



University of New South Wales

Software Engineering Workshop 3

SENG3011

Testing Documentation

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1.0 Testing Processes Used

1.1 Environment and / or tools used

Our testing framework is written **Node.js**, with the following dependencies / packages:

Dependencies / Package	Justification
Mocha JS	Used for test framework
Chai JS	Used to make assertions
SuperTest	Used for making API calls
loadtest	Used in load and performance testing

Figure 1. Environment and Tools

1.2 Limitations

As of submission of this document, our API only has GET requests, therefore no authentication. Because of this, we cannot test the security of this API, as there is none to test.

As of this report, we have yet to fully configure CI/CD with GitHub actions, and so the tests must be run manually.

1.3 Testing Process

Our API will be tested with a multitude of Mocha API tests. They will perform queries with different query parameters and ensure that the correct status codes and responses are generated. The tests test:

- Stress and volume test
- Correct responses for valid queries
- Correct responses for invalid queries
- Correct status codes
- Edge cases

The tests are run manually using the mocha command inside the 'PHASE_1/TestScripts', with the exception of loadtest, which was run in, and made requests to the api from the terminal.

Our API will be tested with mock JSON responses from the database. This ensures that regardless of the state of the database the API should be tested with the same input.

2.0 Overview of Tests

2.1 Overview of test cases, test data and results

Testing our endpoints helped us understand how our API would respond in all kinds of request situations.

Load testing our API showed that our api could complete around 1500 requests over 20 seconds. After analysing the results, we have generated ideas of how to improve response time and handle more clients.

2.2 Output of testing and actions taken

2.2.1 API Endpoint Testing

All of these tests can be run from the **TestScripts** directory, using the command `npm run test`. The following tables outline the results of all our endpoints tested.

/diseases

Test Case	Test Query	Results
Endpoint with no query parameters	GET /diseases	200 response. Asserts there are 2 diseases.
Endpoint with 'disease_names' query parameter	GET /diseases?disease_names=chikungunya	200 response. Chikungunya disease is returned with all correct details.
Endpoint with 'disease_names' query parameter	GET /diseases?disease_names=cholera	200 response. Cholera disease is returned with all correct details.
Endpoint with 'symptoms' query parameter	GET /diseases?symptoms=vomiting	200 response. Cholera diseases is returned with correct results. Chikungunya is not returned.
Endpoint with invalid query parameters	GET /diseases?invalidquery=invalidquery	200 response.
Invalid endpoint returns 404	GET /diseases/invalidendpoint	404 response.

/disease/{disease_id}

Test Case	Test Query	Results
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Endpoint with valid disease_id	GET /disease/b4d780dd311fae981c01e339f90afdae	200 response, asserts that the data of the request matches exactly the disease_id <i>b4d780dd311fae981c01e339f90afdae</i> as scraped (maintaining integrity)
Endpoint with valid disease_id	GET /disease/4a1239ee4df81a98a51a3eb15c5521b3	200 response, asserts that the data of the request matches exactly the disease_id <i>4a1239ee4df81a98a51a3eb15c5521b3</i> as scraped (maintaining integrity)
Endpoint with invalid disease_id	GET /disease/invalid_disease_id	404 response

/articles

Test Case	Test Query	Results
Endpoint with no query parameters	GET /articles	200 response code with all articles.
Endpoint with filled 'start_date', 'end_date' and 'key_terms' query parameters	GET /articles?start_date=2010-01-01&end_date=2015-01-01&key_terms=DENV	200 response code with 1 article that matched the query filters.
Endpoint with filled 'start_date', 'end_date' and 'key_terms' query parameters that fetch nothing	GET /articles?start_date=2010-01-01&end_date=2015-01-01&key_terms=hedgehogs	200 response code with an empty JSON list of no articles.

/article/{article_id}

Test Case	Test Query	Results
Endpoint with valid article_id	GET /article/b99957498d7205494ecc90d1c1acc7bb	200 response returned with correct article.
Endpoint with invalid article_id	GET /article/invalid_article_id	404 response

/reports

Test Case	Test Query	Results
Endpoint, no args	GET /reports	200 response, JSON of all entries returned.

