Center for Translational Data Science
AT THE UNIVERSITY OF CHICAGO

OPEN COMMONS CONSORTIUM

Introduction to the Gen3 Platform for Data Commons and Data Ecosystems

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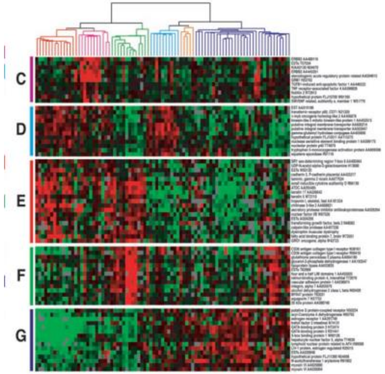
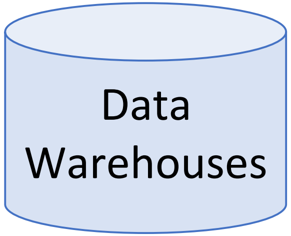
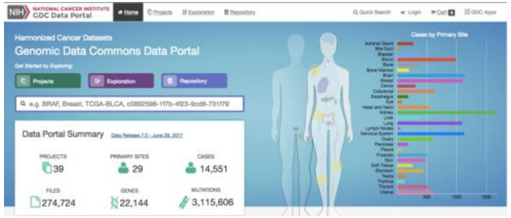


Databases organize the data around a **project**.



Data warehouses organize the data for an **organization** (and are enabled by enterprise computing)



Harmonized Cancer Datasets

Genomic Data Commons Data Portal

Get Started by Exploring:

e.g. BRAF, Breast, TCGA-BLCA, c0892598-1f7b-4f23-9cd8-731f79

Data Portal Summary Data Release 7.0 - June 29, 2017

PROJECTS	PRIMARY SITES	CASES
39	29	14,551
FILES	GENES	MUTATIONS
274,724	22,144	3,115,606

Data Commons organize the data for a scientific discipline, **community**, or field and are enabled by large scale cloud computing.

Project

Databases

1982 - present

- Data repository
- Data catalogs
- Download data

(Virtual) Organization

OSDC OPEN SCIENCE DATA CLOUD

A Petabyte-scale Scientific Community Cloud

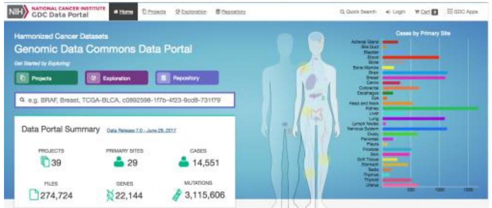
The OSDC enables scientific researchers to easily manage, share, and analyze large datasets.

Data Clouds

2010 - 2020

- Supports large data & data intensive computing with **cloud computing**
- Researchers can analyze data with collaborative tools (**workspaces**) – so data does **not** have to be downloaded)

Discipline



NIH NATIONAL CANCER INSTITUTE GDC Data Portal

Harmonized Cancer Datasets

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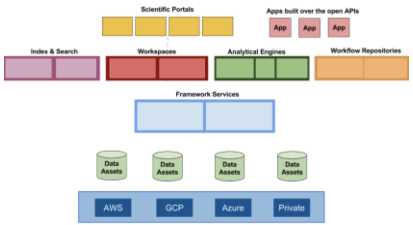
Data Commons

2014 - 2024

- Supports large data
- Workspaces
- **Common data models**
- **Core data services**
- **Data & Commons Governance**
- **Harmonized data**
- **Data sharing**
- **Reproducible research**

Multi-Discipline



Data Ecosystems

2018 - 2028

- Interoperates **multiple data commons, databases, knowledge bases**, and other resources
- Supports **ecosystem of commons, portals, notebooks, applications & simulations** across multiple disciplines

