Open Source Software in CMS

Centers for Medicare and Medicaid Services | Digital Service - Open Source Team

Nicholas Jean, Full-Stack Software Engineer Fellow | *UC Berkeley, Computer Science*

Brandon Yee, Full-Stack Software Engineer Fellow | *Yale, Computer Science*

Ricardo Zamora, Full-Stack Software Engineer Fellow | *Wesleyan University, Computer Science*

Keywords:

LLMs, User Interface, Process Automations, Open-Source (Best Practices, Standards, Metadata), Sorting/Filtering, Python, Automation, Data Visualization, API Endpoints, JavaScript, Full-Stack

Summary:

During their summer internship, Nicholas, Brandon and Ricardo each made significant contributions to various projects. Ricardo laid the groundwork for establishing code.json as an agency-wide metadata standard by adding Cookiecutter prompts to generate code.json files with project metadata. He also worked on both the backend and frontend of the metrics site, creating a new API endpoint for the project code.json fields, adding sorting and filtering features based on project data to improve user experience, and visualizing top committers for each organization. Brandon added several contributions to the repository metrics project, enabling developers to estimate the cost, time, and labor associated with software projects, and to the repository scaffolder project, which automates the input of required open-source documentation. He also added frontend tests to the dedupliFHIR Electron app. Nicholas developed a multimodal LLM assistant via Ollama to help users navigate the office's Murals, created the brand identity for CMS's dedupliFHIR Electron app by designing its icon, added new Cookiecutter CLI variables for the MAINTAINERS.md in the repo-scaffolder project, and used the GitHub API to fetch data on the predominant languages of repositories in the repository metrics project. Together, they laid a strong foundation for these projects and contributed to the agency's open-source initiatives.

DIGITAL SERVICE AT CMS

Coding it Forward Fellowship Final Presentation

Digital Service at CMS // August 2024

Nicholas Jean
Brandon Yee
Ricardo Zamora

coding it forward >

creative commons
PUBLIC DOMAIN

Open Source Program Office (OSPO) at CMS

1. About CMS and Our OSPO
2. Repo-Scaffolder
3. dedupliFHIR
4. Metrics
5. Open
6. Ollama

What does the Digital Service at CMS do?

We work to transform the U.S. healthcare system by:

Improving the design of healthcare experiences

Delivering value to the government, healthcare providers, and patients

Modernizing systems

Participating in policy development

How do we do it?

By hiring great talent!

We deploy **small groups** of designers, engineers, and product managers on a "tour of duty" to work alongside **dedicated civil servants**.

These **multidisciplinary teams** bring best practices and new approaches to support government **modernization** efforts.

Who we serve: The American People

65 M

Medicare Beneficiaries

(2022)

88 M

Medicaid Beneficiaries

(2022)

31 M

Healthcare.gov

(2021)

https://data.cms.gov/fact-sheet/cms-fast-facts
https://www.cms.gov/files/document/2022-medicare-trustees-report.pdf

Who we serve: Taxpayers

$ 1.7 T

CMS Budget - 12% of the federal budget

(FY 2022)

$ 829 B

Total Medicare Payments

(FY 2021)

$ 646 B

Total Medicaid Payments

(FY 2019)

https://data.cms.gov/fact-sheet/cms-fast-facts
https://www.cms.gov/files/document/2022-medicare-trustees-report.pdf

Who we serve: The Health Care System

6,244

CMS Employees

(FY 2022)

1.4M

Health Care Providers

(2022)

20%

National Health Care Spending is Medicare

(2022)

https://data.cms.gov/fact-sheet/cms-fast-facts
https://www.cms.gov/files/document/2022-medicare-trustees-report.pdf

CMS Open Source Program Office (OSPO) Functional Statement:

"Establishes and maintains guidance, policies, practices, and talent pipelines that ***advance equity****,* ***build trust****, and* ***amplify impact*** *across CMS, HHS, and Federal Open Source Ecosystems by working and sharing openly."*

How do we do Open Source at CMS?

Policies

How we **inbound** and **outbound** open source contributions and content

Projects

How we **solve real-world problems** by working in the open

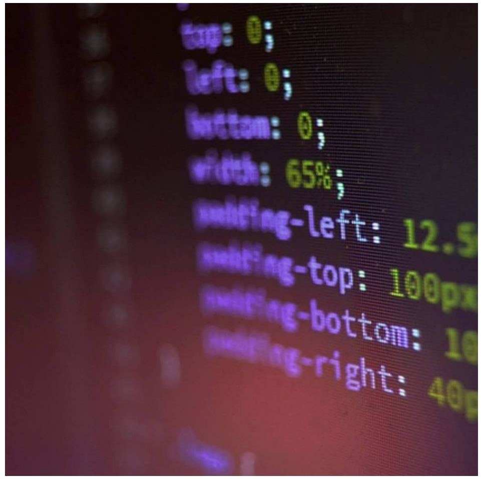
Programs

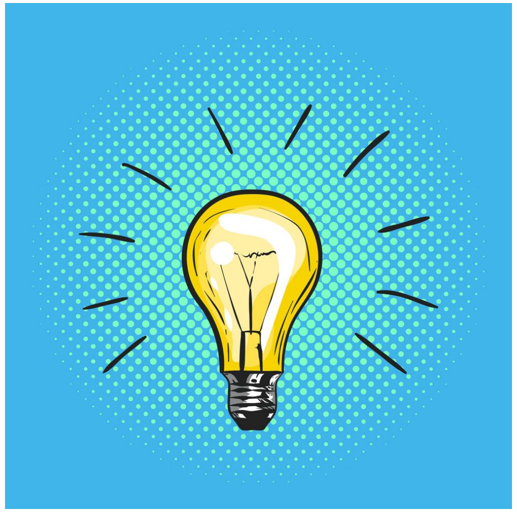
How we **measure**, and **manage** contributors, projects, **risks**, and **opportunities**

repo-scaffolder

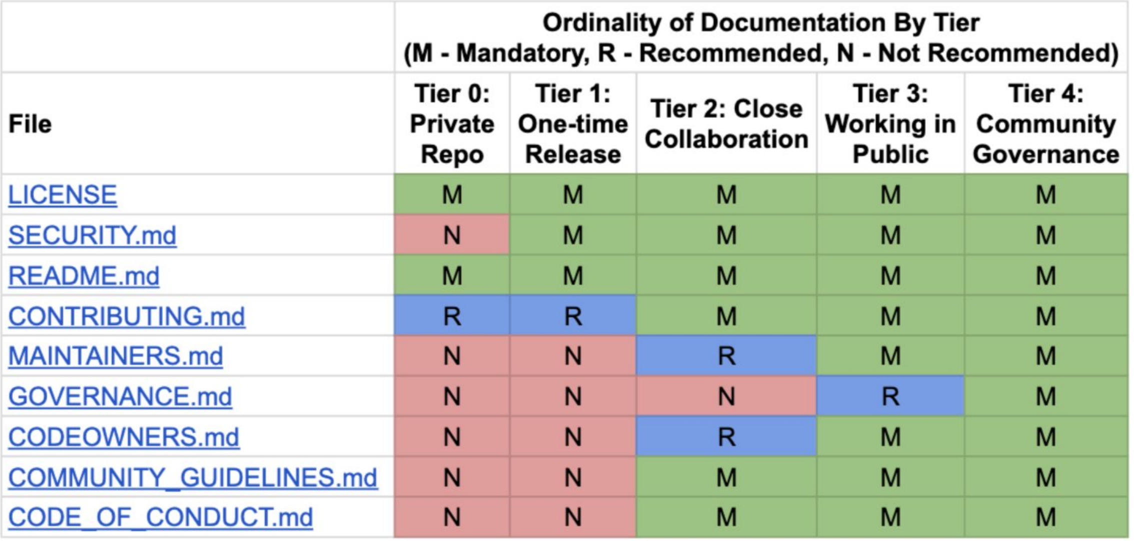
Purpose

Promote open-source best practices & standards and align with Code.gov’s mission by integrating metadata management processes, overall promoting code quality and maintainability.

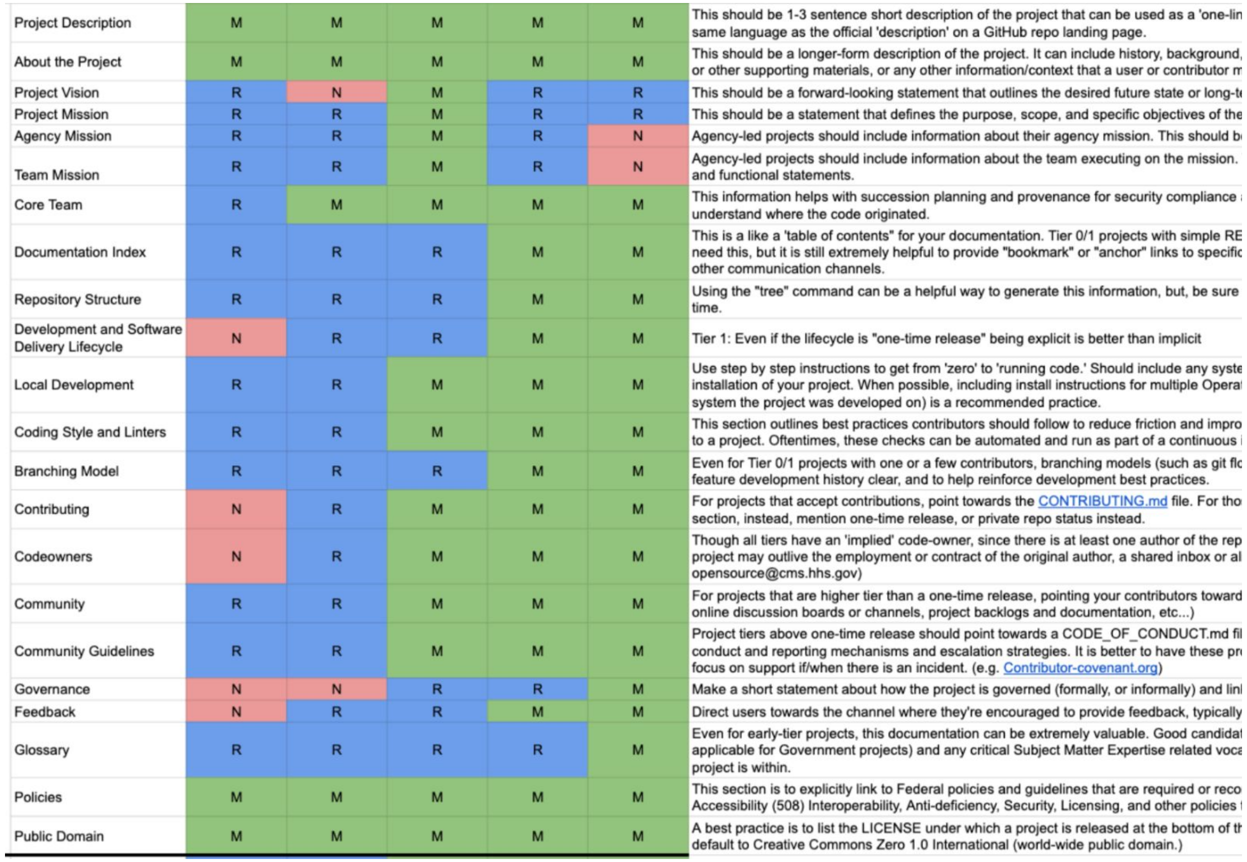




Tiers



	Ordinality of Documentation By Tier (M - Mandatory, R - Recommended, N - Not Recommended)				
File	Tier 0: Private Repo	Tier 1: One-time Release	Tier 2: Close Collaboration	Tier 3: Working in Public	Tier 4: Community Governance
LICENSE	M	M	M	M	M
SECURITY.md	N	M	M	M	M
README.md	M	M	M	M	M
CONTRIBUTING.md	R	R	M	M	M
MAINTAINERS.md	N	N	R	M	M
GOVERNANCE.md	N	N	N	R	M
CODEOWNERS.md	N	N	R	M	M
COMMUNITY_GUIDELINES.md	N	N	M	M	M
CODE_OF_CONDUCT.md	N	N	M	M	M



Project Description	M	M	M	M	M	This should be 1-3 sentence short description of the project that can be used as a 'one-lin same language as the official 'description' on a GitHub repo landing page.
About the Project	M	M	M	M	M	This should be a longer-form description of the project. It can include history, background, or other supporting materials, or any other information/context that a user or contributor m
Project Vision	R	N	M	R	R	This should be a forward-looking statement that outlines the desired future state or long-t
Project Mission	R	R	M	R	R	This should be a statement that defines the purpose, scope, and specific objectives of the
Agency Mission	R	R	M	R	N	Agency-led projects should include information about their agency mission. This should b
Team Mission	R	R	M	R	N	Agency-led projects should include information about the team executing on the mission. and functional statements.
Core Team	R	M	M	M	M	This information helps with succession planning and provenance for security compliance understand where the code originated.
Documentation Index	R	R	R	M	M	This is a like a 'table of contents" for your documentation. Tier 0/1 projects with simple RE need this, but it is still extremely helpful to provide "bookmark" or "anchor" links to specifi other communication channels.
Repository Structure	R	R	R	M	M	Using the "tree" command can be a helpful way to generate this information, but, be sure time.
Development and Software Delivery Lifecycle	N	R	R	M	M	Tier 1: Even if the lifecycle is "one-time release" being explicit is better than implicit
Local Development	R	R	M	M	M	Use step by step instructions to get from 'zero' to 'running code.' Should include any syste installation of your project. When possible, including install instructions for multiple Opera system the project was developed on) is a recommended practice.
Coding Style and Linters	R	R	M	M	M	This section outlines best practices contributors should follow to reduce friction and impro to a project. Oftentimes, these checks can be automated and run as part of a continuous
Branching Model	R	R	R	M	M	Even for Tier 0/1 projects with one or a few contributors, branching models (such as git fl feature development history clear, and to help reinforce development best practices.
Contributing	N	R	M	M	M	For projects that accept contributions, point towards the CONTRIBUTING.md file. For tho section, instead, mention one-time release, or private repo status instead.
Codeowners	N	R	M	M	M	Though all tiers have an 'implied' code-owner, since there is at least one author of the rep project may outlive the employment or contract of the original author, a shared inbox or al opensource@cms.hhs.gov)
Community	R	R	M	M	M	For projects that are higher tier than a one-time release, pointing your contributors toward online discussion boards or channels, project backlogs and documentation, etc...)
Community Guidelines	R	R	M	M	M	Project tiers above one-time release should point towards a CODE_OF_CONDUCT.md fi conduct and reporting mechanisms and escalation strategies. It is better to have these pr focus on support if/when there is an incident. (e.g. Contributor-covenant.org)
Governance	N	N	R	R	M	Make a short statement about how the project is governed (formally, or informally) and lin
Feedback	N	R	R	M	M	Direct users towards the channel where they're encouraged to provide feedback, typically
Glossary	R	R	R	R	M	Even for early-tier projects, this documentation can be extremely valuable. Good candida applicable for Government projects) and any critical Subject Matter Expertise related voca project is within.
Policies	M	M	M	M	M	This section is to explicitly link to Federal policies and guidelines that are required or reco Accessibility (508) Interoperability, Anti-deficiency, Security, Licensing, and other policies
Public Domain	M	M	M	M	M	A best practice is to list the LICENSE under which a project is released at the bottom of th default to Creative Commons Zero 1.0 International (world-wide public domain.)

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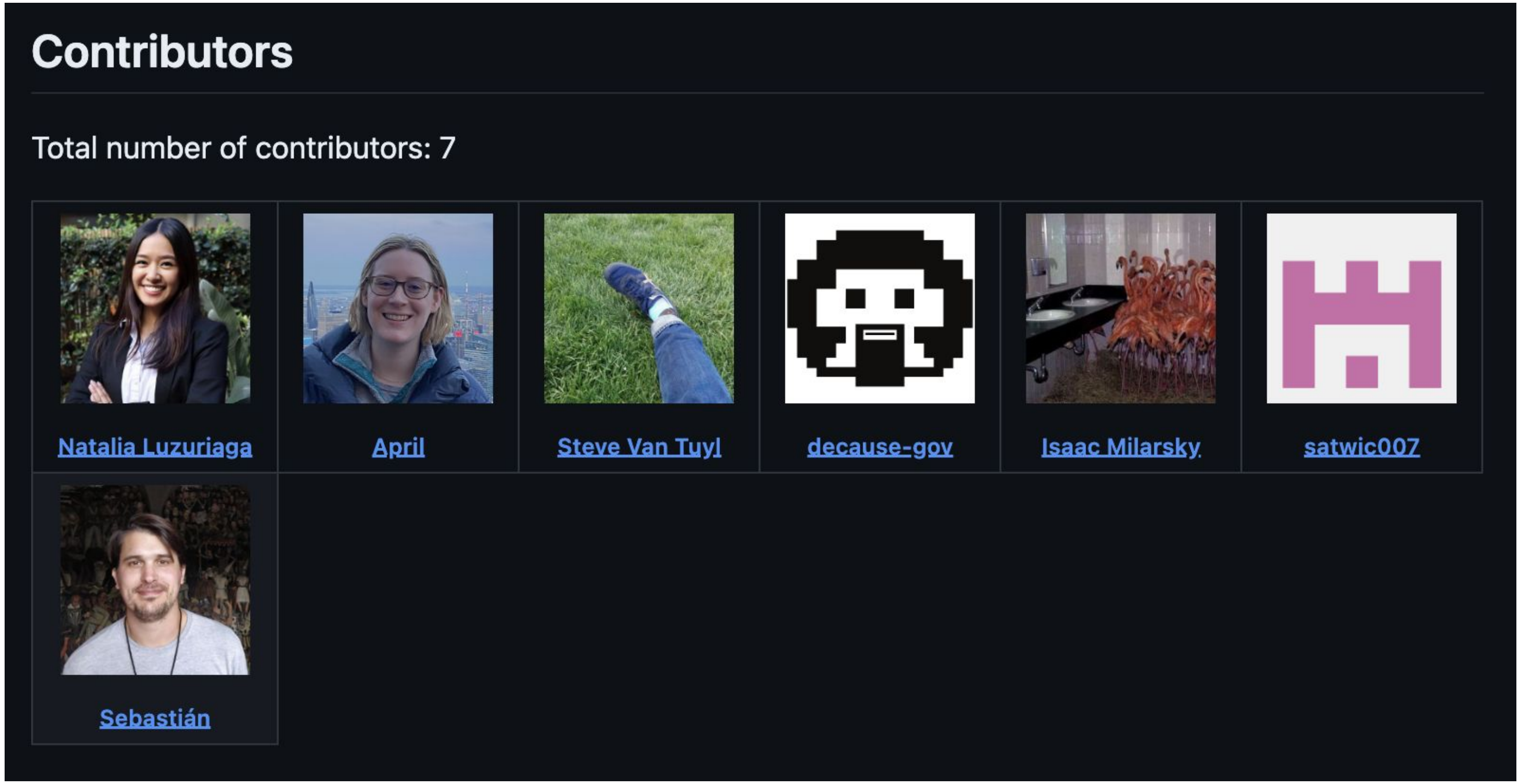
Automation of Contributors



