MagicBox Documentation

UNICEF Office of Innovation

Aug 13, 2018

General:

MagicBox is an open-source platform that uses real-time information to inform life-saving humanitarian responses to emergency situations. It’s composed of multiple GitHub repositories designed to ingest, aggregate, and serve data.

CHAPTER 1

Administrative boundaries

UNICEF uses **administrative boundaries** (or administrative areas) to define geographic areas in MagicBox and related projects. Administrative boundaries (ABs) extend the concepts of a country, state, or region. Examples of an administrative boundary may be…

- Country
- State
- Province
- County
- Municipality
- And more…

ABs come from GADM and the Humanitarian Data Exchange (HumData), databases of global administrative areas. In addition, more ABs may come from other sources like municipal governments. These databases make it easier to work with this data in GIS or related software.

1.1 Levels

Levels are a hierarchy system to explain different concepts of administrative boundaries. For example, a city may belong to a municipality, which belongs to a country. Levels help us explain this hierarchy.

UNICEF uses this system of levels:

- **Level 0**: Countries
- **Level 1**: States
- **Level 2**: Counties
- **Level 3**: Municipalities
- And so on…

1.2 Why we use them

Different definitions of geographic areas by different nations makes worldwide geographic mapping a challenge. Not everyone uses the same names for regions. In MagicBox projects, each region, or **shape**, is assigned an `admin_id`.

An `admin_id` is an interpretation of a political border for a specific time. They point to a specific shape in a shapefile that represents an individual country. Time is a part of the admin ID to ingest historical data. For example, mobility or temperature might require a series from an earlier date where a region was known by a different name.

See the following example of an AB for Afghanistan, with an `admin_id`.

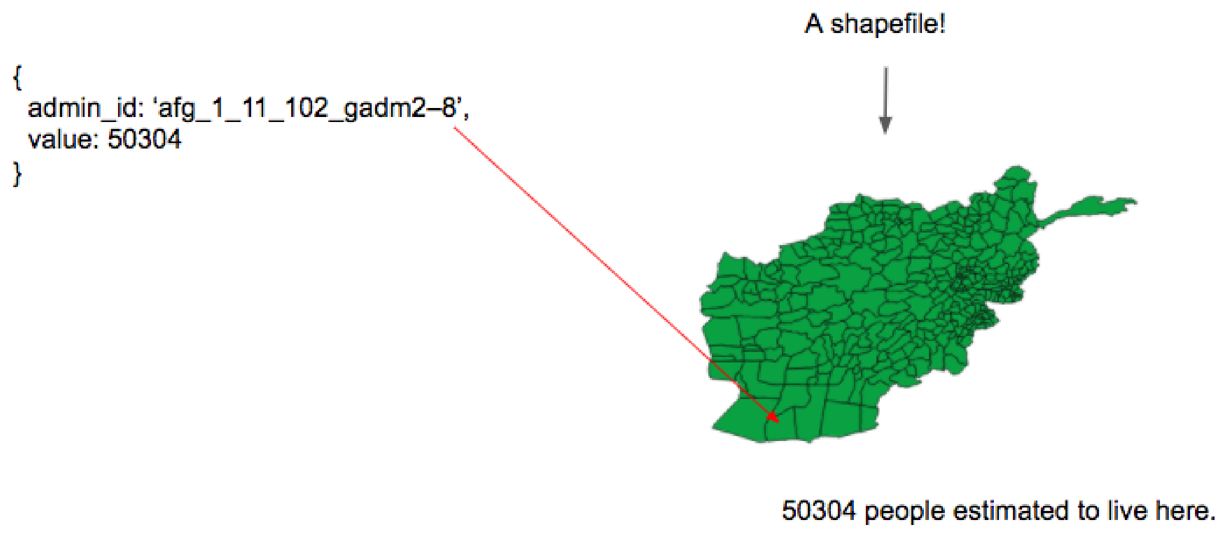

A shapefile!
{
admin_id: 'afg_1_11_102_gadm2–8',
value: 50304
}
50304 people estimated to live here.

Fig. 1: Example of an administrative boundary for Afghanistan

To understand where `afg_1_11_102-gadm2-8` points to, note that Afghanistan has three **levels** of administrative boundaries. The `admin_id` has three integers, one per admin level:

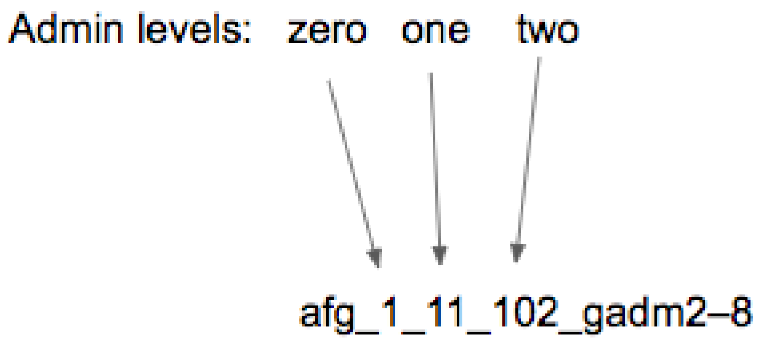


Fig. 2: Afghanistan has three levels of administrative boundaries

1.3 Naming string explained

1.3.1 First integer

The first integer is `1` because Afghanistan is the first country in GADM's database.

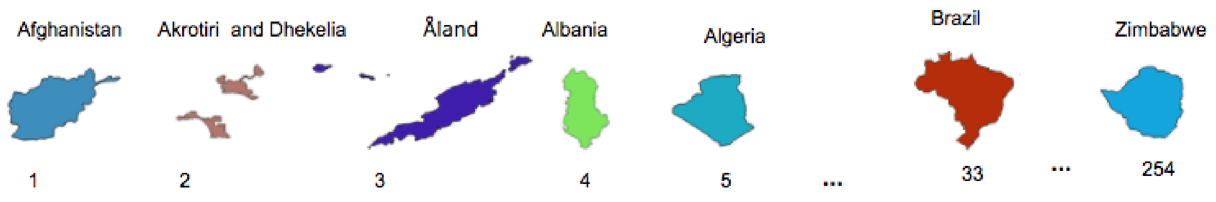


Fig. 3: The first few countries in GADM's database

1.3.2 Second and third integer

Afghanistan has 34 shapes at level one and 320 shapes in level two.

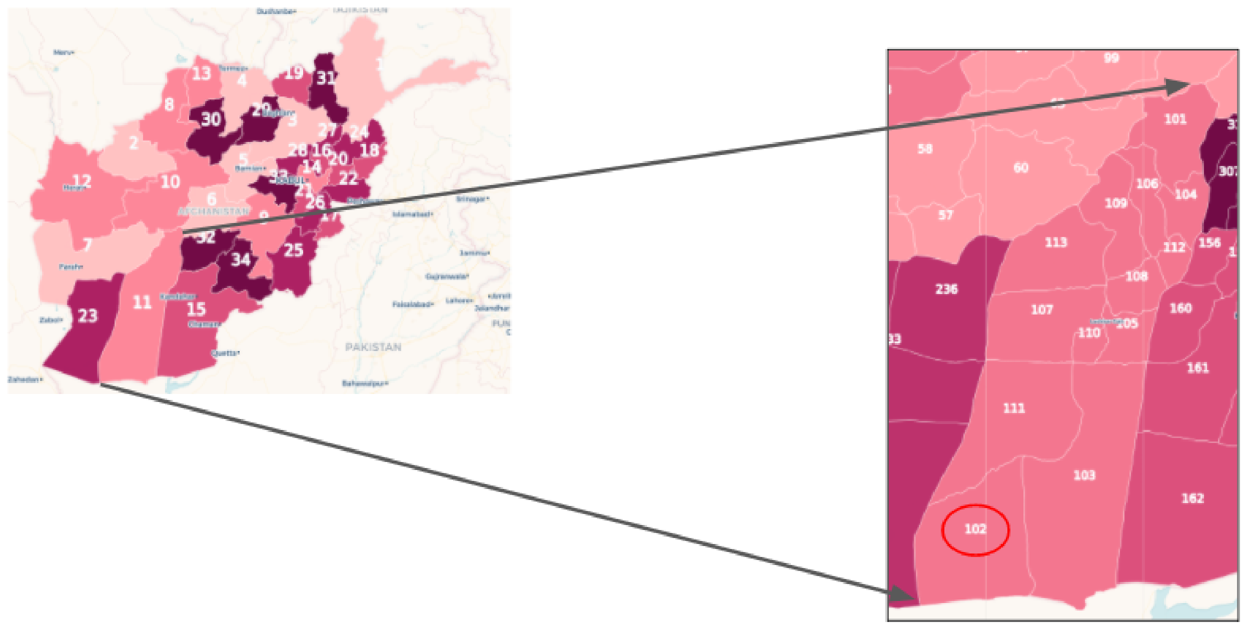


Fig. 4: Afghanistan: Higher level administrative boundaries

1.3.3 Putting it together

Thus, `afg_1_11_102-gadm2-8` indicates any population value attached to it is related to:

- First country in the gadm collection
- 11th shape in the admin level 1 shapefile
- 102nd shape in the admin level 2 shapefile

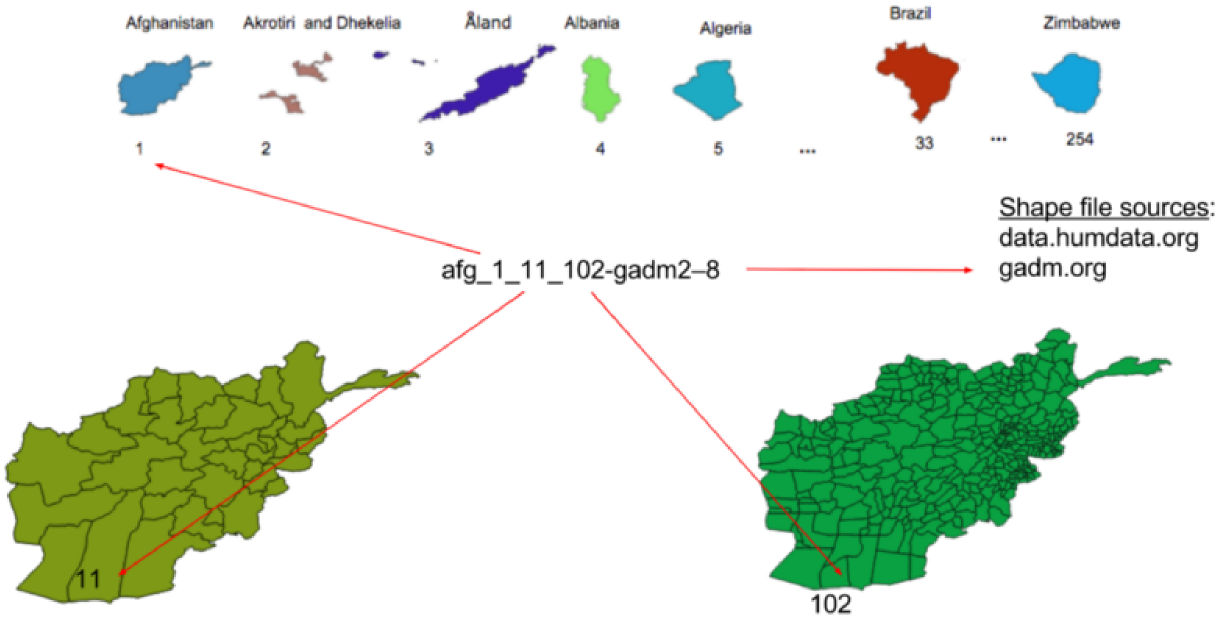


Fig. 5: Putting it together: What the admin ID represents

CHAPTER 2

Access control

Information about schools can be sensitive. Potential bad actors could use school data for malicious purposes and terrorism. How school data is shared outside of the API is important.

