interdisciplinary Centre for Security, Reliability and Trust (SnT), University of Luxembourg, Luxembourg
{kui.liu, dongsun.kim, tegawende.bissyande, kisub.kim, koyuncu.anil, yves.letraon}@uni.lu
[‡]Department of Software Engineering, Chonbuk National University, South Korea
{rlaxodud1200, jipsin08}@gmail.com

```
Commit 70106770ea61a5fe845653a0b793f4934cc00144
-public double inverseCummulativeProbability(final double p){
+public double inverseCumulativeProbability(final double p){
```

# MODELO

# MODELO




Architeture

Deep Belief Network

Number of encoders, decoders

Randon Forest

Tree-based

RNN

Seq2Seq

Paragraph Vector

CNN

Genetic Algorithms

LSTM

GRU

Attention/Copying Mechanism

Unsupervised

GRU

# MODELO

Learning to Spot and Refactor Inconsistent Method Names

Kui Liu†, Dongsun Kim†, Tegawendé F. Bissyandé†, Taeyoung Kim‡, Kisub Kim†, Anil Koyuncu†, Suntae Kim‡, Yves Le Traon†
†Interdisciplinary Centre for Security, Reliability and Trust (SnT), University of Luxembourg, Luxembourg
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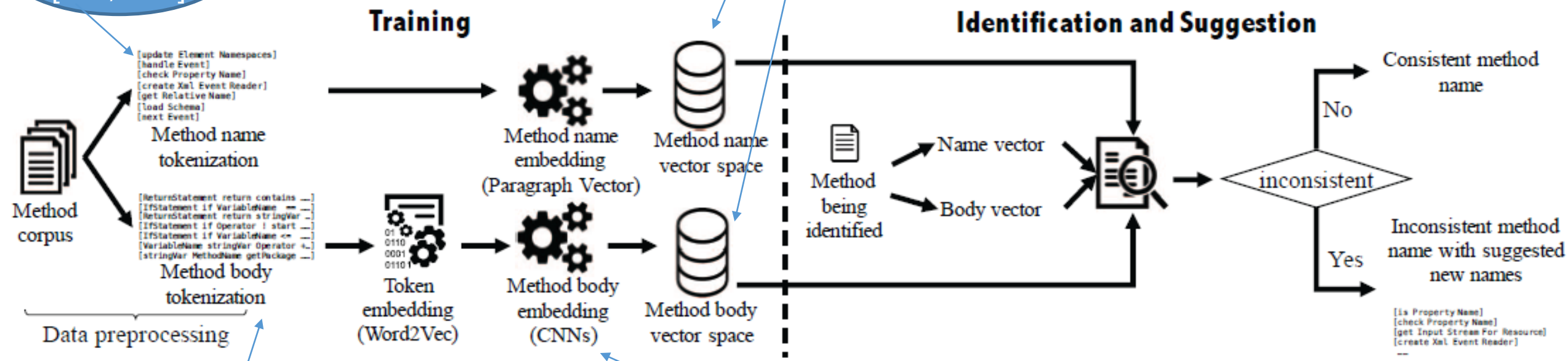
‡Department of Software Engineering, Chonbuk National University, South Korea
{rlaxodud1200, jipsin08}@gmail.com

findField
find_field
[find, field]

Place similar method names and bodies into adjacent locations

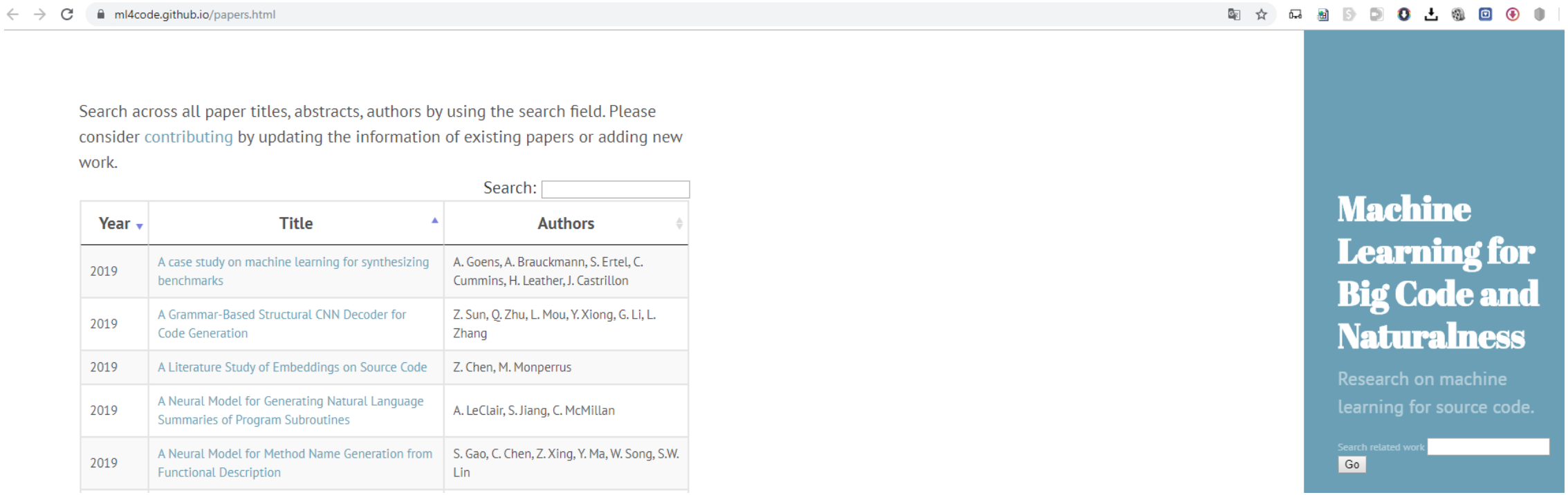



int a;
[PrimitiveType, int,Variable,a]