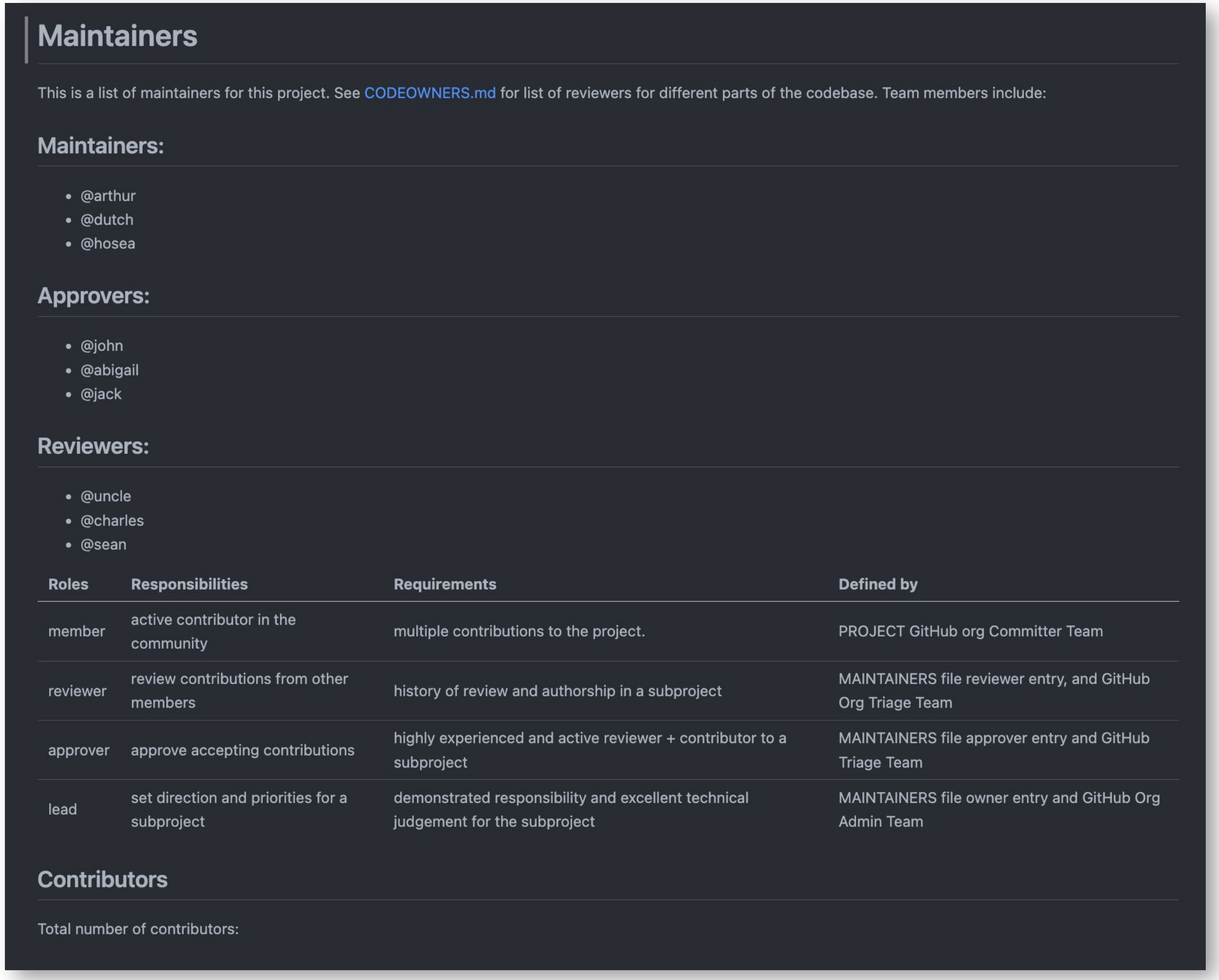
Contributors

Total number of contributors: 7

Natalia Luzuriaga	April	Steve Van Tuyl	decause-gov	Isaac Milarsky	satwic007
Sebastián					

Slugification of MAINTAINERS.md

Tier 4



Maintainers

This is a list of maintainers for this project. See CODEOWNERS.md for list of reviewers for different parts of the codebase. Team members include:

Maintainers:

- @arthur
- @dutch
- @hosea

Approvers:

- @john
- @abigail
- @jack

Reviewers:

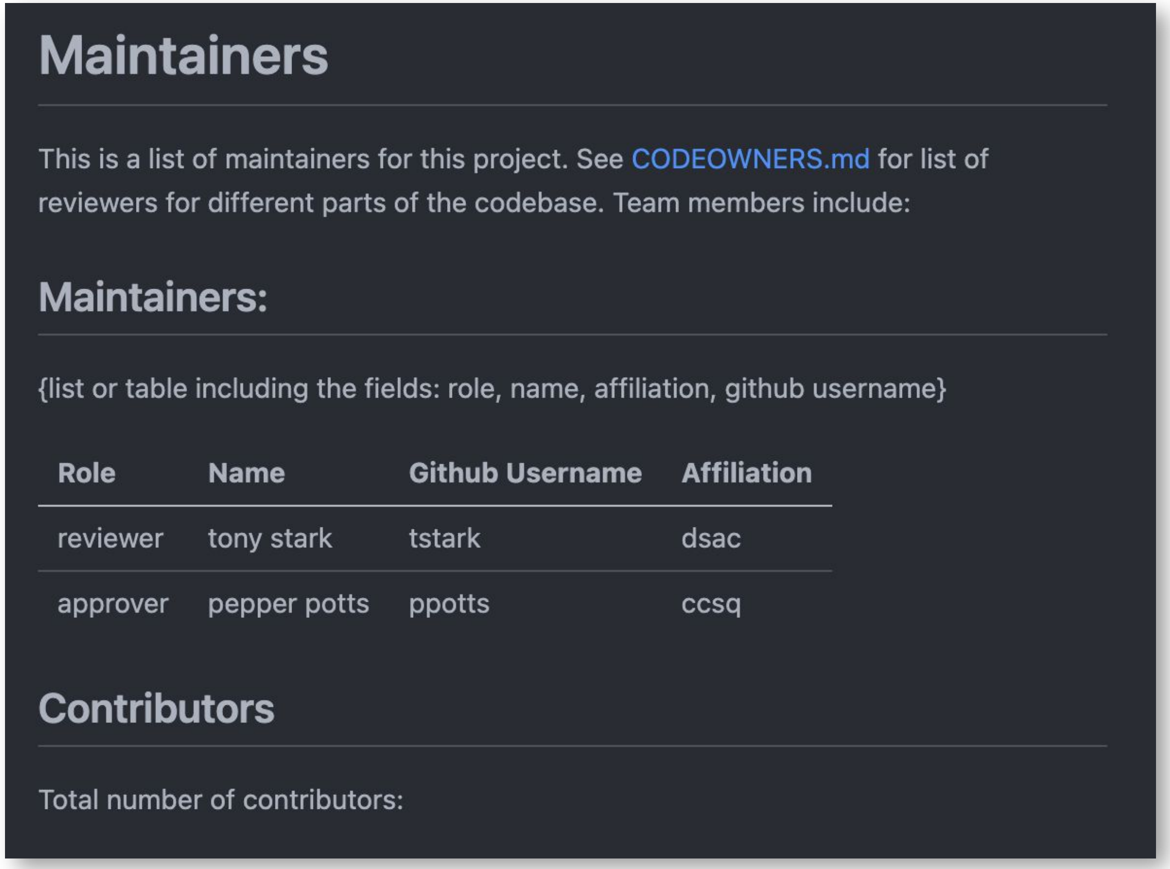
- @uncle
- @charles
- @sean

Roles	Responsibilities	Requirements	Defined by
member	active contributor in the community	multiple contributions to the project.	PROJECT GitHub org Committer Team
reviewer	review contributions from other members	history of review and authorship in a subproject	MAINTAINERS file reviewer entry, and GitHub Org Triage Team
approver	approve accepting contributions	highly experienced and active reviewer + contributor to a subproject	MAINTAINERS file approver entry and GitHub Triage Team
lead	set direction and priorities for a subproject	demonstrated responsibility and excellent technical judgement for the subproject	MAINTAINERS file owner entry and GitHub Org Admin Team

Contributors

Total number of contributors:

Tier 2



Maintainers

This is a list of maintainers for this project. See CODEOWNERS.md for list of reviewers for different parts of the codebase. Team members include:

Maintainers:

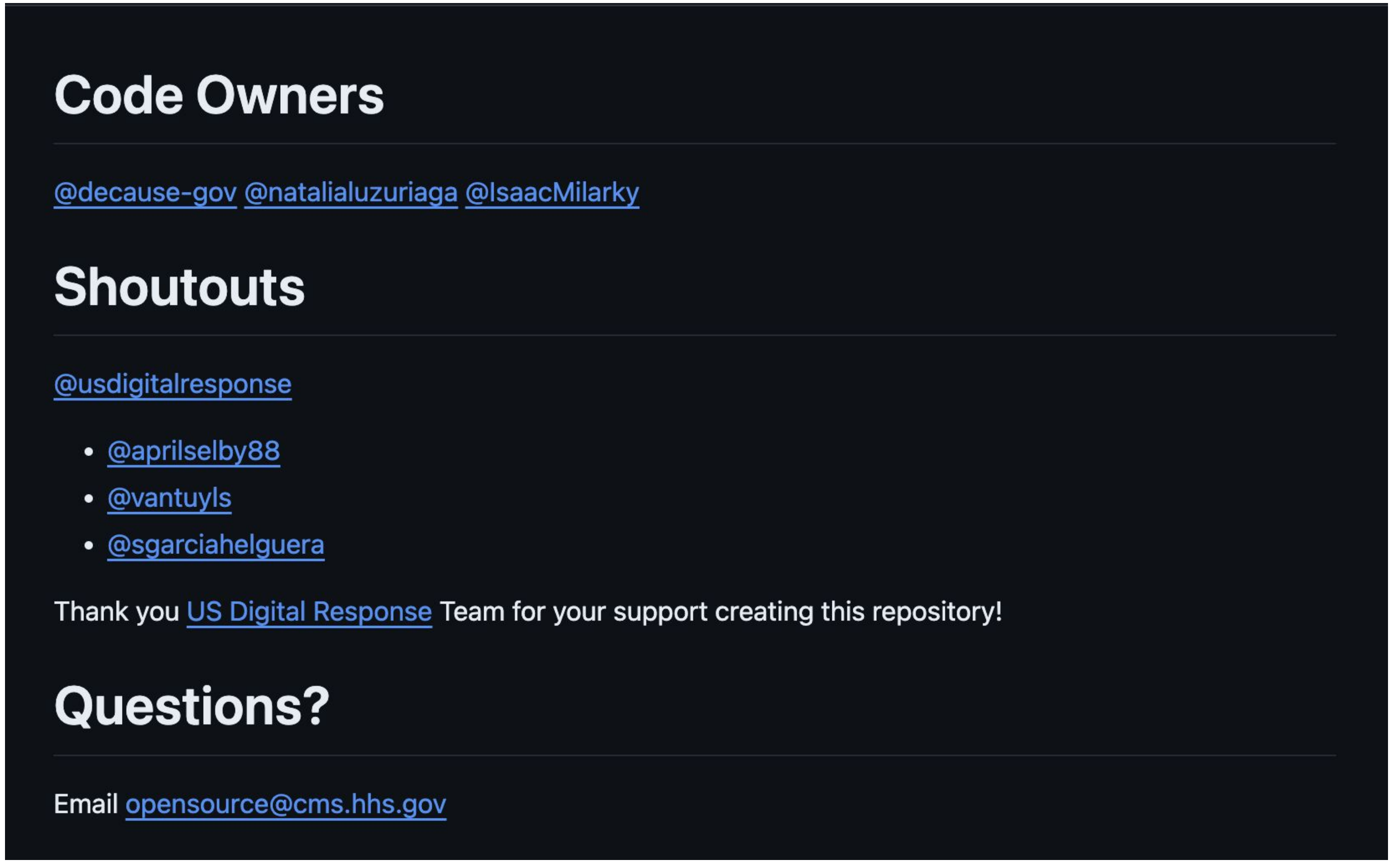
{list or table including the fields: role, name, affiliation, github username}

Role	Name	Github Username	Affiliation
reviewer	tony stark	tstark	dsac
approver	pepper potts	ppotts	ccsq

Contributors

Total number of contributors:

Slugification of CODEOWNERS.md



Code Owners

@decause-gov @natalialuzuriaga @IsaacMilarky

Shoutouts

@usdigitalresponse

- @aprilselby88
- @vantuyls
- @sgarciahelguera

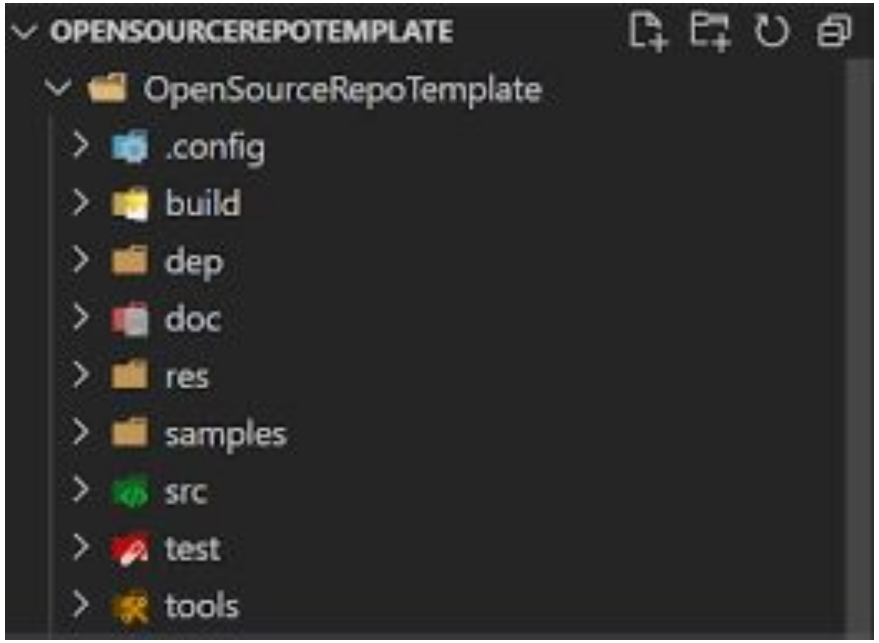
Thank you US Digital Response Team for your support creating this repository!

Questions?

Email opensource@cms.hhs.gov

Generate Repository Structure Documentation

tree -d



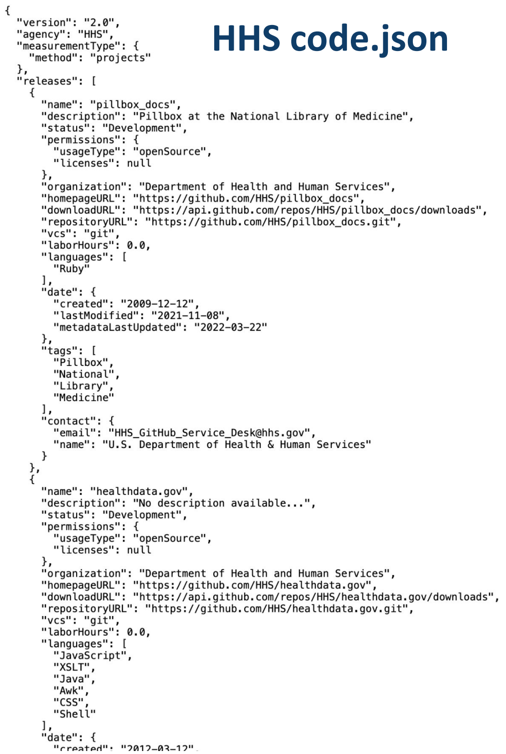
OPENSOURCEREPOTEMPLATE

- OpenSourceRepoTemplate
  - .config
  - build
  - dep
  - doc
  - res
  - samples
  - src
  - test
  - tools

Code.json

A standardized metadata file used by U.S. federal agencies to catalog their open-source projects.