Endpoint with valid start date.	GET /reports?start_date=2018-01-01	200 response. JSON of all entries after 2018-01-01.
Endpoint with valid end date.	GET /reports?end_date=2000-01-01	200 response. JSON of all entries before 2000-01-01.
Endpoint with valid start date & end date.	GET /reports?start_date=1990-01-01&end_date=2000-01-01	200 response, json of all entries published within bounds
Endpoint with invalid start date and end date	GET /reports?start_date=1990-01-01&end_date=1980-01-01	400 response, error message saying that bounds are incorrect.
Endpoint with valid country	GET /reports?location=Tazmania	200 response, json of all entries in Tazmania
Endpoint with invalid country	GET /reports?location=unknown	200 response, empty json
Endpoint with text found in reports	GET /reports?key_terms=epidemiologically	200 response, json of all entries containing "epidemiologically"
Endpoint with texts not found in reports	GET /reports?key_terms=asdf	200 response, empty json
Endpoint with invalid query	GET /reports?invalid_query=invalid_query	200 response, same result as GET /reports (API ignores unknown parameters)
Endpoint with invalid endpoint	GET /reports/invalidendpoint	200 response, same result as GET /reports (API ignores unknown parameters)

/report/{report_id}

Test Case	Test Query	Results
Endpoint with valid report_id	GET /report/5d61d0a41744a0e18014a9e508bb5e73	200 response, json of report with the specified report_id
Endpoint with invalid report_id	GET /report/invalid_id	404 response

/log

Test Case	Test Query	Results
Normal endpoint	GET /log	200 response, with log of correct length.

Log endpoint after disease endpoint is called	GET /diseases GET /log	200 response. The log has a new log added into it correctly for 'diseases'
Normal endpoint with invalid query parameters shouldn't change behaviour	GET /log?invalidquery=invalidquery	200 response, with log of correct length.
Normal endpoint with invalid endpoint	GET /log/invalidendpoint	404 response

```

GET /diseases
✓ gives the correct status code and response length (441ms)
✓ ?disease_names=chikungunya has correct values and 200 status code (319ms)
✓ ?disease_names=cholera has correct values and 200 status code (330ms)
✓ check 'symptoms' query works (308ms)
✓ check request doesn't alter behaviour with extra invalid parameters (315ms)
✓ check request returns 404 status code when given further endpoint

GET /disease/id for cholera
✓ gets correct details and status code for cholera (318ms)
✓ gets correct details and status code for chikungunya (309ms)
✓ returns 404 if invalid disease id (159ms)

GET /articles
✓ returns all articles (444ms)
✓ gets an ebola article within 2020 (326ms)
✓ gets no relevant articles if queries fetch nothing (164ms)

GET /article/id for same report as in /articles test
✓ gets 200 response and the correct article with the corresponding id (323ms)
✓ gets 404 response for invalid id (153ms)

GET /log
✓ 200 response
✓ request /diseases (323ms)
✓ checks last log output has accurate time, date, request, and status code
✓ check request doesn't alter behaviour with extra invalid parameters
✓ check request returns 404 status code when given further endpoint

GET /reports
✓ gives the correct status code and response length (380ms)
✓ ?start_date=2018-01-01 only got one report and has correct values (306ms)
✓ ?end_date=2000-01-01 only got one report and has correct values (313ms)
✓ ?start_date=1990-01-01&end_date=2000-01-01 only got one report and has correct values (299ms)
✓ ?start_date=1980-01-01&end_date=1990-01-01 got no reports (146ms)
✓ ?start_date=1990-01-01&end_date=1980-01-01 got no reports and returned status code 400
✓ ?location=Tazmania got one report and has correct values (360ms)
✓ ?location=unknown got no reports (383ms)
✓ ?key_terms=epidemiologically got one report and has correct values (354ms)
✓ ?key_terms=asdf got no reports (369ms)
✓ check request doesn't alter behaviour with extra invalid parameters (354ms)
✓ check request returns 404 status code when given further endpoint

GET /report/id for cholera
✓ gets correct details and status code for cholera (295ms)
✓ returns 404 if invalid report id (157ms)

```

33 passing (8s)

Figure 2. Test Results

As seen in Figure 2., there are a total of 33 tests that test all endpoints over a bunch of scenarios: valid queries, invalid queries, invalid endpoints and edge cases.

