# From OpenRank to OpenPerf

## —— Enhancing Open Source Ecosystem Insights with Graph-Based Approaches

**Wei Wang**

**East China Normal University**

**X-lab Community**

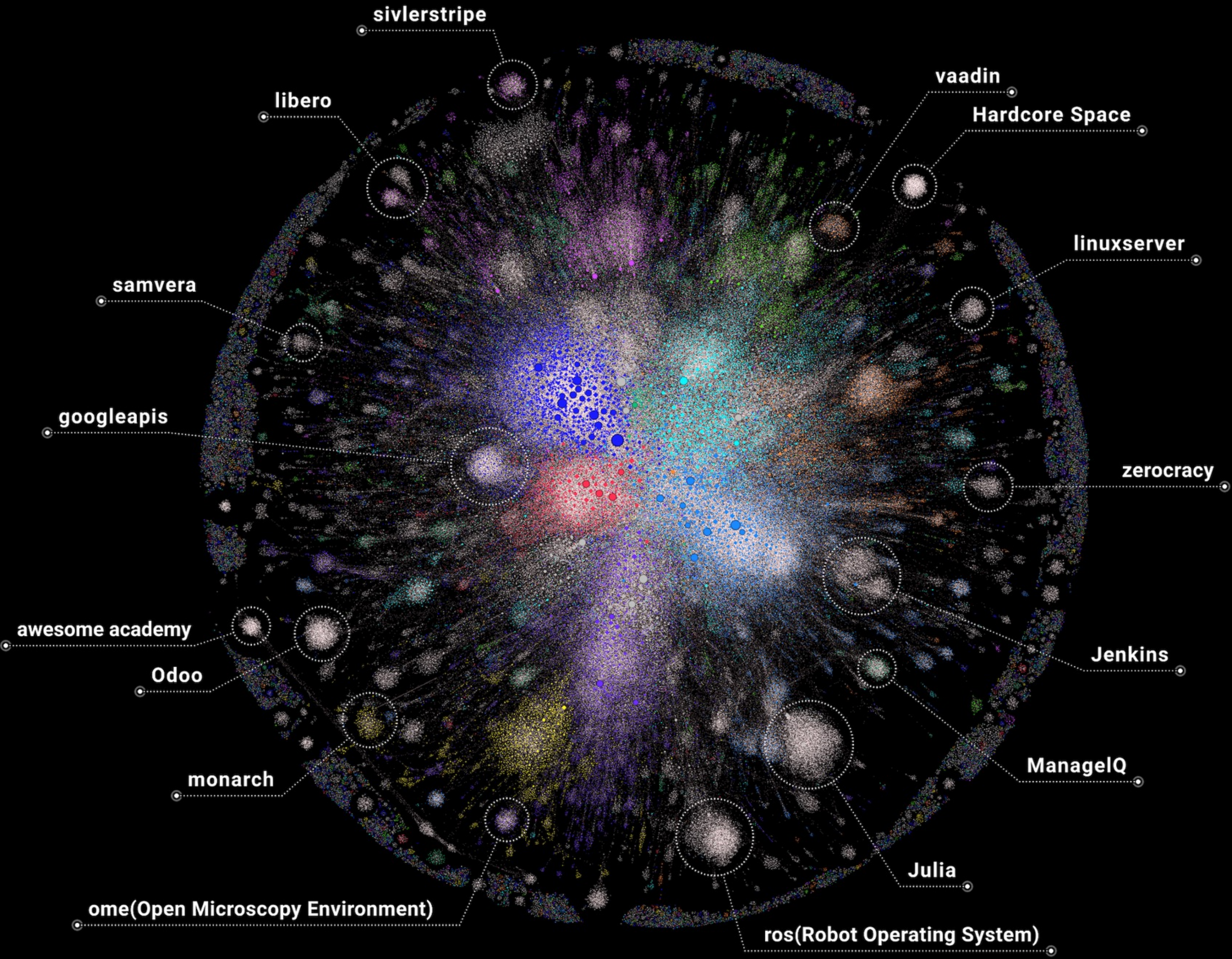
**July 2024**

# OpenGalaxy 2019

OpenGalaxy is generated by collaboration network of all active GitHub repos in 2019. This graph contains 171,141 nodes and 2,811,489 edges. The generate method can be found in here [1] and the data is from GHArchive [2].

OpenGalaxy 是通过 GitHub 2019 年全域所有活跃项目的协作网络生成的。本图共包含 171,141 个节点和 2,811,489 条边。具体生成方法请参见这里 [1]，数据来自于 GHArchive [2]。

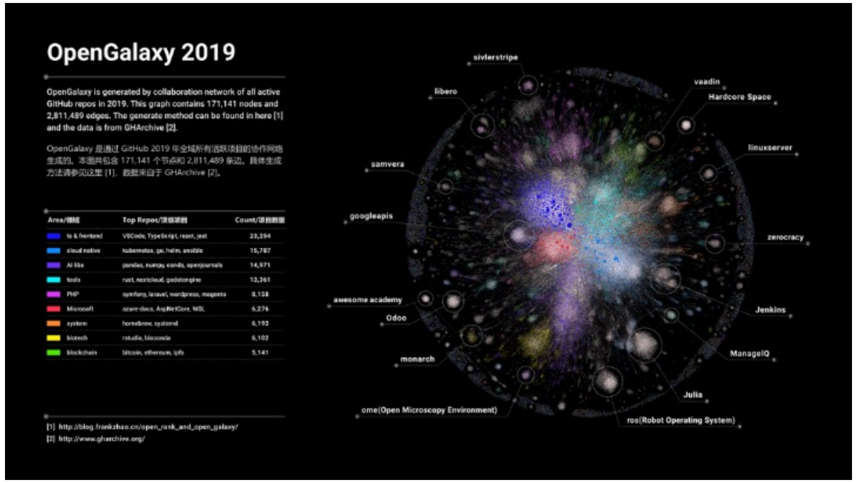
| Area/领域 | Top Repos/顶级项目 | Count/项目数量 |
|---|---|---|
| 🟦 ts & frontend | VSCode, TypeScript, react, jest | 23,254 |
| 🟦 cloud native | kubernetes, go, helm, ansible | 15,787 |
| 🟪 AI libs | pandas, numpy, conda, openjournals | 14,971 |
| 🟦 tools | rust, nextcloud, godotengine | 13,361 |
| 🟪 PHP | symfony, laravel, wordpress, magento | 8,158 |
| 🟥 Microsoft | azure-docs, AspNetCore, WSL | 6,276 |
| 🟧 system | homebrew, systemd | 6,193 |
| 🟨 biotech | rstudio, bioconda | 6,102 |
| 🟩 blockchain | bitcoin, ethereum, ipfs | 5,141 |



[1] http://blog.frankzhao.cn/open_rank_and_open_galaxy/

[2] http://www.gharchive.org/

# OpenGalaxy 3D



## OpenGalaxy 2019

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| Area/领域 | Top Repos/顶级项目 | Count/项目数量 |
|---|---|---|
| 🟦 js & frontend | VSCode, TypeScript, react, jest | 23,294 |
| 🟦 cloud native | kubernetes, go, helm, ansible | 15,787 |
| 🟪 AI libs | pandas, numpy, conda, openjournals | 14,971 |
| 🟦 tools | rust, nextcloud, godotengine | 13,261 |
| 🟪 PHP | symfony, laravel, wordpress, magento | 8,158 |
| 🟥 Microsoft | azure-docs, AspNetCore, WSL | 6,276 |
| 🟧 system | homebrew, systemd | 6,193 |
| 🟨 biotech | rstudio, bioconda | 6,102 |
| 🟩 blockchain | bitcoin, ethereum, ipfs | 5,141 |

