# Deliverable 1

# Exception(al) Coders

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## API Development & Implementation as a Web Service

We intend to develop our REST API module as a server-side Web API, that is, an interface consisting of one or more publicly exposed endpoints to a defined request-response message system which is exposed via a web server.

Our development process is structured as follows:

1. Building REST endpoints using Firestore’s Cloud functions.
2. Routing the API URL to a Firebase HTTPS cloud function to map function name to URL name
3. Scraping and parsing data from our main data-source (flutracker.com) using Python’s Beautiful Soup library
4. Converting this scraped data into JSON format
5. Adding a POST endpoint for ease of populating JSON data into Firestore
6. Setting up query parameters in our endpoints
7. Deploying our API using Firebase’s CLI
8. Testing API endpoints and response format with Postman
9. Providing API documentation with Swagger
10. Adding in log files
11. Monitoring the performance of the API by in terms of response time by using “HTTPs network request trace” offered by Firebase
12. Allowing scope for scalability and further optimising response time by allowing caching of responses

This API serves as a medium to expose health and other disease related data to the browser.  Once deployed and tested, our serverless API endpoints will be accessible as a web-service publicly to be used by other clients.

## Parameters and Responses

In accordance with standards for REST, we plan to pass input information to our module via HTTP GET requests. Parameters will be provided in the URL of our API endpoint in the form of query string parameters.
We expect the following compulsory parameters:

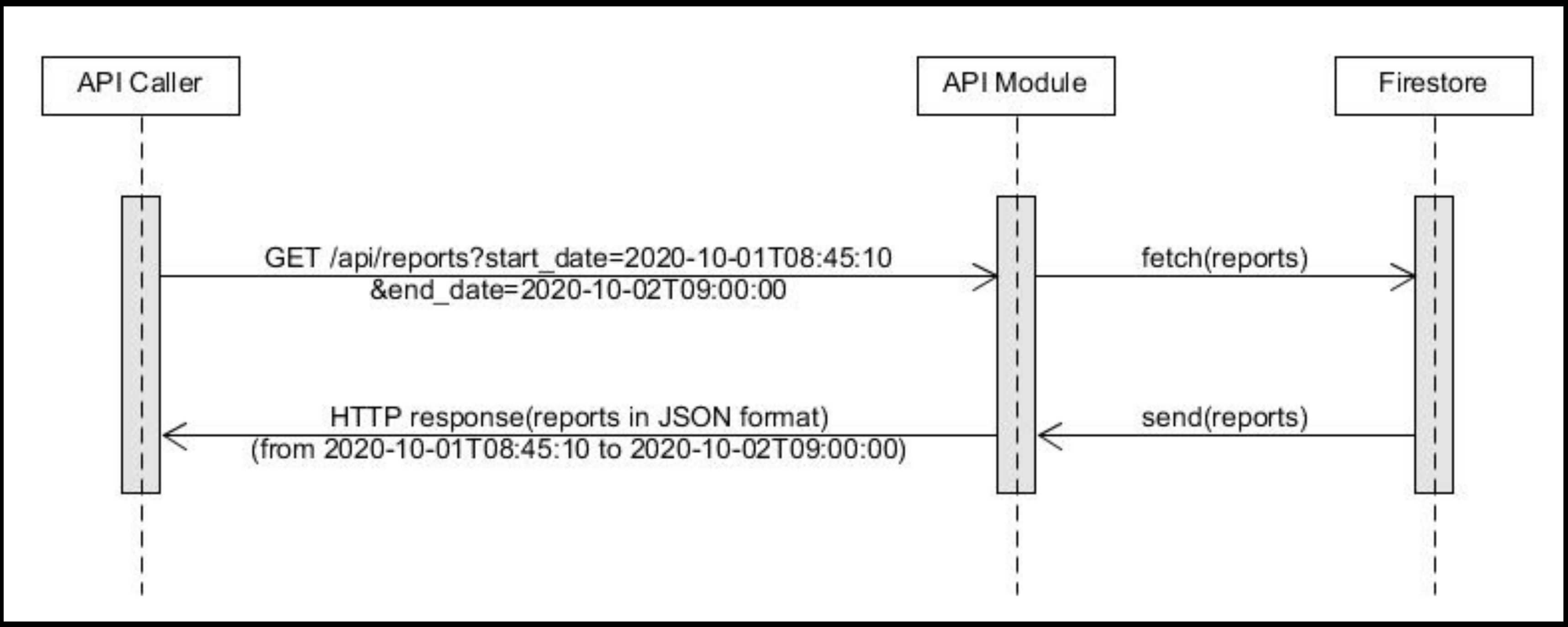
1. date::start_date - contains a single date (2018-xx-xx xx:xx:xx)
2. date::end_date - contains a single date (2018-xx-xx xx:xx:xx)
3. string::key terms - Comma separated key search terms. Note: key terms can be omitted.
4. string::location - contains a city/country/continent