Unserpevised learning

# MODELO

## Papers from https://ml4code.github.io/papers.html



# MODELO

## Readability and Understandability of Snippets Recommended by General-purpose Web Search Engines: a Comparative Study

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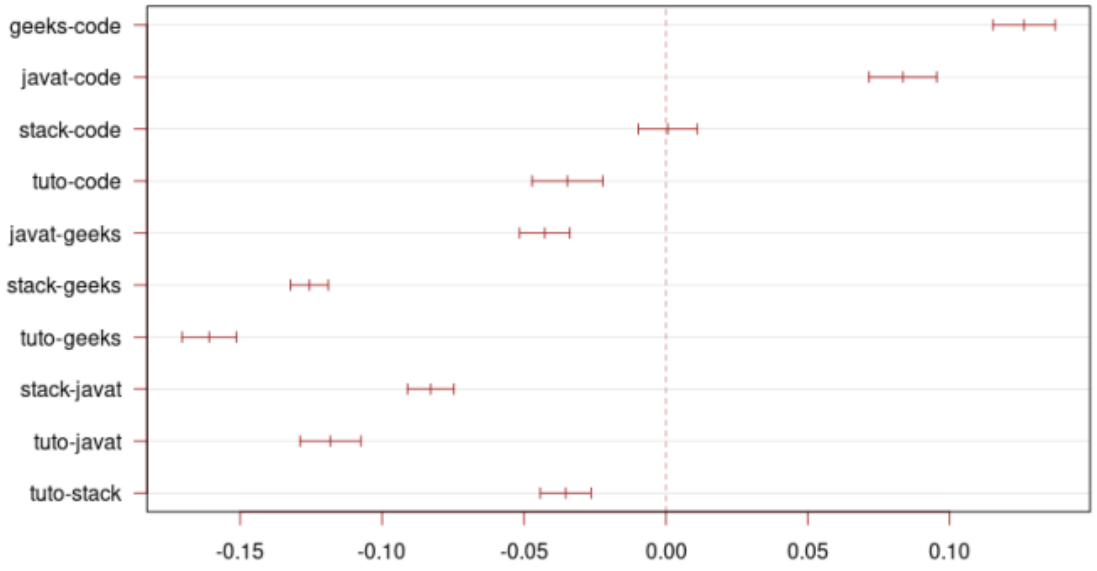
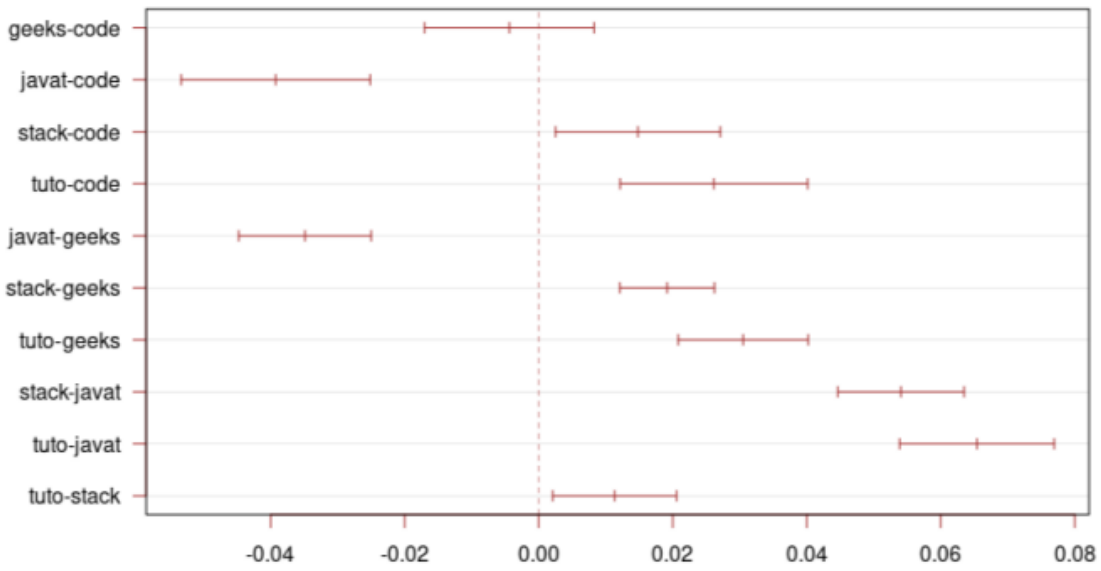
Brazil

