Brute-force login and Bypass Account lockout on elabFTW 1.8.5

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Contents

1 Introduction

This paper will explain how to bypass brute-force protection or account lockout on *elabFTW 1.8.5*. During a penetration test, I came across this specific version and it has an authenticated remote code execution vulnerability so it needs valid accounts and credentials. The protection bypass was found using code review and then leveraged that to automate the attacks using *Burp Suite Intruder*.

1.1 What is elabFTW

eLabFTW is a free and open source electronic laboratory notebook for researchers.[1] Once installed on a server, it allows researchers to track their experiments, but also to manage their assets in the lab (antibodies, mouse, siRNAs, proteins, etc.).

1.2 Affected version

The attacks have been tested against these specific versions. The later version might be affected as well.

- 1.8.5

1.3 Mitigation

1. create *readFailedLoginByIp* function on *app/models/Logs.php* to execute query where *user* field is *REMOTE_ADDR* and the *body* is **Failed login attempt**.
2. Invoke *readFailedLoginByIp* function on **login.php** to validates if the count is reach the failed attempt limit and banned.

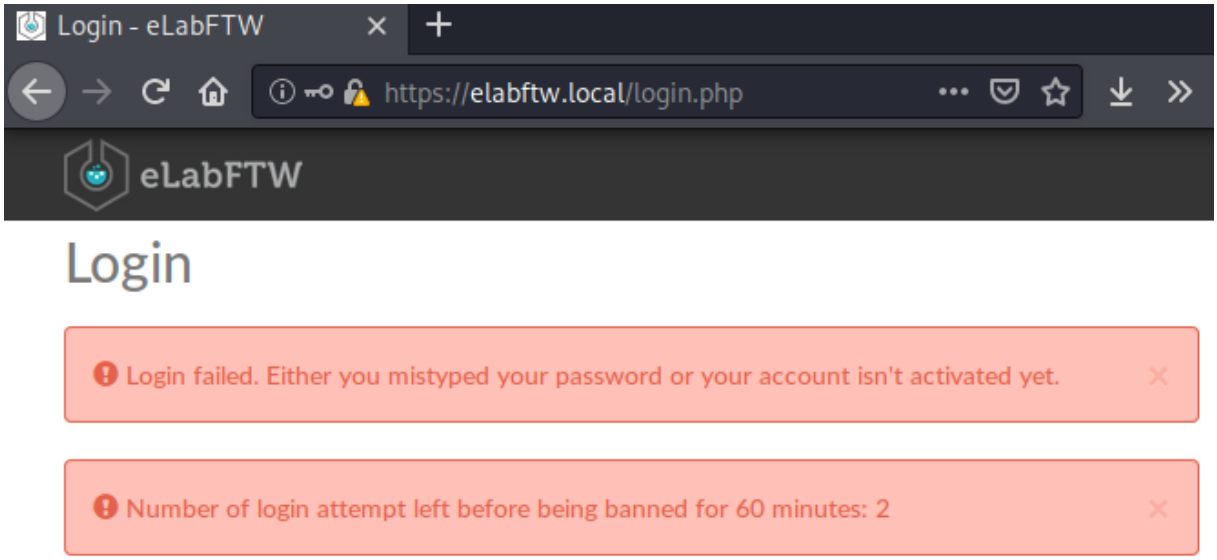
[1] https://github.com/elabftw/elabftw

2 Technical analysis

This section will explain how the lockout process works by testing the login page while also reviewing the source code and then making an attack process.

2.1 Lockout process

Assuming the administrator email is already known as “administrator@elabftw.local” with a wrong password submitted in the login form will produce a failed login message. See Appendix A to enumerate valid email accounts.



From the flash messages above, failing 3 times will result in being banned for 1 hour. Let’s find out where in the source code these messages are triggered.

```
kali@kali:elabftw-1.8.5$ find . -type f -name "*.php" -exec grep -nH 'Login failed.' {} \;
./app/controllers/LoginController.php:72:                _("Login failed. Either you mistype
d your password or your account isn't activated yet.")
kali@kali:elabftw-1.8.5$ find . -type f -name "*.php" -exec grep -nH 'Number of login' {} \;
kali@kali:elabftw-1.8.5$ find . -type f -name "*.html" -exec grep -nH 'Number of login' {} \
;
./app/tpl/login.html:7:    {{ 'Number of login attempt left before being banned for %s minut
es: %s'|trans|format(
kali@kali:elabftw-1.8.5$
```

From the grep result above there are two files triggering the error messages: **LoginController.php** and **login.html**. Upon further inspection in **LoginController.php** file at line **74** there is an *if-else* validation for login failed attempt.

```
74 if (!$Session->has('failed_attempt')) {
75     $Session->set('failed_attempt', 1);
76 } else {
77     $n = $Session->get('failed_attempt');
78     $n++;
79     $Session->set('failed_attempt', $n);
80 }
```

The code above will set `failed_attempt` key with value `1` in `$Session` variable if it's not exist or, increment the value if it does. Because *PHP* handles and tracks `$Session` variable using *PHPSESSID* in a *Cookie* request header, which is controlled by user, the bypass is very obvious. Simply using random value in *PHPSESSID* or, completely removing the *Cookie* header on each request to **login.php** will force the application to create a new session and the `failed_attempt` key will always be set to `1`.