2.2.2 Load Testing

LOAD TESTING OUTPUT

Key:

- t = MAX num of seconds to wait until requests no longer sent
- c = concurrency level, number of clients sending requests.

Load Testing 1, /diseases

t = 20, c = 10

```
[Fri Mar 26 2021 17:40:21 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:40:26 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 49, requests per second: 10, mean latency: 930.8 ms
[Fri Mar 26 2021 17:40:31 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 117, requests per second: 14, mean latency: 752.5 ms
[Fri Mar 26 2021 17:40:36 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 185, requests per second: 14, mean latency: 744.9 ms
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 10
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 249
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 0
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.030597792000002 s
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 12
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 791.4 ms
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 758 ms
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 877 ms
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 1954 ms
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 1702 ms
[Fri Mar 26 2021 17:40:41 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 1735 ms (longest request)
```

Load Testing 2, /diseases

t = 20, c = 20

```
[Fri Mar 26 2021 17:43:28 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:43:33 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 72, requests per second: 14, mean latency: 1210.8 ms
[Fri Mar 26 2021 17:43:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 177, requests per second: 21, mean latency: 996.8 ms
[Fri Mar 26 2021 17:43:43 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 270, requests per second: 19, mean latency: 991 ms
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 20
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 375
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 0
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.010780792000002 s
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 19
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 1042.8 ms
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 1012 ms
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 1254 ms
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 1451 ms
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 1763 ms
[Fri Mar 26 2021 17:43:48 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 2555 ms (longest request)
```

Load Testing 3, /diseases

t = 20, c = 40

```
[Fri Mar 26 2021 17:49:39 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:49:44 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 130, requests per second: 26, mean latency: 1396.5 ms
[Fri Mar 26 2021 17:49:49 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 361, requests per second: 46, mean latency: 871.1 ms
[Fri Mar 26 2021 17:49:54 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 602, requests per second: 48, mean latency: 841.5 ms
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 40
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 832
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 0
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.023635167000002 s
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 42
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 937.1 ms
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 838 ms
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 1152 ms
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 1521 ms
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 2763 ms
[Fri Mar 26 2021 17:49:59 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 2823 ms (longest request)
```

Load Testing 4, /diseases

t = 20, c = 80

```
[Fri Mar 26 2021 17:50:37 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:50:42 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 180, requests per second: 36, mean latency: 1967 ms
[Fri Mar 26 2021 17:50:47 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 399, requests per second: 44, mean latency: 1677.5 ms
[Fri Mar 26 2021 17:50:52 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 661, requests per second: 52, mean latency: 1555.1 ms
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 936, requests per second: 55, mean latency: 1474.6 ms
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 80
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 936
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 0
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.051439332999998 s
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 47
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 1639.3 ms
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 1201 ms
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 3342 ms
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 3841 ms
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 4525 ms
[Fri Mar 26 2021 17:50:57 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 4811 ms (longest request)
```

Load Testing 5, /diseases

t = 20, c = 160

```
[Fri Mar 26 2021 17:52:18 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:52:23 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 149, requests per second: 30, mean latency: 3243.1 ms
[Fri Mar 26 2021 17:52:28 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 412, requests per second: 53, mean latency: 3187.8 ms
[Fri Mar 26 2021 17:52:33 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 683, requests per second: 54, mean latency: 3117.1 ms
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 160
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 898
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 0
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.052629166 s
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 45
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 3085.5 ms
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 2782 ms
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 5055 ms
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 6042 ms
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 7322 ms
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 8919 ms (longest request)
[Fri Mar 26 2021 17:52:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 898, requests per second: 43, mean latency: 2811.3 ms
```

Load Testing 6, /diseases

t = 20, c = 320

```
[Fri Mar 26 2021 17:53:50 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:53:55 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 104, requests per second: 21, mean latency: 3483.4 ms
[Fri Mar 26 2021 17:54:00 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 322, requests per second: 44, mean latency: 7070.8 ms
[Fri Mar 26 2021 17:54:05 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 569, requests per second: 49, mean latency: 7405 ms
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 320
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 820
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 0
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.132714958 s
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 41
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 6533.8 ms
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 6614 ms
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 8771 ms
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 9739 ms
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 11795 ms
[Fri Mar 26 2021 17:54:10 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 13657 ms (longest request)
```