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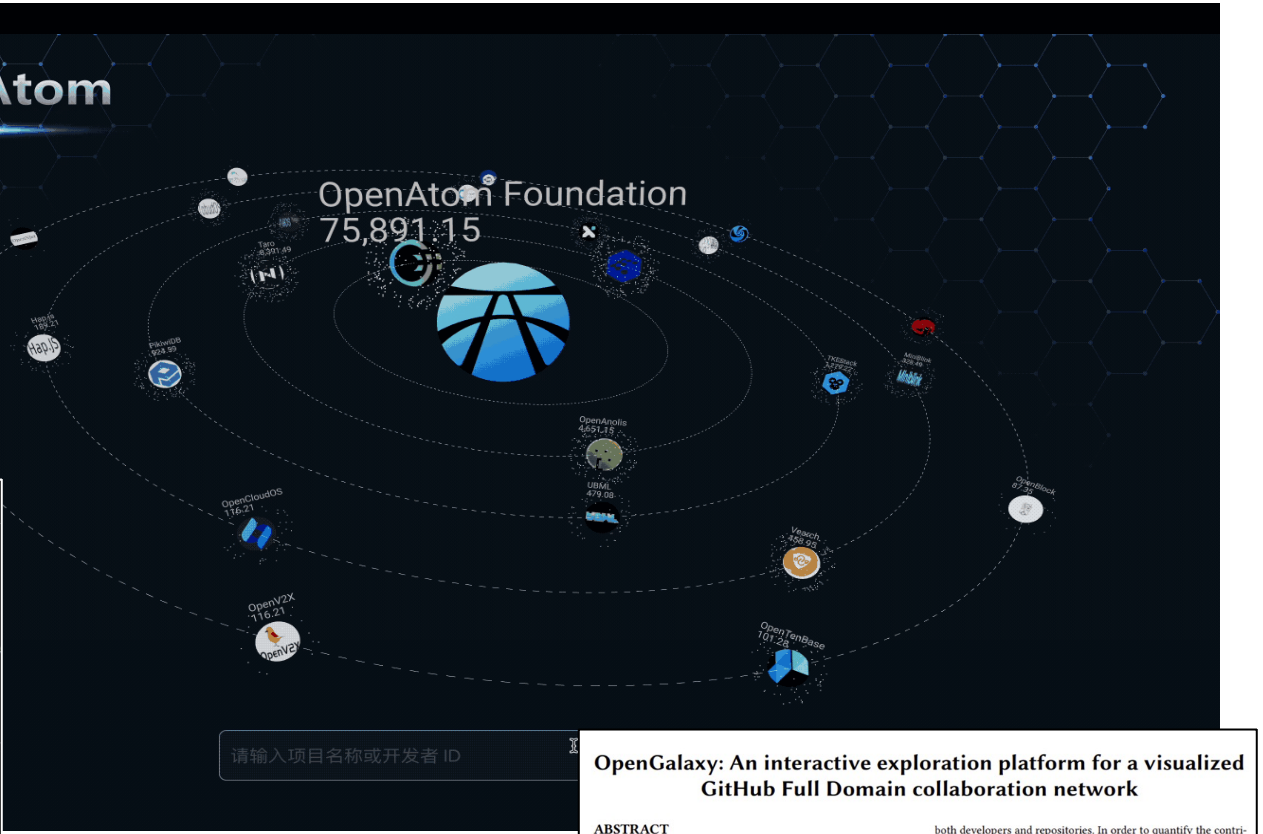
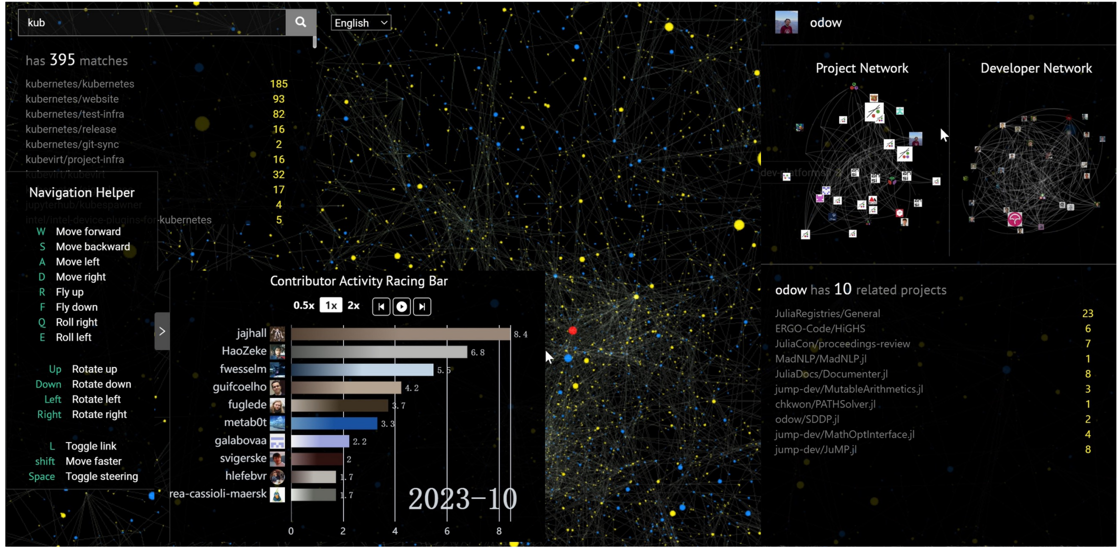
[2] http://www.gharchive.org/





kub

English

has 395 matches

| | |
|---|---|
| kubernetes/kubernetes | 185 |
| kubernetes/website | 93 |
| kubernetes/test-infra | 82 |
| kubernetes/release | 16 |
| kubernetes/git-sync | 2 |
| kubevirt/project-infra | 16 |
| kubevirt/kubevirt | 32 |
| [illegible] | 17 |
| jupyterhub/kubespawner | 4 |
| intel/intel-device-plugins-for-kubernetes | 5 |

Navigation Helper

| | |
|---|---|
| W | Move forward |
| S | Move backward |
| A | Move left |
| D | Move right |
| R | Fly up |
| F | Fly down |
| Q | Roll right |
| E | Roll left |
| Up | Rotate up |
| Down | Rotate down |
| Left | Rotate left |
| Right | Rotate right |
| L | Toggle link |
| shift | Move faster |
| Space | Toggle steering |

Contributor Activity Racing Bar

odow

odow has 10 related projects

| | |
|---|---|
| JuliaRegistries/General | 23 |
| ERGO-Code/HiGHS | 6 |
| JuliaCon/proceedings-review | 7 |
| MadNLP/MadNLP.jl | 1 |
| JuliaDocs/Documenter.jl | 8 |
| jump-dev/MutableArithmetics.jl | 3 |
| chkwon/PATHSolver.jl | 1 |
| odow/SDDP.jl | 2 |
| jump-dev/MathOptInterface.jl | 4 |
| jump-dev/JuMP.jl | 8 |

## OpenGalaxy: An interactive exploration platform for a visualized GitHub Full Domain collaboration network

### ABSTRACT

In this work, we introduce OpenGalaxy - an interactive exploration platform for a visualized GitHub Full Domain collaboration network based on 3D force-oriented layouts. We first collected Github domain-wide log data, built a developer-repository heterogeneous collaboration network, calculated both the Influence value for each repository and the activity value for each developer, finally per-

both developers and repositories. In order to quantify the contributions of developers, we introduced an activity metric, and for measuring the project's influence, we employed a weighted PageRank algorithm. Finally, a 3D force-guided layout was implemented to effectively visualize this intricate collaborative network. Furthermore, we implemented an interactive 3D game-like mobile mode to enrich user exploration. This tool not only supports dynamic

ICPC 2024 The 32nd IEEE/ACM International Conference on Program Comprehension
Lisbon, Portugal. April 15-16, 2024

Xingran Zhang, Xiaoya Xia, Shengyu Zhao, Wei Wang, **OpenGalaxy: An interactive exploration platform for a visualized GitHub Full Domain collaboration network**, ICPC, 2024.

# Motivation: GitHub Platform and Open Data

### GitHub

- The world's largest code hosting platform
- Acquired by Microsoft in May 2019 for $7.5 billion

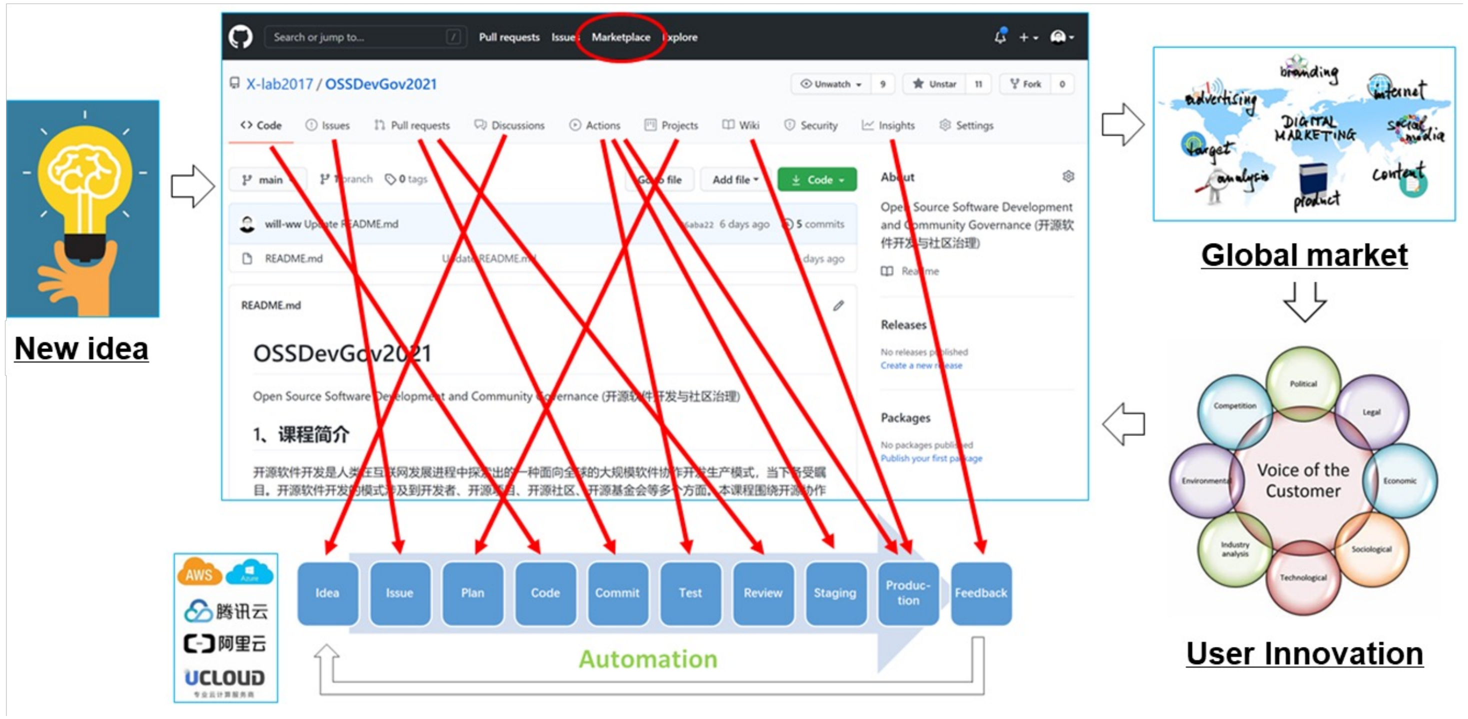
### Not Just Code

- Issue Management
- Distributed Collaboration
- Continuous Integration
- Project Management
- Security Risk Management