HHS code.json

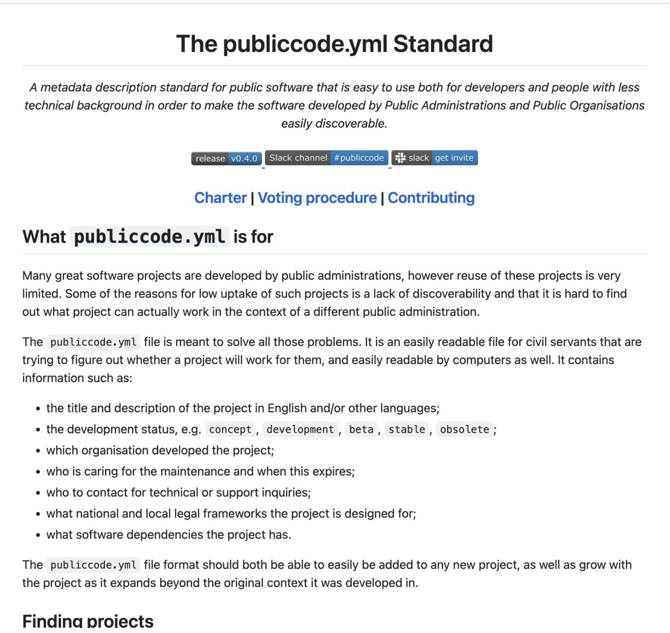


```
{
  "version": "2.0",
  "agency": "HHS",
  "measurementType": {
    "method": "projects"
  },
  "releases": [
    {
      "name": "pillbox_docs",
      "description": "Pillbox at the National Library of Medicine",
      "status": "Development",
      "permissions": {
        "usageType": "openSource",
        "licenses": null
      },
      "organization": "Department of Health and Human Services",
      "homepageURL": "https://github.com/HHS/pillbox_docs",
      "downloadURL": "https://api.github.com/repos/HHS/pillbox_docs/downloads",
      "repositoryURL": "https://github.com/HHS/pillbox_docs.git",
      "vcs": "git",
      "laborHours": 0.0,
      "languages": [
        "Ruby"
      ],
      "date": {
        "created": "2009-12-12",
        "lastModified": "2021-11-08",
        "metadataLastUpdated": "2022-03-22"
      },
      "tags": [
        "Pillbox",
        "National",
        "Library",
        "Medicine"
      ],
      "contact": {
        "email": "HHS_GitHub_Service_Desk@hhs.gov",
        "name": "U.S. Department of Health & Human Services"
      }
    },
    {
      "name": "healthdata.gov",
      "description": "No description available...",
      "status": "Development",
      "permissions": {
        "usageType": "openSource",
        "licenses": null
      },
      "organization": "Department of Health and Human Services",
      "homepageURL": "https://github.com/HHS/healthdata.gov",
      "downloadURL": "https://api.github.com/repos/HHS/healthdata.gov/downloads",
      "repositoryURL": "https://github.com/HHS/healthdata.gov.git",
      "vcs": "git",
      "laborHours": 0.0,
      "languages": [
        "JavaScript",
        "XSLT",
        "Java",
        "Awk",
        "CSS",
        "Shell"
      ],
      "date": {
        "created": "2012-03-12",
```

publiccode.yml

International standardized metadata file particularly used by Europe to document and share information about open-source software projects.

Examples



The publiccode.yml Standard

A metadata description standard for public software that is easy to use both for developers and people with less technical background in order to make the software developed by Public Administrations and Public Organisations easily discoverable.

Charter | Voting procedure | Contributing

What `publiccode.yml` is for

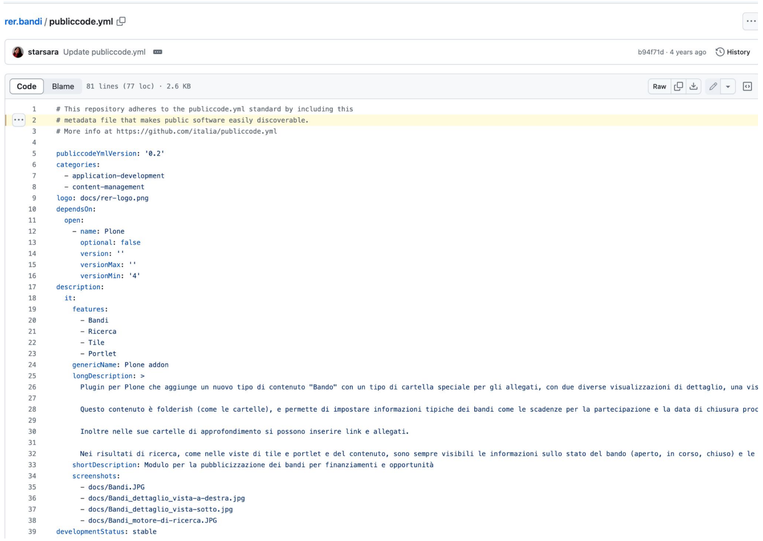
Many great software projects are developed by public administrations, however reuse of these projects is very limited. Some of the reasons for low uptake of such projects is a lack of discoverability and that it is hard to find out what project can actually work in the context of a different public administration.

The `publiccode.yml` file is meant to solve all those problems. It is an easily readable file for civil servants that are trying to figure out whether a project will work for them, and easily readable by computers as well. It contains information such as:

- the title and description of the project in English and/or other languages;
- the development status, e.g. `concept`, `development`, `beta`, `stable`, `obsolete`;
- which organisation developed the project;
- who is caring for the maintenance and when this expires;
- who to contact for technical or support inquiries;
- what national and local legal frameworks the project is designed for;
- what software dependencies the project has.

The `publiccode.yml` file format should both be able to easily be added to any new project, as well as grow with the project as it expands beyond the original context it was developed in.

Finding projects

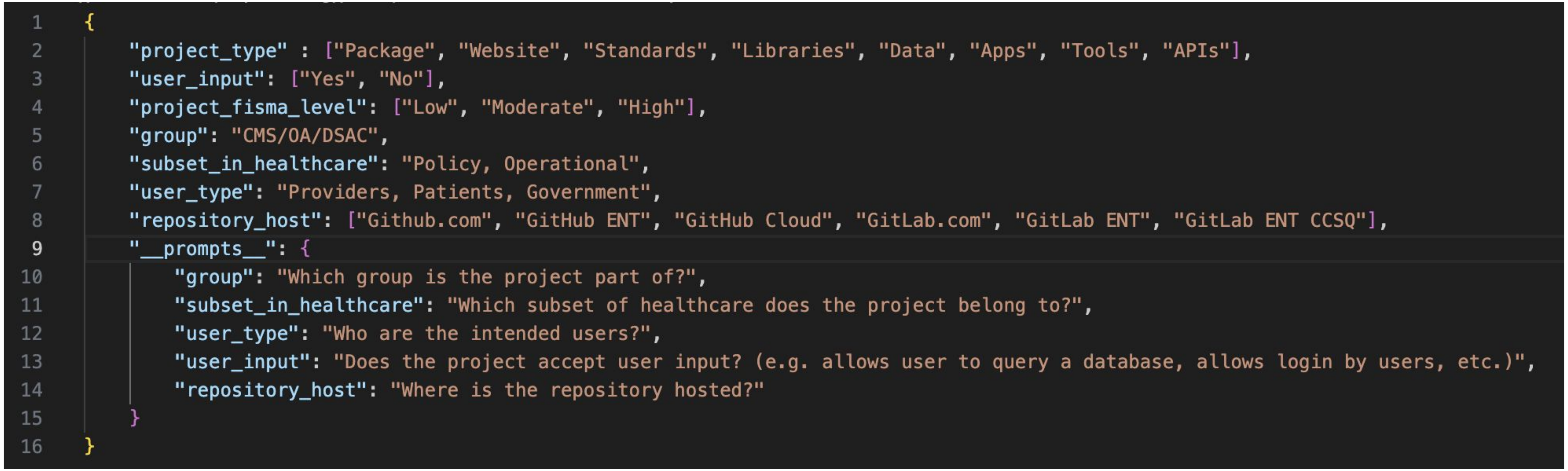


rer.bandi / publiccode.yml
starsara Update publiccode.yml
b94f71d · 4 years ago
History
Code
Blame
81 lines (77 loc) · 2.6 KB
Raw

```
# This repository adheres to the publiccode.yml standard by including this
# metadata file that makes public software easily discoverable.
# More info at https://github.com/italia/publiccode.yml

publiccodeYmlVersion: '0.2'
categories:
  - application-development
  - content-management
logo: docs/rer-logo.png
dependsOn:
  open:
    - name: Plone
      optional: false
      version: ''
      versionMax: ''
      versionMin: '4'
description:
  it:
    features:
      - Bandi
      - Ricerca
      - Tile
      - Portlet
    genericName: Plone addon
    longDescription: >
      Plugin per Plone che aggiunge un nuovo tipo di contenuto "Bando" con un tipo di cartella speciale per gli allegati, con due diverse visualizzazioni di dettaglio, una vis

      Questo contenuto è folderish (come le cartelle), e permette di impostare informazioni tipiche dei bandi come le scadenze per la partecipazione e la data di chiusura proc

      Inoltre nelle sue cartelle di approfondimento si possono inserire link e allegati.

      Nei risultati di ricerca, come nelle viste di tile e portlet e del contenuto, sono sempre visibili le informazioni sullo stato del bando (aperto, in corso, chiuso) e le
    shortDescription: Modulo per la pubblicizzazione dei bandi per finanziamenti e opportunità
    screenshots:
      - docs/Bandi.JPG
      - docs/Bandi_dettaglio_vista-a-destra.jpg
      - docs/Bandi_dettaglio_vista-sotto.jpg
      - docs/Bandi_motore-di-ricerca.JPG
developmentStatus: stable
```

Adding code.json

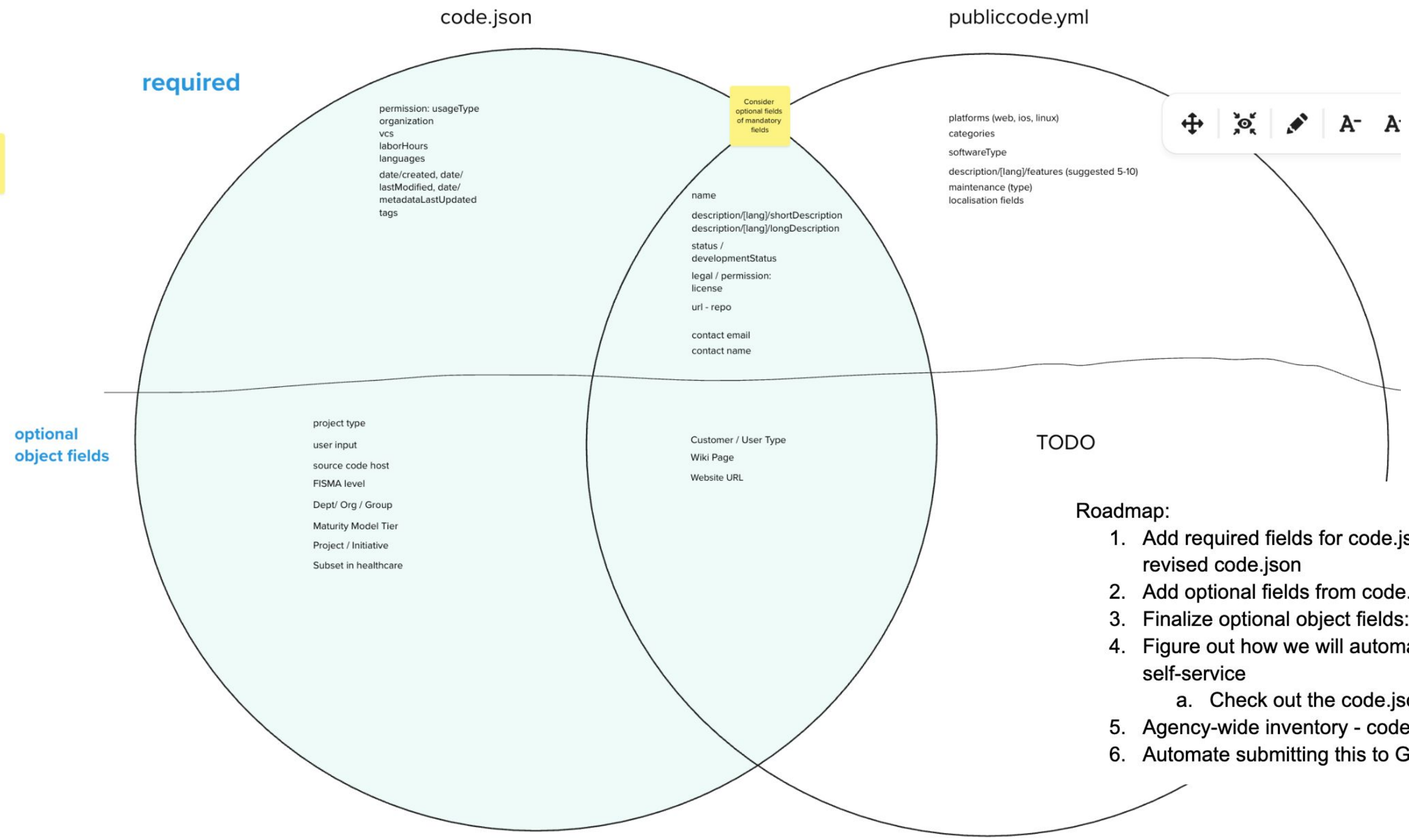
First Implementation:



```json
{
    "project_type" : ["Package", "Website", "Standards", "Libraries", "Data", "Apps", "Tools", "APIs"],
    "user_input": ["Yes", "No"],
    "project_fisma_level": ["Low", "Moderate", "High"],
    "group": "CMS/OA/DSAC",
    "subset_in_healthcare": "Policy, Operational",
    "user_type": "Providers, Patients, Government",
    "repository_host": ["Github.com", "GitHub ENT", "GitHub Cloud", "GitLab.com", "GitLab ENT", "GitLab ENT CCSQ"],
    "__prompts__": {
        "group": "Which group is the project part of?",
        "subset_in_healthcare": "Which subset of healthcare does the project belong to?",
        "user_type": "Who are the intended users?",
        "user_input": "Does the project accept user input? (e.g. allows user to query a database, allows login by users, etc.)",
        "repository_host": "Where is the repository hosted?"
    }
}
```

Adding code.json

What’s Next?

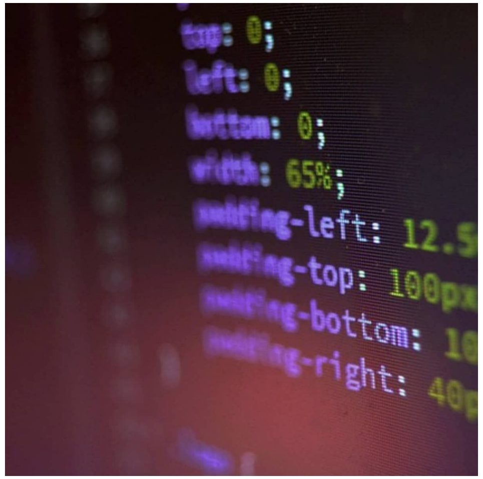


Roadmap:

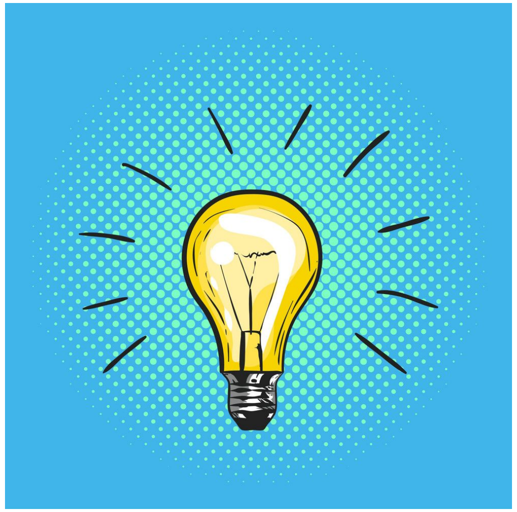
1. Add required fields for code.json + publiccode.yml & create a minimum version of revised code.json
2. Add optional fields from code.json + publiccode.yml and create extended version
3. Finalize optional object fields: CMS-specific fields
4. Figure out how we will automate each of the fields. If cannot be automated, make it self-service
    a. Check out the code.json generators
5. Agency-wide inventory - code.json, generated by the OSPO using metrics website
6. Automate submitting this to GSA

dedupliFHIR

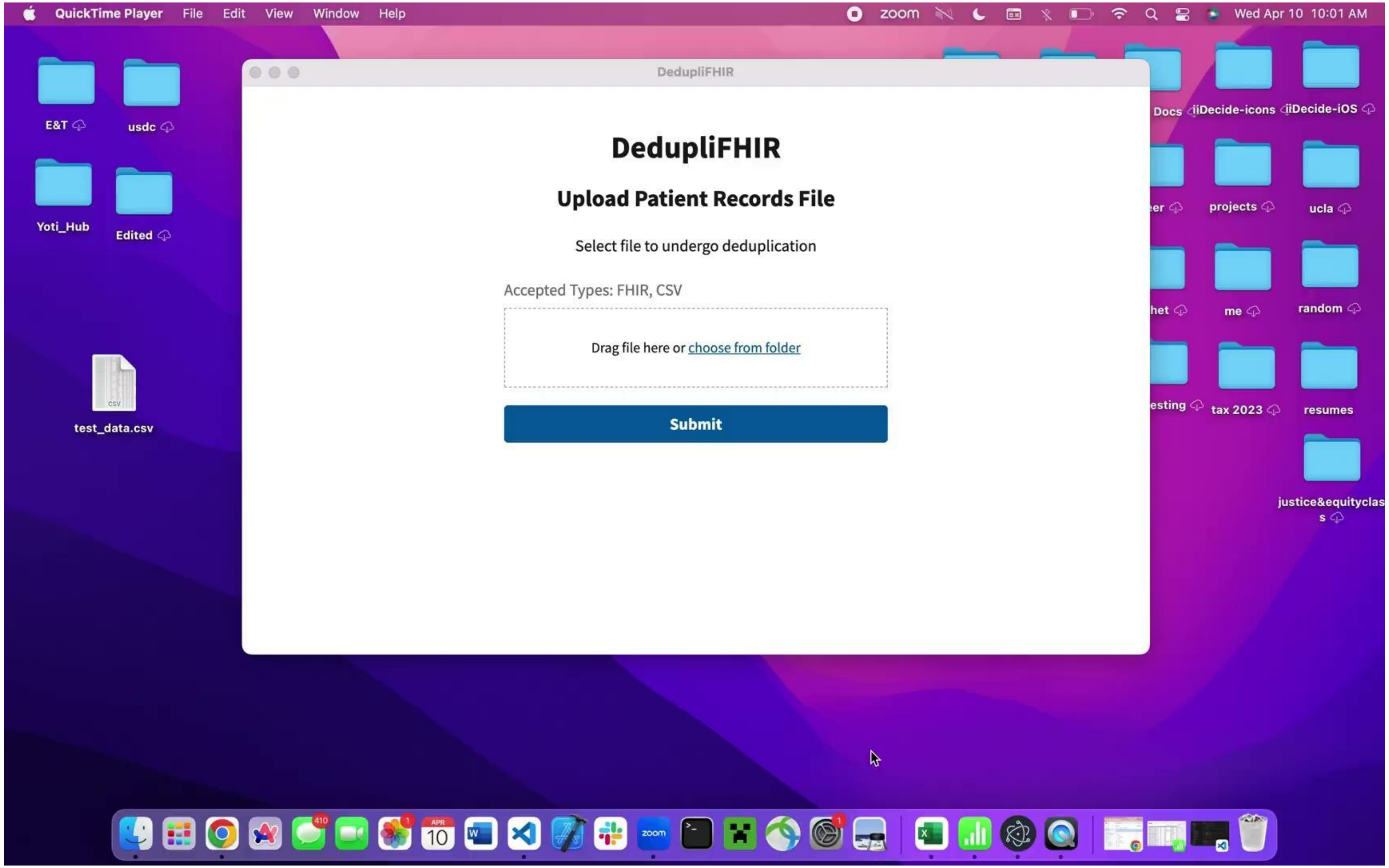
Purpose



dedupliFHIR de-duplicates and aggregates eCQM *(electronic Clinical Quality Measure)* data to ensure accurate and comprehensive quality reporting in healthcare