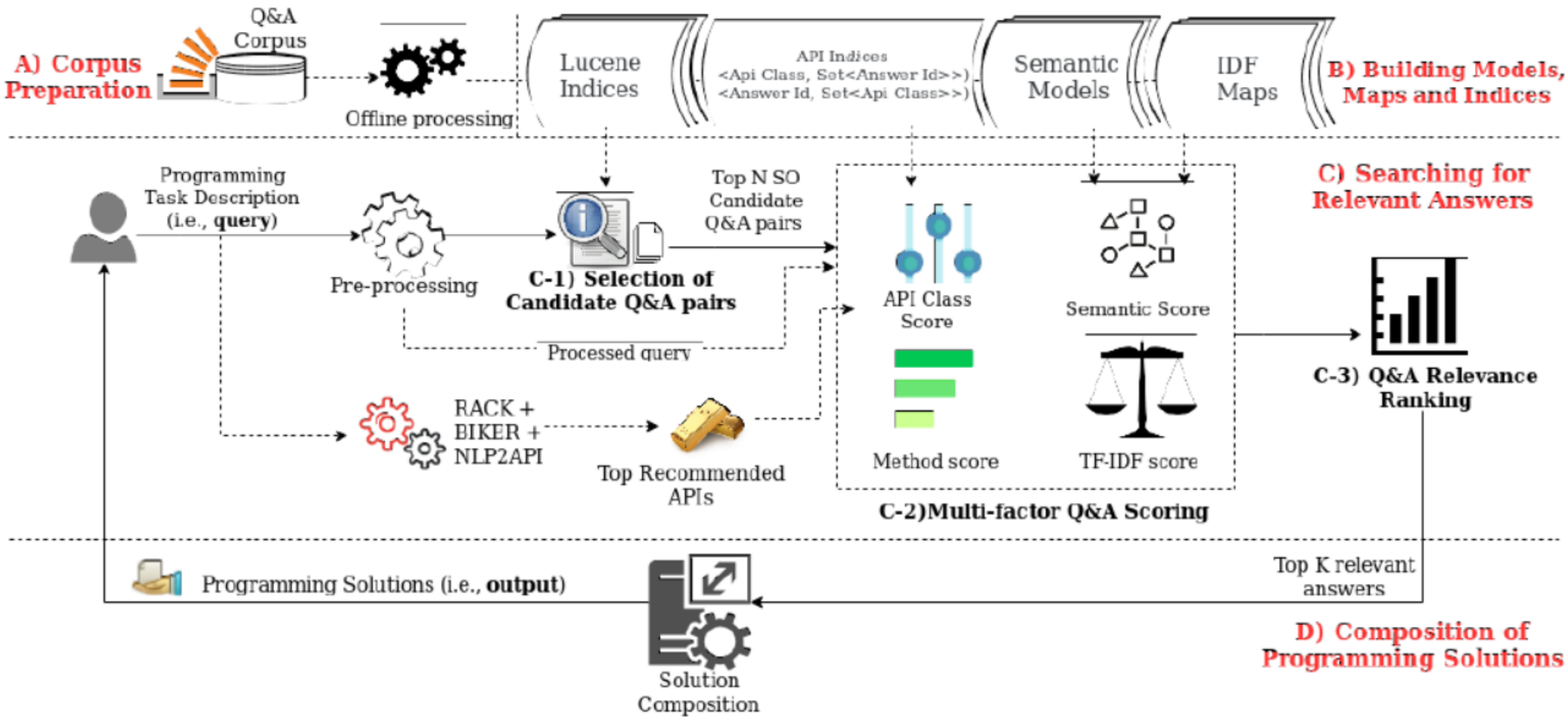



(a) Readability




(b) Understandability

# DADOS


A) Corpus Preparation
Q&A Corpus
Offline processing
Lucene Indices
API Indices
<Api Class, Set<Answer Id>>)
<Answer Id, Set<Api Class>>)
Semantic Models
IDF Maps
B) Building Models, Maps and Indices
Programming Task Description (i.e., query)
Pre-processing
C-1) Selection of Candidate Q&A pairs
Top N SO Candidate Q&A pairs
Processed query
C) Searching for Relevant Answers
API Class Score
Semantic Score
Method score
TF-IDF score
C-2)Multi-factor Q&A Scoring
C-3) Q&A Relevance Ranking
RACK + BIKER + NLP2API
Top Recommended APIs
Programming Solutions (i.e., output)
Solution Composition
Top K relevant answers
D) Composition of Programming Solutions

# DADOS

https://archive.org/details/stackexchange

## Stack Exchange Data Dump

by Stack Exchange, Inc.

| | |
|---|---|
| Publication date | 2021-09-07 |
| Usage | Attribution-ShareAlike 4.0 International |
| Topics | Stack Exchange Data Dump |
| Contributor | Stack Exchange Community |

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| | |
|---|---|
| stackoverflow.com-Badges.7z | 296.4M |
| stackoverflow.com-Comments.7z | 4.8G |
| stackoverflow.com-PostHistory.7z | 29.7G |
| stackoverflow.com-PostLinks.7z | 103.3M |
| stackoverflow.com-Posts.7z | 16.9G |
| stackoverflow.com-Tags.7z | 867.3K |
| stackoverflow.com-Users.7z | 777.9M |
| stackoverflow.com-Votes.7z | 1.3G |

# DADOS


## An Empirical Study on Refactoring-Inducing Pull Requests

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Everton L. G. Alves
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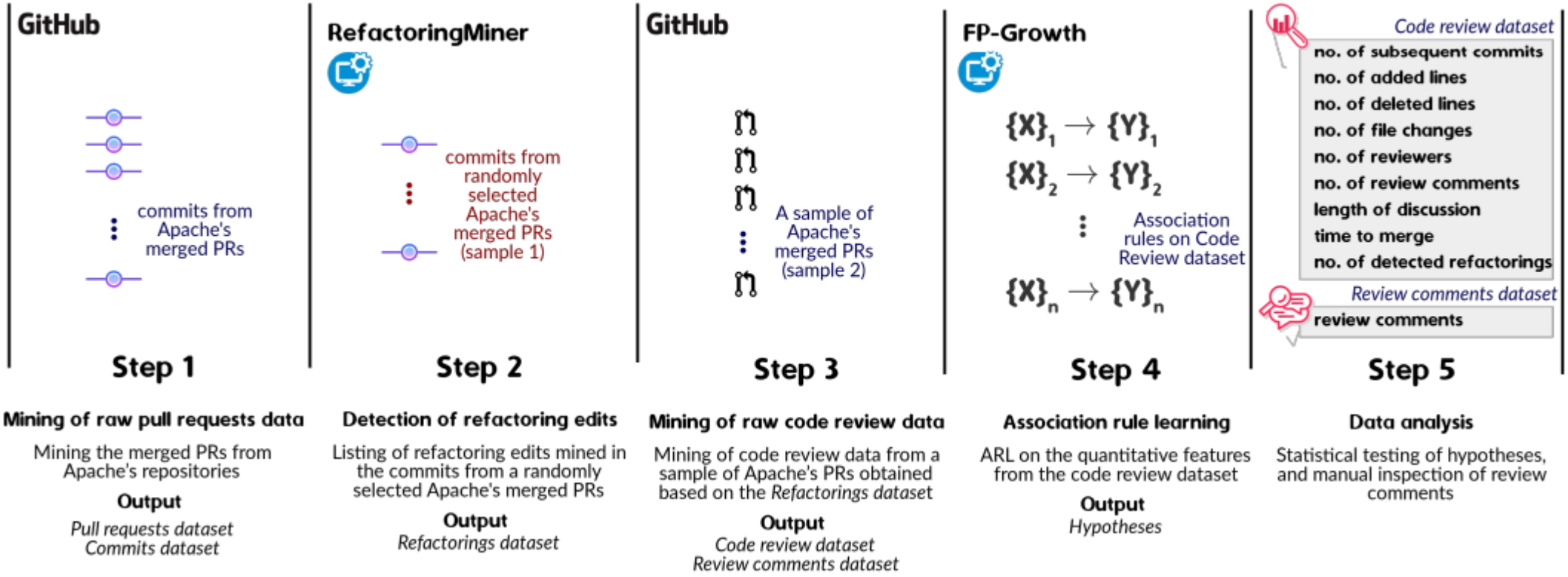