### Open data

- GitHub Restful API
- GitHub Event log

## Vertical Integration of Open Source Innovation

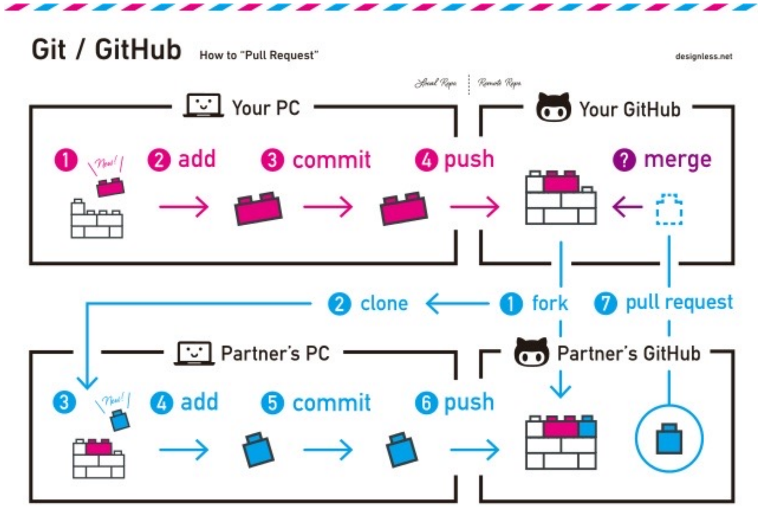


# Method: Data-Driven Developer Behavioral Science

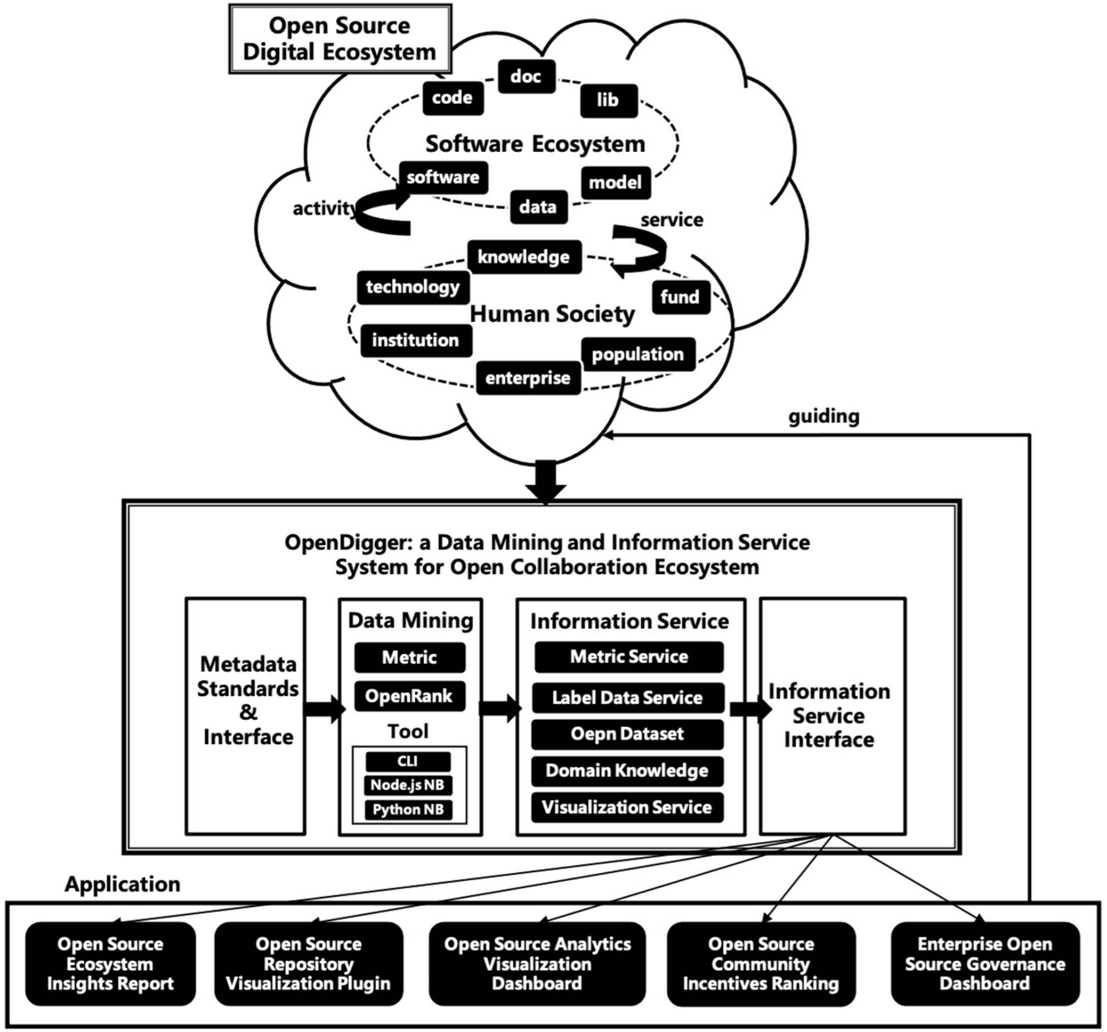
**Activity data** in open source software development and ecosystem evolution is a very broad concept. Any data generated in the process of **software development**, **maintenance**, **operation**, as well as ecosystem **governance**, **evolution**, etc., can be called open source software activity data, including but not limited to:

- Git/GitHub Log Event
- Source Code
- Documentation
- Configuration Files
- Changes

- Development Process
- Developers
- Package Hosting Platforms
- Social Data
- Software Ecosystem Network



# OpenDigger project



Open Source Digital Ecosystem

doc
code
lib
Software Ecosystem
software
model
data
activity
service
knowledge
technology
fund
Human Society
institution
population
enterprise
guiding

OpenDigger: a Data Mining and Information Service System for Open Collaboration Ecosystem

Metadata Standards & Interface

Data Mining
Metric
OpenRank
Tool
CLI
Node.js NB
Python NB

Information Service
Metric Service
Label Data Service
Oepn Dataset
Domain Knowledge
Visualization Service

Information Service Interface

Application
Open Source Ecosystem Insights Report
Open Source Repository Visualization Plugin
Open Source Analytics Visualization Dashboard
Open Source Community Incentives Ranking
Enterprise Open Source Governance Dashboard

- GitHub action log entries: 5.8 billion
- Artifact repository data from NPM/PyPI, etc: 6.2 million entries
- CVE security vulnerability data: 160,000 entries
- StackOverflow Q&A posts: 25 million
- Labeled data, including 413 GitHub orgs, covering 89,427 repositories

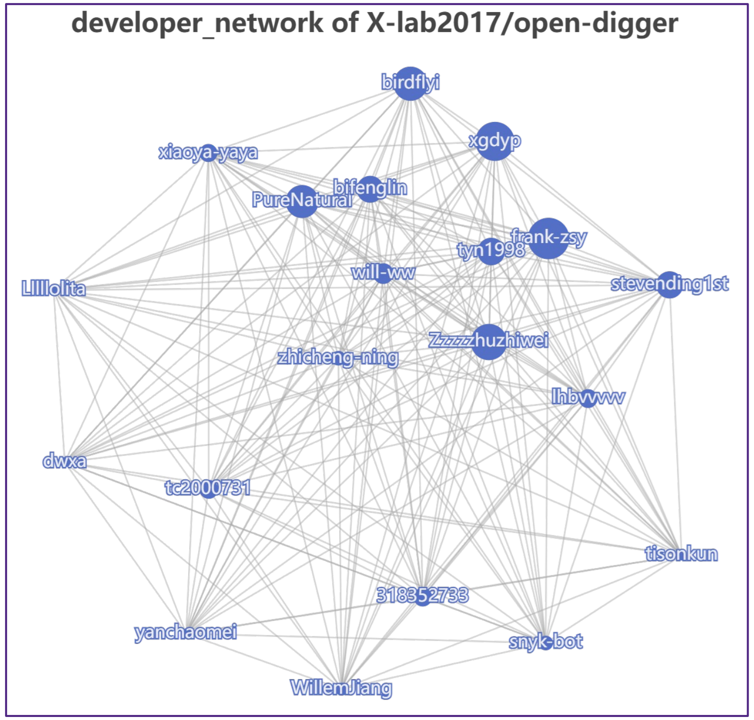
Research chanllenges: Identification, Recognition, Accounting, and Rewarding of Open Source Contributions

