SENG3011 T1 2021

Design Details

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1. Describe how you intend to develop the API module and provide the ability to run it in Web service mode

Overview of How We'll Develop the API Module

Our plan for developing the module will consist of the following series of steps. Since we're a group of 5 we'll be able to implement some of this functionality concurrently by assigning tasks to different group members but some functionality will have to be completed sequentially:

1. Plan and document the API requests that our system will support in Stoplight.
2. Create an AWS EC2 instance running Ubuntu and implement a Python server.
3. Setup an AWS Database and connect with that database on the EC2 instance using the Python SDK.
4. Create Lambda functions for scraping and loading data from WHO. Call these Lambda functions via the Python SDK on the EC2 instance.
    a. Schedule the web-scraping lambda functions to occur periodically (exact period is still undecided) and cache the results from WHO (in case WHO becomes unavailable).
5. All of the API request handling will be implemented on the EC2 instance which will be running a Python Flask server to respond to the API calls.

Web Service Mode and API Module Architecture Overview

Our API module architecture will consist of several key components including frontend, backend and database functionality that will enable it to run in web service mode for users. We decided to go "all in" on using Amazon's AWS services for our application and have modelled our architecture accordingly:

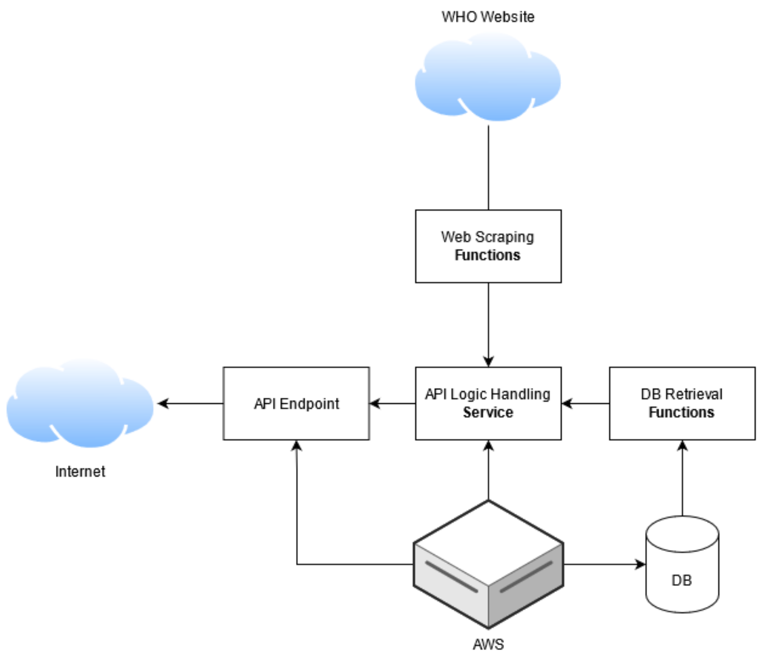
- Stoplight for designing the REST API and documenting it
- An Amazon EC2 instance (running Ubuntu)
- A Python Flask server running on the EC2 instance to handle incoming API requests
- Lambda functions that trigger when an API request is made handling:
    - Web scraping through a python library (Selenium or BeautifulSoup)
    - Amazon DB interaction with functions for submission and retrieval from the DB
    - API servicing logic using lambda functions
- Amazon's Cloud database solution for storing any web-scraped data and/or data POSTed by users

We also considered an alternative architecture which didn't use as many of the AWS services:

- Stoplight for designing the REST API and documenting it
- A python flask server, publicly hosted on AWS to handle incoming API requests
- A python backend system that handles:
  - Web scraping through a python library (Selenium or BeautifulSoup)
  - DB interaction with functions for submission and retrieval from the DB
  - API servicing logic using python functions
- A MongoDB database to store any web-scraped data and/or data POSTed by users

However, the team ultimately voted in favour of the AWS centric architecture as we felt it would make our API module's design more cohesive and easier to manage by using AWS services as much as possible.