And the following optional parameter:

1. string::timezone - string representing a valid timezone

Sample examples of our API endpoint structure:

1. GET /reports - to get a list most recent disease reports
2. GET  /reports?
start_date=2020-10-01T08:45:10&end_date=2020-10-02T09:00:00&keyterm=corona&keyte
rm=zika&location=sydney


API Caller
API Module
Firestore
GET /api/reports?start_date=2020-10-01T08:45:10
&end_date=2020-10-02T09:00:00
fetch(reports)
HTTP response(reports in JSON format)
(from 2020-10-01T08:45:10 to 2020-10-02T09:00:00)
send(reports)

Sequence dig. for sample request and response

Responses are collected in JSON format sent back in a HTTP response body.

Sample JSON response:

```
{
        "url":"https://www.who.int/csr/don/17-january-2020-novel-coronavirus-japan-exchina/en/",
        "date_of_publication": "2020-10-01 13:00:00",
        "headline": "Novel Coronavirus - Japan (ex-China)",
        "main_text": "On 15 January 2020, the Ministry of Health, Labour and    Welfare, Japan (MHLW)
        reported an imported case of laboratory-confirmed 2019-novel coronavirus...",
        "reports": [
                {
                        "event_date": "2020-01-03 xx:xx:xx to 2020-01-15",
                                "locations": [
                                        {
                                                "country": "China",
                                                "location": "Wuhan, Hubei Province"
                                        },
                                        {
                                                "country": "Japan",
                                                "location": ""
                                        }
                        ],
                        "diseases": [
                                        "2019-nCoV"
                                ],
                        "syndromes": [
                                        "Fever of unknown Origin"
                                ]
                }
        ]
}
```

# Technology Choices

Comparison of backends:

| | Google Firebase (serverless) | Amazon EC2 (serverless) | Server-based backends (Eg: Python+Flask/ Django, LAMP etc) |
|---|---|---|---|
| **Ease of Use** | Very simple set up<br><br>The Firebase Admin SDK supports many languages including Python, Node, Java, Go, etc. to write scripts<br><br>The SDK can also communicate between Cloud Functions (API endpoint) and the Firestore database | **Steeper learning curve**, infrastructure is geared more towards large teams<br><br>Has a number of individual modules (e.g. API Gateway, DynamoDB) required to connect all backend components<br><br>Client and server side code required for applications | Team has experience with Python + Flask / Django; Java + Spring; Node.js.<br><br>Has a number of individual modules to be coordinated |
| **Performance** | Usually low-latency (particularly real-time database), but serverless architecture means that there can be delays with **“cold-start”** - when service has not been “triggered” for a while | Excellent performance - high performing database in DynamoDB | No cloud and scalability means that the server can quickly become overloaded. |
| **Interoperability** | API endpoint be accessed by any HTTPS client<br><br>iOS, Android and JS clients share a Real-time DB<br><br>Host operating system is irrelevant as in serverless environments, there are no dedicated servers to service a given application, but rather a pool of OS agnostic resources (including servers, storage, etc.)<br><br>Reduces dependency on hardware and OS | Host operating system is irrelevant as in serverless environments, there are no dedicated servers to service a given application, but rather a pool of OS agnostic resources (including servers, storage, etc.)<br><br>Reduces dependency on hardware and OS | Not cross-compatible on machines running different OS.<br><br>Individual frameworks have dependencies |
| **Scalability** | Extremely scalable due to serverless architecture | Extremely scalable due to serverless architecture Extremely scalable - Elastic allows changing capacity within minutes | Difficult to scale |