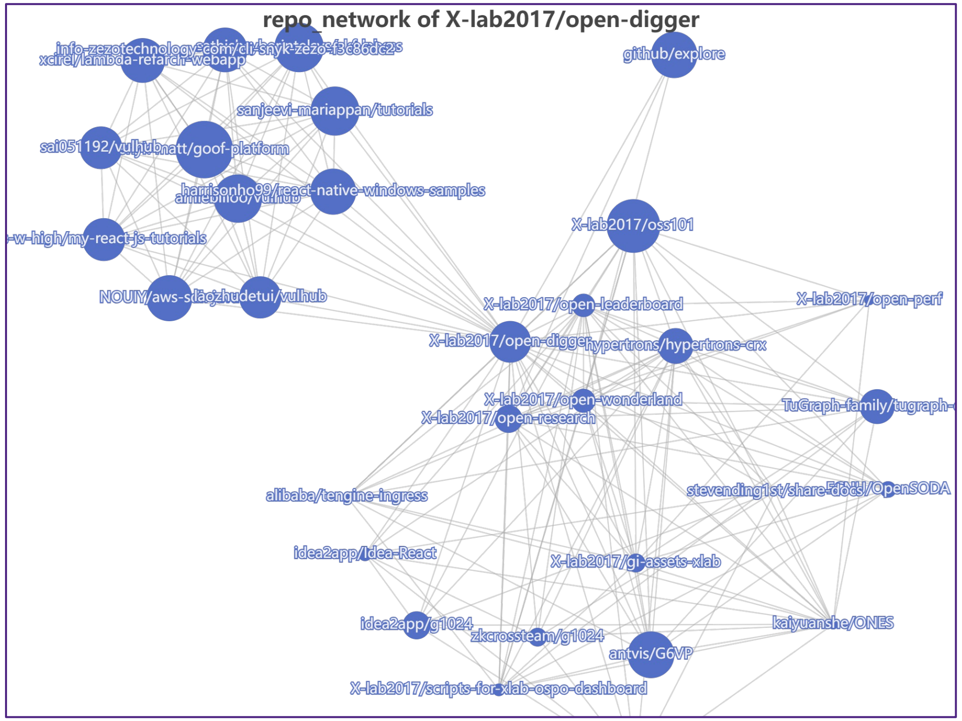
# The Essence of Open Source Contribution: A Graph Perspectives

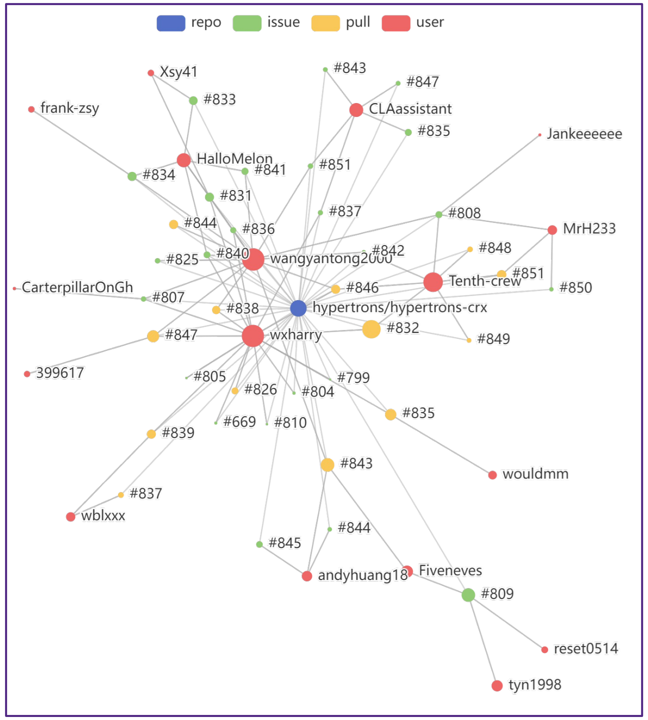
**Deveoper network**

**Repo network**

**Value unit network**







From the Perspective of Digital Economics: Not only is the Internet a network, but all economic phenomena are networks

# OpenRank Developer Contribution Evaluation

### OpenRank Leaderboard: Motivating Open Source Collaborations Through Social Network Evaluation in Alibaba

Shengyu Zhao[1], Xiaoya Xia[2*]
Brian Fitzgerald[3], Xiaozhou Li[4], Valentina Lenarduzzi[4], Davide Taibi[4]
Rong Wang[5], Wei Wang[2*], Chunqi Tian[1]
[1]Tongji University, China — [2]East China Normal University, China
[3] Lero - Irish Software Research Centre, Ireland — [4]University of Oulu, Finland — [5]Alibaba Group, China
frank_zsy@tongji.edu.cn;xiaoya@stu.ecnu.edu.cn;bf@lero.ie;
xiaozhou.li@oulu.fi;valentina.lenarduzzi@oulu.fi;davide.taibi@oulu.fi;
tunan.wr@alibaba-inc.com;wwang@dase.ecnu.edu.cn;tianchunqi@tongji.edu.cn

**ABSTRACT**

Open source has revolutionized how software development is carried out, with a growing number of individuals and organizations contributing to open source projects. As the importance of open source continues to grow, companies also expect to grow thriving and sustainable open source communities with continued contributions and better collaborations. In this study, we applied the contribution leaderboard to seven open source projects initiated by Alibaba. We conducted a case study to investigate the perceptions and facts regarding how to motivate collaboration through gamification. Specifically, we employed a social network algorithm, OpenRank, to evaluate and steer developers' contributions. We validated the effectiveness of OpenRank by comparing it with other evaluation metrics and surveying developers. Through semi-structured interviews and project metric analysis, we found that the OpenRank Leaderboard can promote transparent communication environments, a better community atmosphere, and improved collaboration behavior.

**1 INTRODUCTION**

The increasing popularity of open source projects has led to the development of an ecosystem in which individuals and organizations can collaborate to create high-quality software that is available to all [1]. Unlike traditional software development activities that are conducted internally with designated tasks for specific individuals, open source development relies on voluntary work that requires extensive asynchronous communication and distributed collaboration [2]. With the rise of companies as significant users and even major players in the open source software ecosystem, they are increasingly taking the initiative to create, open source, and maintain their own projects as a way to contribute to the community and build technical influence in the industry [3]. Naturally, companies want their open source projects to flourish as thriving communities, receiving contributions from non-employees rather than just from their own employees. This requires attracting new developers to projects in the first place (magnetism) [4, 5] and subsequently retaining these developers over time (stickiness) [6–8]. To achieve

Research Questions

RQ1
OR Effectiveness
Comparison
Survey

RQ2
Impact on Projs
RDD over
CHAOSS metrics

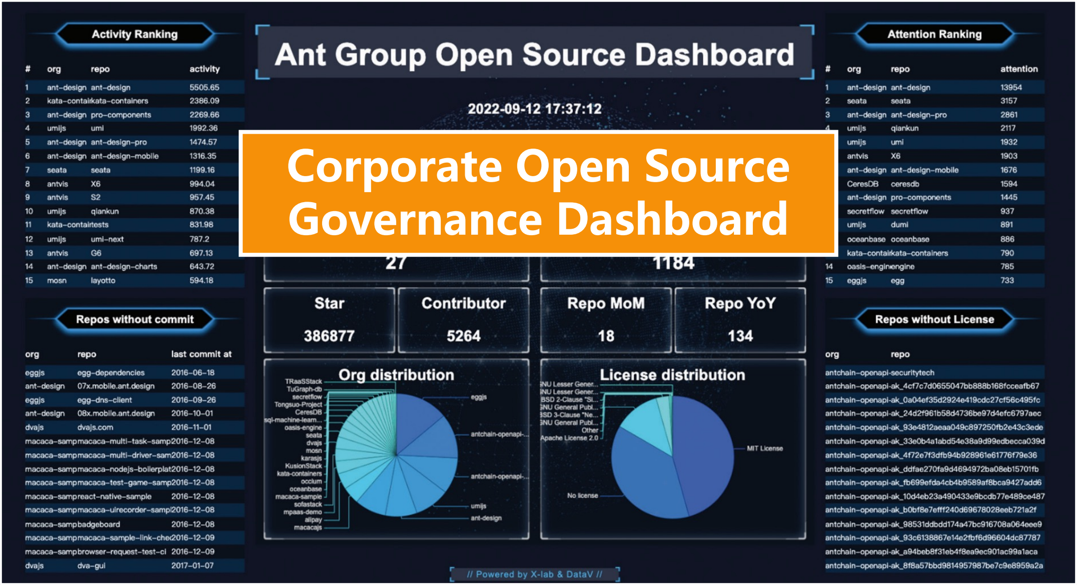
RQ3
Devs Perception
Semi-structured
Interview

The **OpenRank algorithm** is an evaluative method that generalizes the PageRank algorithm to accommodate directed, weighted, heterogeneous networks with initial values that are not necessarily strongly connected. When applied to the assessment of contributions in the open-source context.

- **Significant positive correlation with traditional metrics. Developers endorse the OpenRank results.**
- **Noticeable impact on developers already in the projects, particularly in issue discussions, PRs submission and emojis.**
- **Observation of desirable developers' behavior impact and improvement of community collaboration.**

Shengyu Zhao, Xiaoya Xia, Brian Fitzgerald, et al., **Motivating Open Source Collaborations Through Social Network Evaluation: A Gamification Practice from Alibaba**, ICSE 2024.