At a high level our application would be setup in a similar way to the below diagram:



Proposed application architecture diagram

Link: https://app.diagrams.net/#G1Y1KMzLPMlLzZrrGqsApp2yWlAqc6mjBT

2. **Discuss your current thinking about how parameters can be passed to your module and how results are collected. Show an example of a possible interaction. (e.g.- sample HTTP calls with URL and parameters)**

How Parameters Can be Passed to Our Module

At the moment we're planning to outline the valid "key-value pair" parameters for each request in our API documentation. These pairs can be appended to the end of the URL using a ? and then separated by using the & symbol in the standard format for API requests. That is:

```
https://examplesite.com/api?num=1&string=hello
```

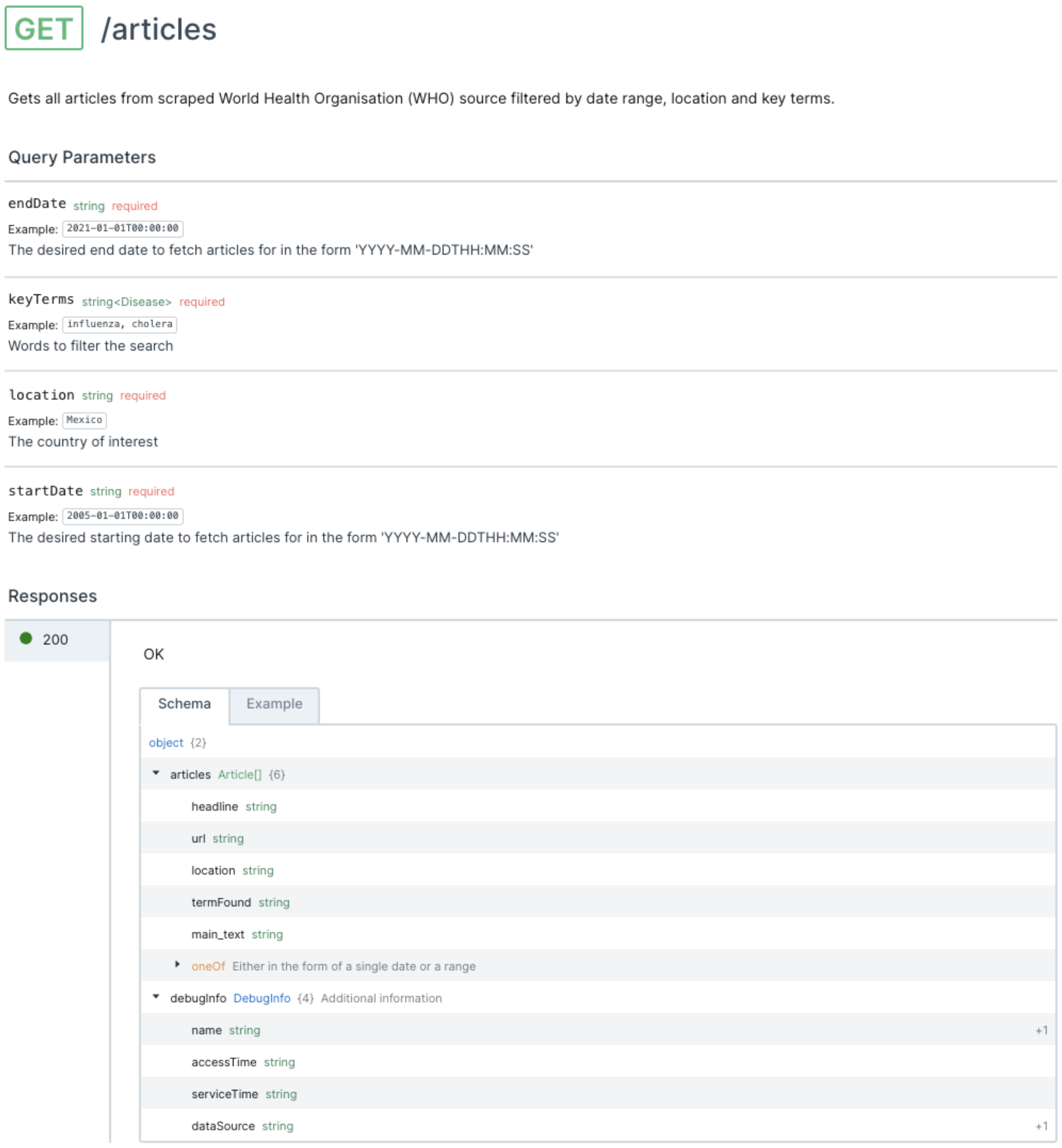
This can be done by formatting the URL like the above example or the user can use a tool like Postman to input the data using a graphical interface.