Gen3 Data Commons

BRAIN Commons

Total Files: 16,722
Total Size: 270.14 GB

BloodPAC
BLOOD PROFILING ATLAS IN CANCER

Total Files: 1,825
Total Size: 242.77 GB

NHLBI
DATA STAGE

Total Files: 71,368
Total Size: 344.03 TB

ACCOUNT

Total Files: 1,952
Total Size: 3.77 TB

NIAID DATA HUB

Total Files: 2,553
Total Size: 271.52 GB

GenoMEL
the Melanoma Genetics Consortium

Total Files: 4,008
Total Size: 20.77 TB

Gabriella Miller
Kids First
PEDIATRIC RESEARCH PROGRAM
Data Resource Center

Total Files: 113,319
Total Size: 2.08 PB

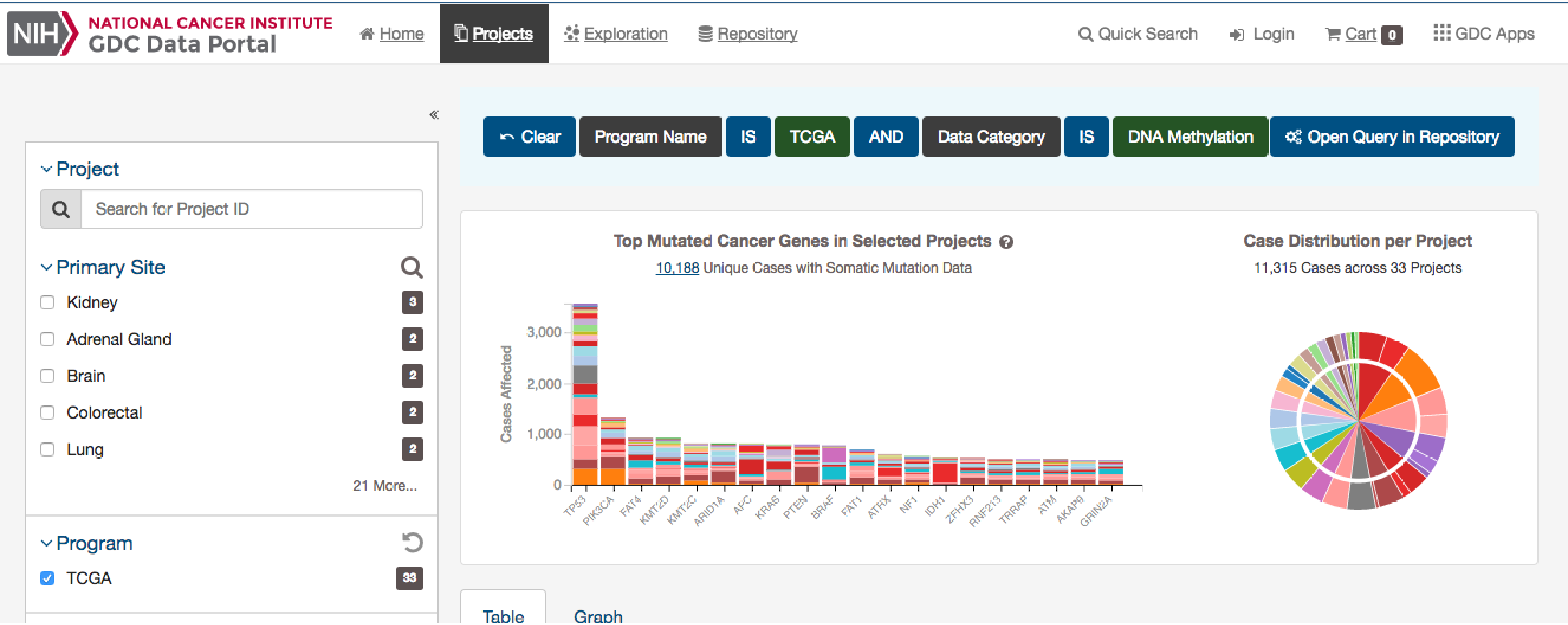
NIH NATIONAL CANCER INSTITUTE
Cancer Research Data Commons