Demo Video



DedupliFHIR

Upload Patient Records File

Select file to undergo deduplication

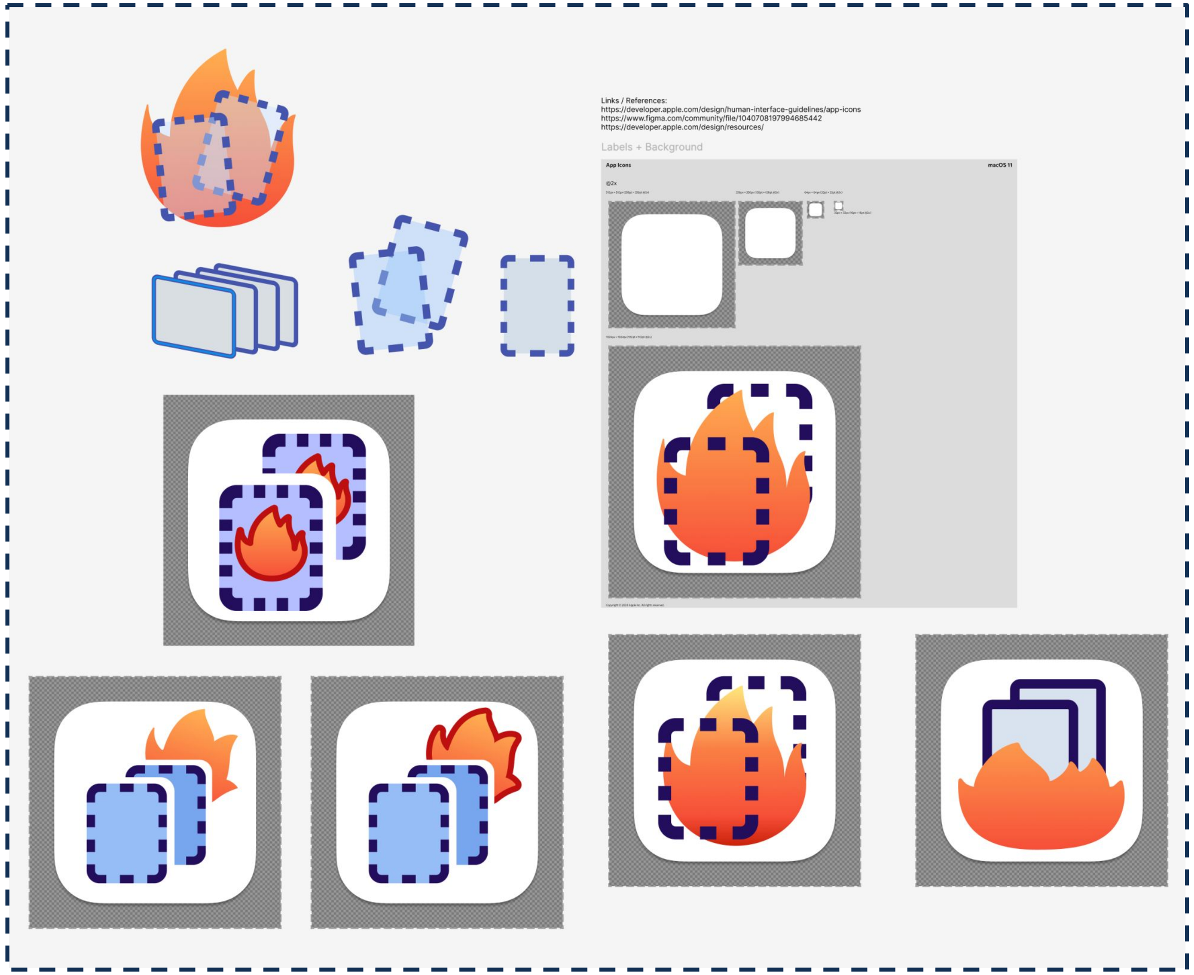
Accepted Types: FHIR, CSV

Drag file here or choose from folder

DIGITAL SERVICE AT CMS

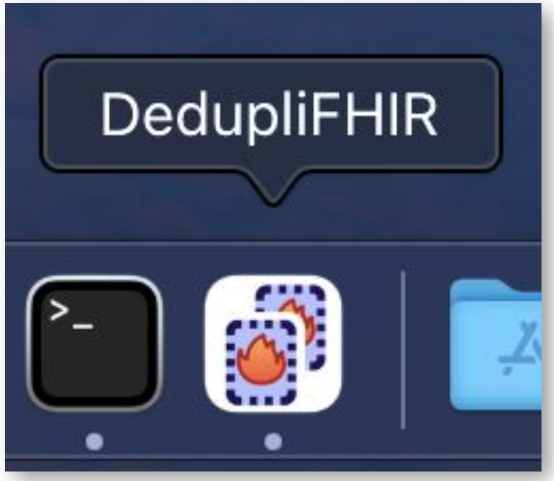
Electron App Icon

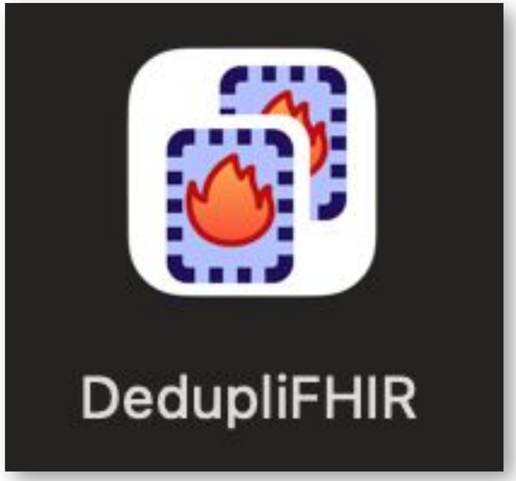
Design

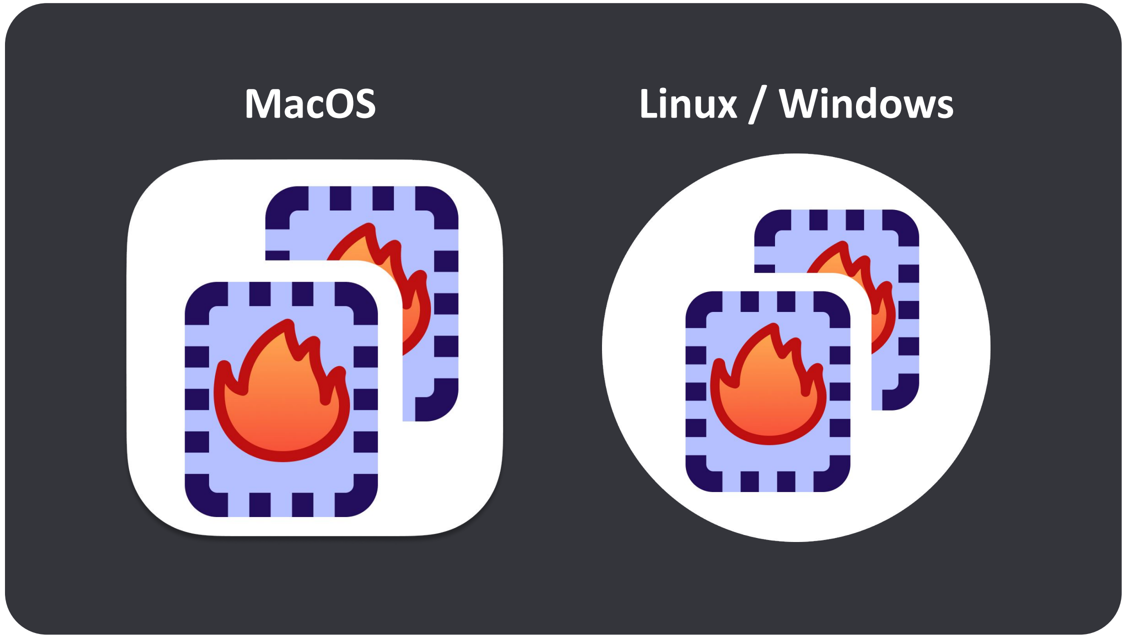


Links / References:
https://developer.apple.com/design/human-interface-guidelines/app-icons
https://www.figma.com/community/file/1040708197994685442
https://developer.apple.com/design/resources/

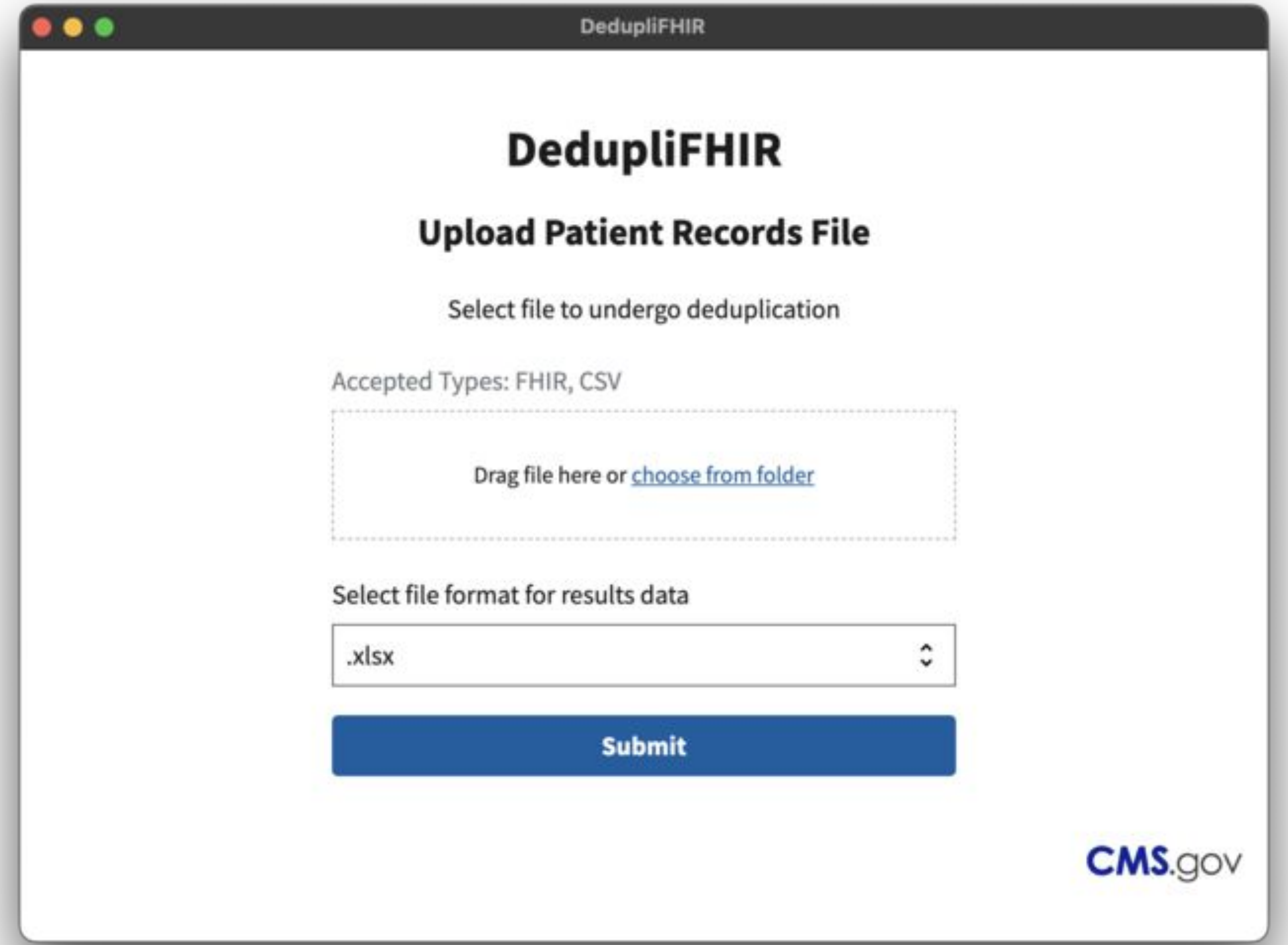
End Result







Frontend Tests


DedupliFHIR

DedupliFHIR

Upload Patient Records File

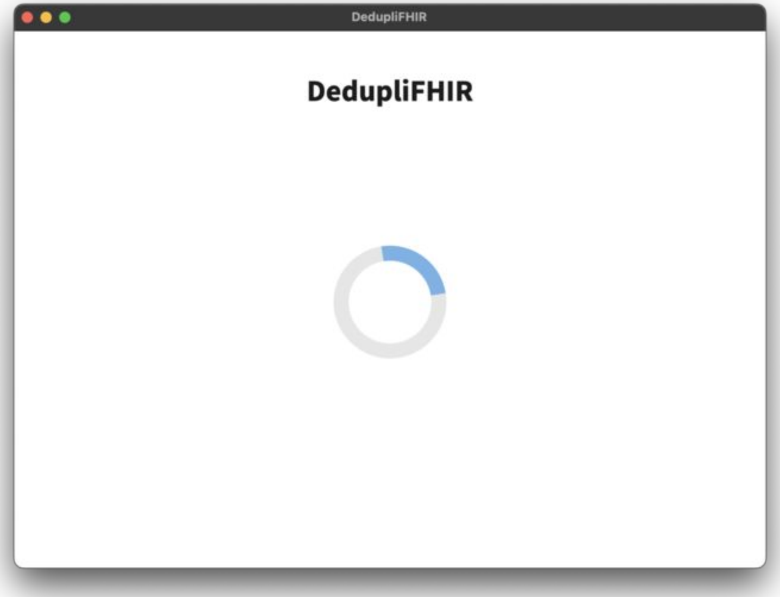
Select file to undergo deduplication

Accepted Types: FHIR, CSV

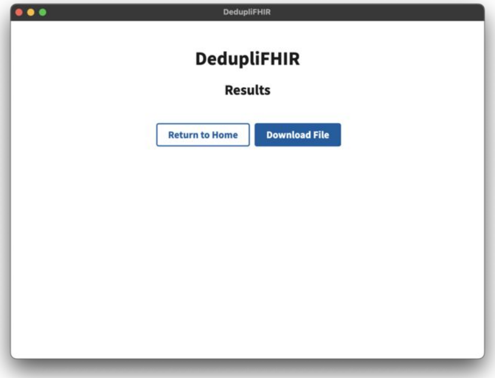
Drag file here or choose from folder

Select file format for results data

.xlsx


DedupliFHIR

DedupliFHIR


DedupliFHIR

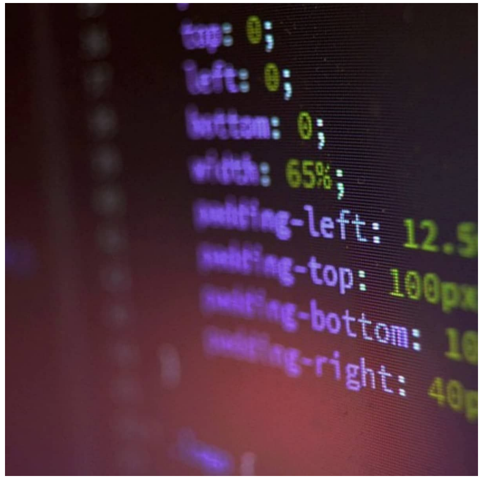
DedupliFHIR

Results

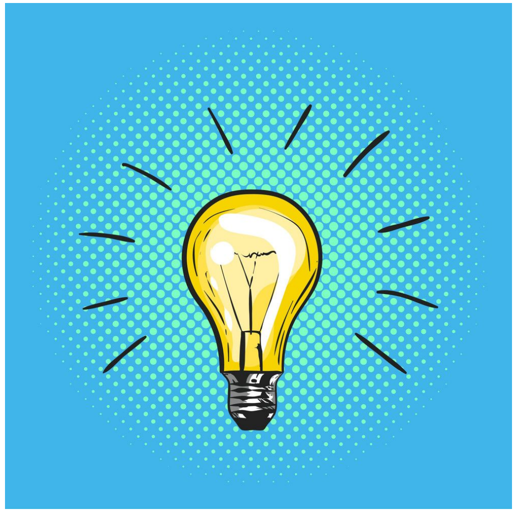
Metrics

Purpose

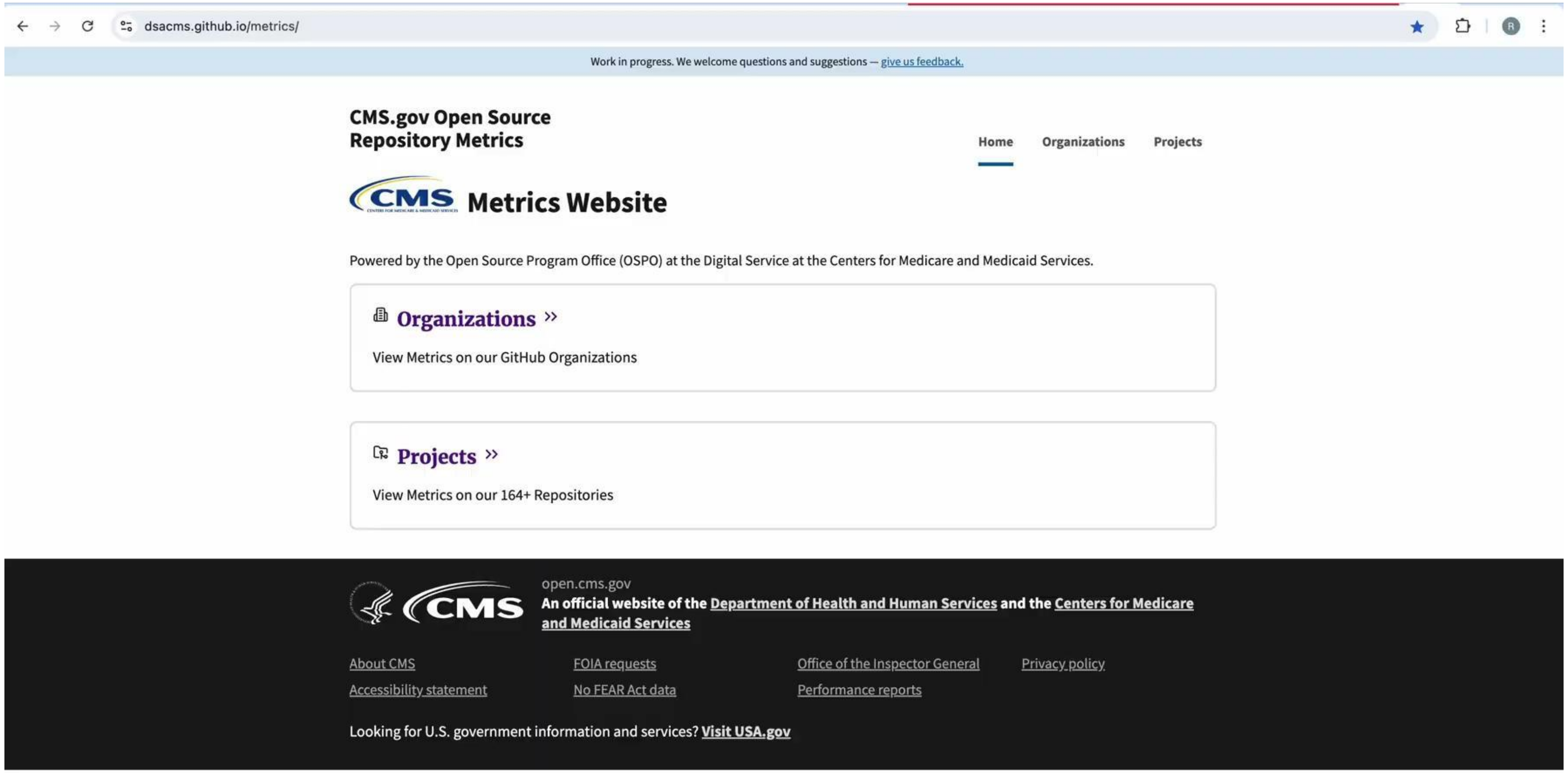
Metrics provide valuable insights into various aspects of open source projects to foster a more effective and transparent development environment.



```
top: 0;
left: 0;
bottom: 0;
width: 65%;
padding-left: 12.5
padding-top: 100px
padding-bottom: 10
padding-right: 40
```