When inspecting the login page a hidden input called *formkey* was found and it's required along with email and password as a data submitted to **LoginController.php**

2.2 Attack process

This section will assemble what was found when identifying how the lockout process works.

1. Make a *GET* request to **login.php**

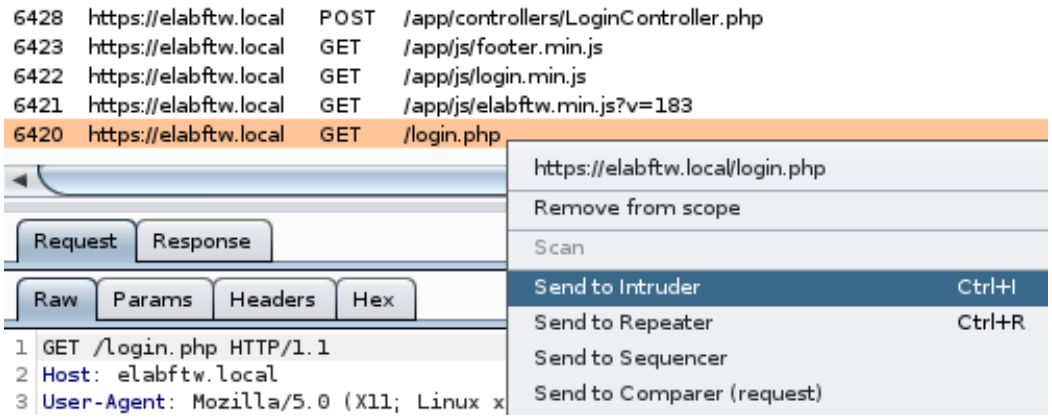
   - Extract *PHPSESSID* from the response header
   - Extract *formkey* from the response body

2. Make a *POST* request to **LoginController.php** with *PHPSESSID* and *formkey* from step 1 included and, use valid email address and wordlists for password on data field
3. Follow *url* redirections from step 2 response location header

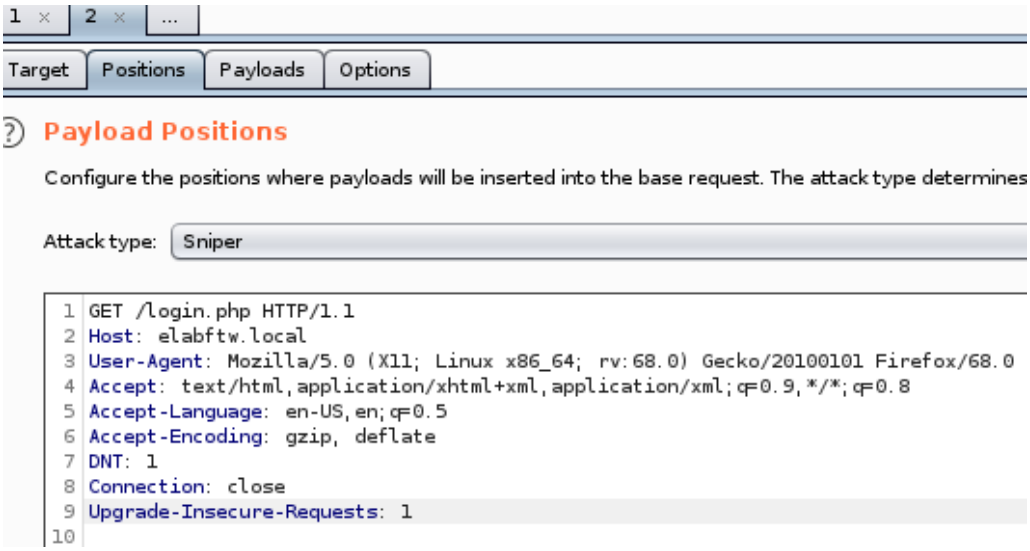
   - If *url* redirect location is **login.php**, automatically remove the *Cookie* header
   - If *url* redirect location is not **login.php**, the attack is succeed

3 Exploitation

The exploitation will use *Burp Suite's Intruder*[2] tool to automate the attack process. First step is to extract *PHPSESSID* and *formkey* from the **login.php** assuming the request was already made from the browser through *Burp Suite Proxy*. Navigating to *Proxy* > *HTTP History*, right-clicking on the GET request `/login.php` and select *Send to Intruder*:

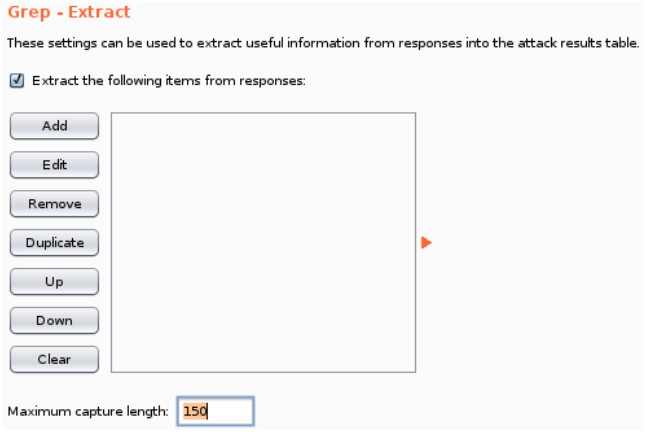


Now navigate to *Intruder* window and choose *Positions* tab and remove a *Cookie* header if it exists:

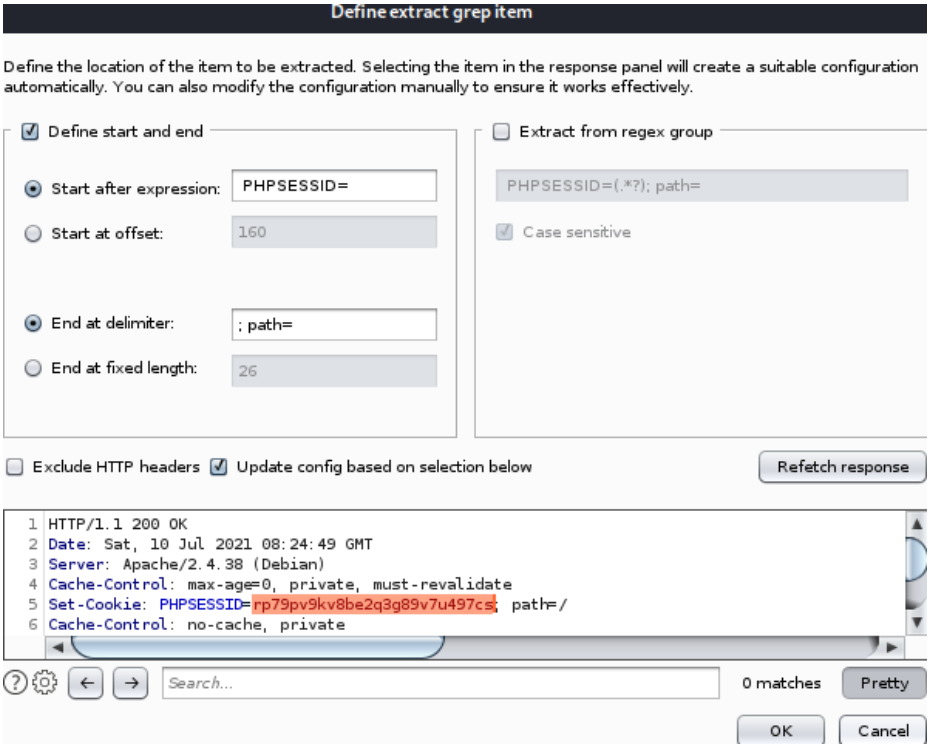


[2] https://portswigger.net/burp/documentation/desktop/tools/intruder/using

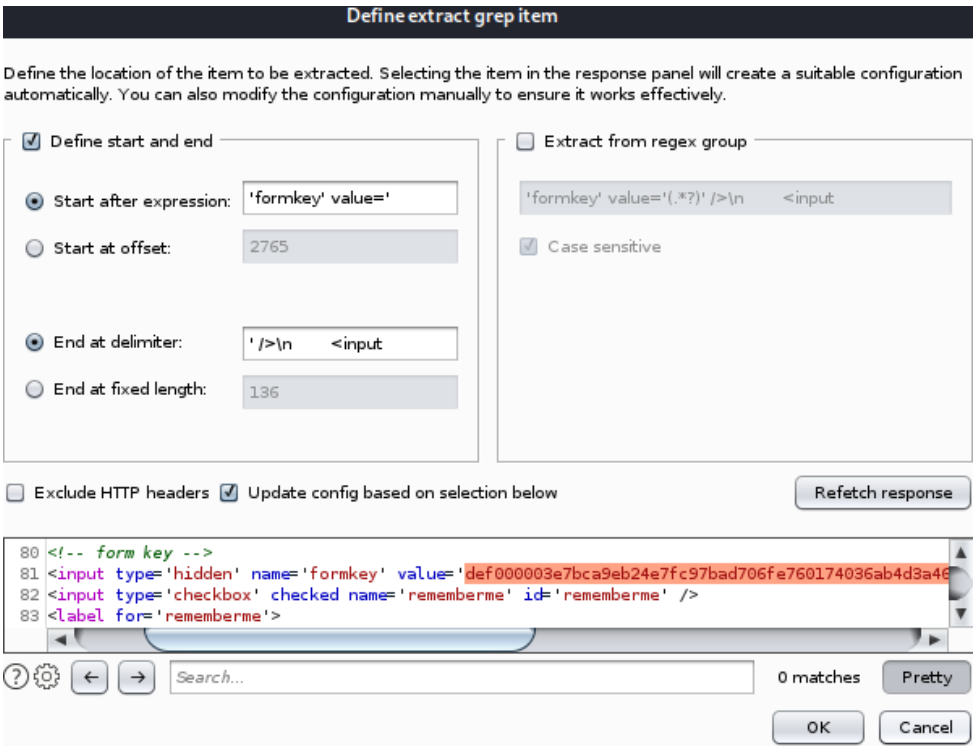
Next, choose *Options* tab and scroll down to *Grep Extract*. Tick *Extract the following items from responses* and set *Maximum capture length* to **150**:



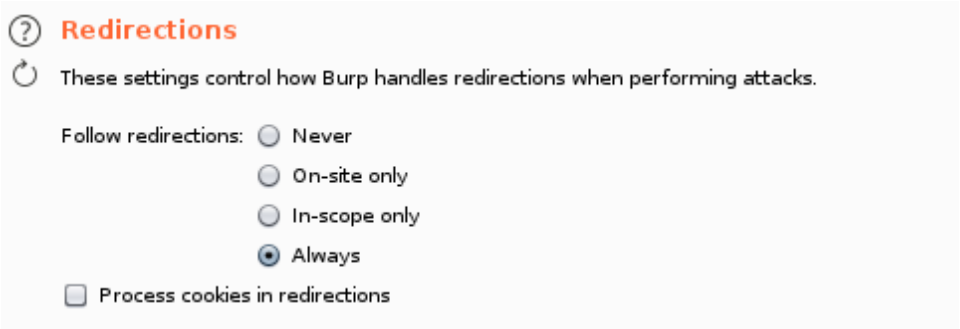
Click *Add* button then *Refetch response* and notice *Set-Cookie* header is being set. Select *PHPSESSID* value and click *OK*:



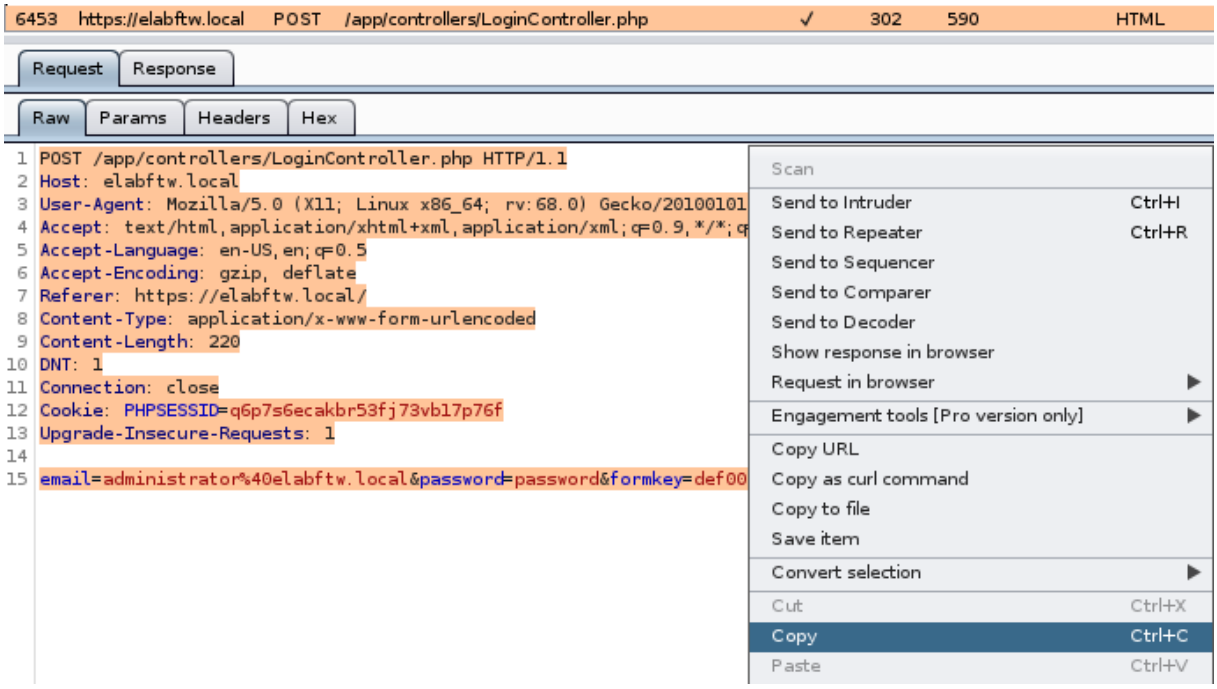
Click *Add* button again and do the same for *formkey* value:



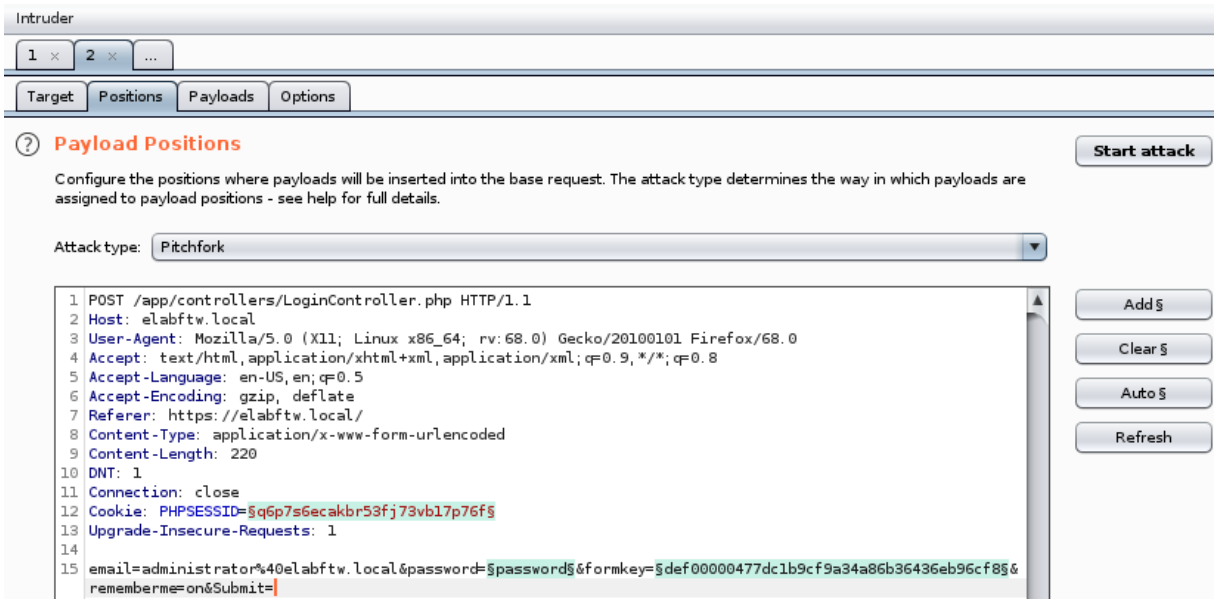
Select *Always* option on *Redirections*:



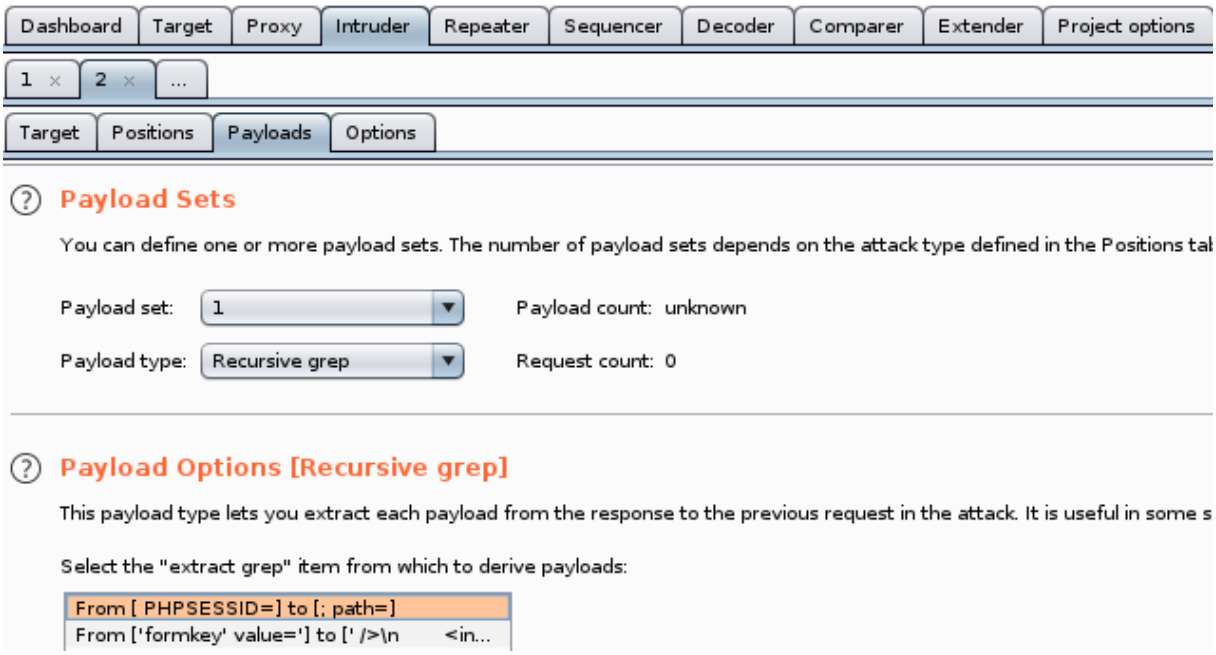
Navigate to *HTTP History* tab on *Proxy* window then select **POST /app/controllers/LoginController.php** and copy the raw request:



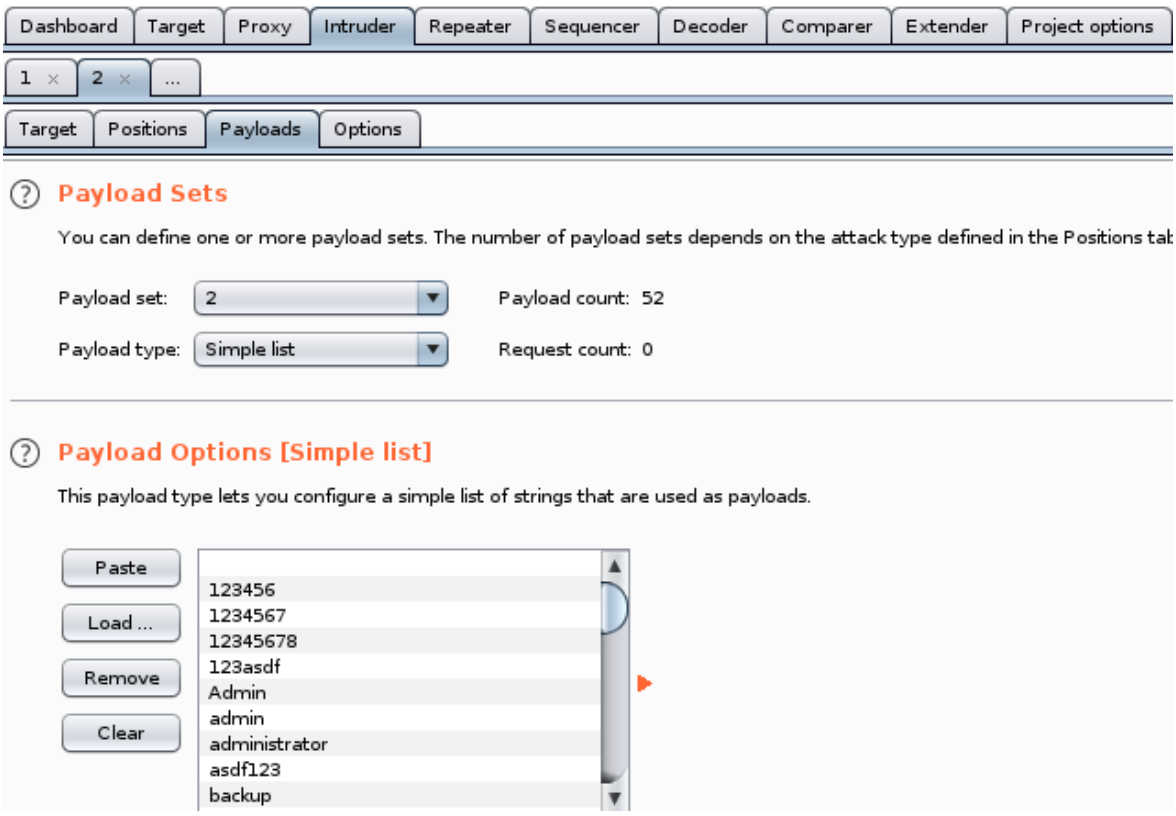
Go back to *Positions* tab on *Intruder* window and paste copied raw request in the editor and then click *Add §* button to set a mark on these fields: `PHPSESSID`, `password`, `formkey` and set *Attack type* to **Pitchfork**:



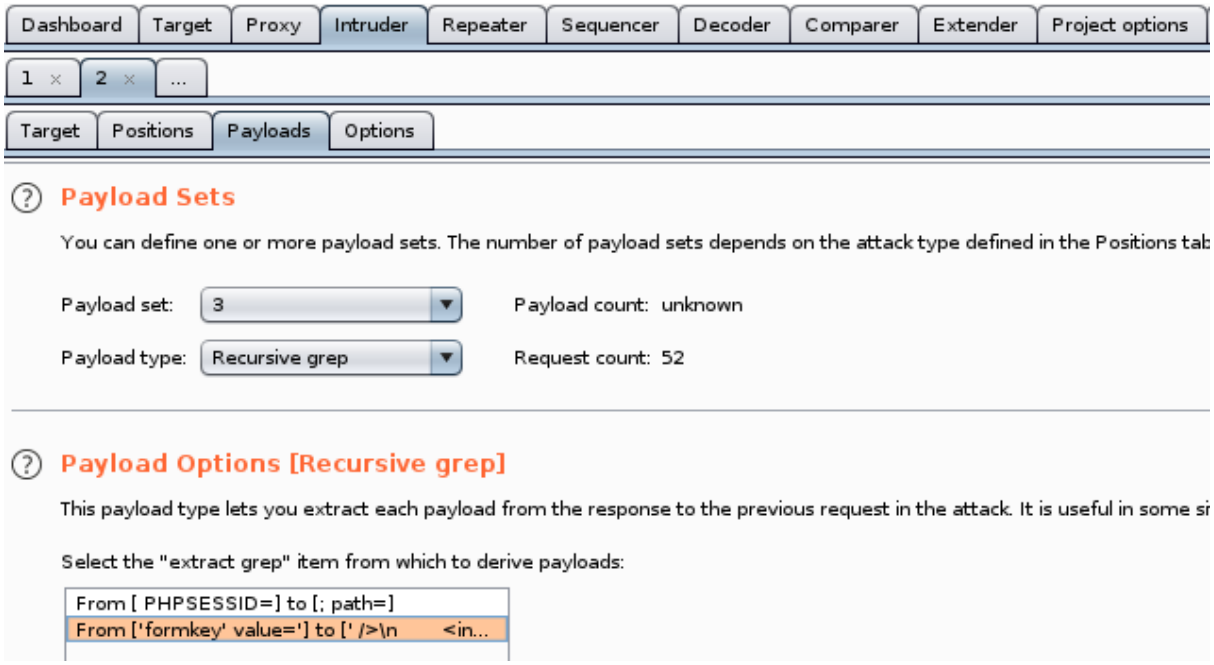
Next, clicking the *Payloads* tab to set 3 payloads. *Payload set 1* for *PHPSESSID* cookie value using "**Recursive Grep**":



Payload set 2 for *password* and set *Payload type* to "**Simple list**" then click *Load* to choose a small wordlist file from **/usr/share/wordlists/wfuzz/others/common_pass.txt**:



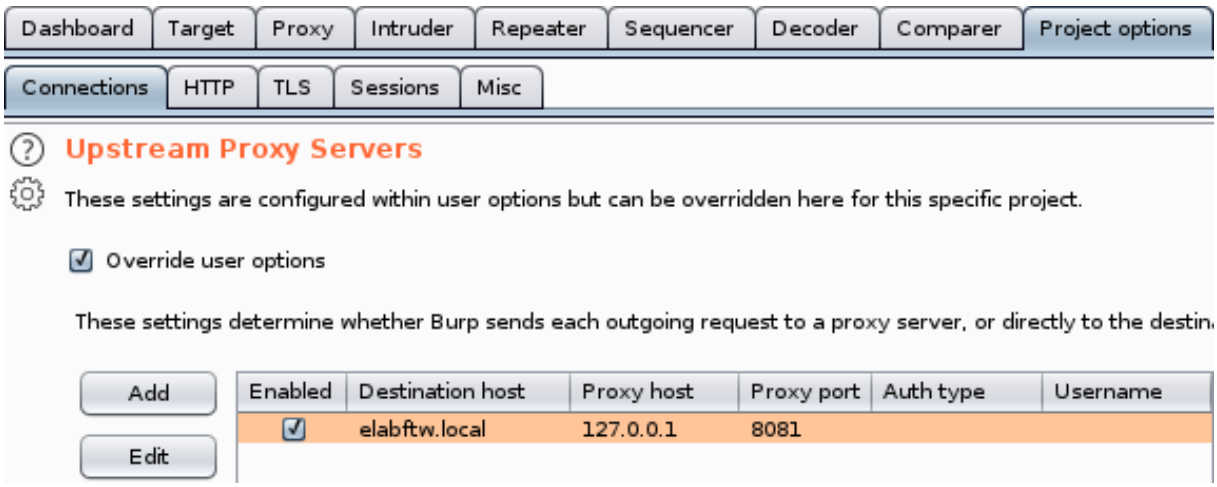
Payload set 3 for *formkey* using "**Recursive Grep**":