Total Files: 1,156,065
Total Size: 1.58 PB

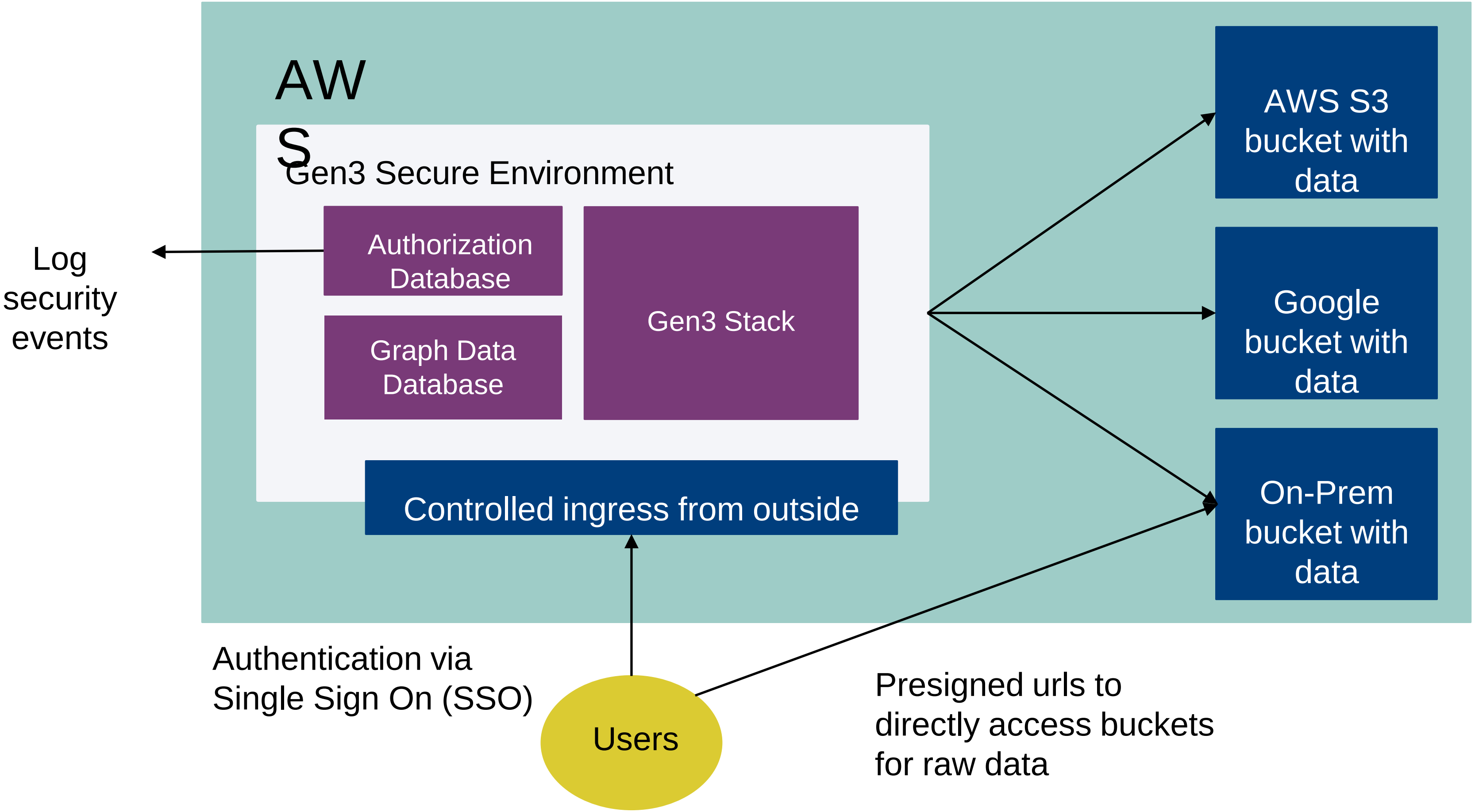
OCC Environmental Data Commons

Total Files: 9,402,905
Total Size: 22.25 TB

Genomic Data Commons - data exploration



GEN3 Data Commons



Authentication via Single Sign On (SSO)

Presigned urls to directly access buckets for raw data

Data Access Control

Cloud Bucket With Data

- Bucket policy prevents access by unauthorized users
- Data access is logged for auditing and compliance

Gen3 Auth

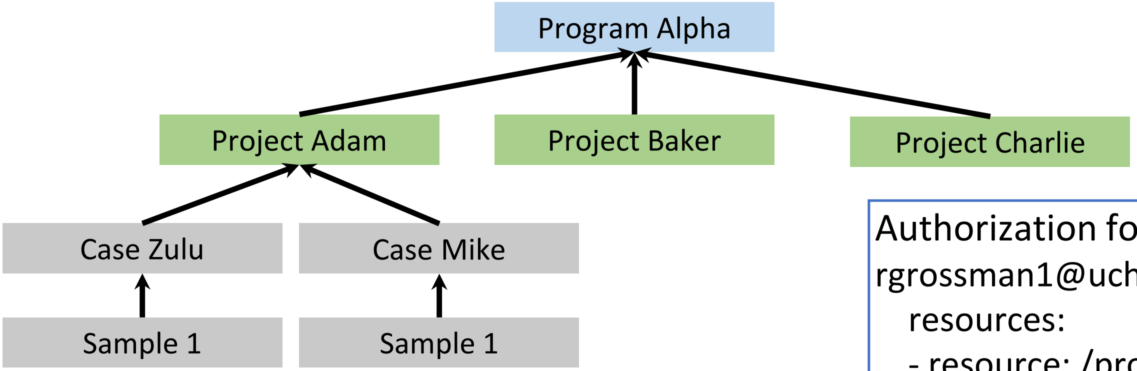
- Gen3 Auth(Fence) provides Authentication and Authorization, and Data Access.
- Gen3 Auth works with multiple identify providers (IdP) including Google, and easily adaptable for any support OIDC provider
- This enables Single Sign On (SSO) compatibility with most systems
- Authorization for data access via internal Access Control List specified by the stakeholders