# The Applications of OpenRank



Ant Group Open Source Dashboard

2022-09-12 17:37:12

Activity Ranking

| # | org | repo | activity |
|---|---|---|---|
| 1 | ant-design | ant-design | 5505.65 |
| 2 | kata-contai | kata-containers | 2386.09 |
| 3 | ant-design | pro-components | 2269.66 |
| 4 | umijs | umi | 1992.36 |
| 5 | ant-design | ant-design-pro | 1474.57 |
| 6 | ant-design | ant-design-mobile | 1316.35 |
| 7 | seata | seata | 1199.16 |
| 8 | antvis | X6 | 994.04 |
| 9 | antvis | S2 | 957.45 |
| 10 | umijs | qiankun | 870.38 |
| 11 | kata-contai | katatests | 831.98 |
| 12 | umijs | umi-next | 787.2 |
| 13 | antvis | G6 | 697.13 |
| 14 | ant-design | ant-design-charts | 643.72 |
| 15 | mosn | layotto | 594.18 |

Attention Ranking

| # | org | repo | attention |
|---|---|---|---|
| 1 | ant-design | ant-design | 13954 |
| 2 | seata | seata | 3157 |
| 3 | ant-design | ant-design-pro | 2861 |
| 4 | umijs | qiankun | 2117 |
| 5 | umijs | umi | 1932 |
| 6 | antvis | X6 | 1903 |
| 7 | ant-design | ant-design-mobile | 1676 |
| 8 | CeresDB | ceresdb | 1594 |
| 9 | ant-design | pro-components | 1445 |
| 10 | secretflow | secretflow | 937 |
| 11 | umijs | dumi | 891 |
| 12 | oceanbase | oceanbase | 886 |
| 13 | kata-contai | kata-containers | 790 |
| 14 | oasis-engine | engine | 785 |
| 15 | eggjs | egg | 733 |

| Star | Contributor | Repo MoM | Repo YoY |
|---|---|---|---|
| 386877 | 5264 | 18 | 134 |

Repos without commit

| org | repo | last commit at |
|---|---|---|
| eggjs | egg-dependencies | 2016-06-18 |
| ant-design | 07x.mobile.ant.design | 2016-08-26 |
| eggjs | egg-dns-client | 2016-09-26 |
| ant-design | 08x.mobile.ant.design | 2016-10-01 |
| dvajs | dvajs.com | 2016-11-01 |
| macaca-samp | macaca-multi-task-samp | 2016-12-08 |
| macaca-samp | macaca-multi-driver-sam | 2016-12-08 |
| macaca-samp | macaca-nodejs-boilerplat | 2016-12-08 |
| macaca-samp | macaca-test-game-samp | 2016-12-08 |
| macaca-samp | react-native-sample | 2016-12-08 |
| macaca-samp | macaca-uirecorder-sampl | 2016-12-09 |
| macaca-samp | badgeboard | 2016-12-08 |
| macaca-samp | macaca-sample-link-che | 2016-12-09 |
| macaca-samp | browser-request-test-ci | 2016-12-09 |
| dvajs | dva-gui | 2017-01-07 |

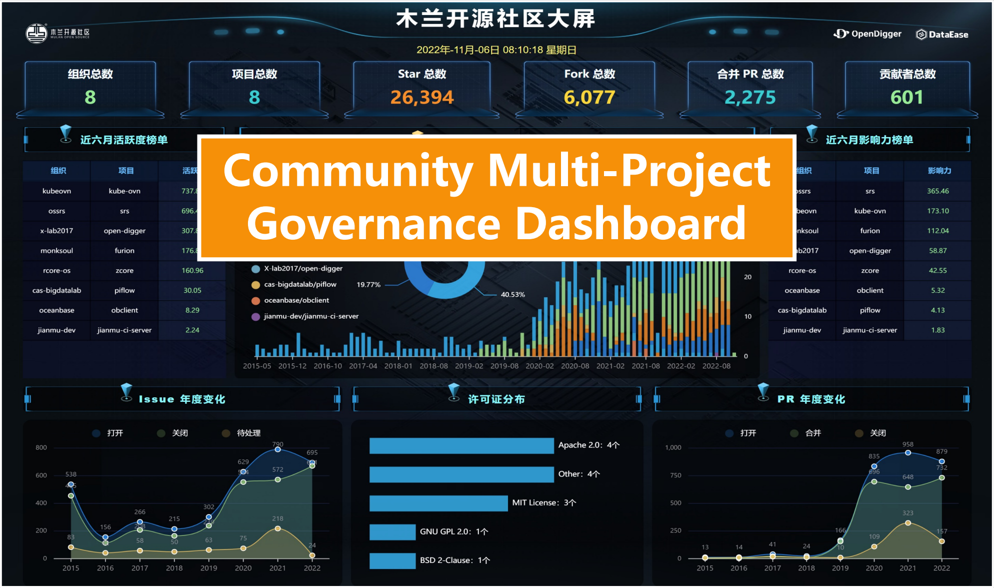
Repos without License

Org distribution

License distribution

// Powered by X-lab & DataV //

Corporate Open Source Governance Dashboard



木兰开源社区大屏

2022年11月06日 08:10:18 星期日

| 组织总数 | 项目总数 | Star 总数 | Fork 总数 | 合并 PR 总数 | 贡献者总数 |
|---|---|---|---|---|---|
| 8 | 8 | 26,394 | 6,077 | 2,275 | 601 |

近六月活跃度榜单

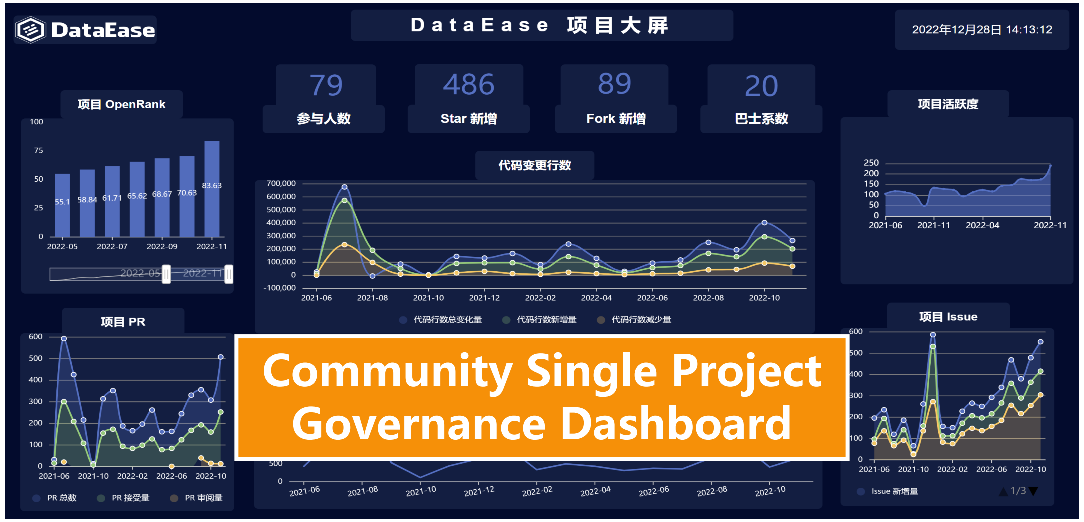
近六月影响力榜单

Issue 年度变化

许可证分布

PR 年度变化

Community Multi-Project Governance Dashboard



DataEase

DataEase 项目大屏

2022年12月28日 14:13:12

| 79 | 486 | 89 | 20 |
|---|---|---|---|
| 参与人数 | Star 新增 | Fork 新增 | 巴士系数 |

项目 OpenRank

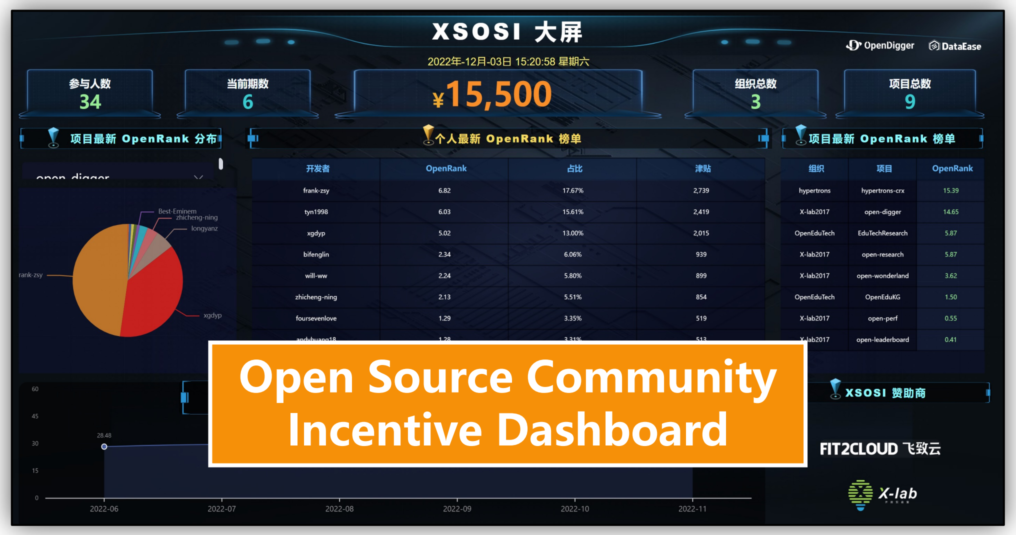
代码变更行数

项目活跃度

项目 PR

项目 Issue

Community Single Project Governance Dashboard



XSOSI 大屏

2022年12月03日 15:20:58 星期六

| 参与人数 | 当前期数 |  | 组织总数 | 项目总数 |
|---|---|---|---|---|
| 34 | 6 | ¥15,500 | 3 | 9 |