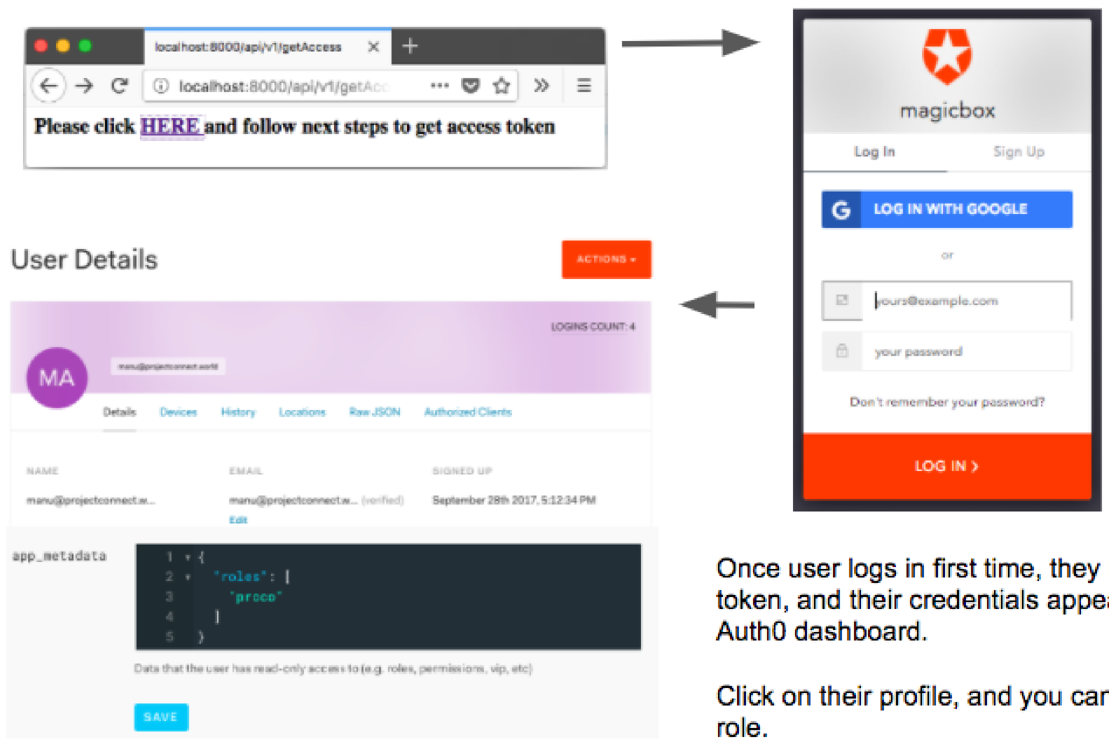
MagicBox uses Auth0 to authenticate users and assign them roles.

2.1 Tokens

Auth0 creates tokens for users authenticating to the API. A user may make a request with their token like this.

```
curl -i localhost:8000/api/v1/schools/countries/GL -H "Token: Bearer␣
↪xxxxxxxxxx9gek6Z5Ilnkx"
```

After receiving the token, UNICEF reviews the applicant before privileges are granted. Once our API receives the token, we pass it to Auth0 which returns the user's profile and roles.



Please click HERE and follow next steps to get access token

manu@projectconnect.w... manu@projectconnect.w... (verified) September 28th 2017, 5:12:34 PM

app_metadata

```
{
  "roles": [
    "proco"
  ]
}
```

Data that the user has read-only access to (e.g. roles, permissions, vip, etc)

Once user logs in first time, they receive a token, and their credentials appear in Auth0 dashboard.

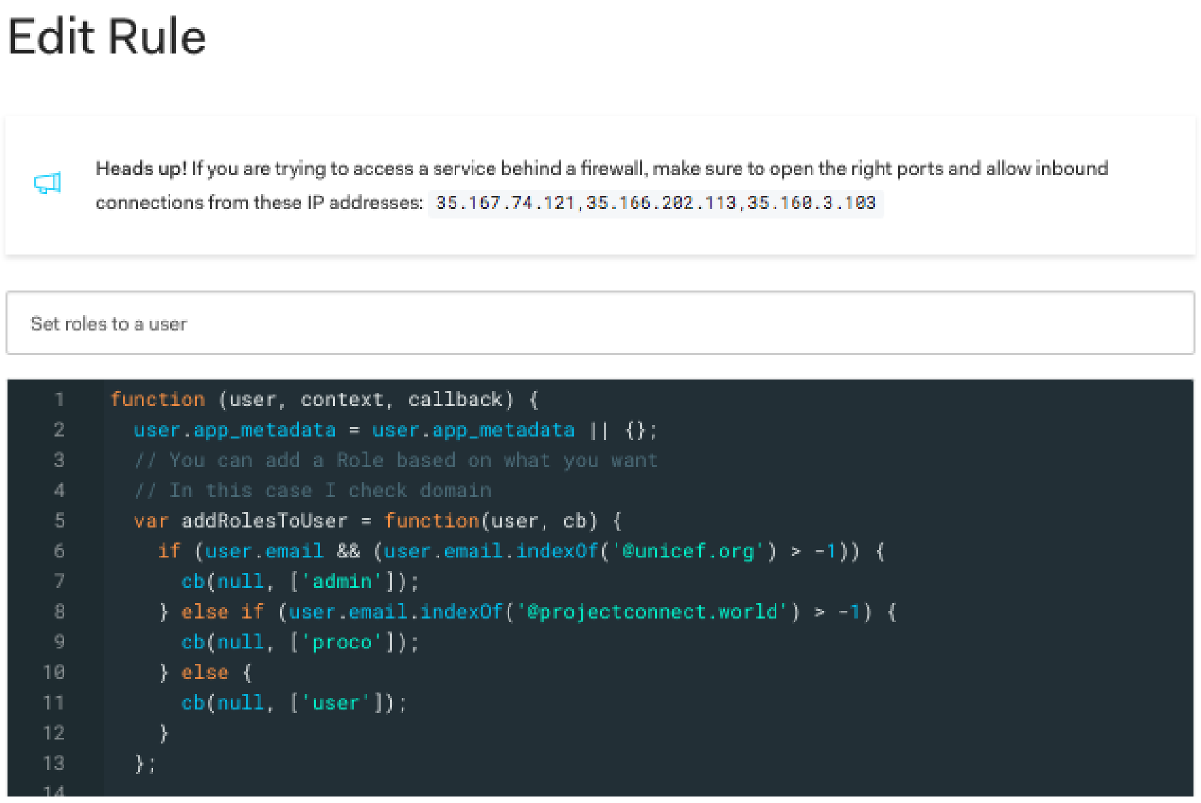
Click on their profile, and you can assign a role.

2.2 Rules

General rules can be assigned by email domain via Auth0.

See also:

See *Data ingestion rules* for more information about data rules.



Edit Rule

Heads up! If you are trying to access a service behind a firewall, make sure to open the right ports and allow inbound connections from these IP addresses: `35.167.74.121,35.166.202.113,35.160.3.103`

Set roles to a user

```
function (user, context, callback) {
  user.app_metadata = user.app_metadata || {};
  // You can add a Role based on what you want
  // In this case I check domain
  var addRolesToUser = function(user, cb) {
    if (user.email && (user.email.indexOf('@unicef.org') > -1)) {
      cb(null, ['admin']);
    } else if (user.email.indexOf('@projectconnect.world') > -1) {
      cb(null, ['proco']);
    } else {
      cb(null, ['user']);
    }
  };
```

Fig. 1: Code that implements checking for the email domain of a user

CHAPTER 3

Ingesting data into MagicBox

Importing new data sets to MagicBox is important for expanding coverage and how we retrieve new data insights. This document explains how we ingest and import new data to MagicBox.

3.1 School data ingestion

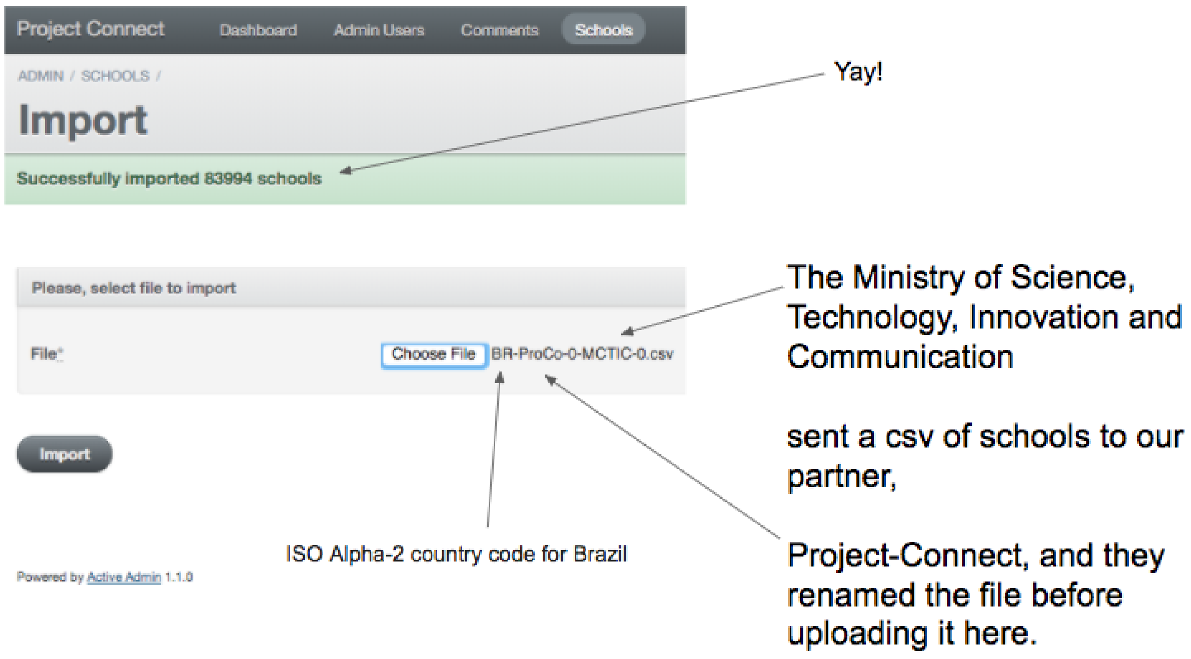
Data for schools comes in CSV files with a specific naming scheme. We developed a Ruby on Rails-based CRUD[1] application, Project Connect to ingest this data.