Metrics Website



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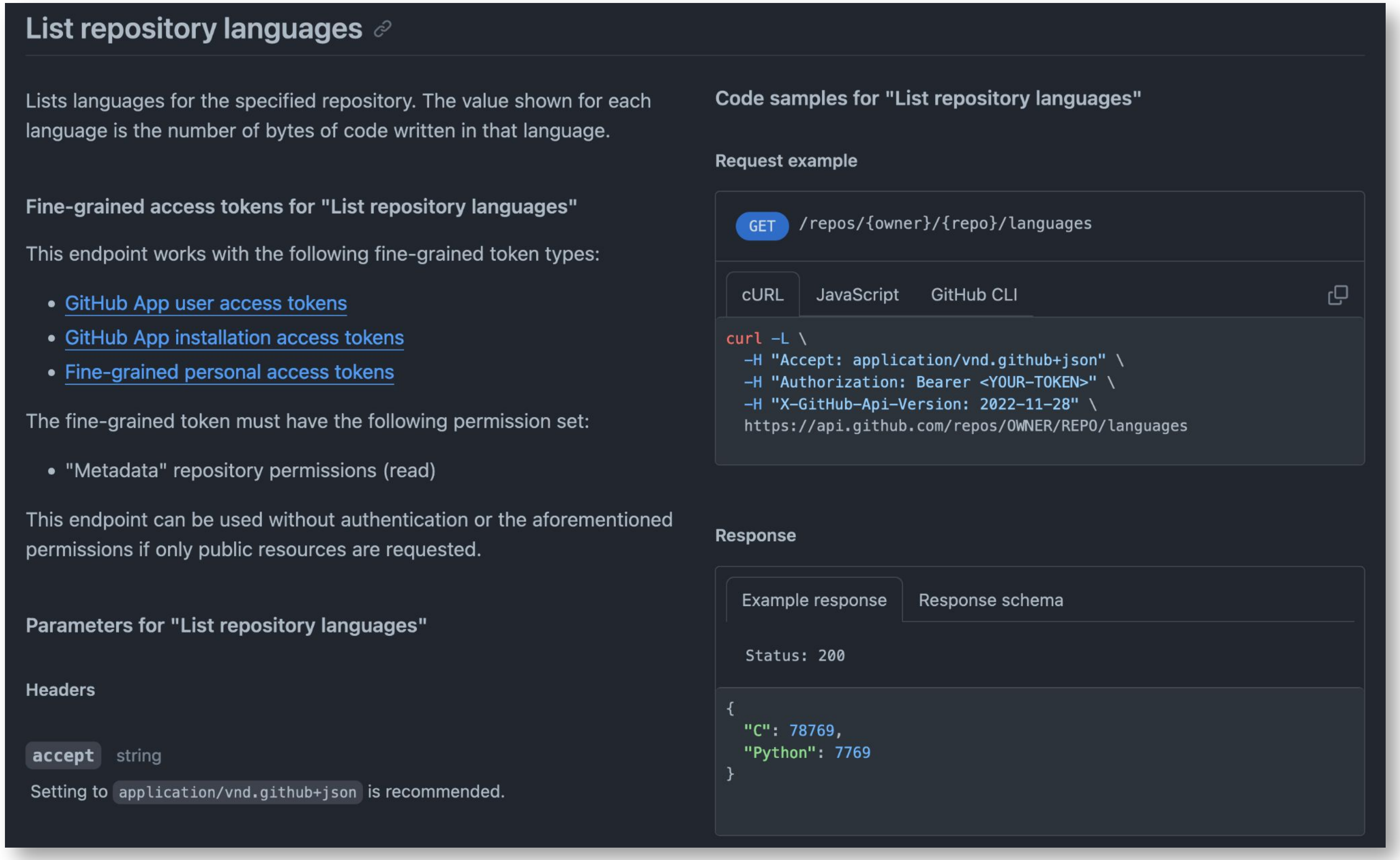
Predominant Languages



List repository languages

Lists languages for the specified repository. The value shown for each language is the number of bytes of code written in that language.

Fine-grained access tokens for "List repository languages"

This endpoint works with the following fine-grained token types:

- GitHub App user access tokens
- GitHub App installation access tokens
- Fine-grained personal access tokens

The fine-grained token must have the following permission set:

- "Metadata" repository permissions (read)

This endpoint can be used without authentication or the aforementioned permissions if only public resources are requested.

Parameters for "List repository languages"

Headers

`accept` string

Setting to `application/vnd.github+json` is recommended.

Code samples for "List repository languages"

Request example

GET `/repos/{owner}/{repo}/languages`

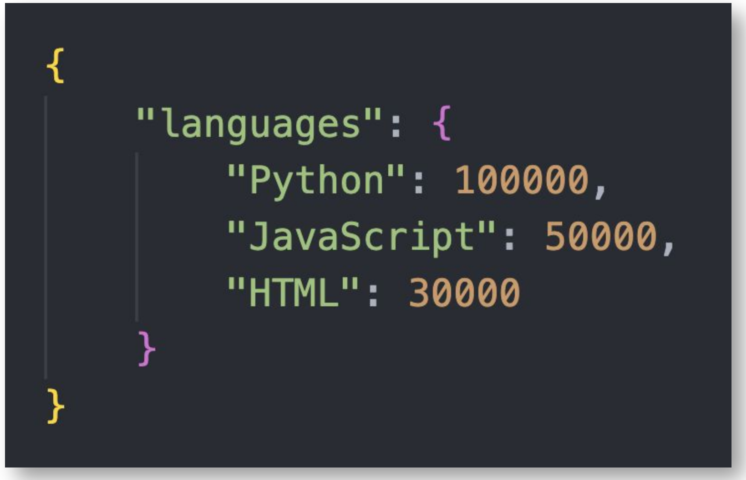
```
curl -L \
  -H "Accept: application/vnd.github+json" \
  -H "Authorization: Bearer <YOUR-TOKEN>" \
  -H "X-GitHub-Api-Version: 2022-11-28" \
  https://api.github.com/repos/OWNER/REPO/languages
```

Response

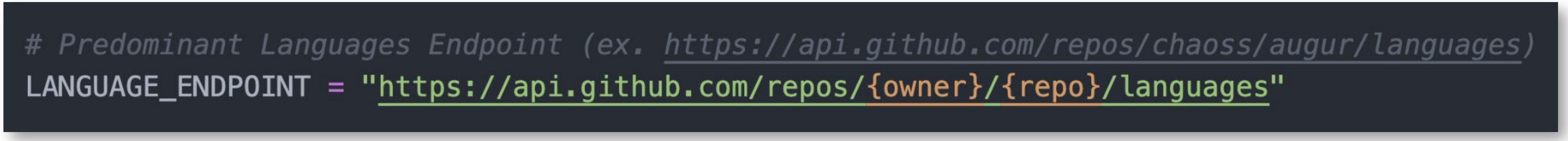
```
Status: 200
```

```
{
  "C": 78769,
  "Python": 7769
}
```

Example:



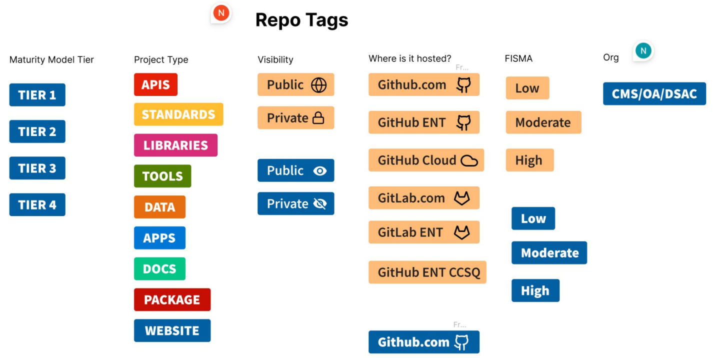
```
{
    "languages": {
        "Python": 100000,
        "JavaScript": 50000,
        "HTML": 30000
    }
}
```



```
# Predominant Languages Endpoint (ex. https://api.github.com/repos/chaoss/augur/languages)
LANGUAGE_ENDPOINT = "https://api.github.com/repos/{owner}/{repo}/languages"
```

Repo Metrics Tags

Design



Repo Tags

Maturity Model Tier
TIER 1
TIER 2
TIER 3
TIER 4

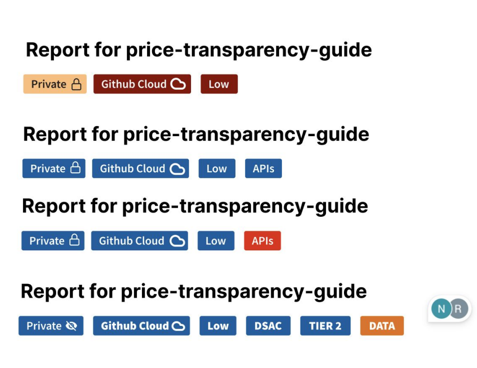
Project Type
APIS
STANDARDS
LIBRARIES
TOOLS
DATA
APPS
DOCS
PACKAGE
WEBSITE

Visibility
Public
Private
Public
Private

Where is it hosted?
Github.com
GitHub ENT
GitHub Cloud
GitLab.com
GitLab ENT
GitHub ENT CCSQ
Github.com

FISMA
Low
Moderate
High
Low
Moderate
High

Org
CMS/OA/DSAC



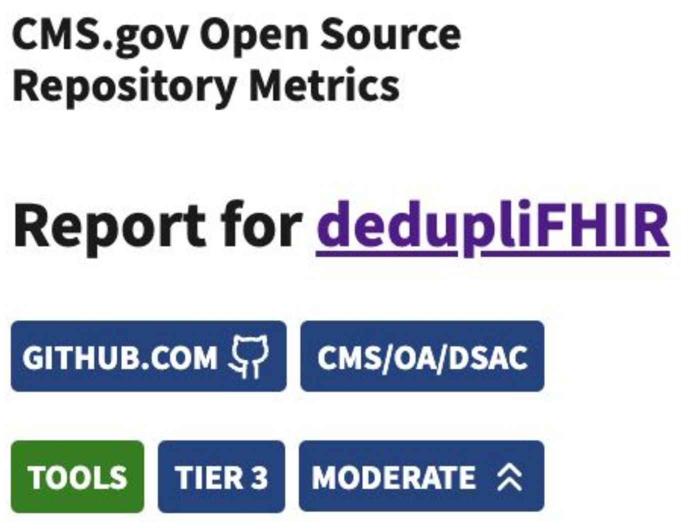
Report for price-transparency-guide
Private | Github Cloud | Low

Report for price-transparency-guide
Private | Github Cloud | Low | APIs

Report for price-transparency-guide
Private | Github Cloud | Low | APIs

Report for price-transparency-guide
Private | Github Cloud | Low | DSAC | TIER 2 | DATA

End Result



CMS.gov Open Source Repository Metrics

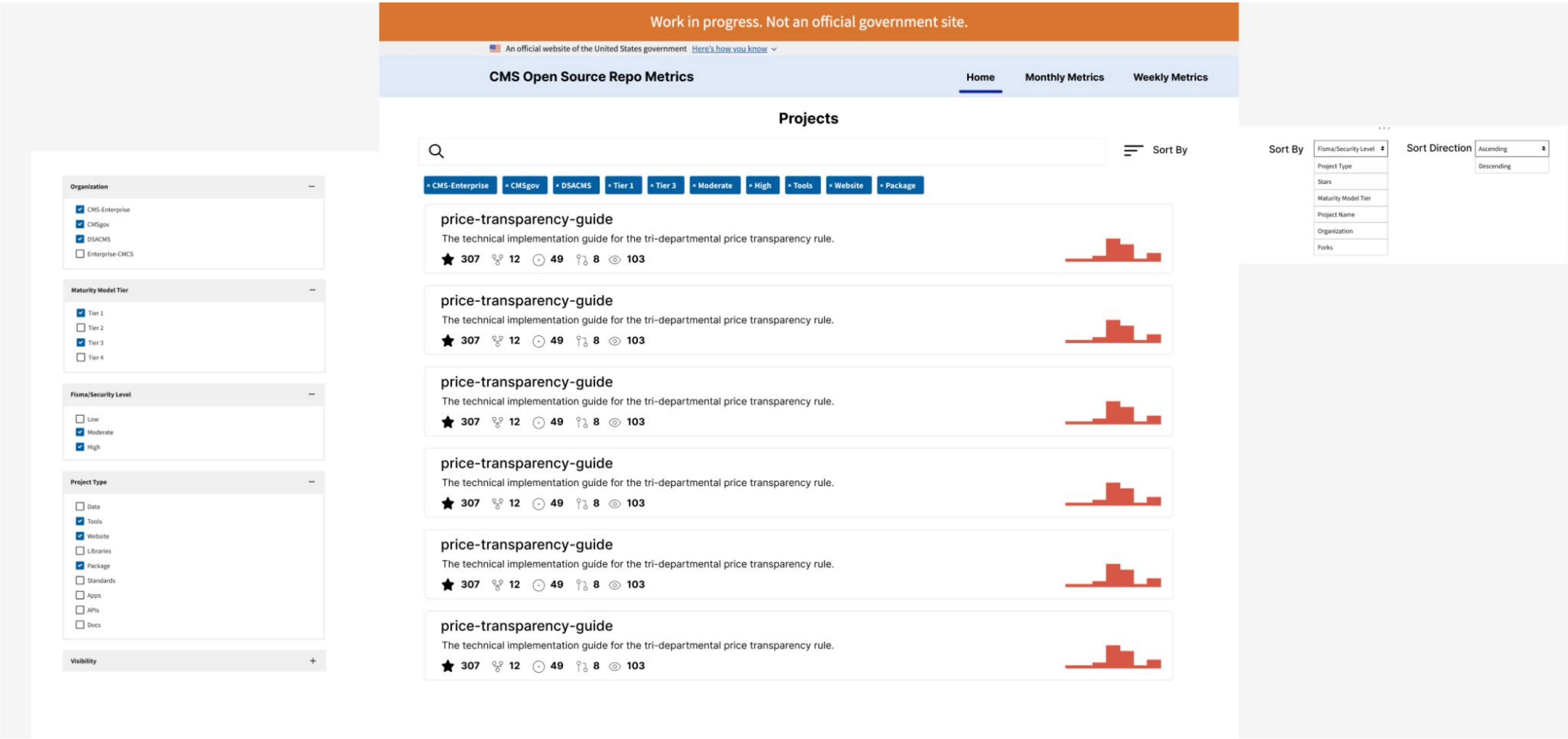
Report for dedupliFHIR

GITHUB.COM | CMS/OA/DSAC

TOOLS | TIER 3 | MODERATE

Projects Page: New Look!