How Results are Collected

Given the current scope of the assignment we'll just be returning a JSON object. We think the nicest way of formatting that data for our users is to return it in the JSON format (for more standard data formatting and easier integration into existing programs). We'll outline how returned data will be structured for each API request in our API documentation.

Interaction Example

A client looks at the api documentation to find the request they need to make to GET reports from the database.



GET /articles

Gets all articles from scraped World Health Organisation (WHO) source filtered by date range, location and key terms.

Query Parameters

`endDate` string required
Example: `2021-01-01T00:00:00`
The desired end date to fetch articles for in the form 'YYYY-MM-DDTHH:MM:SS'

`keyTerms` string<Disease> required
Example: `influenza, cholera`
Words to filter the search

`location` string required
Example: `Mexico`
The country of interest

`startDate` string required
Example: `2005-01-01T00:00:00`
The desired starting date to fetch articles for in the form 'YYYY-MM-DDTHH:MM:SS'

Responses

● 200

OK

Schema | Example

```
object {2}
▾ articles Article[] {6}
    headline string
    url string
    location string
    termFound string
    main_text string
  ▸ oneOf Either in the form of a single date or a range
▾ debugInfo DebugInfo {4} Additional information
    name string                                   +1
    accessTime string
    serviceTime string
    dataSource string                             +1
```

They then make the GET request to the API to collect data about cholera cases in Mexico for the years 2000 to 2021:

http://52.87.94.130:5000/articles?keyTerms=cholera&location=Mexico&startDate=2000-01-01T00%3A00%3A00&endDate=2021-01-01T00%3A00%3A00