There are two admin interfaces for Rails applications:

- Rails Admin
- Active Admin

Active Admin has an import plugin for uploading CSVs with `before_batch_import` support. We chose Active Admin for this reason.

[1] Create, Read, Update, Delete


Project Connect
Dashboard
Admin Users
Comments
Schools
ADMIN / SCHOOLS /
Import
Successfully imported 83994 schools
Yay!
Please, select file to import
File*
Choose File
BR-ProCo-0-MCTIC-0.csv
Import
ISO Alpha-2 country code for Brazil
Powered by Active Admin 1.1.0
The Ministry of Science, Technology, Innovation and Communication
sent a csv of schools to our partner,
Project-Connect, and they renamed the file before uploading it here.

3.2 School data database

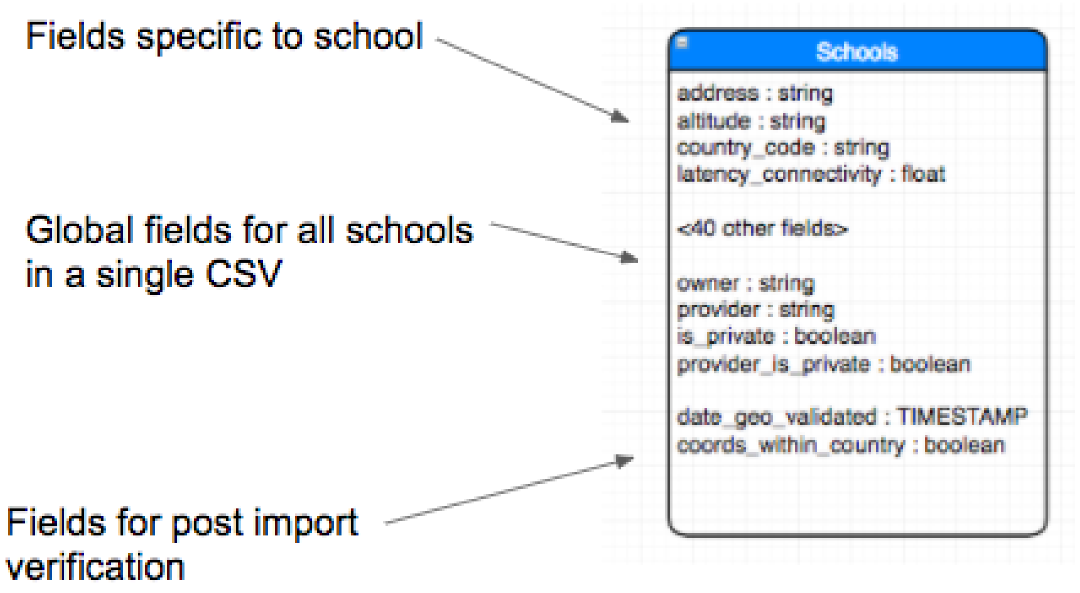
MagicBox needed a database to manage large amounts of school data and process it quickly. To do this, MagicBox uses a relational database, PostgreSQL, to store data. PostgreSQL was chosen because it was used in a tutorial for building a similar use case as ours (thus, a relational database is not a "married" idea).

All school data is stored in a single table named `schools`. This keeps things simple at the expense of some repeated values in the database.

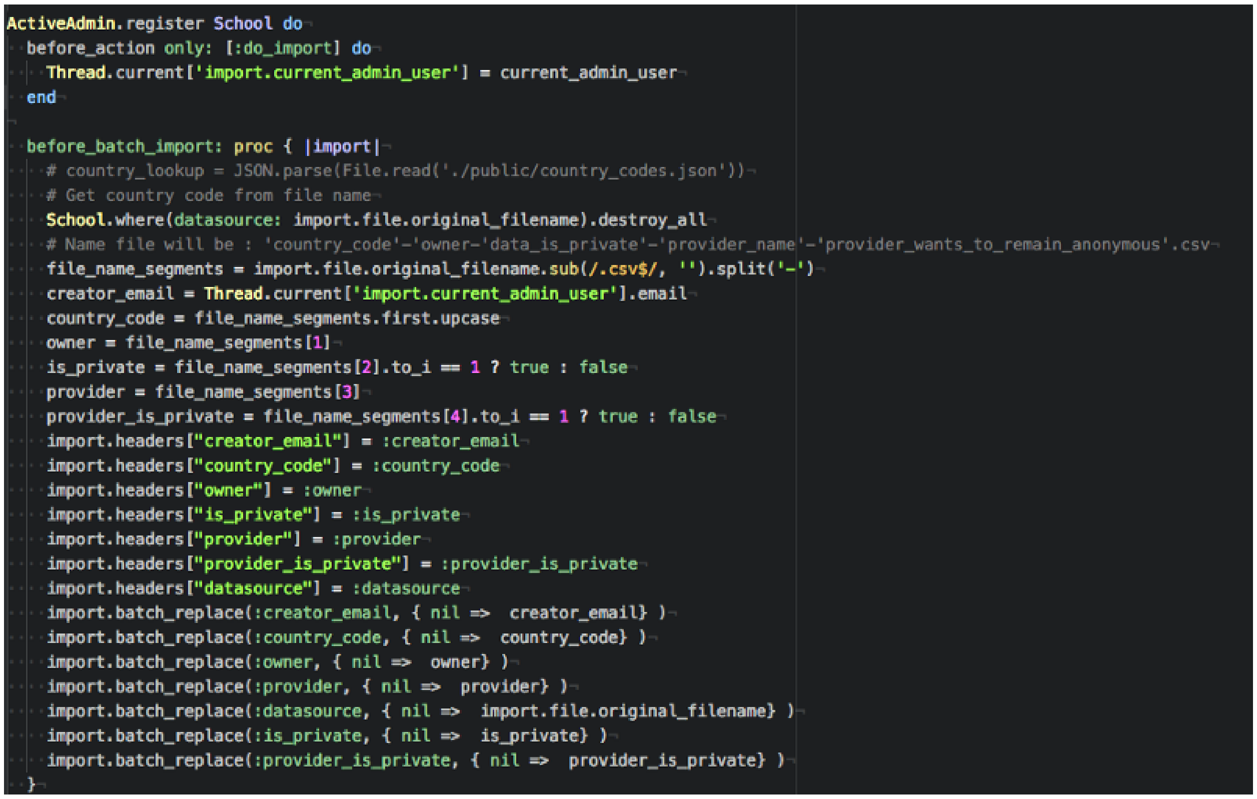
3.2.1 Inserted data

When data is imported, new data is inserted alongside the imported data. Four new types of important data are added:

- Provider / owner of school CSV data
- Organization that received school data
- Identity of uploader
- If uploader chooses to remain private


Fields specific to school
Global fields for all schools in a single CSV
Fields for post import verification
Schools
address : string
altitude : string
country_code : string
latency_connectivity : float
<40 other fields>
owner : string
provider : string
is_private : boolean
provider_is_private : boolean
date_geo_validated : TIMESTAMP
coords_within_country : boolean

These values are not included with the data. We use the `before_batch_import` hook in Active Admin to parse file names, insert this data, and assign values.



```
ActiveAdmin.register School do
  before_action only: [:do_import] do
    Thread.current['import.current_admin_user'] = current_admin_user
  end

  before_batch_import: proc { |import|
    # country_lookup = JSON.parse(File.read('./public/country_codes.json'))
    # Get country code from file name
    School.where(datasource: import.file.original_filename).destroy_all
    # Name file will be : 'country_code'-'owner-'data_is_private'-'provider_name'-'provider_wants_to_remain_anonymous'.csv
    file_name_segments = import.file.original_filename.sub(/.csv$/, '').split('-')
    creator_email = Thread.current['import.current_admin_user'].email
    country_code = file_name_segments.first.upcase
    owner = file_name_segments[1]
    is_private = file_name_segments[2].to_i == 1 ? true : false
    provider = file_name_segments[3]
    provider_is_private = file_name_segments[4].to_i == 1 ? true : false
    import.headers["creator_email"] = :creator_email
    import.headers["country_code"] = :country_code
    import.headers["owner"] = :owner
    import.headers["is_private"] = :is_private
    import.headers["provider"] = :provider
    import.headers["provider_is_private"] = :provider_is_private
    import.headers["datasource"] = :datasource
    import.batch_replace(:creator_email, { nil =>  creator_email} )
    import.batch_replace(:country_code, { nil =>  country_code} )
    import.batch_replace(:owner, { nil =>  owner} )
    import.batch_replace(:provider, { nil =>  provider} )
    import.batch_replace(:datasource, { nil =>  import.file.original_filename} )
    import.batch_replace(:is_private, { nil =>  is_private} )
    import.batch_replace(:provider_is_private, { nil =>  provider_is_private} )
  }
```

Fig. 1: Implementation of how data is modified before imported. See schools.rb

CHAPTER 4

Querying MagicBox data

The MagicBox API (magicbox-open-api) serves different sets of data through its API. Currently, five datasets are available.

- Cases
- Mobility
- Mosquitoes
- Population
- Schools

The benefit of querying this data is to analyze and cross different data sets together. For example, this is done in magicbox-maps, where population and mosquito prevelance data are crossed together.

This document explains how the API works but does not document how to use it. For more information on using the API, see the magicbox-open-api repository.

4.1 Cases

Note: This section needs to be written.

4.2 Mobility

Note: This section needs to be written.

4.3 Mosquitoes

Note: This section needs to be written.

4.4 Population

Note: This section needs to be written.

4.5 Schools

The MagicBox API also serves data about schools. The public repositories contain sample data from private data sets. However, in the interest of the privacy and safety of the schools, the full data sets are kept private.