# DADOS

## Why We Refactor? Confessions of GitHub Contributo

GitHub


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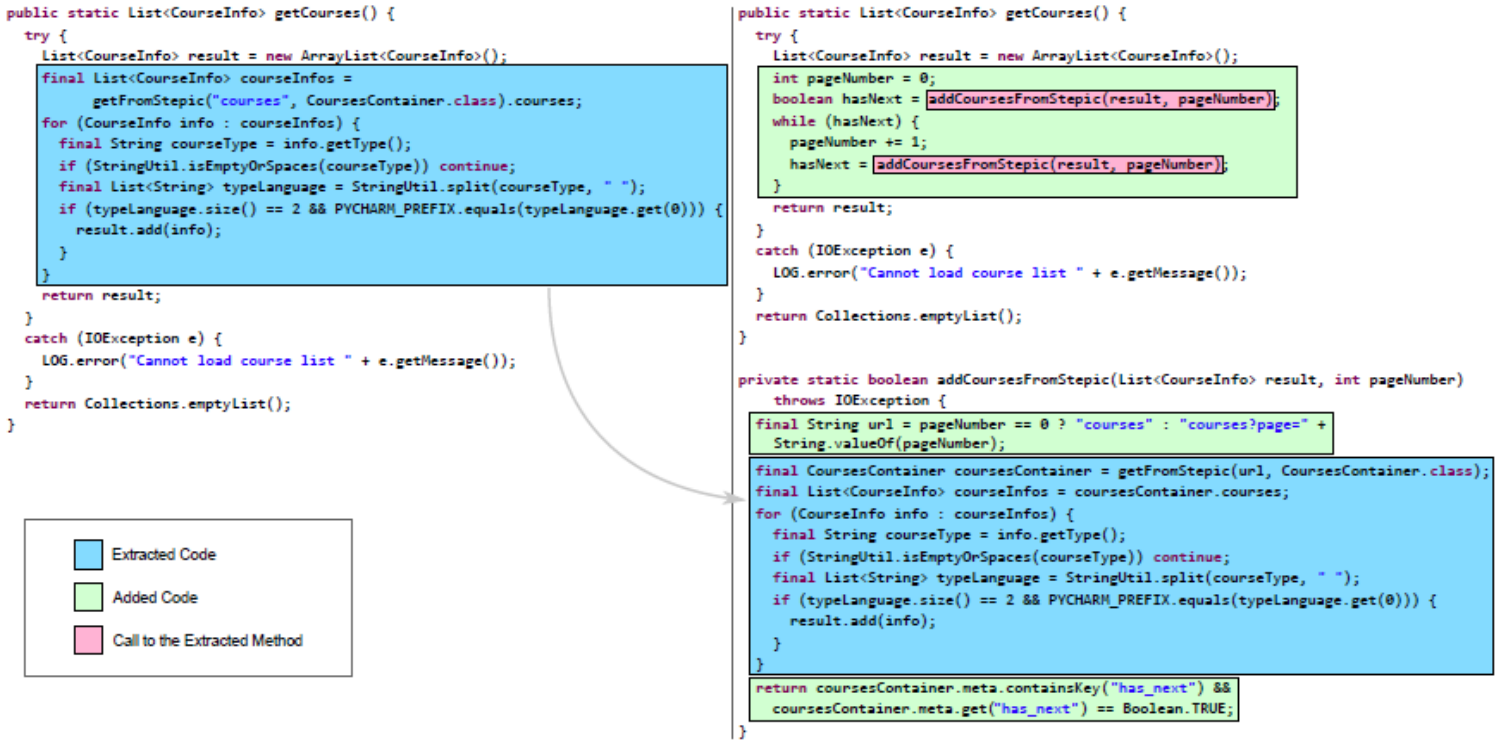