Data Access Control

- Gen3 auth has a Role Based Access Control (RBAC) engine

Gen3 Auth

The RBAC engine understands the hierarchical nature of a users permissions, and can be used to determine if the user has access to a specific piece of data



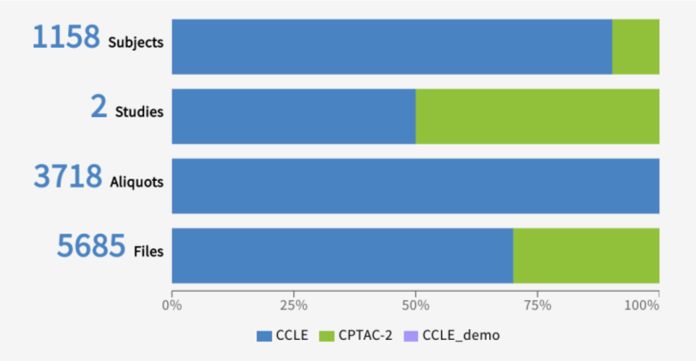
Authorization for a user would then be stored as:

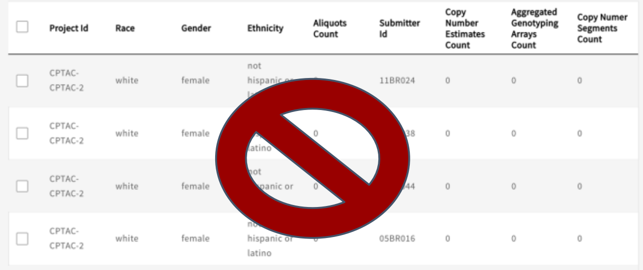
```
rgrossman1@uchicago.edu:
   resources:
   - resource: /programs/alpha/projects/baker
     privilege: [create, read, read-storage, write-storage]
   - resource: /programs/alpha/projects/adam/cases/zulu
     privilege: [read, read-storage]
```

Giving write (submission) access to the Baker project and all nodes underneath it, while read access to only the Zulu case in the Adam project

Data Access Control

Query Gateway





□	Project Id	Race	Gender	Ethnicity	Aliquots Count	Submitter Id	Copy Number Estimates Count	Aggregated Genotyping Arrays Count	Copy Numer Segments Count
□	CPTAC-CPTAC-2	white	female	not hispanic or latino	0	11BR024	0	0	0
□	CPTAC-CPTAC-2	white	female	[illegible] latino	0	[illegible]38	0	0	0
□	CPTAC-CPTAC-2	white	female	not hispanic or [illegible]	0	[illegible]44	0	0	0
□	CPTAC-CPTAC-2	white	female	not hispanic or latino	0	05BR016	0	0	0

- Query gateway provides the potential to limit the queries that users can perform and control when results are returned.

Examples of queries:
Query1: StandardDeviation(variable) where STUDENTS_GENDER is MALE