4.5.1 How we do it

There are three endpoints for querying school data. They serve the following data:

1. List of countries with school data
2. Schools in a country
3. Specific school data by ID value

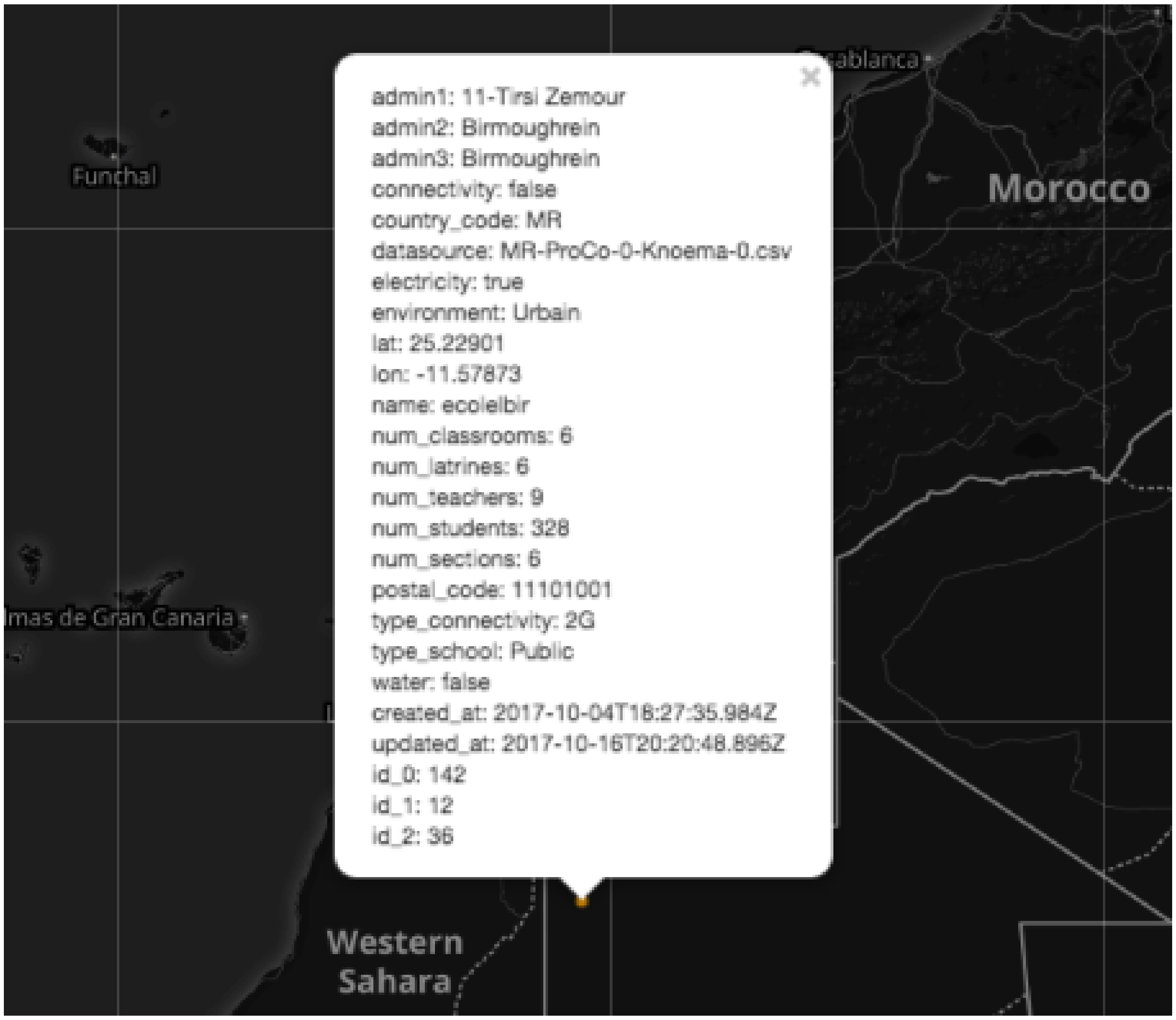
The first endpoint returns a comma-seperated list of country codes. There is available data about schools in the countries returned in the list.

The second endpoint returns an array of arrays, where

- First array returns column names (e.g. `lat`, `lon`, `speed_connectivity`, `type_connectivity`)
- Subsequent arrays return values for school records

The third endpoint returns column values from a specific school, as selected by its ID number. Some of the values available are listed below:

- Address
- Network connectivity
- Number of teachers
- Number of students
- If electricity is available
- If running water is available
- And more



```
admin1: 11-Tirsi Zemour
admin2: Birmoughrein
admin3: Birmoughrein
connectivity: false
country_code: MR
datasource: MR-ProCo-0-Knoema-0.csv
electricity: true
environment: Urbain
lat: 25.22901
lon: -11.57873
name: ecolelbir
num_classrooms: 6
num_latrines: 6
num_teachers: 9
num_students: 328
num_sections: 6
postal_code: 11101001
type_connectivity: 2G
type_school: Public
water: false
created_at: 2017-10-04T18:27:35.984Z
updated_at: 2017-10-16T20:20:48.896Z
id_0: 142
id_1: 12
id_2: 36
```

Fig. 1: Example of output from third endpoint inside of a front-end utilizing the API

4.6 Caveats

There are some caveats with querying the MagicBox API.

- Cannot specify or limit columns included in response
- Cannot request values where value is null
- Cannot use operators (e.g. greater than, less than, etc.)

CHAPTER 5

Data ingestion rules

This document explains how the format we receive data in. It also details how certain flags, or rules, are applied to the data when ingested.

5.1 Available flags

There are two flags available. These flags are applied to data when ingested.

- **Private data**: Data is private and is only accessible to UNICEF and uploading organization
- **Anonymity**: Uploading organization chooses to remain anonymous

These flags are not inside of the data sets. The flags must be applied when the data is ingested.

See also:

See *Ingesting data into MagicBox* for more information about data ingestion.

5.2 School data file names

School mapping data is provided in a unique file name format. Some information must be gathered from the file name. See this example:

```
BR-ProCo-0-MCTIC-0.csv
```

There are five parts to the file name.

1. **BR**: Country code (BR is Brazil)
2. **ProCo**: Partner (ProCo is Project Connect)
3. **0**: Sets privacy of data (0 is public, 1 is private)
4. **MCTIC**: Provider (MCTIC is Ministério da Ciência, Tecnologia, Inovação e Comunicação)

5. **0**: Sets privacy of uploader (0 is public, 1 is anonymous)

5.3 Caveats

Code is not yet written to enforce rules. We still need to implement permissions based on user information forwarded from Auth0.

CHAPTER 6

Data validation

Data validation ensures correct and consistent data is processed and aggregated for use in MagicBox. The validated data is used by implementations of the MagicBox API, such as magicbox-maps.

This article explains how we verify values, identify duplicates, and merge multiple records into one.

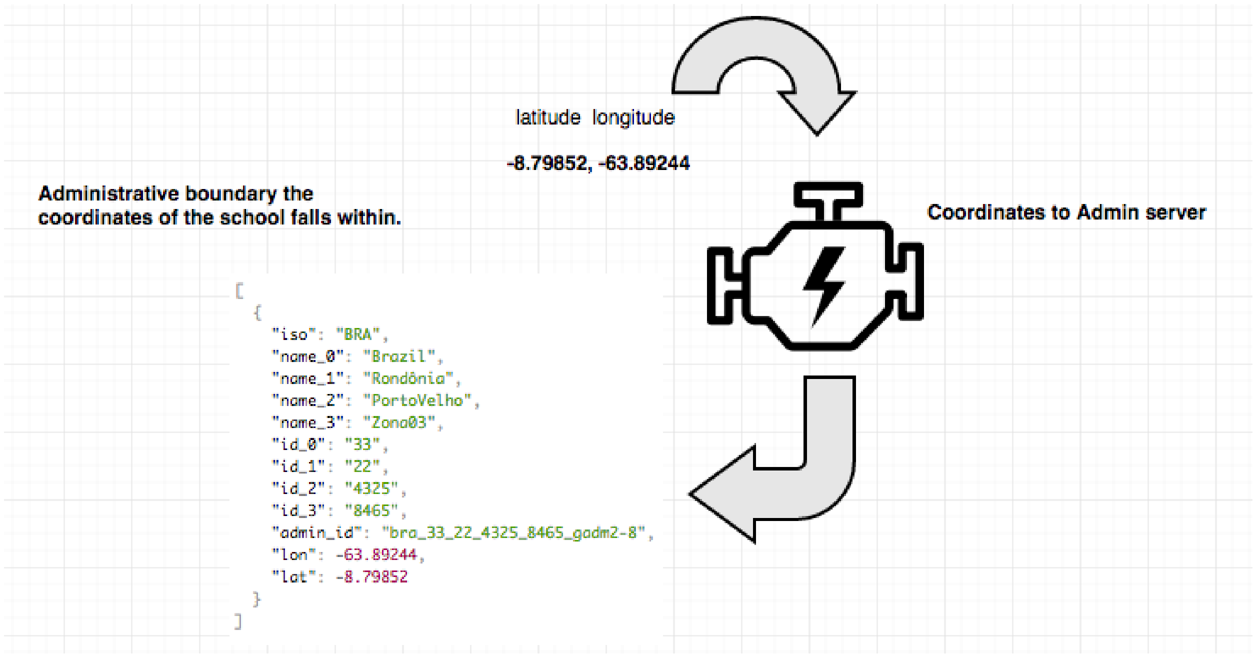
6.1 How we do it

Fig. 1: How magicbox-latlong-admin-server validates coordinate pairs

Data validation is performed by magicbox-latlong-admin-server. The server verifies a pair of latitude / longtitude coordinates are located within the country indicated by the beginning of a file name.

The data validation program processes every ten minutes as a cron job. It runs a programatic version of this query:

```
// Do a select on all schools that have not been geo validated
"SELECT id, lat, lon, country_code FROM schools WHERE date_geo_validated IS null AND␣
↪lat IS NOT null AND lon IS NOT null"
```


latitude longitude
-8.79852, -63.89244
Administrative boundary the coordinates of the school falls within.
Coordinates to Admin server

```
[
  {
    "iso": "BRA",
    "name_0": "Brazil",
    "name_1": "Rondônia",
    "name_2": "PortoVelho",
    "name_3": "Zona03",
    "id_0": "33",
    "id_1": "22",
    "id_2": "4325",
    "id_3": "8465",
    "admin_id": "bra_33_22_4325_8465_gadm2-8",
    "lon": -63.89244,
    "lat": -8.79852
  }
]
```

6.1.1 Adding new attributes

After the data is validated, the magicbox-latlong-admin-server updates attributes for some data. The attributes are only added if the engine returns an admin area ID for the target country (see *Administrative boundaries*).

1. `date_geo_validated`: To `CURRENT_TIMESTAMP`
2. `coords_within_country`: true or false

6.2 Why we do it

Some CSV files we import and aggregate contain tens of thousands of records. Data validation is an expensive operation. We chose not to verify each school's coordinates in the `before_batch_import` hook for this reason.

Instead, we opted for the data validation program to run as a cron job every ten minutes to accomplish this.

CHAPTER 7

Data visualization

MagicBox is a full-stack application. While the back-end API (magicbox-open-api) serves the data and makes it available for querying, the magicbox-maps application visualizes the data inside a world map.

7.1 How we do it

magicbox-maps draws the plot points using OpenStreetMap Leaflet and WebGL. WebGL allows us to render up to 16 million clickable points at once.

To do this inside of a React application like `magicbox-maps`, we created react-webgl-leaflet. This React module enables us to render several plot points simultaneously, like we use for the school mapping data. Every school is represented with a unique, clickable point.