# DADOS

## An Exploratory Study of Log Placement Recommendation in an Enterprise System

Jeanderson Cândido*†, Jan Haesen†, Maurício Aniche*, and Arie van Deursen*
*Department of Software Technology
Delft University of Technology, The Netherlands
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†Adyen N.V., The Netherlands
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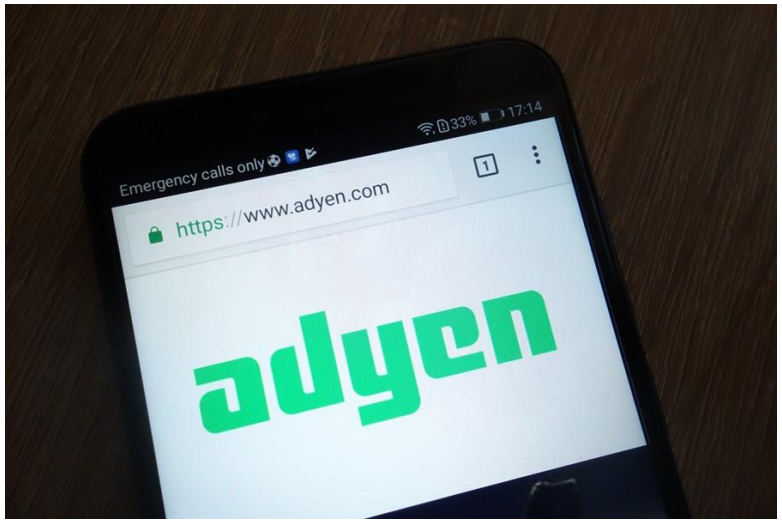
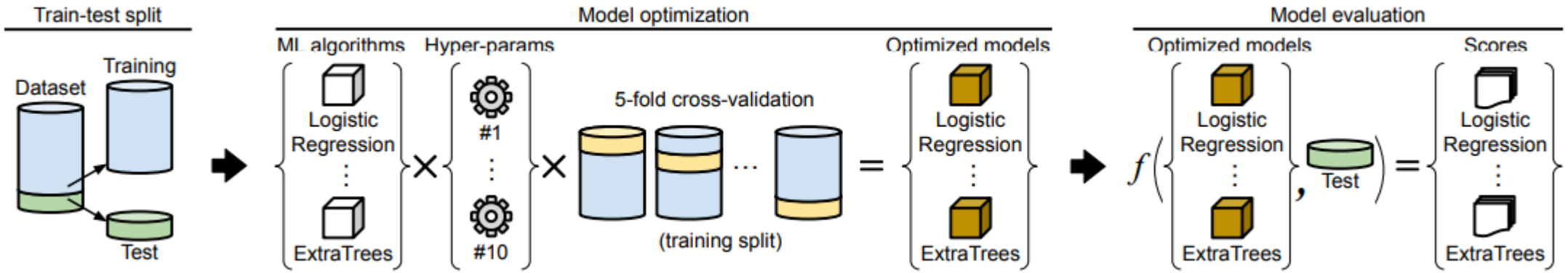
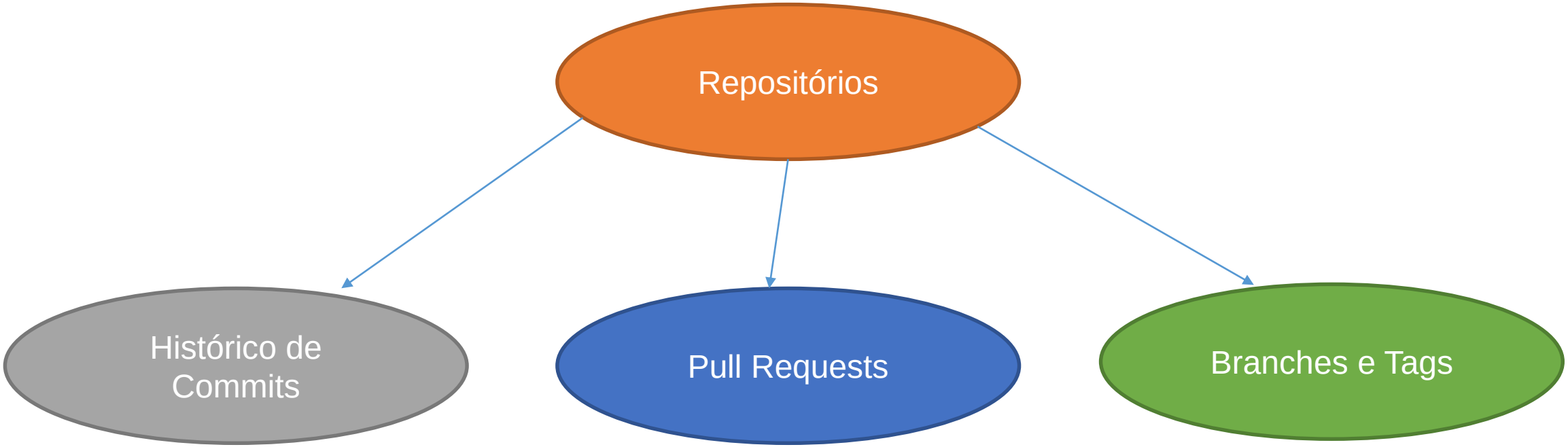


# DADOS


GitHub


Repositórios
Histórico de Commits
Pull Requests
Branches e Tags

# DADOS

Quais repositórios selecionar?