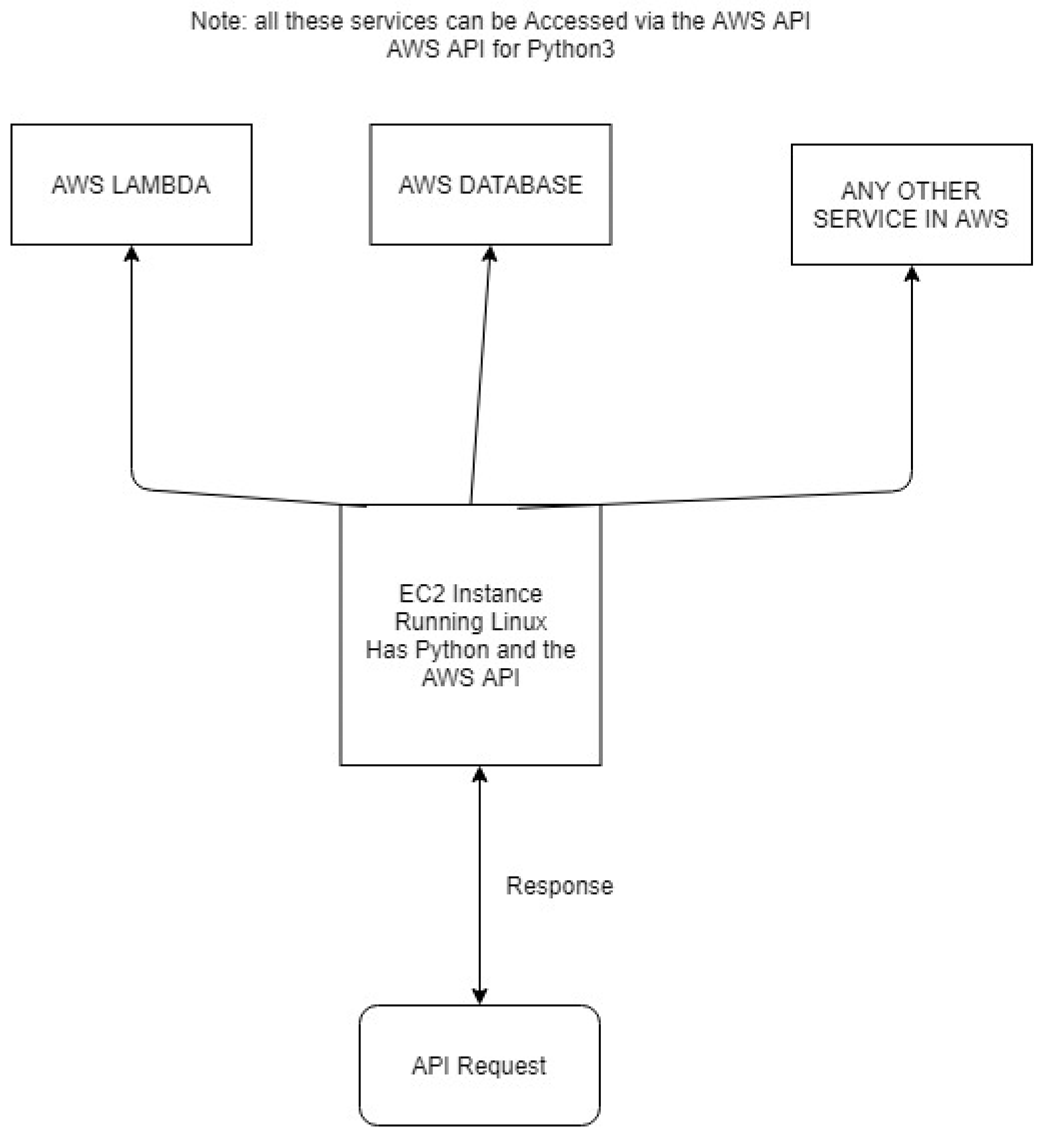
The API processes the three parameters outlined in the request, runs the logic on the server that determines whether to get the data from the database or the source (WHO) directly, fetches the data for the user, formats it as a JSON object and sends that object back in the body of the response to the user:

```
{
      “disease”: “cholera”,
      “country”: “Mexico”,
      “start_date”: “01-01-2019”,
      “end_date”:  “31-12-2019”,


}
```

The user can then parse the response on their end and integrate the data into their project.

3. Present and justify implementation language, development and deployment environment (e.g. Linux, Windows) and specific libraries that you plan to use.


Note: all these services can be Accessed via the AWS API
AWS API for Python3
AWS LAMBDA
AWS DATABASE
ANY OTHER SERVICE IN AWS
EC2 Instance Running Linux Has Python and the AWS API
Response
API Request

Operating System

We plan to host our server on a Linux Operating System (Ubuntu).

We find Linux to be the easiest server OS to maintain due to the availability of open source software compared to Windows. There is also a wide variety of documentation and tutorials for hosting a server on a linux machine.

Deployment Environment

We plan to use AWS (Amazon Web Services) to host our Server. We will use an EC2 Instance to host our Ubuntu API server.

By using AWS EC2 instance we can create a server that can be accessed from anywhere without hosting it on our local machine. This takes away all the issues of hosting the API locally.

We can access the hosted server via a dynamic IP address that AWS gives us. We can also apply for this address to become static, so we have an address that does not change. This way people can use our address as an entry point for accessing our API and not worry about it changing.

Development Environment

We can develop our API either on the AWS instance or locally and port the code over. We will have to make sure that the libraries that we are using are cross platform compatible if we want to develop on a Windows machine. We will utilise the AWS Python3 SDK (BOTO3) to communicate to different AWS services.

For example BOTO3 can be used to create/destroy/run lambda instances and access the database.

We will most likely use the IDE vscode or another widely available text editor.

AWS Services:

AWS services provide a database and lambda functions which we can access via an API.

AWS Lambda Functions

AWS lambda functions allow us to run code without creating a server to host the code.

- By using lambda functions we can scale our product very well. We will have the capability to handle a high volume of requests and reply quickly.

AWS Database

By hosting our database with the AWS Database service we are able to reduce the time needed and the complexity involved in hosting our own sql database.