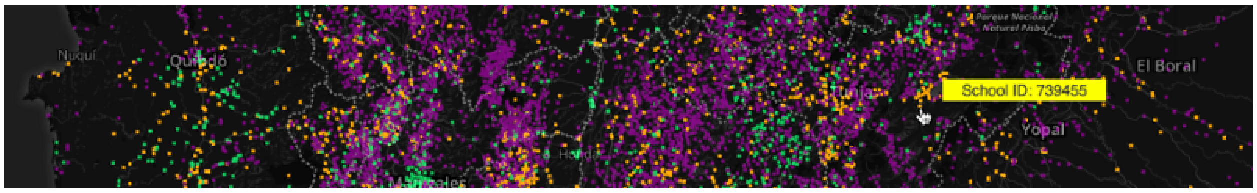
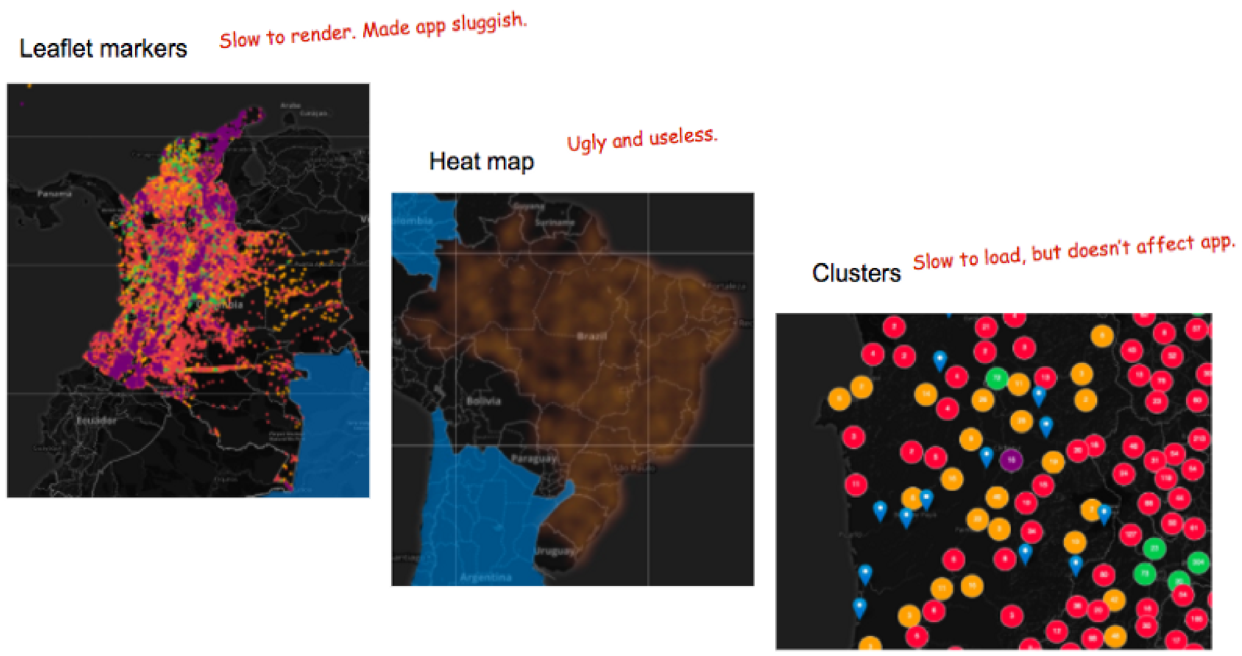


Fig. 1: react-webgl-leaflet npm module

This is currently used for magicbox-maps.

7.2 Why we do it

Originally, we began using Leaflet markers. This worked well for Mauritania with 2,936 schools. However, when we moved to Colombia with 49,020 schools, performance took a significant hit. We experimented with a few other options, like heatmaps and clustering.


Leaflet markers
Slow to render. Made app sluggish.
Heat map
Ugly and useless.
Clusters
Slow to load, but doesn't affect app.

In the end, we decided on using WebGL, as explained above.

CHAPTER 8

How to deploy an application

In the UNICEF Office of Innovation team, we use Azure Web Apps to deploy our applications to the cloud.

This guide will walk you through the deployment process of a WebApp in the Azure environment. At the end of this guide you will be able to develop, tag and deploy the tagged version of the application to the azure servers.

8.1 Create a feature branch for development

While in development, it is useful to make all of your changes in a feature branch named accordingly to the task.

For example, if we want to implement a new feature to show information about the country the user clicked in, we could name the branch accordingly to this task using the command below:

```
git checkout -b show_country_information
```

We can implement our features in this branch and submit a Pull Request to merge it into the master branch of the app.

8.1.1 Create a tag

Once your changes get merged into master, we can create a tag for the current version of the application. Make sure to name the tag accordingly with the project's convention and following the semantic versioning rules.

For example, suppose you made a simple fix in the application and your changes just got merged from the branch "fix_bug_61" into master. In this project, tags are named using the convention "vX.X.X" and the last tag is "v1.1.1".

Since your fix is a patch, you can create the tag "v1.1.2" with the command

```
git tag v1.1.2
```

Always remember to push the tag to the public repository to make others aware of the current project version. You can push your tags to the public repository with the command.

```
git push origin master --tags
```

8.2 Deploying the application

After our changes get merged into master, we can deploy the application to Azure.

Each UNICEF's application in Azure have two main deployment slots: production and staging.

In the production slot lies the code that you can see in your browser, the application as it is, available for the final user.

The staging slot contains the code preparing to be released to production. Once your code is in this slot you can take a look in a private url to see how your code will respond in production.

If everything looks correct in staging, you can swap the code in production with the code in the staging slot to make your changes available for all users.

8.2.1 Adding Azure remote for repository

The first thing we need to do is add the staging remote to our local git repository.

Within the project directory, you can add the stagin remote for the project issuing the command below.

```
git remote add staging https://<username>@<project-name>-staging.scm.azurewebsites.
↪net:443/<project-name>.git
```

Make sure to change <project-name> with the project name you are working on and <username> for your username set in the deployment credentials in Azure.

8.2.2 Pushing changes to the staging slot

Push changes to the staging repository issuing the command below

```
git push staging master
```

This command will push the current version in your master branch to staging in azure.

To push a specific tag to Azure, run:

```
git push staging tagname:master
```

Replace "tagname" with the tag you want to push to azure.

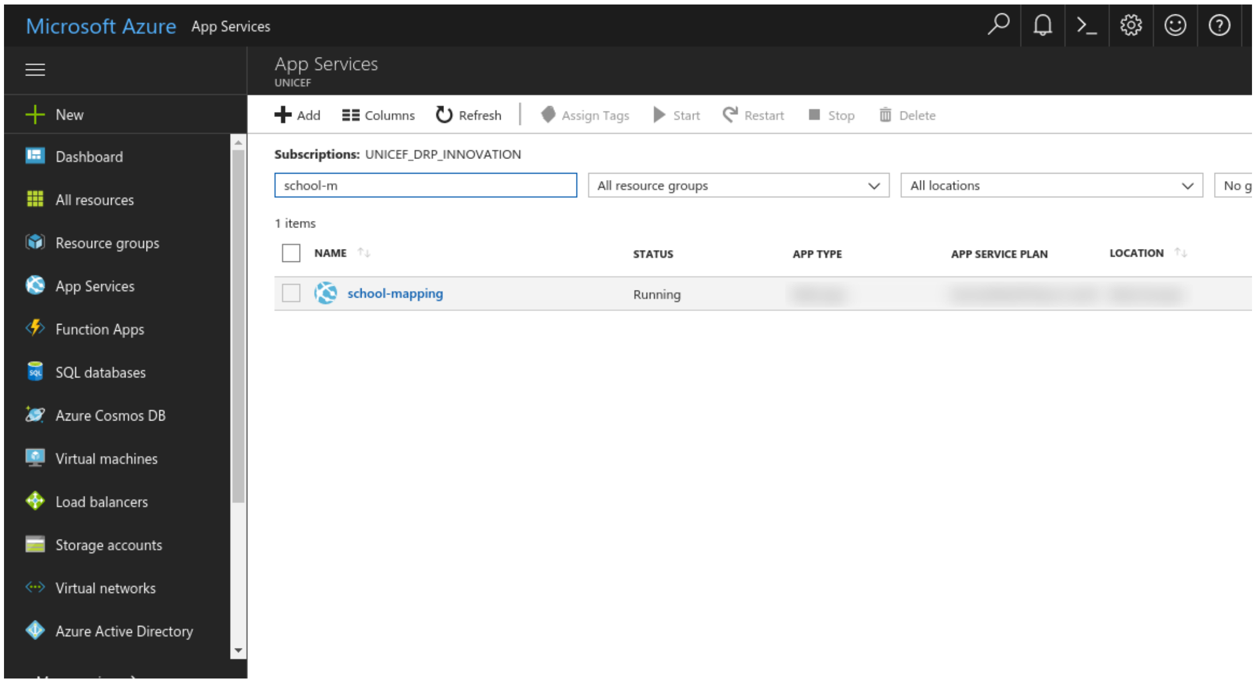
8.2.3 Swap staging to production (Web)

The last step to make your changes available to the public is swap the staging environment with the production environment.

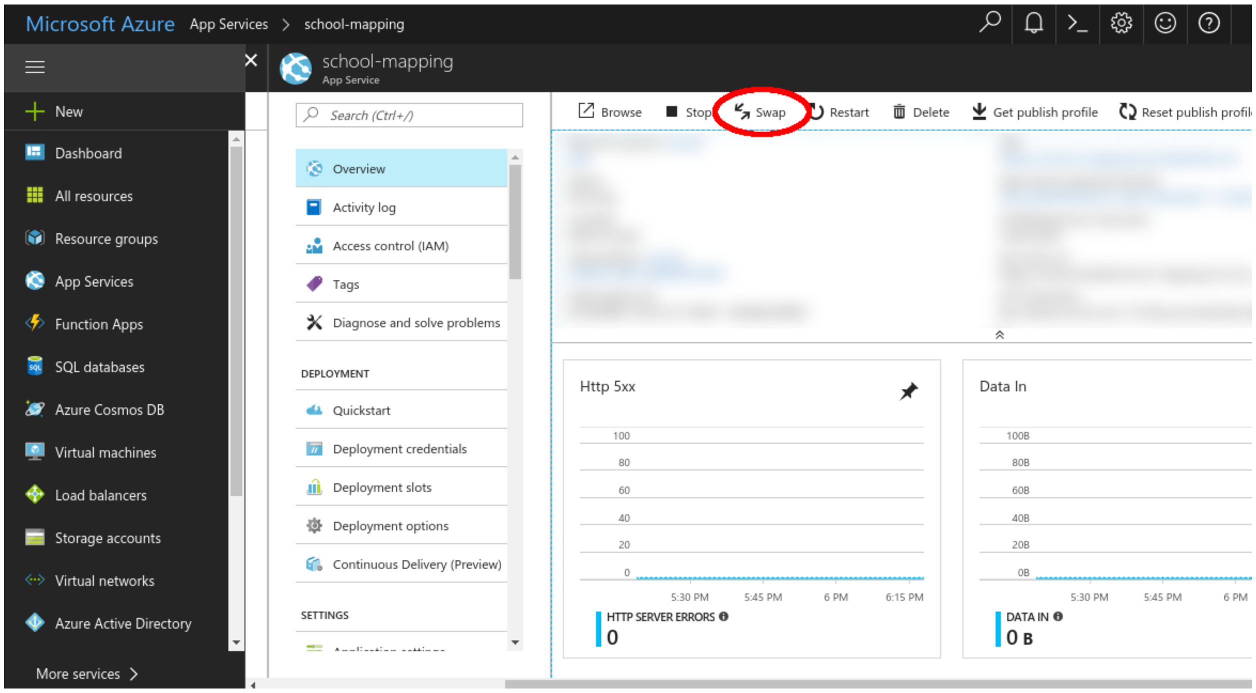
Once your code is working properly in the staging environment, you can swap it with production. Swapping those slots means that the code in the staging environment now answers for the production environment and the code in the production environment now lives in the staging environment.