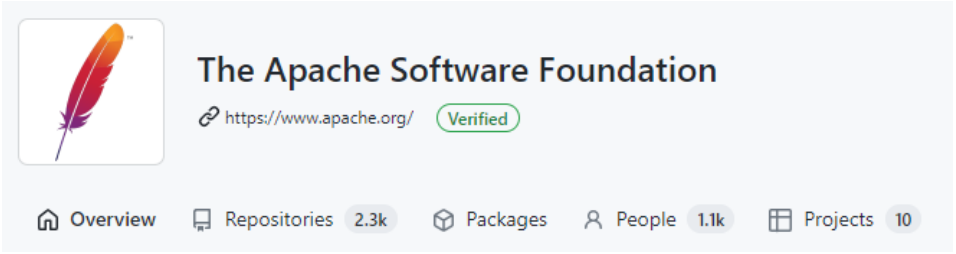

Ecossistemas

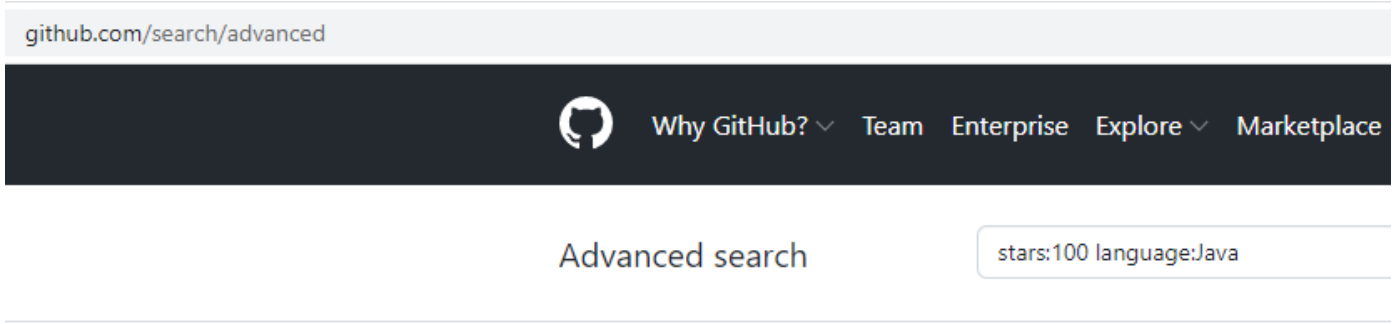
Estrelas

Linguagens de Programação

Quantidade de commits

Tempo



# VALIDAÇÃO

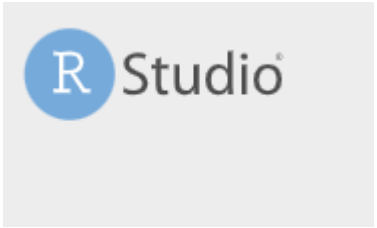
K = 10

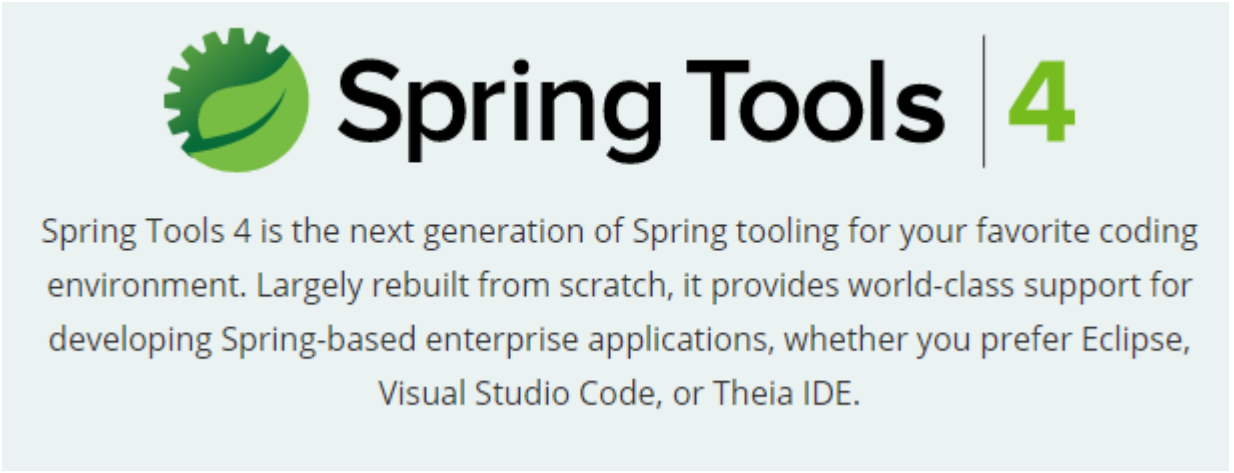
| | Java | | | |
|---|---|---|---|---|
| | Hit | MRR | MAP | MR |
| BIKER | 0.16 | 0.11 | 0.11 | 0.01 |
| BM25 + API Class | 0.58 | 0.18 | 0.17 | 0.10 |
| BM25 + Sent2Vec | 0.49 | 0.22 | 0.20 | 0.08 |
| BM25 | 0.56 | 0.22 | 0.22 | 0.13 |
| BM25 + Method | 0.72 | 0.40 | 0.36 | 0.16 |
| BM25 + fastText | 0.67 | 0.39 | 0.34 | 0.13 |
| BM25 + TF-IDF | 0.63 | 0.34 | 0.32 | 0.16 |
| CROKAGE | 0.81 | 0.55 | 0.49 | 0.22 |

K = 1

| | Java | | | |
|---|---|---|---|---|
| | Hit | MRR | MAP | MR |
| BIKER | 0.07 | 0.07 | 0.07 | 0.01 |
| BM25 + API Class | 0.00 | 0.00 | 0.00 | 0.00 |
| BM25 + Sent2Vec | 0.12 | 0.12 | 0.12 | 0.01 |
| BM25 | 0.09 | 0.09 | 0.09 | 0.01 |
| BM25 + Method | 0.25 | 0.25 | 0.25 | 0.02 |
| BM25 + fastText | 0.28 | 0.28 | 0.28 | 0.03 |
| BM25 + TF-IDF | 0.21 | 0.21 | 0.21 | 0.03 |
| CROKAGE | 0.46 | 0.46 | 0.46 | 0.06 |