AWS provides a simple, easy to use API that lets us query and interact with the database.

These services can help simplify our code and organise it in a structure that can be understood better. By using AWS services we can make our product more easily scalable and manageable.

Programming Language:

We have chosen Python3 for the development of our server because it is simple to use and there are extensive libraries and modules available for it that are well documented.

We will write the API in Python3 using the Flask module and use the Python3 SDK for AWS (BOTO3) to create and maintain Lambda instances and connect with the AWS database.

Python3 FLASK for API server:

https://pypi.org/project/Flask/

Justification:

Flask is well documented and straightforward to use. Most of our team has experience using this module.

Python3 SDK for AWS : BOTO3

https://boto3.amazonaws.com/v1/documentation/api/latest/index.htm

Justification:

The AWS API gives us the power to create/destroy instances of AWS components via a server. With this module we will be able to control every other AWS instance

Web Scraping:

We will scrape the data off of the WHO website using either the python3 module Selenium or Beautiful Soup.

Python3 Selenium:

https://pypi.org/project/selenium/

Python3 BeautifulSoup 4

https://pypi.org/project/beautifulsoup4/

Justification:

Both Selenium and BeautifulSoup seem to be the most popular options for web scraping using Python. We plan to try each one before we commit to using one for the rest of the project.

Overall

As well as these specific libraries we plan to use a wide variety of modules found in the Python3 Standard Library. These modules cover everything, from list manipulation to complex data structures and algorithms.

Frontend Plan

Programming Language

Node js is the language we are going to use to create the frontend server. We will also use the ReactJS framework.

We chose ReactJS as the frontend framework because it is popular, has lots of online support and documentation, and because it is the framework that we are most familiar with.

We chose Bootstrap css because it is well documented and easy to use. There is lots of example code for us to use online.

API Design Details - Deliverable 2

Changes

- We’re now using both Stoplight and Swagger for our API documentation. We’ve moved our API “Try It Out” functionality over to Swagger as we had issues accessing our AWS EC2 instance’s static IP through Stoplight.
- Our lambda functions have now been replaced with a python script that is being run manually, we plan to automate this functionality later.
- We created a db_functions.py file that contains functions for retrieving relevant information from the database, formatting it into the appropriate json format and returning it to the flask server to send back to the user.
- We chose to use the Selenium python library for web scraping as opposed to BeautifulSoup

Final API architecture

- Stoplight for designing the REST API and documenting it
- Swagger as a copy of the documentation and for “Try it Out” functionality
- An Amazon EC2 instance (running Ubuntu)
- A Python Flask server running on the EC2 instance to handle incoming API requests.
- A db_functions.py file that contains our functions for retrieving data from the db and formatting it to send back to the user
- Our lambda functions were replaced with a python script that is manually run (at the moment) to update the database
- Amazon’s Cloud database solution for storing any web-scraped data and/or data POSTed by users (RDS MySQL)
- Selenium python library for web scraping

Choice of implementation

Stoplight/Swagger

We used Stoplight for construction of the API documentation as it allows multiple users to collaborate and work on it through its GitHub integration as opposed to Swagger which only allows 1 user to edit at a time. Users can create API documentation, mock servers with no specialized knowledge required, and it’s faster than other API tools. We then used Swagger for publishing our API for public use.

Python and Flask
We have chosen Python3 for the development of our server because it is simple to use and there are extensive libraries and modules available for it that are well documented.

Python also has well documented web scraping libraries such as Selenium and Requests as well as parsers such as BeautifulSoup, which is one of the main functions of our server. As a result, it is easier to use and learn as opposed to Node JS, for example.

We used Selenium for web scraping due to its detailed documentation and online resources which made it easy to learn.

Furthermore, most of our group members are also familiar with Python. This meant that we could spend less time learning a new language and more time working on the functionality.

We have chosen to use Python's microframework Flask over Django due to its minimalistic design, simplicity and speed.

EC2 Instance
We have chosen to host our Python server on an AWS EC2 instance as it is easily scalable.

EC2 also runs a virtual operating system which would suits our needs for a server.