If a bug was introduced in your changes and it was not caught in the staging environment and is now in the production environment, all you have to do to revert it to the last working version of the application is to swap it again.

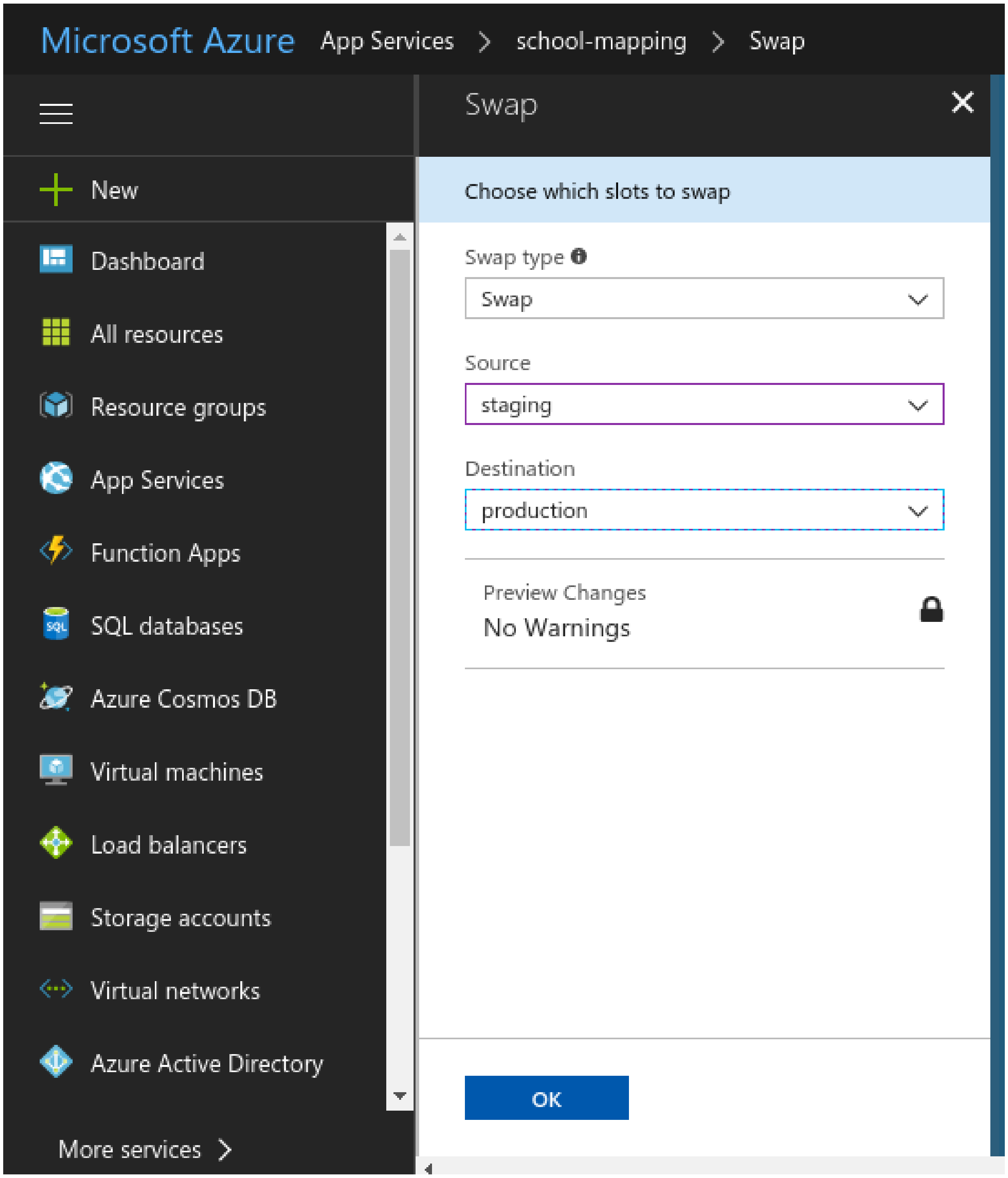
To make the swap, go to the Azure Panel > App Services, find the project you are working on and select it.



In the overview section you will find the "Swap" button, you can click in it.



Make sure to select in the Swap panel "staging" as source and "production" as destination.



Swap

Choose which slots to swap

Swap type: Swap

Source: staging

Destination: production

Preview Changes

No Warnings

Click OK to make the swap. You will get a notification once it finishes.

To replace your changes for the last working version of the application, just repeat this procedure.

8.2.4 Swap staging to production (CLI)

If you have the right permissions in place you can make the swap using the Azure CLI.

To do this, make sure you are in the ASM mode running

```
azure config mode --help
```

Then you can use

```
azure site swap <appname>
```

CHAPTER 9

GitHub workflow best practices

The UNICEF Innovation development team uses GitHub to host open source projects. This document explains the GitHub workflow maintainers and developers use. It also offers suggestions for best practices on using available tools and integrations.

This document explains. . .

- How to make a new GitHub repository
- How to maintain a GitHub repository
- How to communicate effectively

9.1 How to make a new GitHub repository

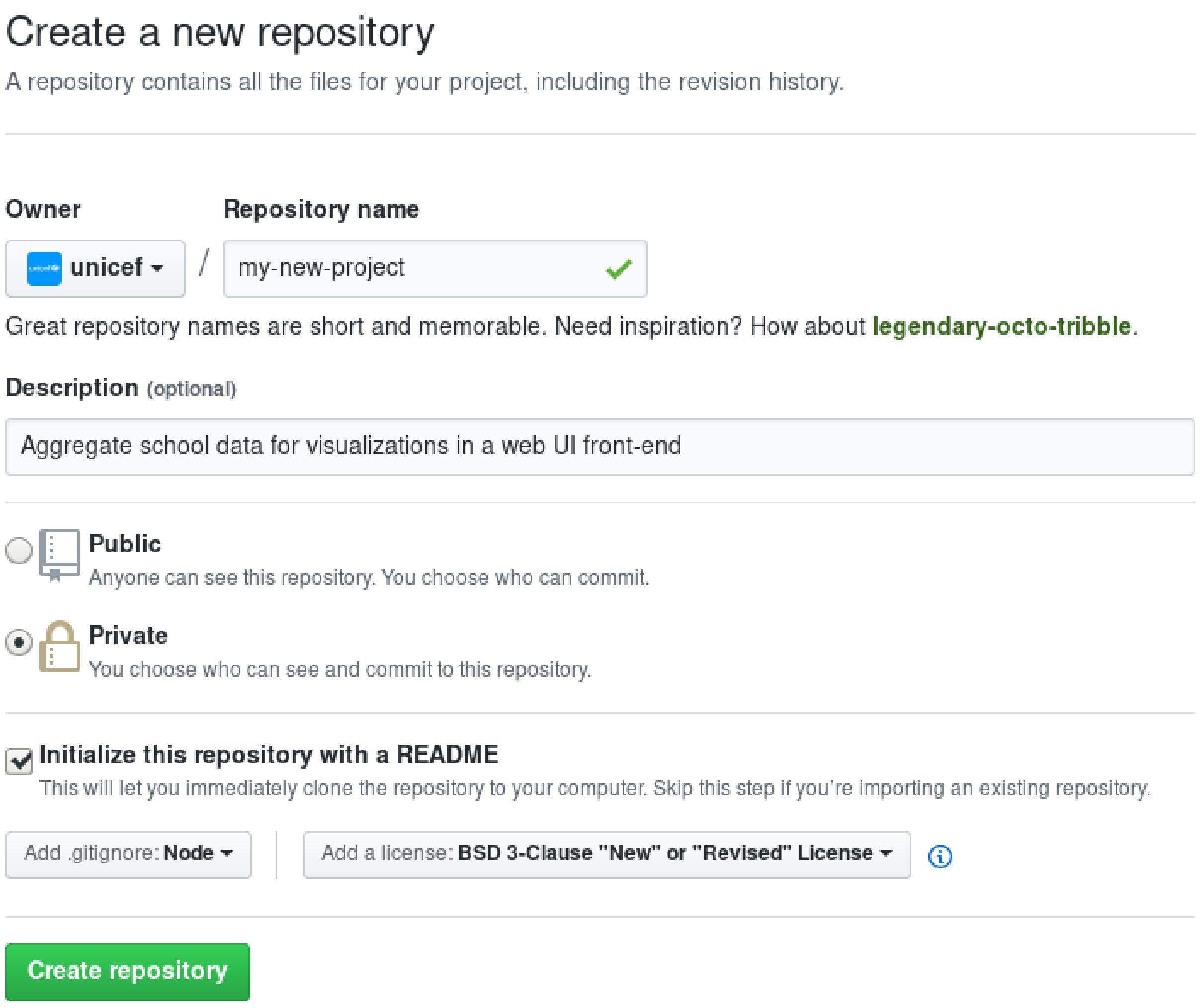
This section explains steps to follow when creating a new GitHub repository. These makes projects more organized, easier to follow from an outsider's perspective, and boosts visibility of development.

9.1.1 Repository creation

These steps focus on the initial repository creation, from github.com/new.

1. **Set a meaningful name**:
    - Try to make purpose obvious in title
    - Use hyphens (−) instead of underscores (_)
2. **Write a description**: Write one or two sentences to quickly describe the project
3. **Initialize with README**: Check to add a `README.md` file
    - If one is not yet written, initialize one
4. **Add .gitignore for project type**: Find project's programming language and choose its `.gitignore` file, if available

5. **Add BSD-3 Clause license**: Standard license used for UNICEF Innovation projects



Create a new repository

A repository contains all the files for your project, including the revision history.

Owner: unicef / Repository name: my-new-project

Great repository names are short and memorable. Need inspiration? How about legendary-octo-tribble.

Description (optional): Aggregate school data for visualizations in a web UI front-end

Public — Anyone can see this repository. You choose who can commit.

[✓ Private] — You choose who can see and commit to this repository.

[✓] Initialize this repository with a README — This will let you immediately clone the repository to your computer. Skip this step if you're importing an existing repository.