# EXEMPLO PRÁTICO

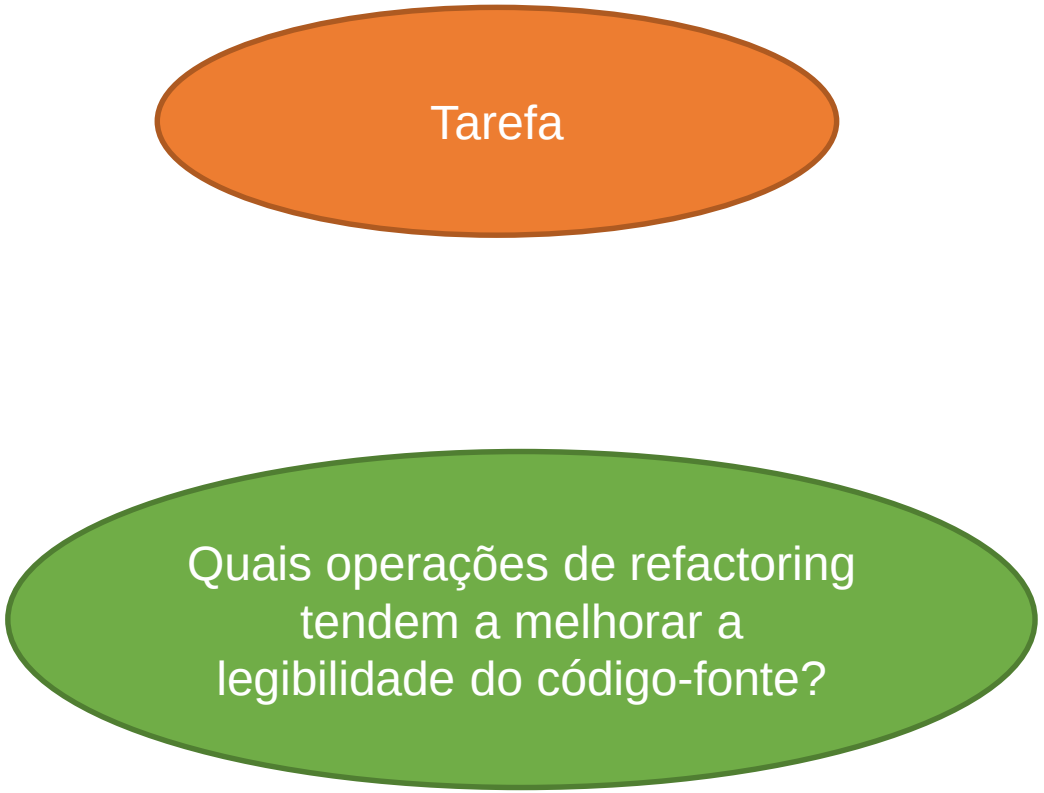




https://www.rstudio.com/

https://spring.io/tools

# EXEMPLO PRÁTICO



# EXEMPLO PRÁTICO

Quais operações de refactoring tendem a melhorar a legibilidade do código-fonte?

Repositórios do Github

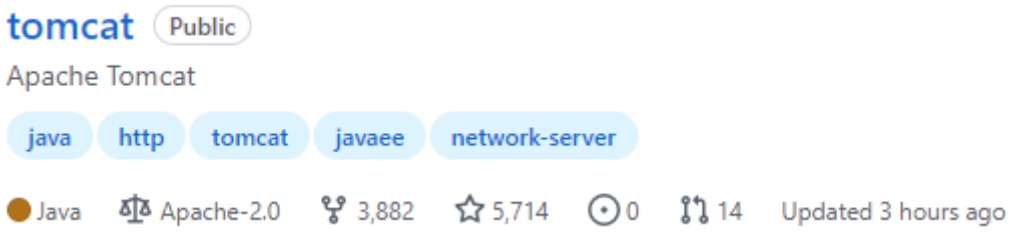
Ferramenta que detecta operações de refactoring

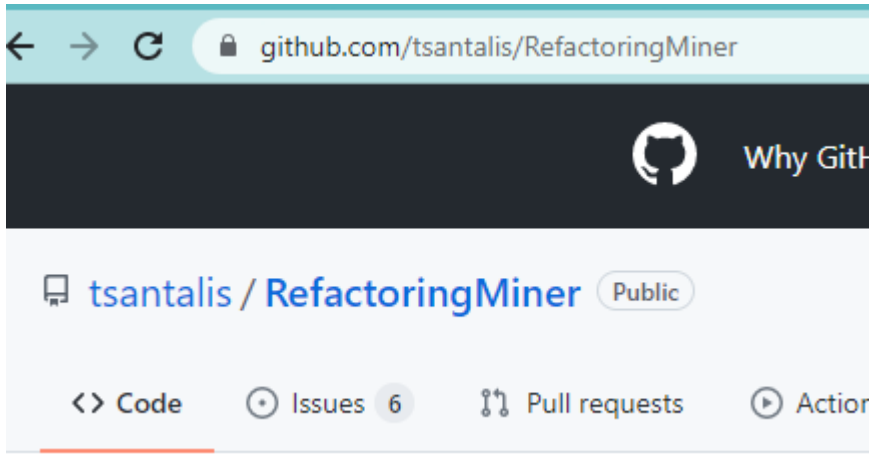
Ferramenta que captura a legibilidade das classes

Análise estatística

# EXEMPLO PRÁTICO

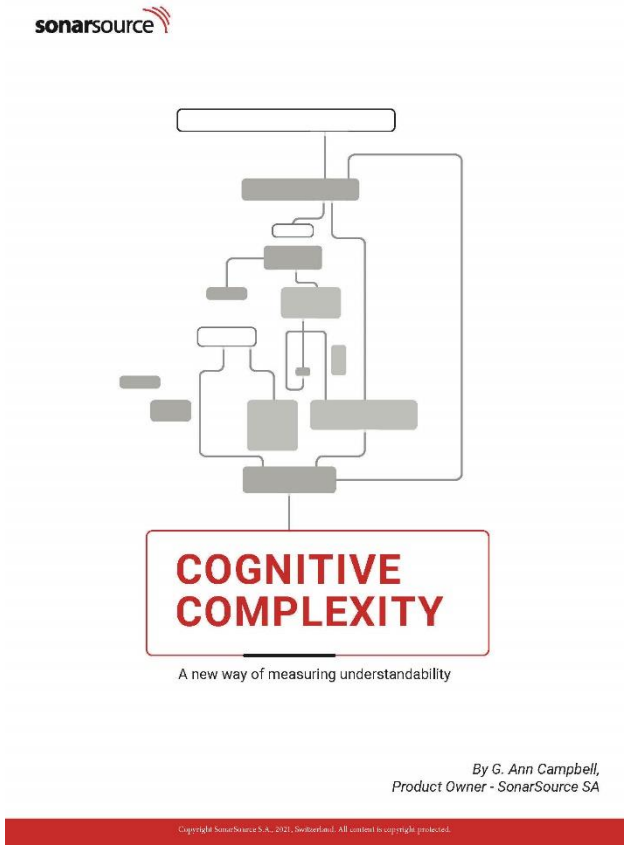
Quais operações de refactoring tendem a melhorar a legibilidade do código-fonte?



# EXEMPLO PRÁTICO

Quais operações de refactoring tendem a melhorar a legibilidade do código-fonte?