Design



Organization
☑ CMS-Enterprise
☑ CMSgov
☑ DSACMS
☐ Enterprise-CMCS

Maturity Model Tier
☑ Tier 1
☐ Tier 2
☑ Tier 3
☐ Tier 4

Fisma/Security Level
☐ Low
☑ Moderate
☑ High

Project Type
☐ Data
☑ Tools
☑ Website
☐ Libraries
☑ Package
☐ Standards
☐ Apps
☐ APIs
☐ Docs

Visibility +

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Projects

Sort By

× CMS-Enterprise × CMSgov × DSACMS × Tier 1 × Tier 3 × Moderate × High × Tools × Website × Package

price-transparency-guide
The technical implementation guide for the tri-departmental price transparency rule.
★ 307 12 49 8 103

price-transparency-guide
The technical implementation guide for the tri-departmental price transparency rule.
★ 307 12 49 8 103

price-transparency-guide
The technical implementation guide for the tri-departmental price transparency rule.
★ 307 12 49 8 103

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The technical implementation guide for the tri-departmental price transparency rule.
★ 307 12 49 8 103

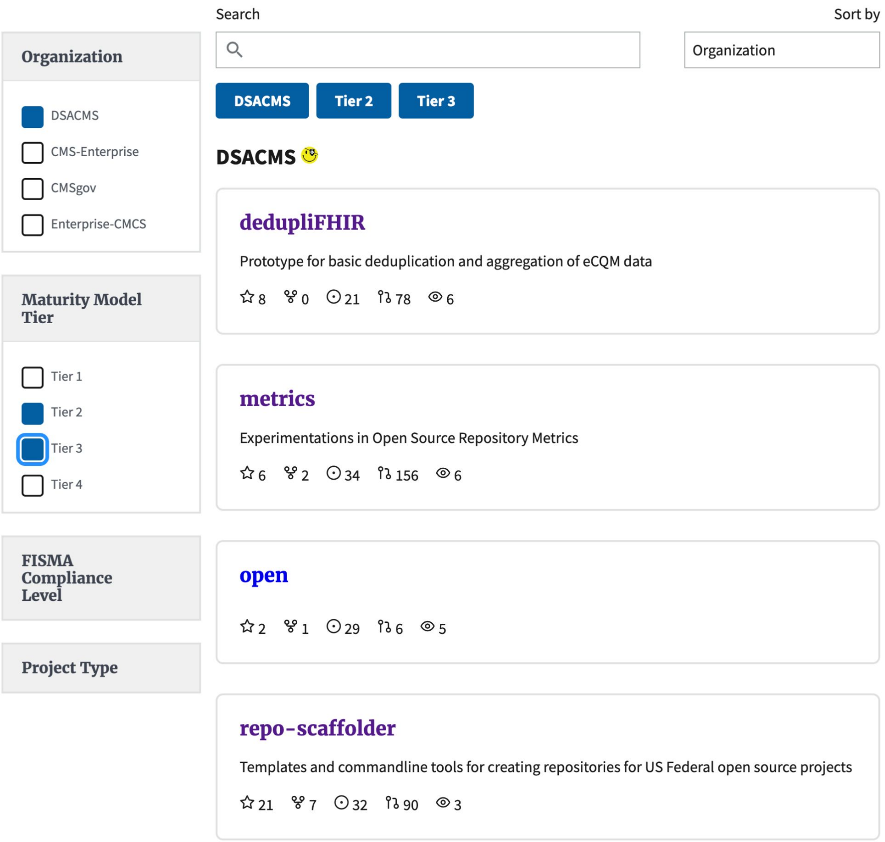
price-transparency-guide
The technical implementation guide for the tri-departmental price transparency rule.
★ 307 12 49 8 103

Sort By: Fisma/Security Level
Project Type
Stars
Maturity Model Tier
Project Name
Organization
Forks

Sort Direction: Ascending
Descending

Projects Page: New Look!

End Result



Search

Sort by: Organization

Organization

☑ DSACMS
☐ CMS-Enterprise
☐ CMSgov
☐ Enterprise-CMCS

Maturity Model Tier

☐ Tier 1
☑ Tier 2
☑ Tier 3
☐ Tier 4

FISMA Compliance Level

Project Type

DSACMS

dedupliFHIR

Prototype for basic deduplication and aggregation of eCQM data

☆ 8 ⑂ 0 ⊙ 21 ⇅ 78 👁 6

metrics

Experimentations in Open Source Repository Metrics

☆ 6 ⑂ 2 ⊙ 34 ⇅ 156 👁 6

open

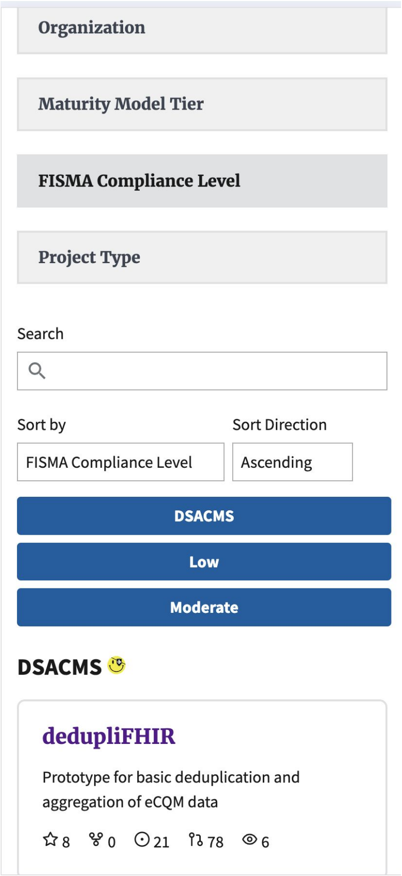
☆ 2 ⑂ 1 ⊙ 29 ⇅ 6 👁 5

repo-scaffolder

Templates and commandline tools for creating repositories for US Federal open source projects

☆ 21 ⑂ 7 ⊙ 32 ⇅ 90 👁 3

End Result (Mobile)



Organization

Maturity Model Tier

FISMA Compliance Level

Project Type

Search

Sort by: FISMA Compliance Level

Sort Direction: Ascending

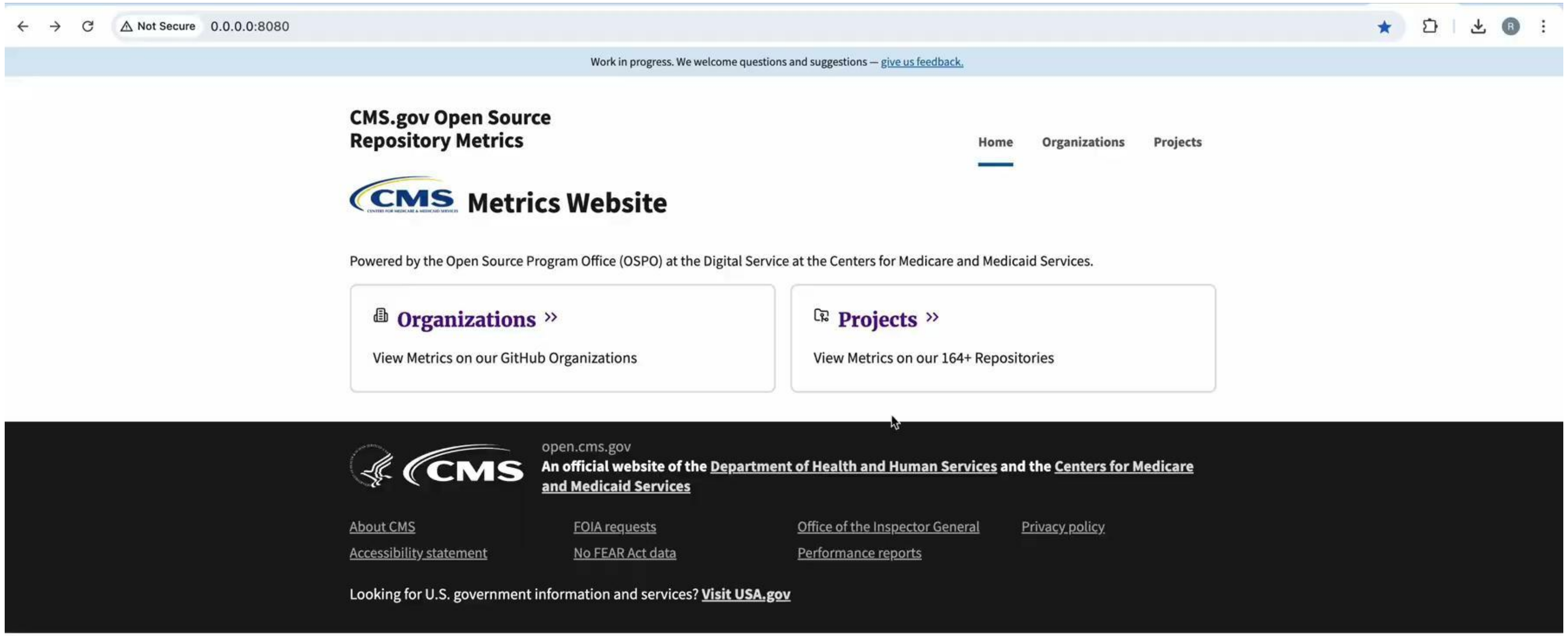
DSACMS

dedupliFHIR

Prototype for basic deduplication and aggregation of eCQM data

☆ 8 ⑂ 0 ⊙ 21 ⇅ 78 👁 6

Projects Page Demo (Video)



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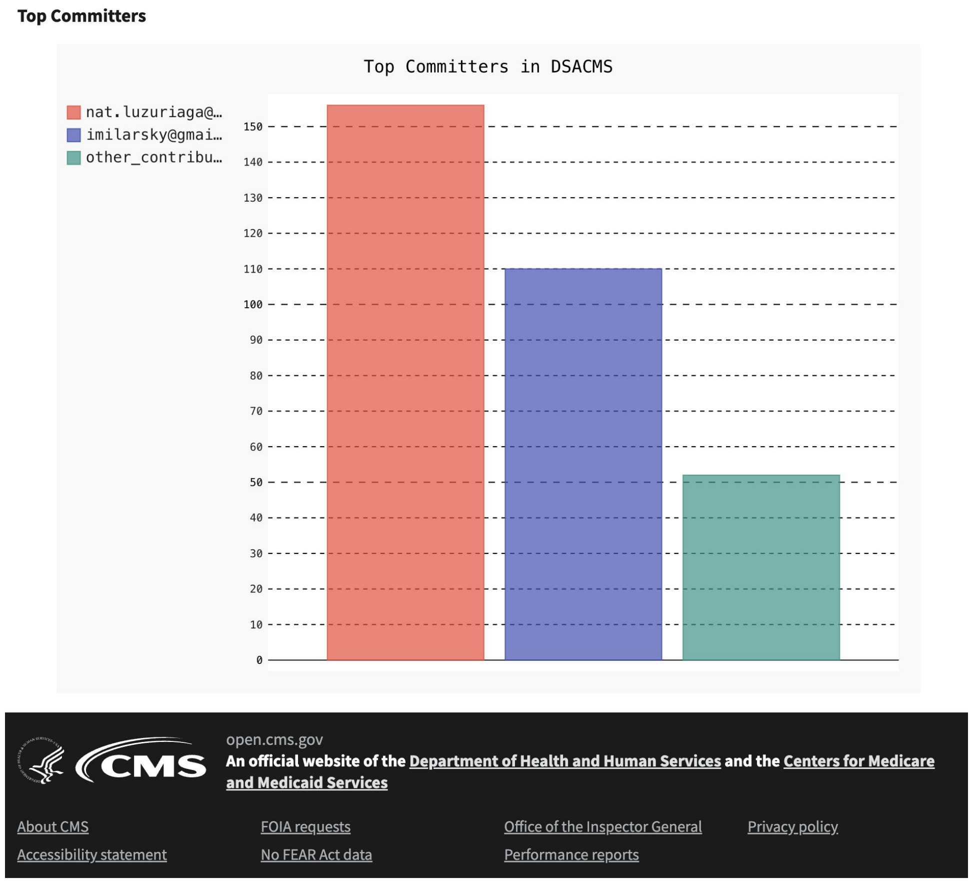
New Metric: Top Committers by Org

Recognizing developers who have made significant contributions to the project.



Top Committers

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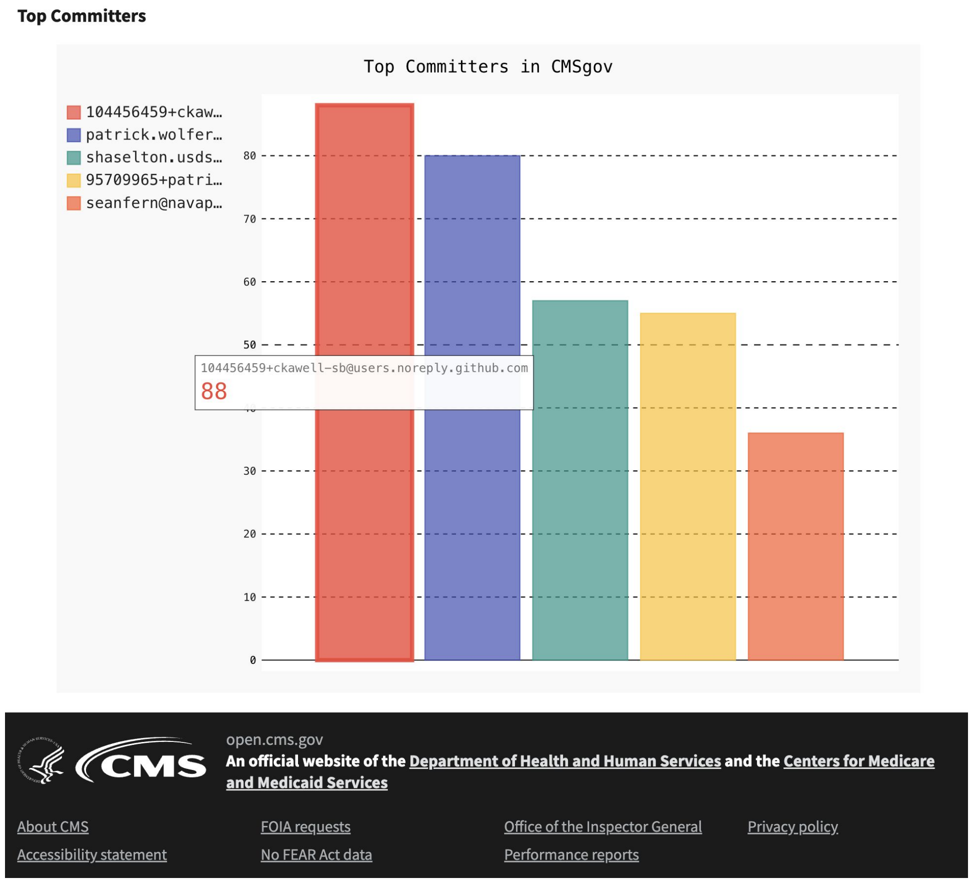

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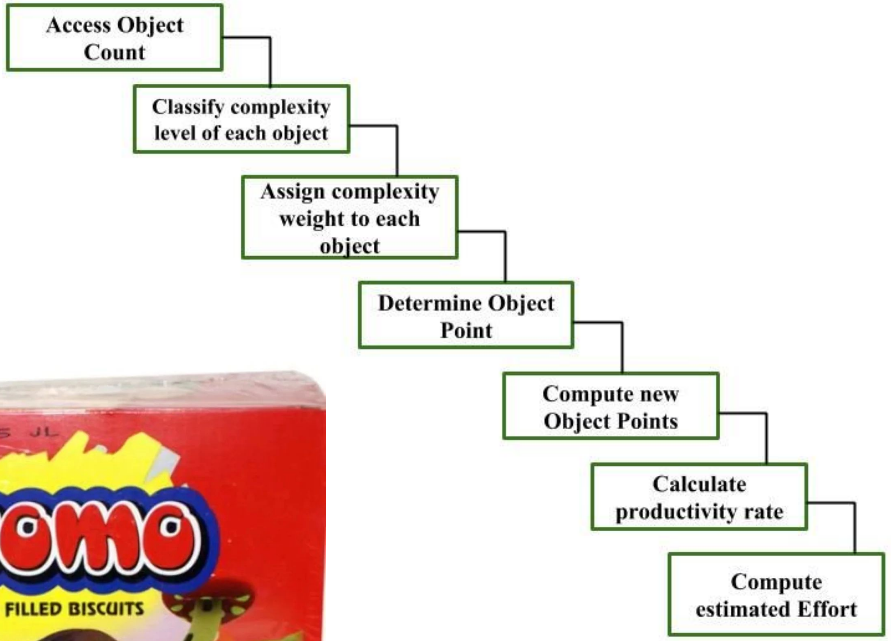
COCOMO & DRYness Scores



Access Object Count

Classify complexity level of each object

Assign complexity weight to each object

Determine Object Point

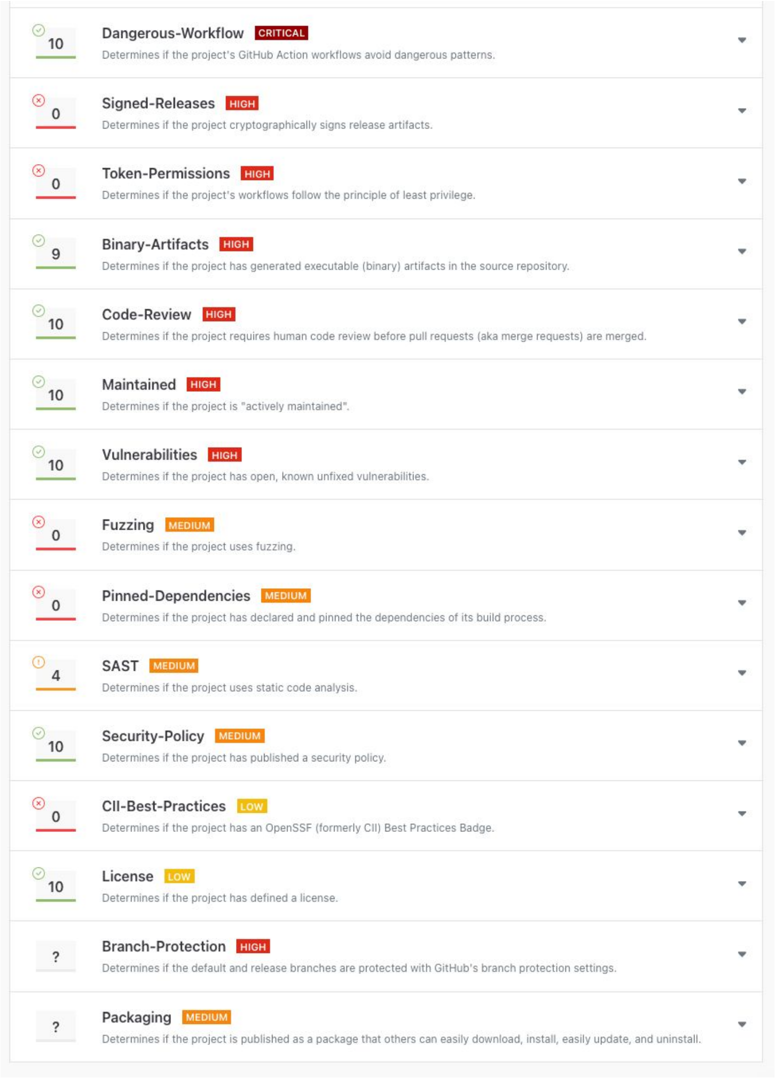
Compute new Object Points

Calculate productivity rate

Compute estimated Effort

I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code
I will not write any more bad code

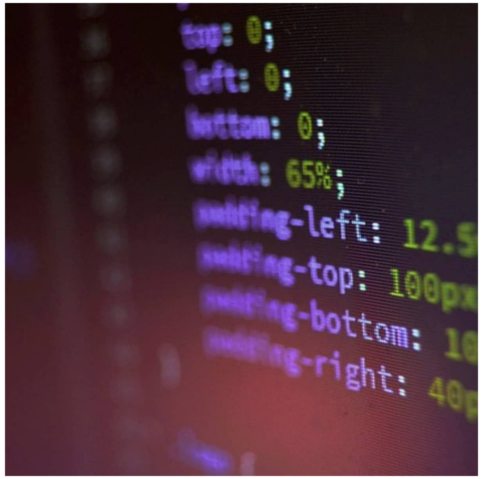
OpenSSF Internal Scorecards



✓ 10	Dangerous-Workflow	CRITICAL	Determines if the project's GitHub Action workflows avoid dangerous patterns.
✗ 0	Signed-Releases	HIGH	Determines if the project cryptographically signs release artifacts.
✗ 0	Token-Permissions	HIGH	Determines if the project's workflows follow the principle of least privilege.
✓ 9	Binary-Artifacts	HIGH	Determines if the project has generated executable (binary) artifacts in the source repository.
✓ 10	Code-Review	HIGH	Determines if the project requires human code review before pull requests (aka merge requests) are merged.
✓ 10	Maintained	HIGH	Determines if the project is "actively maintained".
✓ 10	Vulnerabilities	HIGH	Determines if the project has open, known unfixed vulnerabilities.
✗ 0	Fuzzing	MEDIUM	Determines if the project uses fuzzing.
✗ 0	Pinned-Dependencies	MEDIUM	Determines if the project has declared and pinned the dependencies of its build process.
! 4	SAST	MEDIUM	Determines if the project uses static code analysis.
✓ 10	Security-Policy	MEDIUM	Determines if the project has published a security policy.
✗ 0	CII-Best-Practices	LOW	Determines if the project has an OpenSSF (formerly CII) Best Practices Badge.
✓ 10	License	LOW	Determines if the project has defined a license.
?	Branch-Protection	HIGH	Determines if the default and release branches are protected with GitHub's branch protection settings.
?	Packaging	MEDIUM	Determines if the project is published as a package that others can easily download, install, easily update, and uninstall.