Add .gitignore: Node

Add a license: BSD 3-Clause "New" or "Revised" License

Fig. 1: Example of creating a new repository

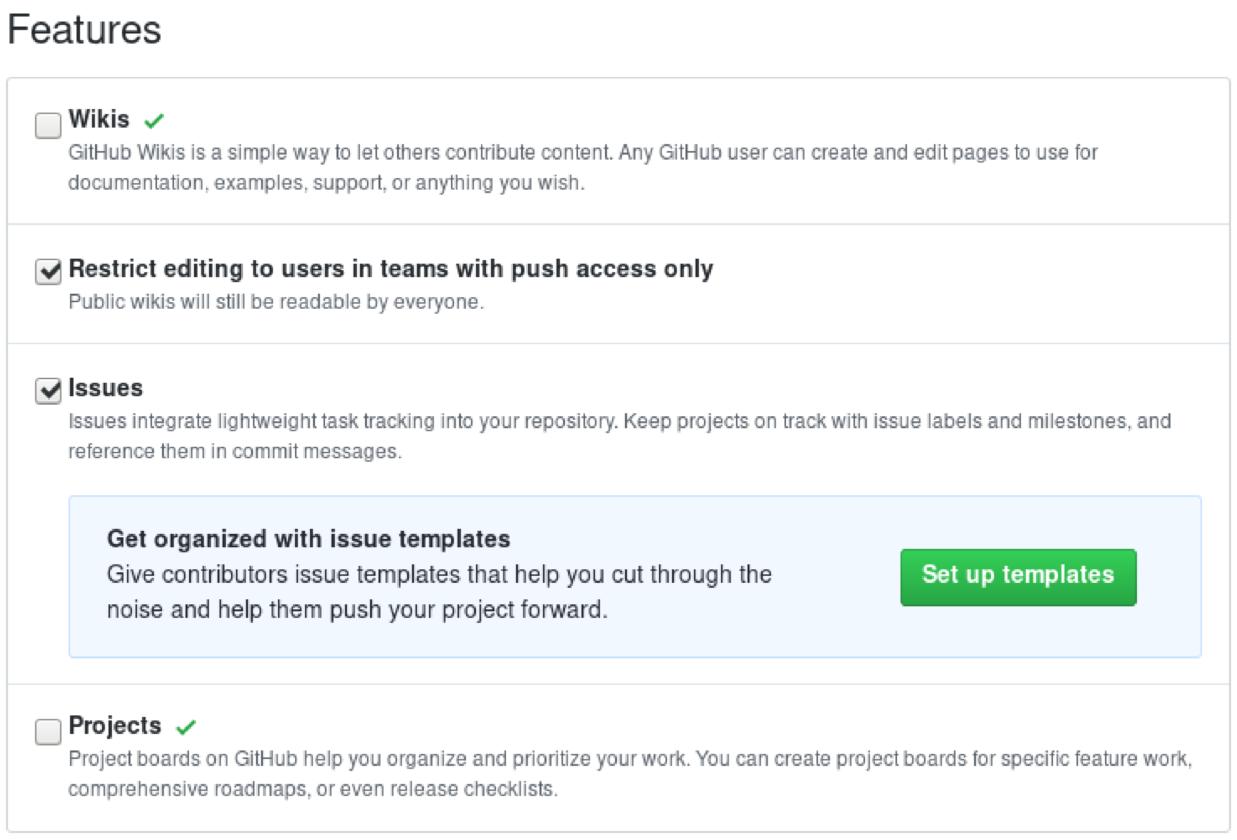
9.1.2 Configure repository

Now, the repository is created. Make sure these settings are updated:

Disable unneeded tools

Disable any unneeded features or repository tools. If they are needed, they can be turned on again later. Turning off unneeded features makes it easier for someone to find the useful places in the project. It can also indicate if the thing they are looking for (e.g. documentation) is somewhere else.

These features are found under the *Settings* menu for every repository.



Features

☐ Wikis ✓
GitHub Wikis is a simple way to let others contribute content. Any GitHub user can create and edit pages to use for documentation, examples, support, or anything you wish.

☑ Restrict editing to users in teams with push access only
Public wikis will still be readable by everyone.

☑ Issues
Issues integrate lightweight task tracking into your repository. Keep projects on track with issue labels and milestones, and reference them in commit messages.

Get organized with issue templates
Give contributors issue templates that help you cut through the noise and help them push your project forward.

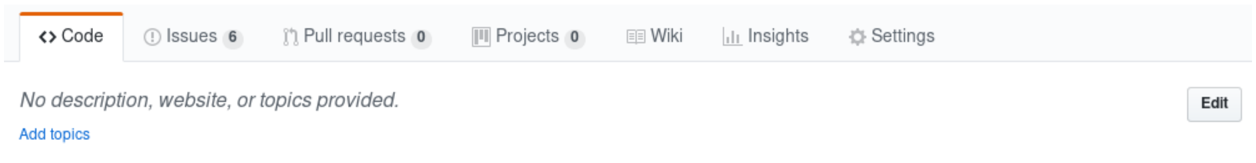
☐ Projects ✓
Project boards on GitHub help you organize and prioritize your work. You can create project boards for specific feature work, comprehensive roadmaps, or even release checklists.

Fig. 2: Disable unneeded tools, like a wiki or project boards. There may be documentation or project boards set up elsewhere. This does not disable organization-level project boards.

Set description, URL, topic tags

Make sure every repository has a description and topic tags set. If there is a URL to view a demo of the project or read more about it, include it too.

At the top of every GitHub repository, there are fields of metadata for a description, a URL, and topic tags. A description and URL helps someone understand the project in one or two sentences or see a live demo. Topic tags raise visibility in the GitHub ecosystem and help other people discover new projects.

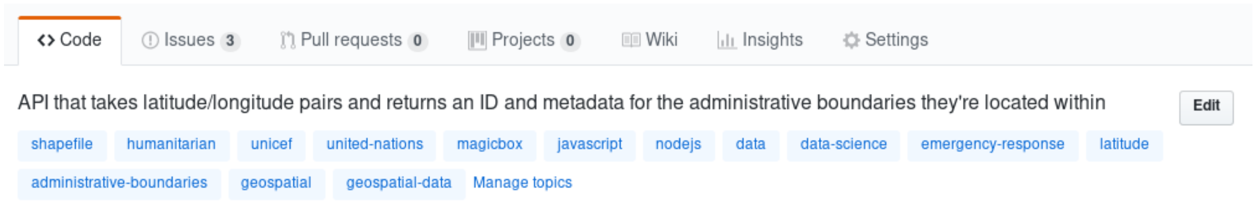


No description, website, or topics provided.

Fig. 3: Example of no description, URL, or topic tags

Do not leave a repository empty like this. Use the *Edit* button on the right to change the description and URL. Two text boxes will appear.

For topic tags, click *Add topics* towards the left. Choose tags related to your project to help identify it. Consider programming languages, frameworks, or other software used. Tags like `humanitarian` or `united-nations` are also examples of tags for types of software.



API that takes latitude/longitude pairs and returns an ID and metadata for the administrative boundaries they're located within

Fig. 4: magicbox-latlon-admin-server with description and topic tags

9.1.3 Set up useful labels

Labels are visual organization tools for your GitHub project. They make issues easier to sort and prioritize tasks. Additionally, they also help new contributors identify areas of interest for your project. They can help improve awareness of different types of contribution methods in your project (e.g. design and documentation tasks).

Configure each repository's labels in a way that makes sense for your project. The labels should mean something to *you* so they are easily applied for sorting later. Every repository's issue and pull request labels are found under the *Issues* tab with the *Labels* button.

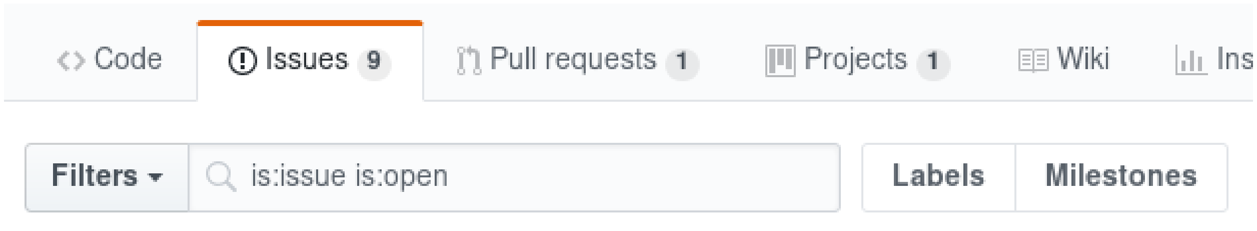


Fig. 5: Click the *Labels* button towards the right of the search bar

A good example of labels is here on the unicef/magicbox repository. To view the color code for a given label, click the *Edit* on its row.

Not all of these labels will be helpful for a new project. Take ones that make sense, and make new labels specific to the project, if needed.

9.1.4 Set up continuous integration (CI)

- Why we need CI

MagicBox repositories use Travis CI for continuous integration. Below is how you can add this service to a new repository:

1. Make sure you have the **admin access** to the repository. New core developers can gain such access across multiple repositories by joining the MagicBox Admins team. Contact Mike (@mikefab) or one of the lead maintainers for this permission.

2. If you are not already on Travis CI, browse to travis-ci.com and log in with your GitHub account. Along the way, you will see the option to add any repository to Travis CI. Select *Only select repositories* and choose `unicef/<the-repo-of-interest>` from the drop-down list. At the moment, we still handpick repositories to be monitored by Travis CI because not all repositories will need this service. Once you arrive at your Travis CI Profile page, you will see a list of all repositories currently under Travis CI tracking, whether they belong to your personal account or the @unicef GitHub account.

3. Now go to the repository's main page on GitHub, click on the *Settings* tab, then select *Integrations & services* from the left-side menu. If everything is properly set up in the previous step, you should see Travis CI under *Installed GitHub Apps*.

4. From the root directory of the repository on GitHub, add a new file called `.travis.yml`. Place the following content in that file:

```
language: node_js
node_js:
  - "8"
cache:
  directories:
    - "node_modules"
```

If these steps do not make sense, refer to this Getting Started guide by Travis CI.

5. The last step is to add the Travis CI badge to the repository's README. Browse to the Travis CI page of the repository - the URL probably looks like this: `https://travis-ci.com/unicef/the-repo-of-interest`. Find the status symbol next to your repository's name (the little bar to the right of the Octocat). In the pop-up window, click the drop-down menu to select Markdown, then copy the generated code block. Paste it to the top of your README file, just under the repository's name. If unclear, see this guide.

9.1.5 Set up code health checks with Code Climate

Code Climate is the chosen code health checker for MagicBox projects. This automated code review service runs checks whenever a pull request is made, helping contributors and maintainers identify issues before they get merged into the code base. That makes it sound similar to Travis CI or other CI tools in general - they all perform pre-merge checks. The main difference is: one is more about the technical functionality of the code (*e.g. will my program crash?*) and the other considers how "clean" and maintainable the code is - hence the term "code health." Examples of issues that Code Climate could bring up: complex or hard-to-understand code; code duplicates; functions or classes that are too long and need refactoring; style issues raised by ESLint.

Aside from that, Code Climate automates and displays test coverage results. Having a high test coverage score is encouraged for any code repository, especially open source projects since the code quality will affect and be affected by a larger group of developers. Code Climate reads output from locally run tests or coverage tools like lcov, then displays the score alongside the analysis of other quality metrics. The score can be viewed via both the dashboard on Code Climate site and the README badge.

Before following the steps below to activate Code Climate for a new repository, make sure to gain **admin access** first.

1. Sign into Code Climate - Quality if you are not on it yet. If this is your first time signing up, use your GitHub account. (If you already have a Code Climate account and it is not **linked with your GitHub account**, follow these instructions to set that up.) Select *Open Source* as you sign up and you can add the repository here. Handpick repositories rather than opting for *All repositories*. If you are already on Code Climate, add new repositories by clicking on the button *Add a repository* from your Dashboard. (If all of this doesn't make sense, use this guide from CodeClimate.)