Load Testing 7, /diseases

t = 20, c = 640

```
[Fri Mar 26 2021 17:54:43 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:54:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 391, requests per second: 79, mean latency: 1902.7 ms
[Fri Mar 26 2021 17:54:48 GMT+1100 (Australian Eastern Daylight Time)] INFO Errors: 298, accumulated errors: 298, 76.2% of total requests
[Fri Mar 26 2021 17:54:53 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 644, requests per second: 51, mean latency: 5969.2 ms
[Fri Mar 26 2021 17:54:53 GMT+1100 (Australian Eastern Daylight Time)] INFO Errors: 67, accumulated errors: 365, 56.7% of total requests
[Fri Mar 26 2021 17:54:58 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 1175, requests per second: 106, mean latency: 8596.3 ms
[Fri Mar 26 2021 17:54:58 GMT+1100 (Australian Eastern Daylight Time)] INFO Errors: 312, accumulated errors: 677, 57.6% of total requests
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 640
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 1597
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 859
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.007797292 s
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 80
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 6000.7 ms
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 5382 ms
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 12422 ms
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 13483 ms
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 15094 ms
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 17023 ms (longest request)
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 17023 ms (longest request)
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:55:02 GMT+1100 (Australian Eastern Daylight Time)] INFO 429: 859 errors
```

Load Testing 7, /diseases

t = 20, c = 1280

```
[Fri Mar 26 2021 17:59:18 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 0, requests per second: 0, mean latency: 0 ms
[Fri Mar 26 2021 17:59:23 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 61, requests per second: 12, mean latency: 4740.4 ms
[Fri Mar 26 2021 17:59:28 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 275, requests per second: 43, mean latency: 8251.2 ms
[Fri Mar 26 2021 17:59:33 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests: 1177, requests per second: 180, mean latency: 13635.1 ms
[Fri Mar 26 2021 17:59:33 GMT+1100 (Australian Eastern Daylight Time)] INFO Errors: 678, accumulated errors: 678, 57.6% of total requests
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Target URL: https://thicc-peas-cdc-api-o54gbxra3a-an.a.run.app/diseases
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Max time (s): 20
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Concurrency level: 1280
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Agent: none
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Completed requests: 1464
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Total errors: 695
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Total time: 20.023035083 s
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Requests per second: 73
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Mean latency: 12316.3 ms
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO Percentage of the requests served within a certain time
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 50% 13158 ms
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 90% 14721 ms
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 95% 15805 ms
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 99% 17769 ms
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 19415 ms (longest request)
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 100% 19415 ms (longest request)
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO
[Fri Mar 26 2021 17:59:38 GMT+1100 (Australian Eastern Daylight Time)] INFO 429: 695 errors
```

LOAD TESTING OUTPUT ANALYSIS

Our team deemed it appropriate to test the /diseases endpoint as a representation of the endpoints of our API, as this endpoint returns the largest amount of data in a JSON object.

The output shows that the API starts to produce errors at around **1500** requests within 20 seconds. Though **Load Testing 7** was initiated with 1280 concurrent users, length of the longest request isn't significantly longer than **Load Testing 6**, and the amount of errors is actually lower than **Load Testing 6**, which suggests hardware limitations rather than API limitations.

In terms of handling large loads with the API, we can fix this through a number of ways:

- 1) FireStore allows automatic upscaling of DB instances allowing it to grow in response to request size. Scaling up FireStore would let it handle more requests from the API. Currently, we set the limit to 3 instances as this API is not in global usage. However, the scaling option is there if required.

- 2) Cloud Run, which the API is currently being run on, also allows automatic scaling. If the API receives heavy load, it can automatically scale up the number of virtual instances to meet with demand.
- 3) However, Cloud Run, despite its useful serverless scaling capability, is not as fast as other VPS services, such as App Engine. For increased speed of handling requests, the API would need to be hosted on dedicated VPS, such as App Engine. However, for the foreseeable future this is unnecessary, as App Engine is more expensive than Cloud Run, and the benefits of switching to it aren't necessary considering the current low load the API is experiencing.