Amazon RDS MySQL
We have chosen to use RDS as it was the cheapest option. It allows 750 hours of usage and 20GB of storage at the base tier. RDS was also easy to use and setup.

We used MySQL which is an open source relational database management system. It allows us to store large amounts of text efficiently.

Challenges
One of the challenges we faced was debugging Stoplight. This was due to all of us trying to push with different versions. As there was limited documentation, it took a while for us to figure out the issue.

Another challenge we had was that Stoplight's 'Try it out' function didn't work with our server's static IP address. We worked around this by putting our 'Try it out' functionality onto a Swagger page along with the documentation. In doing this, we were able to make our real API available to users alongside its documentation.

Shortcomings

Shortcomings of this API design include unforeseen costs (AWS costs are based on usage of resources).

As an interpreted script language, Python can be slower compared to other alternatives.

Also, as Flask is single threaded, it can only handle one API request at a time. However, as the API is not expected to be widely used, we think it is sufficient for this project.

API Implementation

Our API documentation can be found on https://app.swaggerhub.com/apis/KoolKats/KoolKats/1.0.

We aimed to make API endpoints that would be functional for the user. We tried to make an endpoint that made effective use of each input parameter.

Endpoints

The endpoints of our API include:

- /articles
- /disease
- /occurrences
- /popularDiseases

All of these endpoints can only accept GET requests with the input as query parameters.

GET /articles

What does it do?

This endpoint gets all articles available scraped from WHO break out news according to search. Results are ordered by date from recent to less recent.

Why is it needed?

This is the core functionality of our API, as mentioned in the requirements.

How it works

Input

Query parameters:

- startDate
- endDate
- Location
- keyTerms

Response

```
{
articles: [{
        date_of_publication: string,
        headline: string,
        location: string,
        main_text: string,
        termFound: string,
        url: string
        }],
debugInfo: {
        name: ‘KoolKats’,
        accessedTime: string,
        serviceTime: string,
        dataSource: ‘WHO’
        }
}
```

GET /disease

<u>What does it do?</u>
This endpoint gets the number of cases of a disease within the date range. It also provides the number of articles that the specified diseases were found in as well as the total number of articles. Results are ordered by the number of cases for each disease.

<u>Why is it needed?</u>
If the user wants to get specific case related information i.e. number of cases in a location or time period, they can make this request to do that. Users can also get the proportion of articles that reference the specified diseases.

<u>How it works</u>

<u>Input</u>
Query parameters:

- keyTerms
- startDate
- endDate
- Location (optional)

<u>Response</u>
```
{
disease: [{
        name: disease,
        cases: int,
        occurrences: int
        }],
totalArticles: int,
debugInfo: {
        name: ‘KoolKats’,
        accessedTime: string,
        serviceTime: string,
        dataSource: ‘WHO’
        }
}
```

GET /popularDiseases

<u>What does it do?</u>
Gets the most popular diseases within the date range provided. The number of diseases returned is determined by the user. Results are ordered by the number of articles that each disease is found in.

<u>Why is it needed?</u>
For users that want a breakdown of popular disease occurrences in date range.

<u>How it works</u>

<u>Input</u>
Query parameters:

- startDate
- endDate
- Location (optional)
- numDiseases (optional)

<u>Response</u>

```
{
diseases: [
        {
        name: string,
        occurrences: int
        }],
debugInfo: {
        name: 'KoolKats',
        accessedTime: string,
        serviceTime: string,
        dataSource: 'WHO'
        }
}
```

GET /occurrences

What does it do?
This endpoint gets the occurrences of diseases, separated by countries (heatmap of occurrences). Results are ordered by the number of articles that each disease is found in.

Why is it needed?
It shows the distribution of the disease and allows users to easily determine in which countries diseases are occurring the most.

How it works

Input
Query parameters:

- keyTerms
- startDate (optional)
- endDate (optional)

Response
```
{
locations: [{
        name: string
        disease: string,
        occurrences: integer
        }]
debugInfo: {
        name: 'KoolKats',
        accessedTime: string,
        serviceTime: string,
        dataSource: 'WHO'
        }
}
```