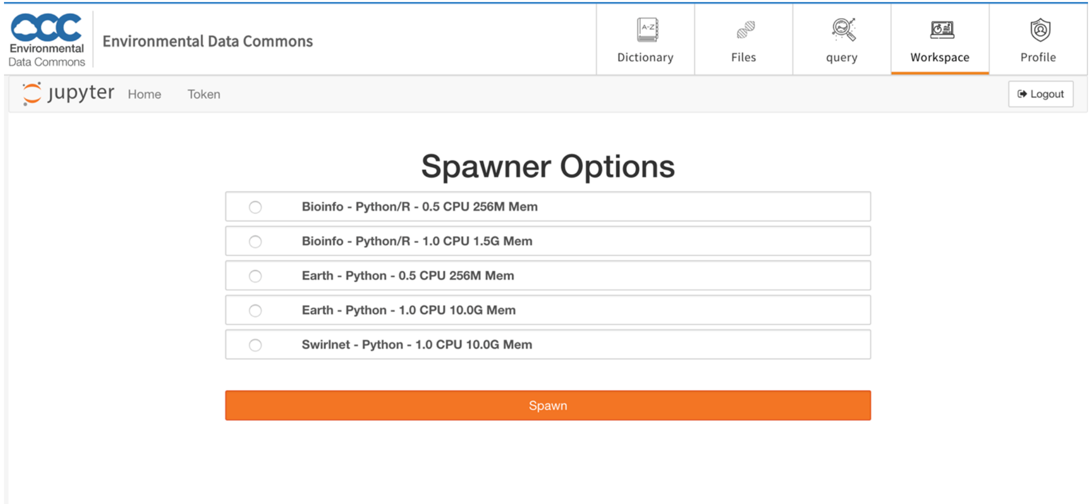
Blue = querying user can specify

Results returned only when # of students represented in the query > a threshold. *I.e. only return standard deviations when the query is computing it for at least 10 students.*

Jupyter Notebooks

Jupyter

- Jupyter Notebooks are powerful tools for creating custom analysis over datasets
- Gen3 runs Jupyter Notebooks in a secure cloud environment helping to reduce the need to download data to laptops, etc.



Spawner Options

○ Bioinfo - Python/R - 0.5 CPU 256M Mem

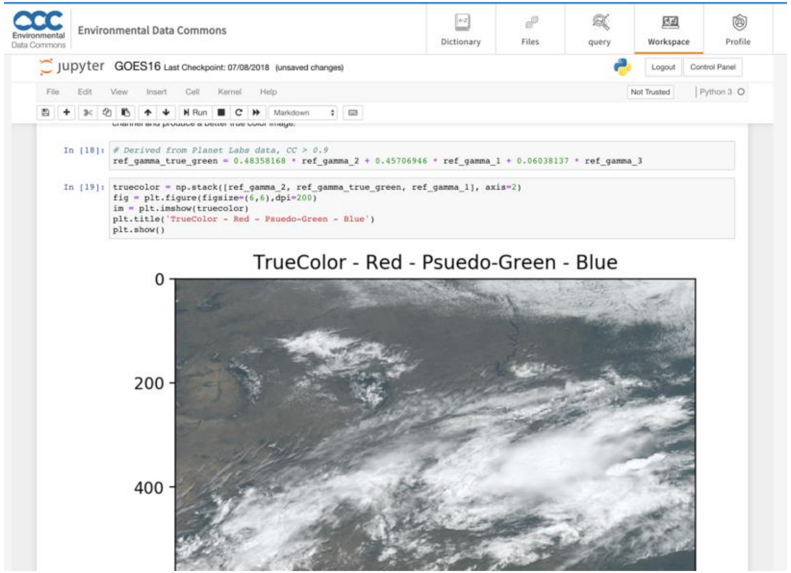
○ Bioinfo - Python/R - 1.0 CPU 1.5G Mem

○ Earth - Python - 0.5 CPU 256M Mem

○ Earth - Python - 1.0 CPU 10.0G Mem

○ Swirlnet - Python - 1.0 CPU 10.0G Mem

Spawn



GOES16 Last Checkpoint: 07/08/2018 (unsaved changes)

channel and produce a better true color image.