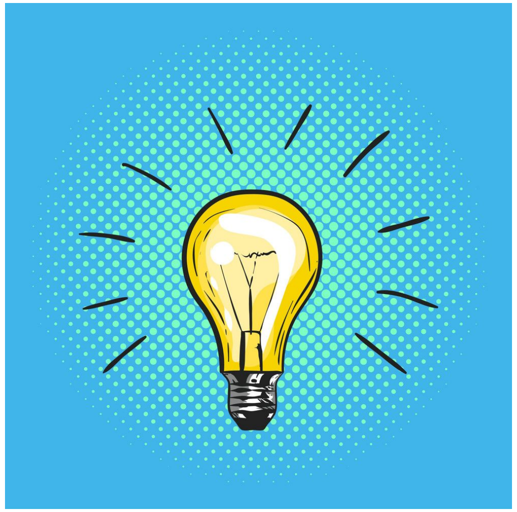
open

Purpose

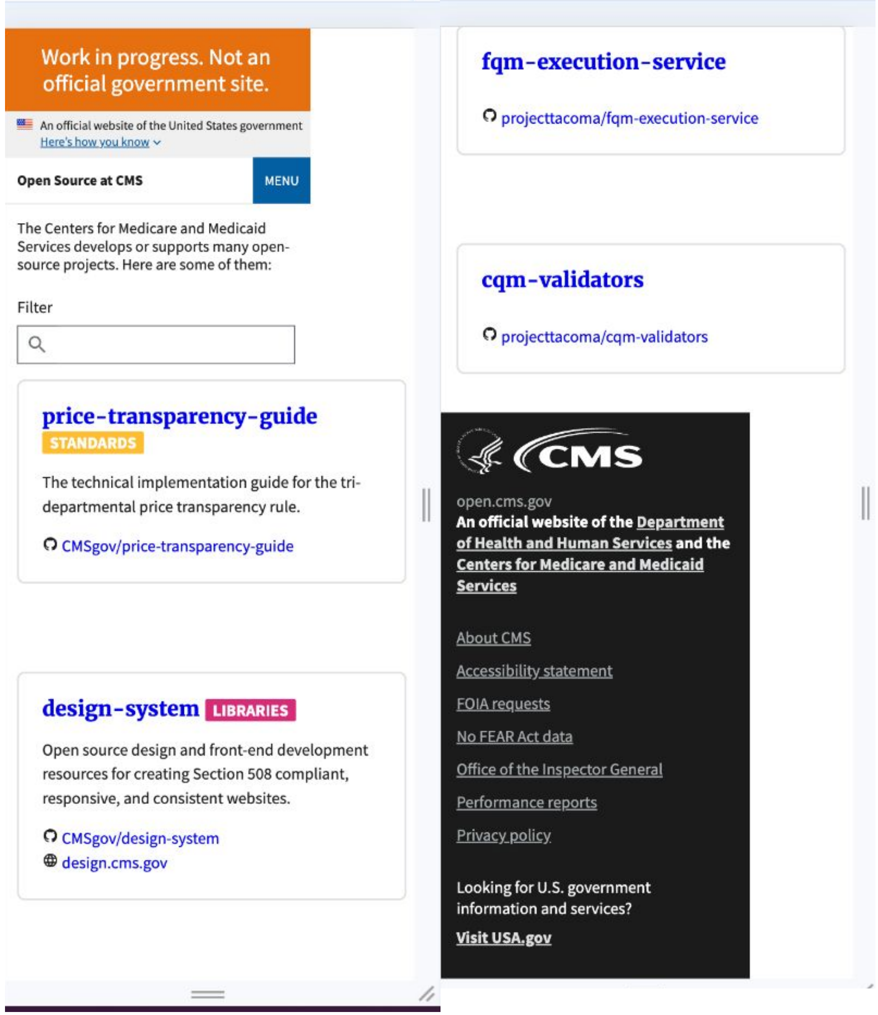


Public-facing website with list of CMS open-source projects, precursor to Metrics project

dsacms.github.io/open/projects



Bug Fixes



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Open Source at CMS

MENU

The Centers for Medicare and Medicaid Services develops or supports many open-source projects. Here are some of them:

Filter

price-transparency-guide STANDARDS

The technical implementation guide for the tri-departmental price transparency rule.

CMSgov/price-transparency-guide

design-system LIBRARIES

Open source design and front-end development resources for creating Section 508 compliant, responsive, and consistent websites.

CMSgov/design-system
design.cms.gov

fqm-execution-service

projecttacoma/fqm-execution-service

cqm-validators

projecttacoma/cqm-validators

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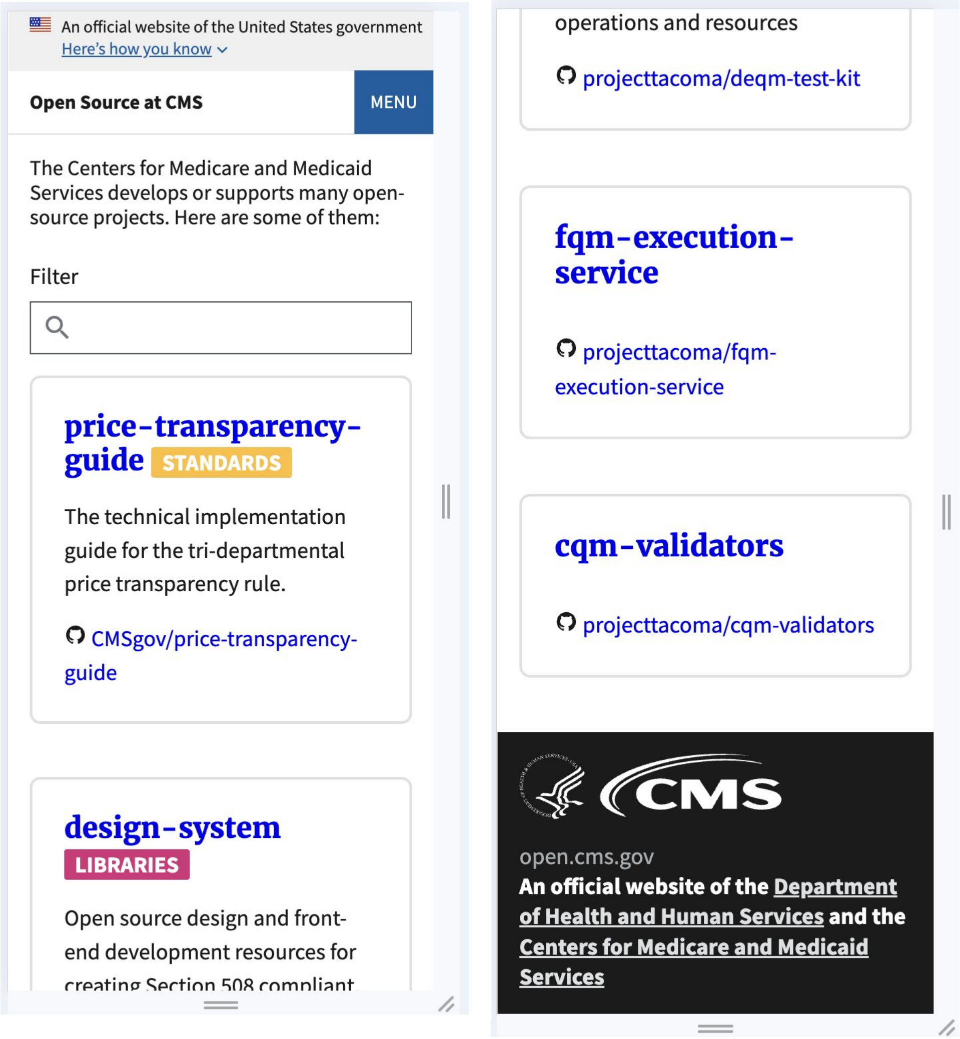
← Before

After →



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design-system LIBRARIES

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operations and resources

projecttacoma/deqm-test-kit

fqm-execution-service

projecttacoma/fqm-execution-service

cqm-validators

projecttacoma/cqm-validators

CMS

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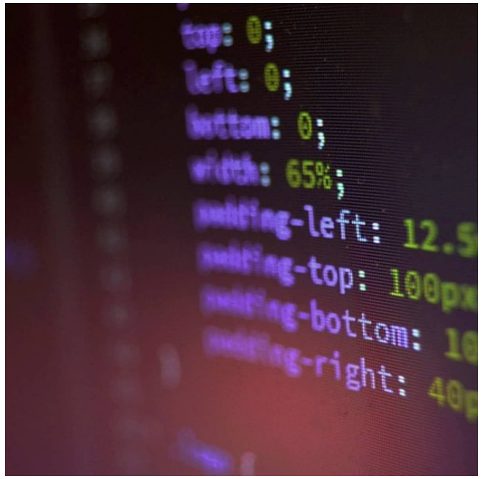
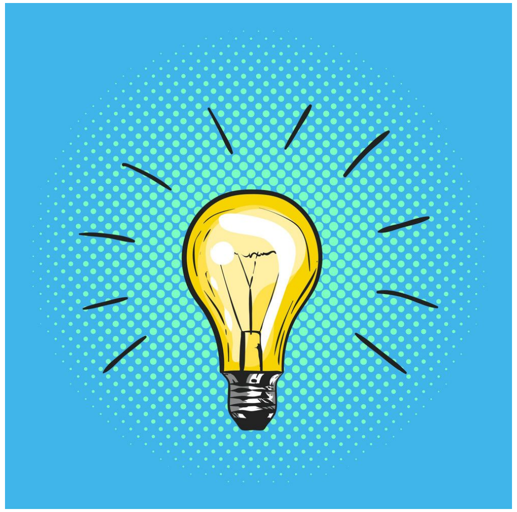
MurAI - Mural LLM Assistant

**Prototype*

Purpose

A multimodal LLM assistant via Ollama for helping users better understand and navigate our office’s Murals





Starting Models / Platforms

*LLaVa 🌋

↘

LLaVa-Llama3

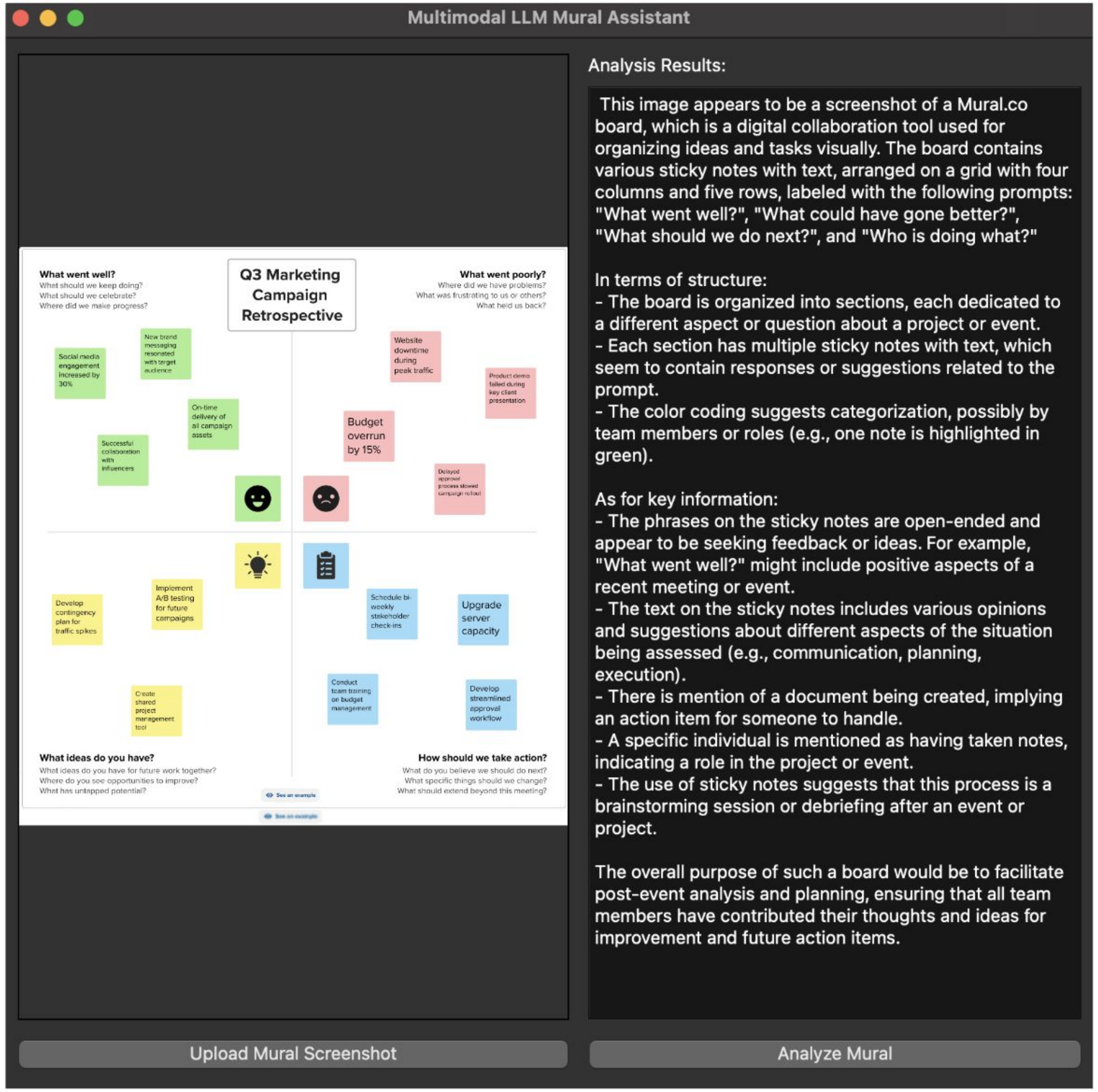
↗

Llama 3.1 🦙

Mixtral

Ollama (platform)

User Interface


Multimodal LLM Mural Assistant
Q3 Marketing Campaign Retrospective
What went well?
What should we keep doing?
What should we celebrate?
Where did we make progress?
What went poorly?
Where did we have problems?
What was frustrating to us or others?
What held us back?
Social media engagement increased by 30%
New brand messaging resonated with target audience
On-time delivery of all campaign assets
Successful collaboration with influencers
Website downtime during peak traffic
Product demo failed during key client presentation
Budget overrun by 15%
Delayed approval process slowed campaign rollout
Develop contingency plan for traffic spikes
Implement A/B testing for future campaigns
Create shared project management tool
Schedule bi-weekly stakeholder check-ins
Upgrade server capacity
Conduct team training on budget management
Develop streamlined approval workflow
What ideas do you have?
What ideas do you have for future work together?
Where do you see opportunities to improve?
What has untapped potential?
How should we take action?
What do you believe we should do next?
What specific things should we change?
What should extend beyond this meeting?
See an example
See an example
Upload Mural Screenshot
Analyze Mural

Analysis Results:

This image appears to be a screenshot of a Mural.co board, which is a digital collaboration tool used for organizing ideas and tasks visually. The board contains various sticky notes with text, arranged on a grid with four columns and five rows, labeled with the following prompts: "What went well?", "What could have gone better?", "What should we do next?", and "Who is doing what?"

In terms of structure:
- The board is organized into sections, each dedicated to a different aspect or question about a project or event.
- Each section has multiple sticky notes with text, which seem to contain responses or suggestions related to the prompt.
- The color coding suggests categorization, possibly by team members or roles (e.g., one note is highlighted in green).