项目最新 OpenRank 分布

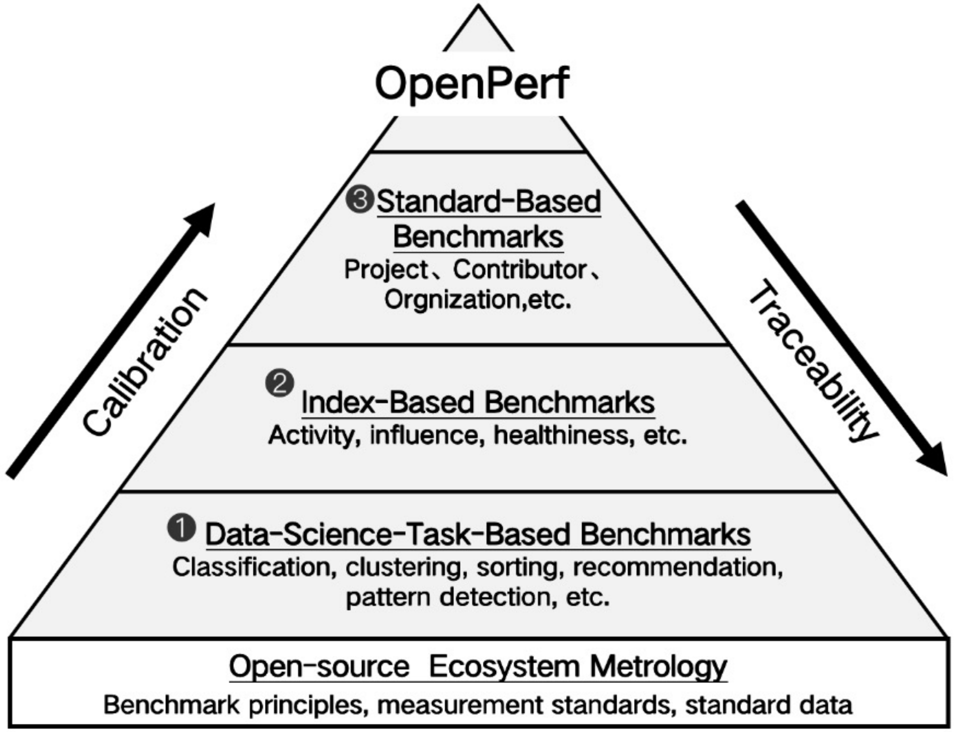
个人最新 OpenRank 榜单

项目最新 OpenRank 榜单

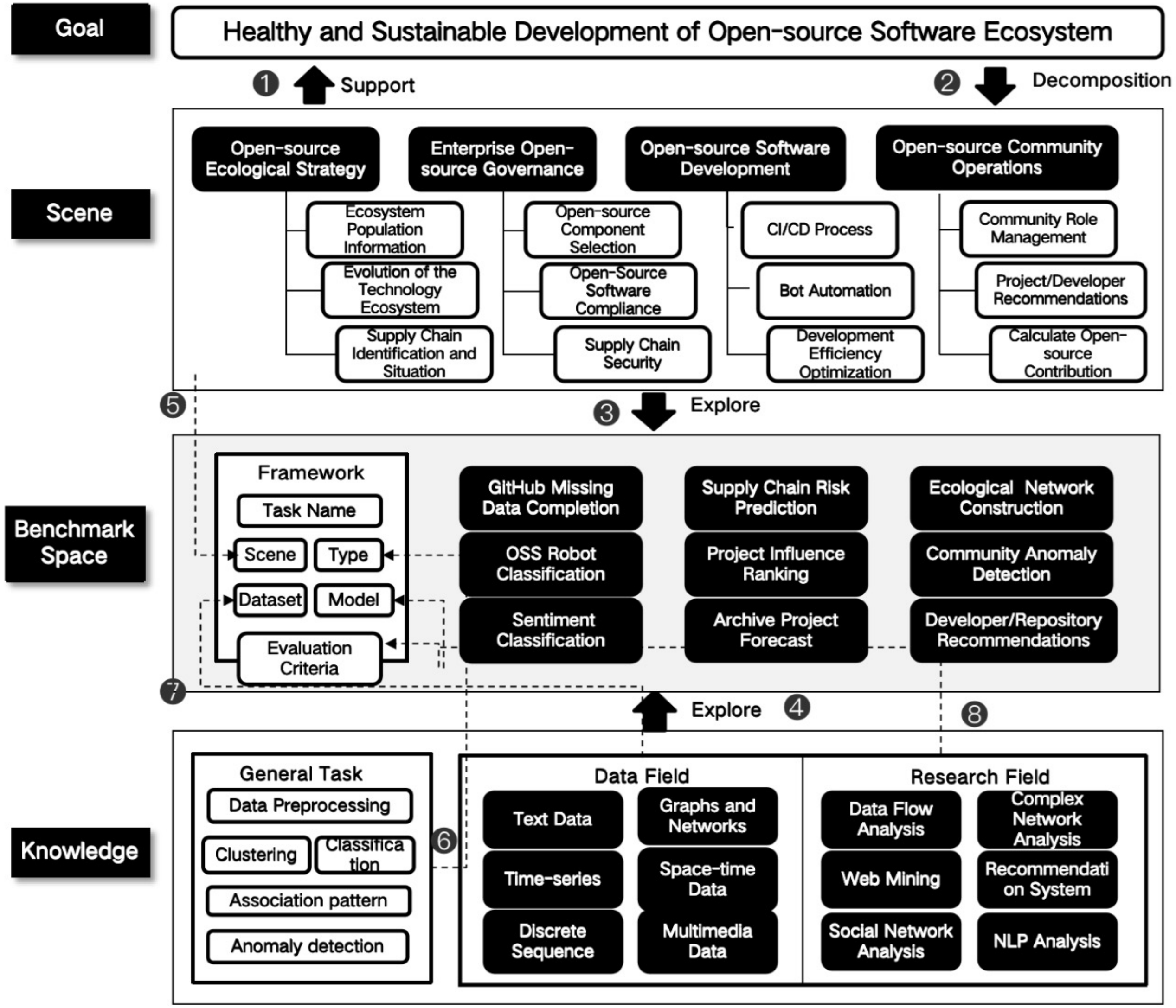
XSOSI 赞助商

Open Source Community Incentive Dashboard

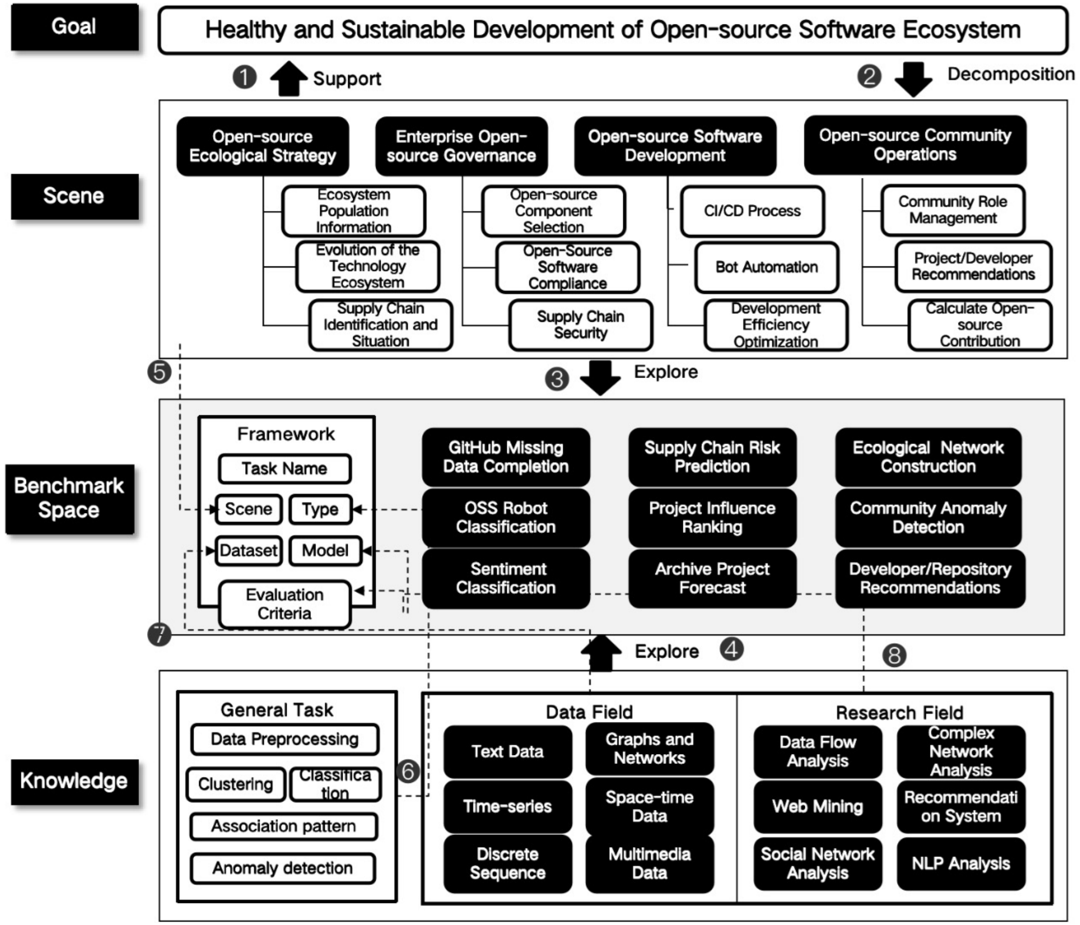
# From OpenRank to OpenPerf


OpenPerf
❸Standard-Based Benchmarks
Project、Contributor、Orgnization,etc.
❷ Index-Based Benchmarks
Activity, influence, healthiness, etc.
❶ Data-Science-Task-Based Benchmarks
Classification, clustering, sorting, recommendation, pattern detection, etc.
Open-source Ecosystem Metrology
Benchmark principles, measurement standards, standard data
Calibration
Traceability

**OpenPerf** enhances the sustainability and growth of the OSS ecosystem by providing tools for measuring and evaluating project metrics, enabling data mining for research, offering methodologies for ranking projects, and assessing contribution levels.


Goal
Healthy and Sustainable Development of Open-source Software Ecosystem
❶ Support
❷ Decomposition
Scene
Open-source Ecological Strategy
Ecosystem Population Information
Evolution of the Technology Ecosystem
Supply Chain Identification and Situation
Enterprise Open-source Governance
Open-source Component Selection
Open-Source Software Compliance
Supply Chain Security
Open-source Software Development
CI/CD Process
Bot Automation
Development Efficiency Optimization
Open-source Community Operations
Community Role Management
Project/Developer Recommendations
Calculate Open-source Contribution
❸ Explore
❺
Benchmark Space
Framework
Task Name
Scene
Type
Dataset
Model
Evaluation Criteria
GitHub Missing Data Completion
OSS Robot Classification
Sentiment Classification
Supply Chain Risk Prediction
Project Influence Ranking
Archive Project Forecast
Ecological Network Construction
Community Anomaly Detection
Developer/Repository Recommendations
❼
Explore ❹
❽
Knowledge
General Task
Data Preprocessing
Clustering
Classification
Association pattern
Anomaly detection
❻
Data Field
Text Data
Graphs and Networks
Time-series
Space-time Data
Discrete Sequence
Multimedia Data
Research Field
Data Flow Analysis
Complex Network Analysis
Web Mining
Recommendation System
Social Network Analysis
NLP Analysis

# OpenPerf Suite Architecture



Goal
Healthy and Sustainable Development of Open-source Software Ecosystem
❶ Support
❷ Decomposition

Scene
Open-source Ecological Strategy
Ecosystem Population Information
Evolution of the Technology Ecosystem
Supply Chain Identification and Situation
Enterprise Open-source Governance
Open-source Component Selection
Open-Source Software Compliance
Supply Chain Security
Open-source Software Development
CI/CD Process
Bot Automation
Development Efficiency Optimization
Open-source Community Operations
Community Role Management
Project/Developer Recommendations
Calculate Open-source Contribution

❸ Explore
❺

Benchmark Space
Framework
Task Name
Scene
Type
Dataset
Model