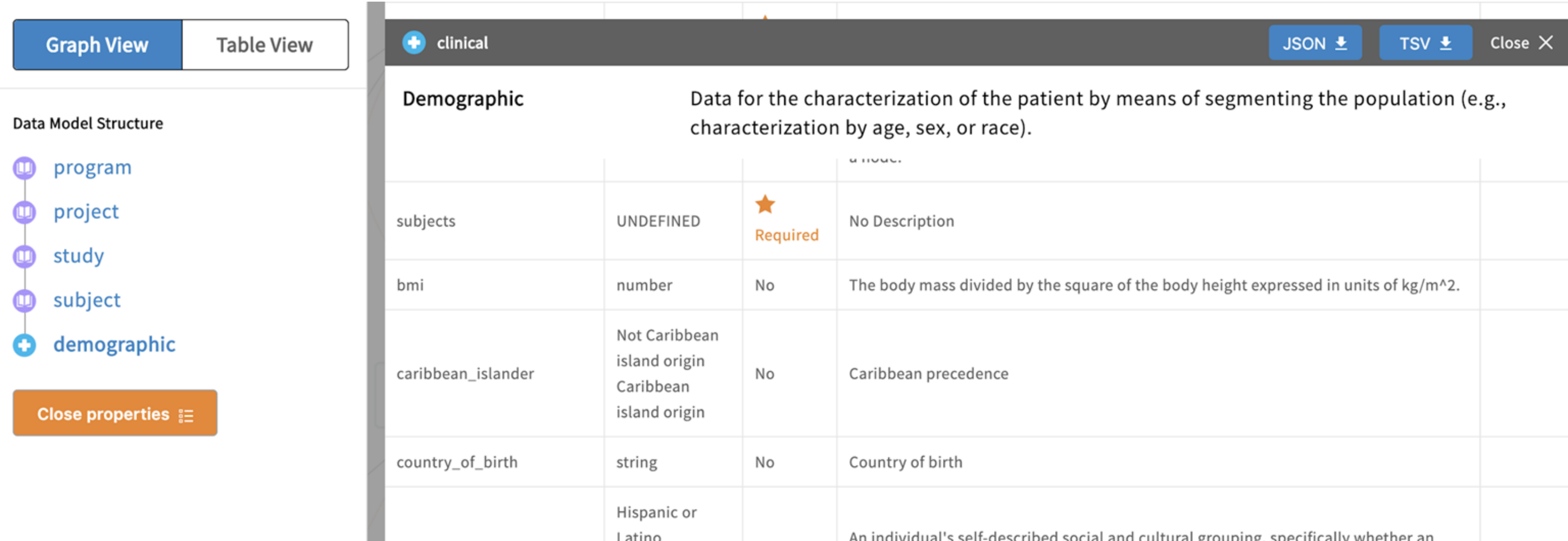
```
In [18]: # Derived from Planet Labs data, CC > 0.9
         ref_gamma_true_green = 0.48358168 * ref_gamma_2 + 0.45706946 * ref_gamma_1 + 0.06038137 * ref_gamma_3

In [19]: truecolor = np.stack([ref_gamma_2, ref_gamma_true_green, ref_gamma_1], axis=2)
         fig = plt.figure(figsize=(6,6),dpi=200)
         im = plt.imshow(truecolor)
         plt.title('TrueColor - Red - Psuedo-Green - Blue')
         plt.show()
```

Data Ontologies

Dictionary viewer

- Gen3 dictionary viewer allows browsing data vocabularies within a particular data commons



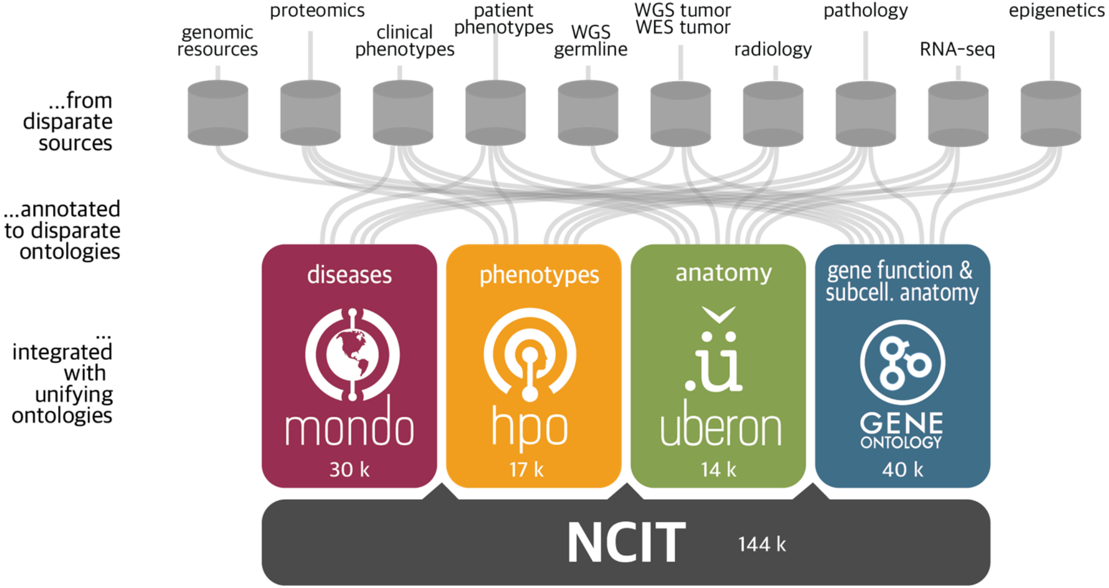
Demographic Data for the characterization of the patient by means of segmenting the population (e.g., characterization by age, sex, or race).