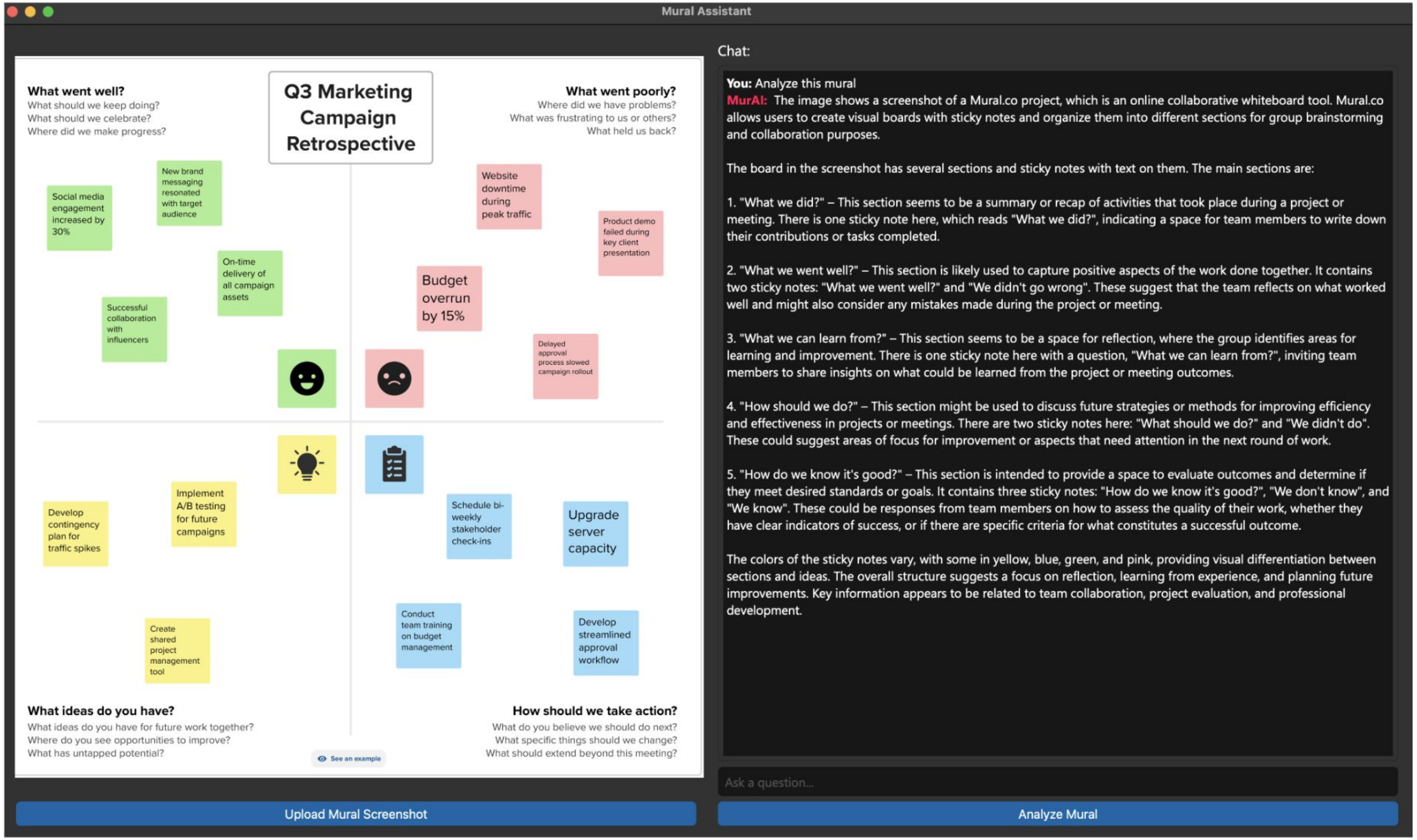
As for key information:
- The phrases on the sticky notes are open-ended and appear to be seeking feedback or ideas. For example, "What went well?" might include positive aspects of a recent meeting or event.
- The text on the sticky notes includes various opinions and suggestions about different aspects of the situation being assessed (e.g., communication, planning, execution).
- There is mention of a document being created, implying an action item for someone to handle.
- A specific individual is mentioned as having taken notes, indicating a role in the project or event.
- The use of sticky notes suggests that this process is a brainstorming session or debriefing after an event or project.

The overall purpose of such a board would be to facilitate post-event analysis and planning, ensuring that all team members have contributed their thoughts and ideas for improvement and future action items.

First iteration of GUI

- Bare bone functionality
  - Can only analyze Mural screenshot once
  - Cannot chat with LLM or continue asking questions
- Uploaded image has low preview resolution

User Interface


Mural Assistant
What went well?
What should we keep doing?
What should we celebrate?
Where did we make progress?
Q3 Marketing Campaign Retrospective
What went poorly?
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See an example
How should we take action?
What do you believe we should do next?
What specific things should we change?
What should extend beyond this meeting?
Chat:
Ask a question...
Upload Mural Screenshot
Analyze Mural

You: Analyze this mural

MurAI: The image shows a screenshot of a Mural.co project, which is an online collaborative whiteboard tool. Mural.co allows users to create visual boards with sticky notes and organize them into different sections for group brainstorming and collaboration purposes.

The board in the screenshot has several sections and sticky notes with text on them. The main sections are:

1. "What we did?" – This section seems to be a summary or recap of activities that took place during a project or meeting. There is one sticky note here, which reads "What we did?", indicating a space for team members to write down their contributions or tasks completed.

2. "What we went well?" – This section is likely used to capture positive aspects of the work done together. It contains two sticky notes: "What we went well?" and "We didn't go wrong". These suggest that the team reflects on what worked well and might also consider any mistakes made during the project or meeting.

3. "What we can learn from?" – This section seems to be a space for reflection, where the group identifies areas for learning and improvement. There is one sticky note here with a question, "What we can learn from?", inviting team members to share insights on what could be learned from the project or meeting outcomes.

4. "How should we do?" – This section might be used to discuss future strategies or methods for improving efficiency and effectiveness in projects or meetings. There are two sticky notes here: "What should we do?" and "We didn't do". These could suggest areas of focus for improvement or aspects that need attention in the next round of work.

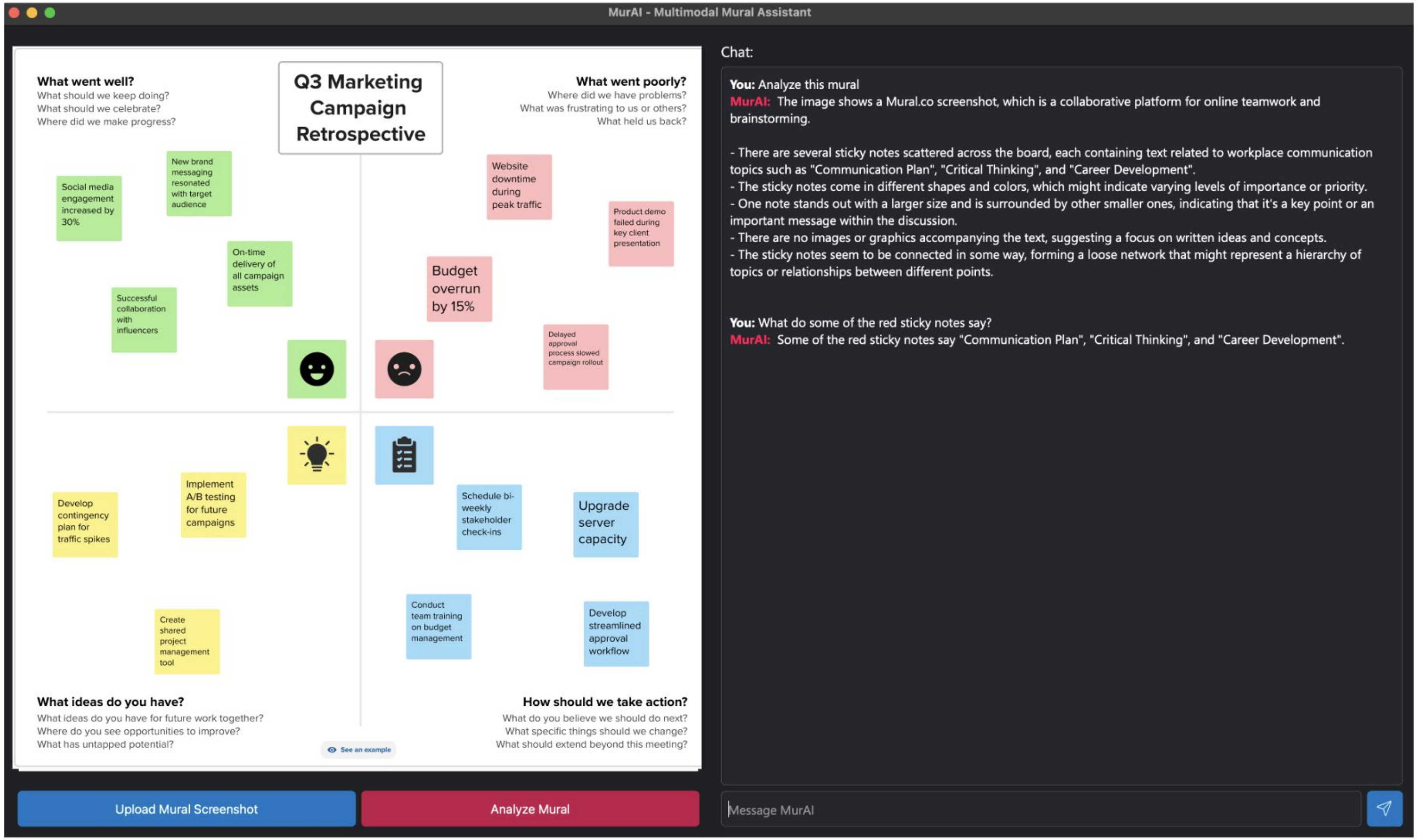
5. "How do we know it's good?" – This section is intended to provide a space to evaluate outcomes and determine if they meet desired standards or goals. It contains three sticky notes: "How do we know it's good?", "We don't know", and "We know". These could be responses from team members on how to assess the quality of their work, whether they have clear indicators of success, or if there are specific criteria for what constitutes a successful outcome.

The colors of the sticky notes vary, with some in yellow, blue, green, and pink, providing visual differentiation between sections and ideas. The overall structure suggests a focus on reflection, learning from experience, and planning future improvements. Key information appears to be related to team collaboration, project evaluation, and professional development.

Several iterations later…

- Now able to ask follow-up questions
- GUI retouch
- Now called “MurAI”!
- Uploaded image preview now at full resolution

User Interface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What do you believe we should do next?
What specific things should we change?
What should extend beyond this meeting?
Upload Mural Screenshot
Analyze Mural
Chat:
Message MurAI

You: Analyze this mural
MurAI: The image shows a Mural.co screenshot, which is a collaborative platform for online teamwork and brainstorming.

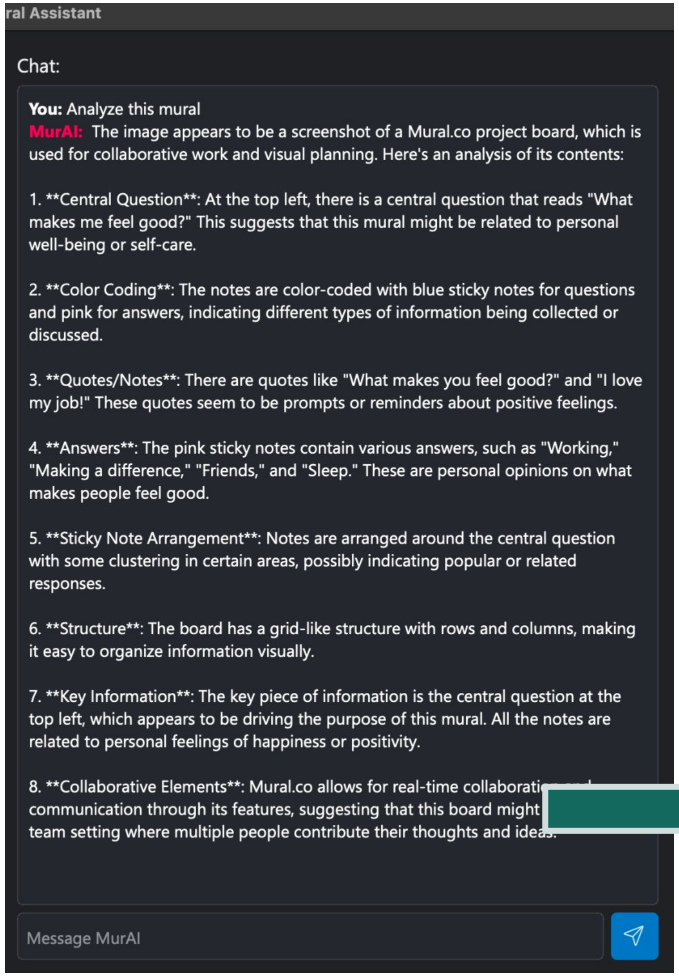
- There are several sticky notes scattered across the board, each containing text related to workplace communication topics such as "Communication Plan", "Critical Thinking", and "Career Development".
- The sticky notes come in different shapes and colors, which might indicate varying levels of importance or priority.
- One note stands out with a larger size and is surrounded by other smaller ones, indicating that it's a key point or an important message within the discussion.
- There are no images or graphics accompanying the text, suggesting a focus on written ideas and concepts.
- The sticky notes seem to be connected in some way, forming a loose network that might represent a hierarchy of topics or relationships between different points.

You: What do some of the red sticky notes say?
MurAI: Some of the red sticky notes say "Communication Plan", "Critical Thinking", and "Career Development".

Final Iteration

- Moved “Analyze Mural” button to left side
- Added send message button (right side)
- Color correction!

LLM Fine-tuning



Chat:

You: Analyze this mural
MurAI: The image appears to be a screenshot of a Mural.co project board, which is used for collaborative work and visual planning. Here's an analysis of its contents:

1. **Central Question**: At the top left, there is a central question that reads "What makes me feel good?" This suggests that this mural might be related to personal well-being or self-care.

2. **Color Coding**: The notes are color-coded with blue sticky notes for questions and pink for answers, indicating different types of information being collected or discussed.

3. **Quotes/Notes**: There are quotes like "What makes you feel good?" and "I love my job!" These quotes seem to be prompts or reminders about positive feelings.

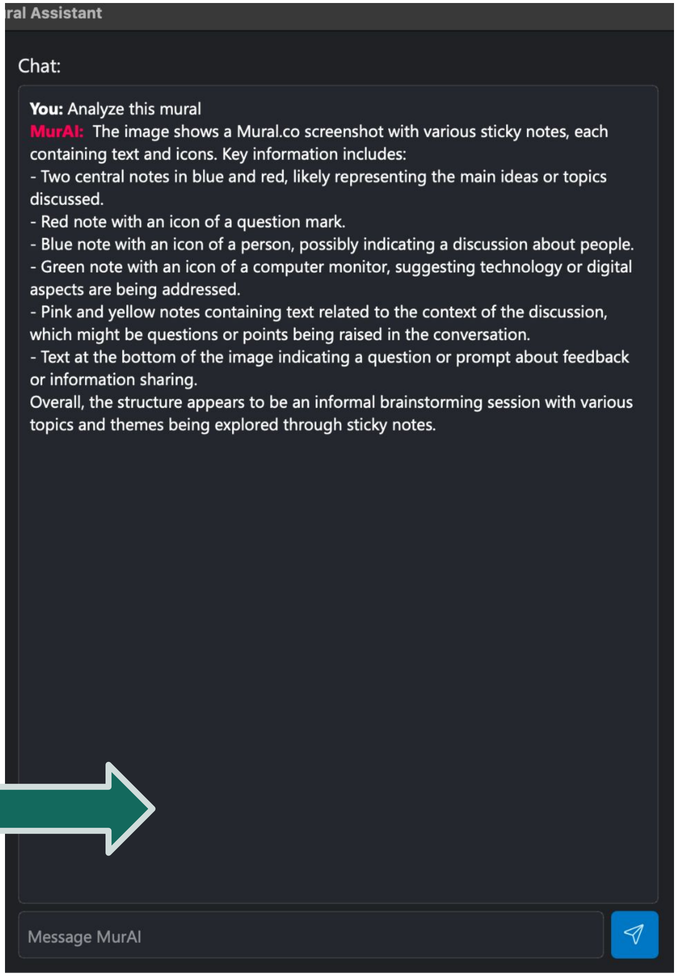
4. **Answers**: The pink sticky notes contain various answers, such as "Working," "Making a difference," "Friends," and "Sleep." These are personal opinions on what makes people feel good.

5. **Sticky Note Arrangement**: Notes are arranged around the central question with some clustering in certain areas, possibly indicating popular or related responses.

6. **Structure**: The board has a grid-like structure with rows and columns, making it easy to organize information visually.

7. **Key Information**: The key piece of information is the central question at the top left, which appears to be driving the purpose of this mural. All the notes are related to personal feelings of happiness or positivity.

8. **Collaborative Elements**: Mural.co allows for real-time collaborati
communication through its features, suggesting that this board might
team setting where multiple people contribute their thoughts and ideas.



Chat:

You: Analyze this mural
MurAI: The image shows a Mural.co screenshot with various sticky notes, each containing text and icons. Key information includes:
- Two central notes in blue and red, likely representing the main ideas or topics discussed.
- Red note with an icon of a question mark.
- Blue note with an icon of a person, possibly indicating a discussion about people.
- Green note with an icon of a computer monitor, suggesting technology or digital aspects are being addressed.
- Pink and yellow notes containing text related to the context of the discussion, which might be questions or points being raised in the conversation.
- Text at the bottom of the image indicating a question or prompt about feedback or information sharing.
Overall, the structure appears to be an informal brainstorming session with various topics and themes being explored through sticky notes.

Goal: "Analyze Mural" should be brief but detailed enough for the user to have an overall understanding of the Mural

- Be as specific as possible!
- Give the LLM a role
- List format for instructions
- Tipping culture
- Order matters

The Future and Next Steps

- Other methods of fine-tuning
  - Breaking down the screenshot into smaller chunks/tokens
  - Training the model with Mural screenshots
  - OCR (Optical Character Recognition) tool integration
  - Confidence scores

- Better models
  - LLaVa:13b **(8 GB)** vs LLaVa:34b **(20 GB)**

- Better GPUs
  - AWS cloud GPUs for greater computational power

Thank You DSAC!

Thank you!

- DSAC team
- Remy DeCausemaker
- Natalia Luzuriaga
- Isaac Milarsky
- Patrick Sier
- Alberto Colon
- Cassie Rubio
- Yuyang Zhong