Evaluation Criteria
GitHub Missing Data Completion
OSS Robot Classification
Sentiment Classification
Supply Chain Risk Prediction
Project Influence Ranking
Archive Project Forecast
Ecological Network Construction
Community Anomaly Detection
Developer/Repository Recommendations

❼
Explore ❹
❽

Knowledge
General Task
Data Preprocessing
Clustering
Classification
Association pattern
Anomaly detection
❻
Data Field
Text Data
Graphs and Networks
Time-series
Space-time Data
Discrete Sequence
Multimedia Data
Research Field
Data Flow Analysis
Complex Network Analysis
Web Mining
Recommendation System
Social Network Analysis
NLP Analysis

**Table 1: Benchmarking Tasks**

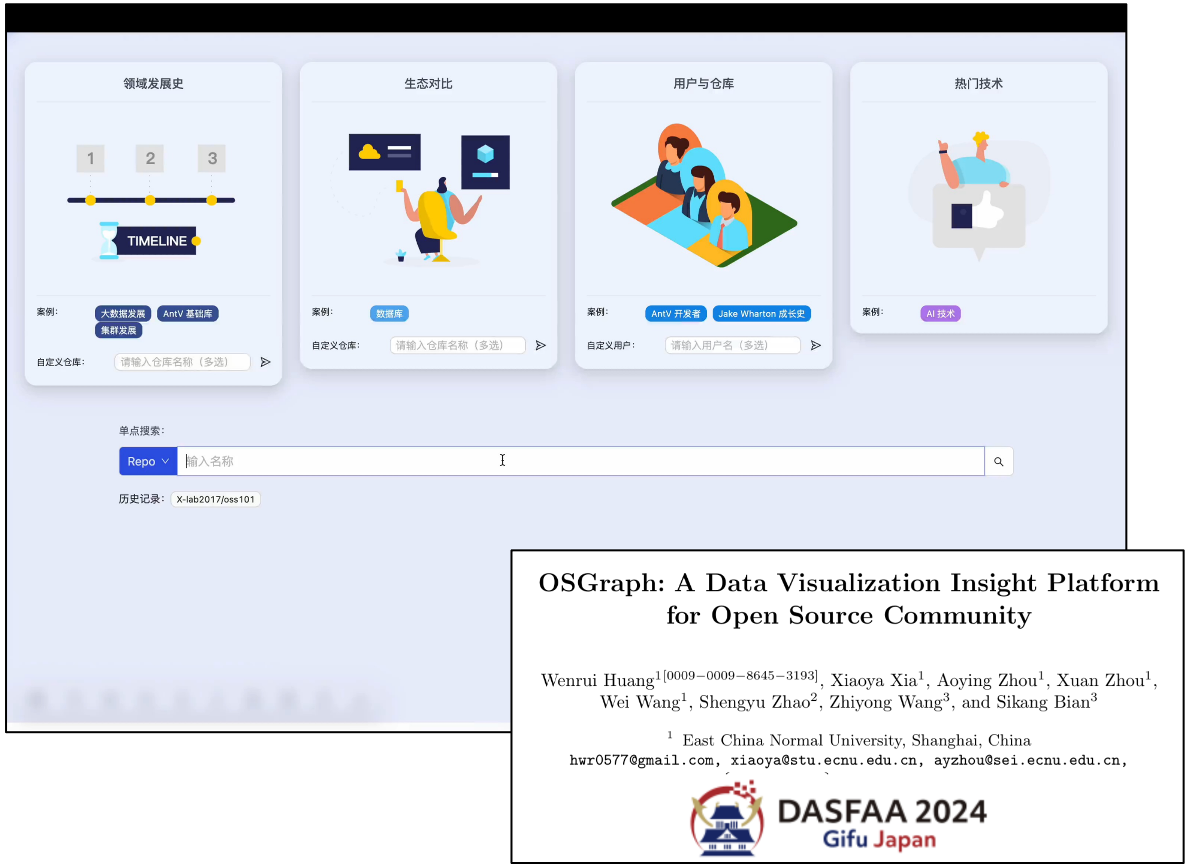
| Benchmarking Task | Data Type | Problem Type | Scene | Research Field |
|---|---|---|---|---|
| Behavior Data Completion and Prediction[11] | Time Series | Regression | Enterprise Governance | Data Flow |
| OSS Bot Identification and Classification[6] | Time Series | Classification | Software Development | Data Flow |
| Community Sentiment Classification[54, 62] | Text Data | Classification | Community Operations | NLP |
| Software Supply Chain Risk Prediction[32] | Time Series | Regression | Ecosystem Strategy | Complex Networks |
| Project Influence Ranking[68] | Graph & Network | Ranking | Community Operations | Complex Networks |
| Archived Project Prediction[60] | Time Series | Regression | Enterprise Governance | Web Mining |
| Network Metric Prediction[59] | Graph & Network | Regression | Enterprise Governance | Data Flow |
| Community Anomalous Detection[10] | Time Series | Anomaly Detection | Enterprise Governance | Complex Networks |
| OSS Project Recommendation[56] | Graph & Network | Recommendation | Community Operations | Recommendation |

**Influence Ranking Comparison Results**

| Repository | Degree Centrality | PageRank | OpenRank |
|---|---|---|---|
| home-assistant/core | 0.015660 | 0.0035 | 2393.86 |
| NixOS/nixpkgs | 0.008743 | 0.0008 | 2207.5 |
| microsoft/vscode | 0.015247 | 0.003 | 1960.39 |
| flutter/flutter | 0.012138 | 0.002 | 1460.34 |
| pytorch/pytorch | 0.009624 | 0.0012 | 1421.18 |
| azure-docs | 0.239616 | 0.08 | 1216.01 |
| dotnet/runtime | 0.004141 | 0.0006 | 1181.12 |
| winget-pkgs | 0.061954 | 0.0075 | 1106.3 |
| godotengine/godot | 0.203330 | 0.045 | 1105.51 |
| odoo/odoo | 0.175534 | 0.043 | 907.97 |

# OSGraph

**OSGraph (Open Source Graph)** is an open-source graph-based analytics tool that leverages the comprehensive graph of GitHub open-source data to provide insights into developer behavior and project community ecosystems. It offers developers, project owners, DevRel advocate, and community operators a clear and intuitive view of open-source data, helping you and your project to create a personalized open-source business card, find compatible development partners, and unearth deep community value.