Note: Highlighted cells show most ideal options from each category

| | Google Firebase (serverless) | Amazon EC2 (serverless) | Server-based backends (Eg: Python+Flask/ Django, LAMP etc) |
|---|---|---|---|
| **Testing** | Google allows remote testing from devices hosted by Google | AWS has support for many testing frameworks | Difficult to test - during development, server is hosted locally so difficult to stress-test |
| **Data Accessibility** | Data stored as JSON and every piece of data has a URL which can be used as a REST endpoint - allows viewing changes in real time | | |
| **Documentati on** | Extensive documentation and video tutorials available | Good documentation | Extensive documentation |
| **Community Support** | Good community support | Good community support | Good community support |
| **Pricing** | Pricing based on number of executions rather than pre-purchased compute capacity<br><br>Low IT costs | Pricing also based on executions rather than pre-purchased capacity<br><br>Slightly higher costs than Firebase - heavier set up | Pricing also based on executions rather than pre-purchased capacity<br><br>Slightly higher costs than Firebase - heavier set up<br>Pre-purchased capacity |
| **Monitoring** | App development platform includes crash analytics and performance monitoring | External monitoring frameworks required e.g. Dynatrace, Datadog, Solarwinds | External monitoring frameworks required |

The ***serverless architecture*** of Firebase was a key reason for selecting it. This produces great benefits in terms of cross-compatibility, scalability, price and not having to worry about a host operating system / deployment environment since these architectures use pools of OS agnostic resources. Uniquely as well, Firebase ***abstracts away most dependencies*** on backend hardware and servers, allowing us to be flexible with our implementation.

Firebase connects many components we require via the Admin SDK, allowing for ***simple coordination*** between the Cloud Functions API endpoint and the Cloud Firestore database, making for simple implementation for us. This was a major advantage over other serverless architectures such as Amazon EC2, which has many separated, more heavyweight components. Firebase also leverages Google’s monitoring and analytics infrastructure and integrates this into its console.

Regarding criteria for which Firebase was not the favourite: although Amazon’s backend services produce greater performance and allows quicker scaling, for the purposes of our Health API and the envisioned demand, Firebase suffices.

## Comparison of web scraping frameworks

| | BeautifulSoup | Cheerio | Scrapy |
|---|---|---|---|
| **Language** | Python | jQuery | Python |
| **Ease of Use** | Easy to learn and use  due to intuitive syntax and structure | Usage of jQuery increases learning curve | Substantial learning curve for beginners |
| **Documentation** | Extensive documentation and online tutorials available | Good documentation | Less than ideal documentation, especially for beginners |
| **Community Support** | Good community support | Community support is mostly for jQuery, not specific to cheerio | Good community support |
| **Performance** | Comparitively slow | Fast due to its simplicity | Fast as it uses asynchronous system calls |
| **Ecosystem** | Has lots of dependencies which is a downside | Confined to jQuery-specific libraries | Good ecosystem (especially for complex projects) |

We chose ***BeautifulSoup*** as our web scraping library due to its
- ease of use
- extensive documentation
- good community support

While Cheerio and Scrapy had better performance in specific cases and a better ecosystem, they lack in their ease of use and have a steep learning curve which is critical for our team and the project, considering the limited 10 week time-frame.

Additionally, based on the difficulty involved in scraping from our website (FluTrackers) which is a series of forum posts directing to links from many external sources, it is important for us to use natural language processing libraries. Our team has experience using NLTK in Python, and so choosing to implement the scraper in Python is more convenient.

Comparison of databases

| | Google's Firestore(noSQL) | MongoDB(noSQL) | MySQL (sql) |
|---|---|---|---|
| **Primary DB Model** | Document Store | Document Store | Relational DBMS |
| **Languages** | Firestore supports some popular programming languages (like Java, JavaScript, Python) | MongoDB has a much larger and exhaustive list of languages that it supports | MySQL supports a moderately large list of languages |
| **Triggers** | Allows usage of triggers with cloud functions. | Allows usage of triggers | Allows usage of triggers |
| **Security** | Less secure when compared to MongoDB | Provides good security of data | Not as good as non-relational databases |
| **Scalability** | Very Good scalability | Good scalability | Does not scale well |

We chose  Google's Firestore as our choice of database because it has a relatively easier setup process considering the team is using Google's firebase platform for the rest of the project.

Additionally, it is easier to store JSON data into a document store DBMS as compared to a Relational DBMS like mySQL.

Although MongoDB provides better security of data, for the purpose of this project the security provided by Firestore will suffice.

## Package Management:

Dependencies with Node.js will be managed with npm, and the versions and packages will be defined in a *package.json* file, to ensure consistency during development and deployment.

## Other Libraries Used:

1. Natural Language Toolkit (NLTK) - for natural language processing and ease of parsing scraped date.