			a node.
subjects	UNDEFINED	★ Required	No Description
bmi	number	No	The body mass divided by the square of the body height expressed in units of kg/m^2.
caribbean_islander	Not Caribbean island origin Caribbean island origin	No	Caribbean precedence
country_of_birth	string	No	Country of birth
	Hispanic or Latino		An individual's self-described social and cultural grouping, specifically whether an

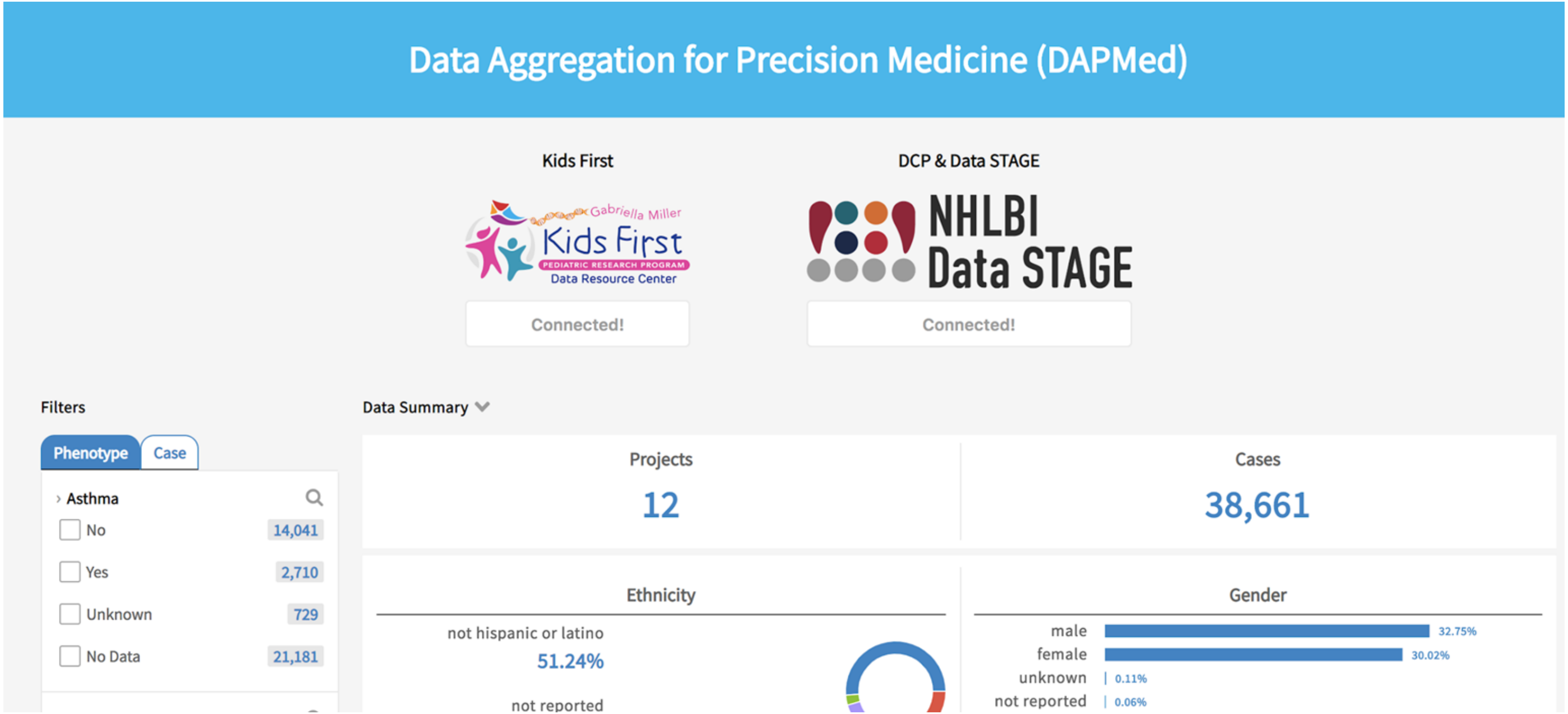
Data Ontologies

PFB

- Ontologies contain controlled vocabulary developed by a standards body.
- Data dictionaries contain references to the ontology terms allowing harmonization of differing data dictionaries



Data Aggregation



Data Aggregation for Precision Medicine (DAPMed)

Kids First

Connected!

DCP & Data STAGE

Connected!