OSGraph: A Data Visualization Insight Platform for Open Source Community

Wenrui Huang[1][0009−0009−8645−3193], Xiaoya Xia[1], Aoying Zhou[1], Xuan Zhou[1], Wei Wang[1], Shengyu Zhao[2], Zhiyong Wang[3], and Sikang Bian[3]

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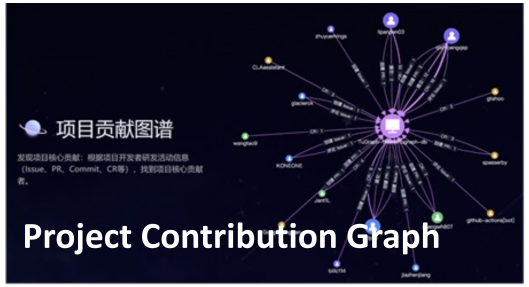
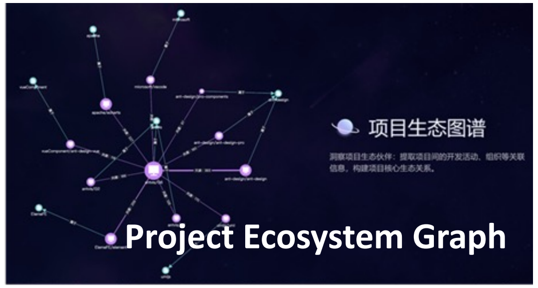
DASFAA 2024
Gifu Japan



项目贡献图谱

发现项目核心贡献：根据项目开发者研发活动信息（Issue、PR、Commit、CR等），找到项目核心贡献者。

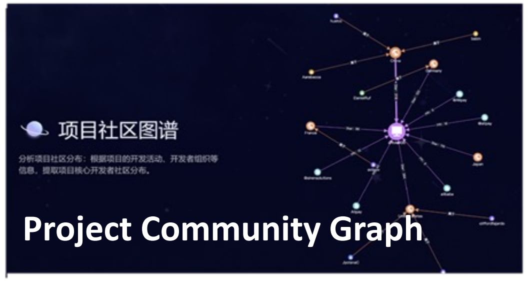
Project Contribution Graph



项目生态图谱

洞察项目生态伙伴：提取项目间的开发活动、组织等关联信息，构建项目核心生态关系。

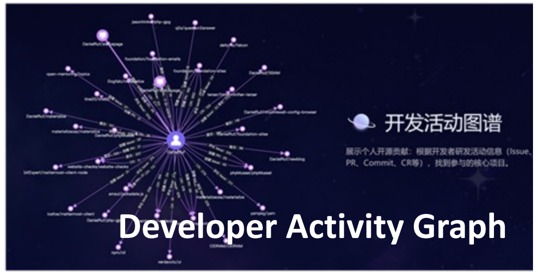
Project Ecosystem Graph



项目社区图谱

分析项目社区分布：根据项目的开发活动、开发者组织等信息，提取项目核心开发者社区分布。

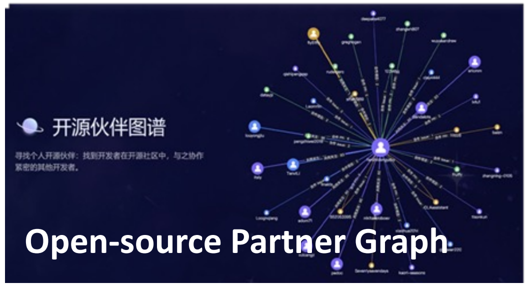
Project Community Graph



开发活动图谱

展示个人开源贡献：根据开发者研发活动信息（Issue、PR、Commit、CR等），找到参与的核心项目。

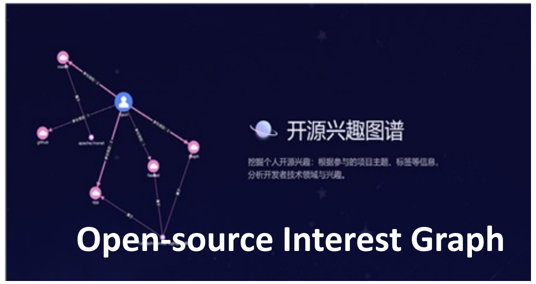
Developer Activity Graph



开源伙伴图谱

寻找个人开源伙伴：找到开发者在开源社区中，与之协作紧密的其他开发者。

Open-source Partner Graph



开源兴趣图谱

挖掘个人开源兴趣：根据参与的项目主题、标签等信息，分析开发者技术领域与兴趣。

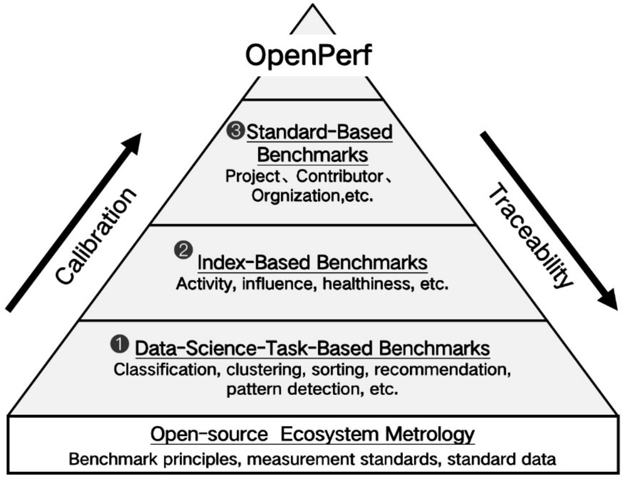
Open-source Interest Graph

Wenrui Huang, Xiaoya Xia, Shengyu Zhao, Wei Wang, **OSGraph: A Data Visualization Insight Platform for Open Source Community**, DASFFA, 2024

# OpenPerf × OSGraph

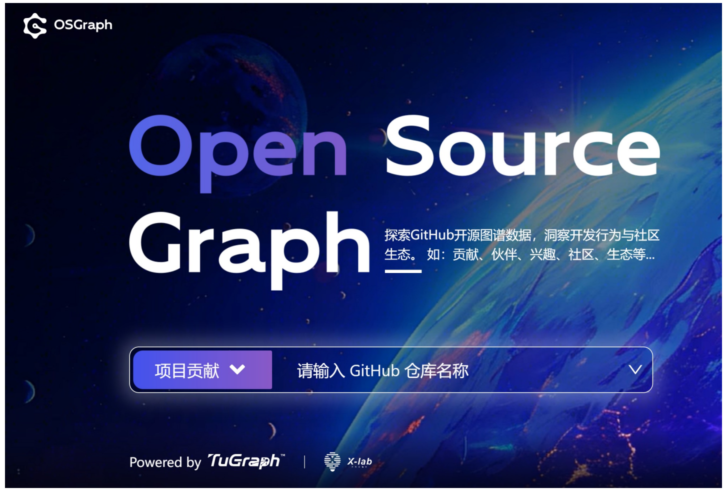
| Scenario / Task | Graph Data Mining Tasks | Graph Neural Network Analysis Tasks | Network Science Tasks |
|---|---|---|---|
| Project Contribution Graph | • Attribute Analysis<br>• Graph Matching<br>• Graph Retrieval<br>• Graph Clustering<br>• Graph Classification<br>• Frequent Subgraph Mining<br>• Graph Pattern<br>• Link Prediction<br>• Anomaly Detection | • Representation Learning<br>• Node Classification<br>• Graph Classification<br>• Link Prediction<br>• Graph Matching<br>• AutoML<br>• Dynamic Graphs<br>• Heterogeneous Graphs | • Properties Analysis<br>• Models Analysis<br>• Evolution<br>• Degree Correlation<br>• Robustness Analysis<br>• Communities Analysis<br>• Propagation |
| Project Ecosystem Graph | | | |
| Project Community Graph | | | |
| Developer Activity Graph | | | |
| Open-source Partner Graph | | | |
| Open-source Interest Graph | | | |

# Connected World = OpenPerf × OSGraph × ...



OpenPerf
Calibration
Traceability
❸ Standard-Based Benchmarks
Project、Contributor、Orgnization,etc.
❷ Index-Based Benchmarks
Activity, influence, healthiness, etc.
❶ Data-Science-Task-Based Benchmarks
Classification, clustering, sorting, recommendation, pattern detection, etc.
Open-source Ecosystem Metrology
Benchmark principles, measurement standards, standard data

×



OSGraph

Open Source Graph

探索GitHub开源图谱数据，洞察开发行为与社区生态。如：贡献、伙伴、兴趣、社区、生态等...

×

GitHub

dblp computer science bibliography

arXiv

stackoverflow

slack

# References

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