**A comprehensive model for code readability**

Simone Scalabrino ✉, Mario Linares-Vásquez, Rocco Oliveto, Denys Poshyvanyk

First published: 08 June 2018 | https://doi.org/10.1002/smr.1958 | Citations: 10

# EXEMPLO PRÁTICO

Quais operações de refactoring tendem a melhorar a legibilidade do código-fonte?

```
Refactoring-readability - RefactoringReadabilityApplication [Spring Boot App] C:\Program Files\Java\jdk1.8.0_151\bin\javaw.exe (23 de nov de 2021 19:19:31)
2021-11-23 19:26:56.102  INFO 7260 --- [va AST analyzer] o.s.analyzer.commons.ProgressReport      : 1 source file to be analyzed
2021-11-23 19:26:56.143  INFO 7260 --- [va AST analyzer] o.s.analyzer.commons.ProgressReport      : 1/1 source file has been analyzed
2021-11-23 19:26:56.143  WARN 7260 --- [           main] org.sonar.java.SonarComponents           : Unresolved imports/types have been detected during analysis. Enable DEBUG mode to see them.
2021-11-23 19:26:56.144  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing tomcat [Commits: 10, Errors: 0, Refactorings: 42]
2021-11-23 19:26:56.165  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat 5a55179a049ec39246c8ba76073ab4485542b98c ...
2021-11-23 19:26:56.181  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat 808e0cb47bc428404e58775606bbe933193340f4 ...
Refactorings at 808e0cb47bc428404e58775606bbe933193340f4
Change Variable Type    e : GSSException to e : GSSException|IllegalStateException in method public getUserPrincipal() : Principal from class org.apache.catalina.connector.Request
2021-11-23 19:27:12.299  INFO 7260 --- [va AST analyzer] o.s.analyzer.commons.ProgressReport      : 1 source file to be analyzed
2021-11-23 19:27:12.414  INFO 7260 --- [va AST analyzer] o.s.analyzer.commons.ProgressReport      : 1/1 source file has been analyzed
2021-11-23 19:27:12.415  WARN 7260 --- [           main] org.sonar.java.SonarComponents           : Unresolved imports/types have been detected during analysis. Enable DEBUG mode to see them.
2021-11-23 19:27:30.195  INFO 7260 --- [va AST analyzer] o.s.analyzer.commons.ProgressReport      : 1 source file to be analyzed
2021-11-23 19:27:30.296  INFO 7260 --- [va AST analyzer] o.s.analyzer.commons.ProgressReport      : 1/1 source file has been analyzed
2021-11-23 19:27:30.296  WARN 7260 --- [           main] org.sonar.java.SonarComponents           : Unresolved imports/types have been detected during analysis. Enable DEBUG mode to see them.
2021-11-23 19:27:30.297  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing tomcat [Commits: 11, Errors: 0, Refactorings: 43]
2021-11-23 19:27:30.309  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat f9e8d2b09f9e9a6c02c674c1464fb5abf68fb000 ...
2021-11-23 19:27:30.317  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat 5a55179a049ec39246c8ba76073ab4485542b98c ...
Refactorings at 5a55179a049ec39246c8ba76073ab4485542b98c
2021-11-23 19:27:30.401  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat a791804b0951da1a67c026926345d6b7191273fd ...
2021-11-23 19:27:30.412  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat f9e8d2b09f9e9a6c02c674c1464fb5abf68fb000 ...
Refactorings at f9e8d2b09f9e9a6c02c674c1464fb5abf68fb000
2021-11-23 19:27:30.502  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat d83479efe35e15125a3be781c9670269abe74bfe ...
2021-11-23 19:27:30.509  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat a791804b0951da1a67c026926345d6b7191273fd ...
Refactorings at a791804b0951da1a67c026926345d6b7191273fd
Refactorings at d83479efe35e15125a3be781c9670269abe74bfe
2021-11-23 19:27:30.607  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat c3412ad28f72cbaf024967978c1c1690d3c5a27d ...
2021-11-23 19:27:30.614  INFO 7260 --- [           main] o.r.rm1.GitHistoryRefactoringMinerImpl   : Processing F:\repositories\tomcat 248e9b74c9ccb8fb7b5072acd932f9deb3e979fb ...
Refactorings at 248e9b74c9ccb8fb7b5072acd932f9deb3e979fb
Move Class      org.apache.tomcat.util.net.openssl.panama.OpenSSLContext.DHParam moved to org.apache.tomcat.util.net.openssl.panama.OpenSSLLifecycleListener.DHParam
```

# EXEMPLO PRÁTICO

Quais operações de refactoring tendem a melhorar a legibilidade do código-fonte?

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| repository | refactoring_type | className | operation | readability | understandability |
| https://github.com/apache/tomcat.git | Add Parameter | org.apache.tomcat.util.net.openssl.panama.OpenSSLContext.ContextState | BEFORE | 0.5000286049318571 | 345.0 |
| https://github.com/apache/tomcat.git | Add Parameter | org.apache.tomcat.util.net.openssl.panama.OpenSSLContext.ContextState | AFTER | 0.4972928118180621 | 345.0 |
| https://github.com/apache/tomcat.git | Move Attribute | org.apache.tomcat.util.net.openssl.panama.OpenSSLContext | BEFORE | 0.5000286049318571 | 345.0 |
| https://github.com/apache/tomcat.git | Move Attribute | org.apache.tomcat.util.net.openssl.panama.OpenSSLContext.ContextState | AFTER | 0.4972928118180621 | 345.0 |
| https://github.com/apache/tomcat.git | Change Attribute Access Modifier | org.apache.tomcat.util.net.openssl.panama.OpenSSLContext | BEFORE | 0.5000286049318571 | 345.0 |
| https://github.com/apache/tomcat.git | Change Attribute Access Modifier | org.apache.tomcat.util.net.openssl.panama.OpenSSLContext.ContextState | AFTER | 0.4972928118180621 | 345.0 |

# EXEMPLO PRÁTICO

Quais operações de refactoring tendem a melhorar a legibilidade do código-fonte?

```
data:  readability by operation
W = 20, p-value = 0.2188
alternative hypothesis: true location shift is not equal to 0
95 percent confidence interval:
 -0.10255220  0.09605526
sample estimates:
difference in location
          -0.001863713
```