Filters

Phenotype | Case

› Asthma

□ No	14,041
□ Yes	2,710
□ Unknown	729
□ No Data	21,181

Data Summary

Projects	Cases
12	38,661

Ethnicity

not hispanic or latino

51.24%

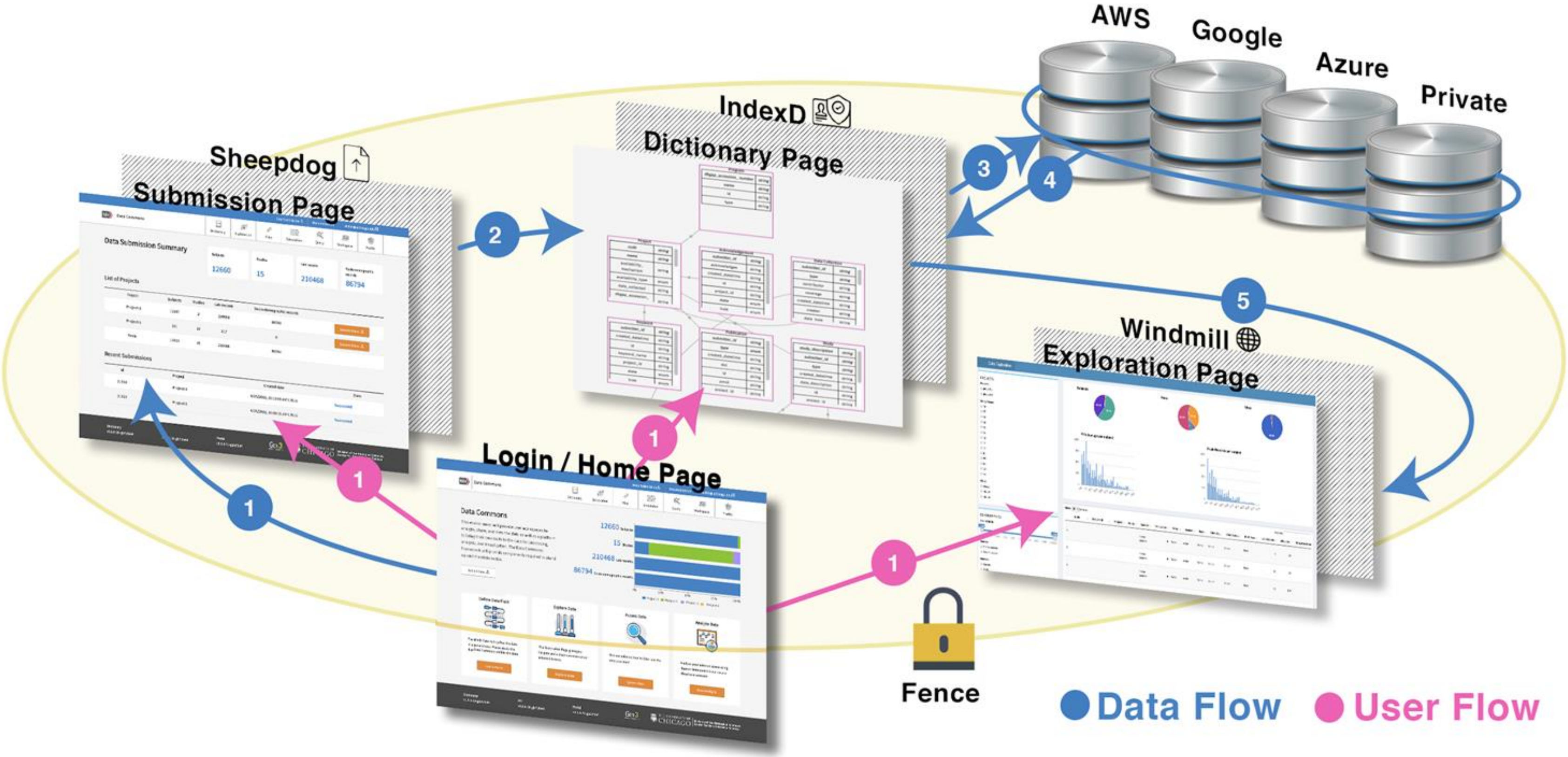
not reported

Gender

male	32.75%
female	30.02%
unknown	0.11%
not reported	0.06%

Data & User Flow with Gen3

GEN3 Data Commons


AWS
Google
Azure
Private
IndexD
Dictionary Page
Sheepdog
Submission Page
Data Submission Summary
12660
15
210468
86794
Windmill
Exploration Page
Login / Home Page
Data Commons
12660
15
210468
86794
Fence
1
1
1
1
2
3
4
5
Data Flow
User Flow