2. Now Code Climate has started tracking your code, but you need a bit more set-up in order to interact with this service more actively. From the list of tracked repositories on your Code Climate profile, click the repository you want to set up and navigate to its *Repo Settings* tab. Look for the following sections in the left-side navigation menu.

   a. **Enable Pull Request integration**: *GitHub* section. Scroll down to *Pull request status updates* and click *Install*. A little green check mark will tell you if the installation succeeds and this feature is now active. If this option is not available or nowhere to be seen, it could be because you have not installed the Code Climate GitHub app. In step 1, by signing up and linking your GitHub account, you have connected with Code Climate via OAuth authentication. Your GitHub repository now sees Code Climate as an OAuth app. However, to automatically display the check status at each pull request, Code Climate needs to have access to your GitHub repository as a GitHub app. Hence, head to Code Climate GitHub app to install it on *both* your personal account and the @unicef GitHub account. You should install it on your personal account to utilize Code Climate power when you work in your own forks.

   b. **Set up Webhooks**: This guide explains why we need Webhooks and how to set it up. You can verify if the setup is successful via either Code Climate (*Repo Settings* > *GitHub* > *Connections* > *Webhook on GitHub*) or GitHub (*Settings* > *Webhooks*).

   c. **Enable ESLint with Code Climate**: *Plugins* section. Check the box in front of *ESLint*. Since the ESLint engine by default only analyzes `.js` files, if the repository uses non-traditional JavaScript syntax such as JSX or ES6, you will need to add the following file to the repository's root directory. Name it `.codeclimate.yml`:

```
plugins:
eslint:
  enabled: true
  channel: "eslint-4"
  config:
    extensions:
    - .js
    - .jsx
nodesecurity:
  enabled: true
```

   This code accesses the newest ESLint release possible (channel 4, see more here: https://docs.codeclimate.com/docs/eslint) and specifies the file extensions that we want ESLint to analyze.

3. By now, most quality metrics have been taken care of except for *test coverage reporting**. As said in point number 7 here, test coverage statuses are enabled by default when you enable Pull Request integration. However, the docs article also says you need to configure test coverage for the statuses to populate. Hence, go to your repository on Code Climate and navigate to *Repo Settings* > *Test coverage*.

There you will find the repository's Test Reporter ID. Copy that token to clipboard. Then go to your repository's main page on GitHub. Replace the content of `.travis-ci.yml` with the following:

```
env:
  global:
    - CC_TEST_REPORTER_ID=<your-token-here>

language: node_js
node_js:
  - "8"
cache:
  directories:
    - "node_modules"

before_script:
  - curl -L https://codeclimate.com/downloads/test-reporter/test-reporter-
↪latest-linux-amd64 > ./cc-test-reporter
  - chmod +x ./cc-test-reporter
  - ./cc-test-reporter before-build
after_script:
  - ./cc-test-reporter after-build --exit-code $TRAVIS_TEST_RESULT
```

The code above tells Code Climate to run and report on test coverage scores every time Travis CI runs checks for a new pull request. Code Climate, however, does not generate test coverage results itself - it reads output from a supported testing framework, which usually are third-party tools, as said here. We, therefore, need to *set up a testing framework* in our code, which is covered below.

Deeper reads:

- If you don't have admin access to a repository but still want to track its detailed code health analysis, go to its README on GitHub, click on its Maintainability badge to open its Code Climate report, and hit *Star* to add this repository to your Code Climate dashboard. If unclear, see this guide.
- If you are a core developer or maintainer, read this article to make better use of Code Climate in your pull request workflow.
- Explore advanced features with review comments.

4. The last step is to embed the **maintainability and test coverage badges** to GitHub. Head to your repository on Code Climate and click on *Repo Settings* > *Badges*. Select the format of your choice and copy that code snippet to the top of the repository's README, just under the repository's name. (This guide has good screenshots to illustrate this step.)

9.1.6 Set up a testing framework

Note: To be written.

9.2 How to maintain a GitHub repository

This section focuses on "housekeeping" with GitHub projects, including labels and project boards.

Housekeeping is important to maintain a repository. This organizes bugs, feature requests, and the project itself. Organized projects help active contributors stay on track and make realistic deadlines. It also helps new contributors understand what is going on.

Housekeeping has five parts:

1. Issue metadata
2. Adding labels
3. Updating project boards
4. Making pull requests
5. Reviewing pull requests

9.2.1 Update issue and pull request metadata

Every GitHub issue and pull request has four metadata properties:

1. **Assignees**: Who is currently working on this and who is the best point-of-contact for updates
2. **Labels**: Visual cues on task status and importance (see below)
3. **Projects**: Advanced business process management (see below)
4. **Milestone**: Relevant feature or version milestone for an issue or pull request

Assignees and labels should always be used at a minimum. Use projects and milestones when they are available.

9.2.2 Adding labels to issues

Above, labels were mentioned as part of issue and pull request metadata. Maintaining and using labels is a good habit. An issue or pull request might have two to four labels, depending on how the project was set up.

If labels are not yet configured, read *Set up useful labels*.

Once a week, check issues and pull requests to see if tags are up-to-date. Update or change any labels that are stale (such as priority labels). Add labels from the metadata sub-menu when you open an issue or pull request.

9.2.3 Updating project boards

GitHub project boards are an organizational tool for the project. They use a kanban-style approach to organizing GitHub issues and pull requests. Our workflow is explained on Opensource.com.

To update and maintain the project boards…

1. Make sure any issues or pull requests not shown are added to the board
2. Ensure important issues are organized by *In progress* or *To Do*
3. Issues not yet ready for consideration go on the backlog
4. All items under *In progress* or *To Do* columns should be GitHub issues, **not** note cards (note cards are okay for the backlog column)

9.2.4 Making pull requests

All major changes to the project should **always be made through a pull request** (PR). Pull requests are like a registry of changes for a project. It is easy for someone to see what is going in and out of a project. Outside contributors will always have to make pull requests, so it is good practice for core / trusted developers to use pull requests too.

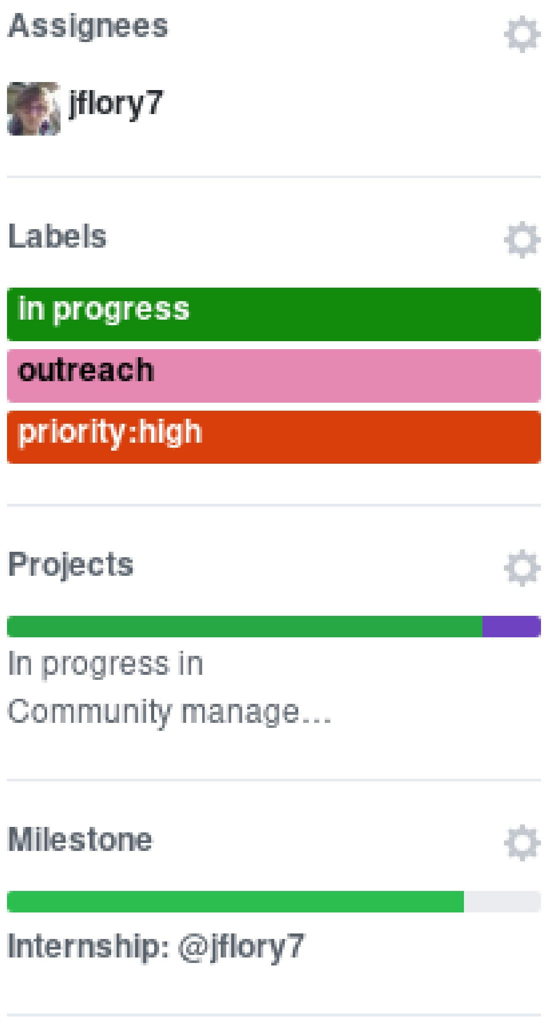


Fig. 6: Set assignees, labels, project boards, and milestones from the side column in every GitHub issue or pull request

Follow contributing guidelines

The contributing guidelines for all MagicBox projects live in the unicef/magicbox repository.

Always follow these contributing guidelines when working in the project. These are the standards and rules we ask the community to follow when contributing. As project maintainers, it is our responsibility to hold ourselves to the same standards we ask of others. Thus, always make sure current development practices are in-line with what our guidelines.

Write useful commit messages

Writing useful commit messages is a good practice to follow. When looking through project commits, it should be somewhat clear what has changed in the project and how. Short or nondescript commit messages are not helpful to maintainers or new contributors. Commit messages do not need to be paragraphs, but they should clearly indicate what changed or why something changed.

Read this blog post for more information about keeping git history clean and tidy with `git rebase`.

9.2.5 Reviewing pull requests

Pull requests (often abbreviated as PRs) are the cornerstone of accepting contributions to countless open source projects. All major contributions to a project, from both core contributors and new contributors, should be made as pull requests. It is important to follow consistent practices when reviewing pull requests.

Triage new pull requests

Update the metadata for all new pull requests, especially if they will be open for *longer than one work day*. Examples of metadata includes the following:

- **Assignees**: Indicates whose responsibility it is to review or accept a pull request
- **Labels**: Indicates what type of change the pull request is and what its priority is
- **Projects**: Provides context to overall project development (if using project boards)
- **Milestones**: Connects pull request to a specific goal or version (if applicable)

Triaging new pull requests by updating the metadata keeps the project organized. It is easier for an outsider to understand the project workflow and development by triaging. It is also helpful to give context for a pull request if you have to update it later. For example, if a pull request cannot be merged because of an external problem, label it as **blocked**.

Use continuous integration (CI)

Use the CI added *in the previous section* as a basic requirement for accepting new contributions. All pull requests will run your test suite and ensure new contributions pass all tests. This prevents bad code from slipping under the cracks and making it into a production environment. It also provides quick, instant feedback for a new contribution. The contributor immediately knows their change broke the application and know test is not passing.

For *all* new contributions, from both active and new contributors, ensure all CI tests pass before merging a pull request. Bypassing CI health checks by pushing directly to the repository or merging a pull request before tests finish bypasses the advantages of CI.

Use code health checks

Use the code health checks added *earlier in this section* as another requirement for accepting new contributions. There are many ways for you to configure the code health checks. Use them as a way to set standards for code quality and enforce those standards automatically in new contributions. The code health checks offer both already active and new contributors a way to understand the impact of their changes. This results in clear code that is easier to maintain in the long-term.

Ensure all new contributions receive passing grades from the code health checking tool before accepting them.

Leave a review

Code review is a helpful practice for any software project and team, as explained in this Atlassian blog post. It is a chance to catch deeper problems before they enter the code base. It also provides a chance for mentorship and guidance for a new contributor. Additionally, it improves the overall health of your project and makes an outside contribution more likely to contribute again. Taking the time to review someone's contribution and code is also validation of their time and energy spent to make that contribution.

Spending the time to review new contributions should be as regular of a practice as writing your own code. Ensure each new pull request receives a review, even if it is a passing review with no comments. If you do leave feedback, make sure it is kind and courteous – be aware of how you deliver your feedback. See this guide on unlearning toxic behavior in code reviews.

Always remember to thank a contributor for their contribution too.

9.3 Communicating about development

Communication about development should be kept public as much as possible in our Gitter chat. Whenever you make a new pull request, always share the link in the main Gitter chat room. This lets other developers know you made a change and also gives them an opportunity to review your code. And if you want a code review, be sure to ask for it too.

CHAPTER 10

Indices and tables

- genindex
- modindex
- search