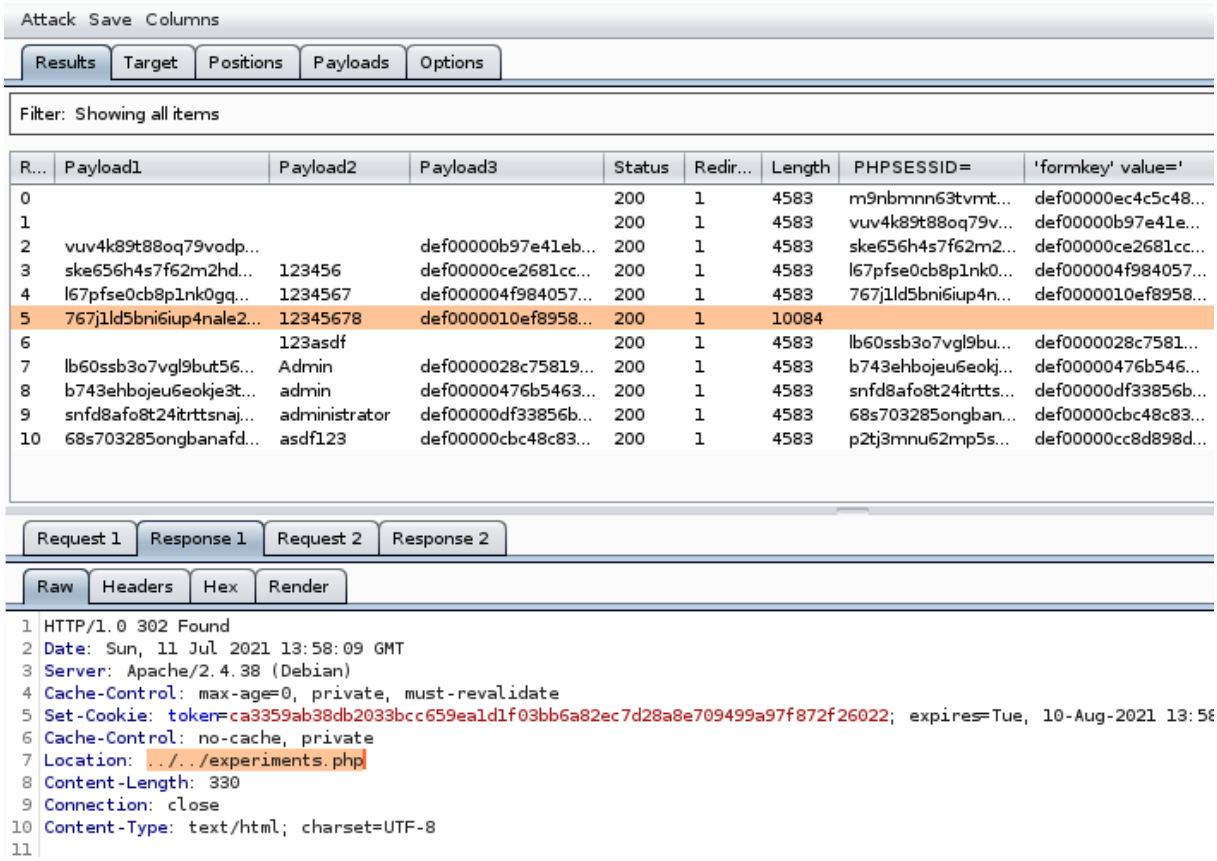
Using *Mitmproxy* command-line *mitmdump* as upstream proxy to automatically remove *Cookie* header when following a redirect location request to `/app/controllers/../../login.php`.

```
kali@kali:~$ mitmdump -p8081 -k -H ":~q ~m GET .*/app/controllers/../../login.php:Cookie:''"
Proxy server listening at http://*:8081
```

Navigate to *Project options* > *Connections* > *Upstream Proxy Servers*, toggle *Override user options* and click *Add* button. Specify the *Destination host* to target domain **elabftw.local**, *Proxy host* to **127.0.0.1** and *Proxy port*: **8081** and click *OK*:



Go back to *Intruder* window and start the attack by clicking on *Start attack* button:



See image above the *Payload1* values are always changing and these values are taken from *PHPSESSID* columns for the next request. Forcing the application to create a new session so the `failed_attempt` key will always be set to 1. The lockout process successfully bypassed.

Notice in the highlighted request, the *Length* size is bigger than others and in the *Response 1* tab, the `Location` header is pointed at "`../../experiments.php`" meaning the attack is successful.

4 Conclusion

Brute-force attacks are often used to break through an application or services to reach the intended goal. The goal is usually to extract confidential data or in this case is to gain administrative access to the application control panel to be able to exploit another critical vulnerability to fully take control of the system.

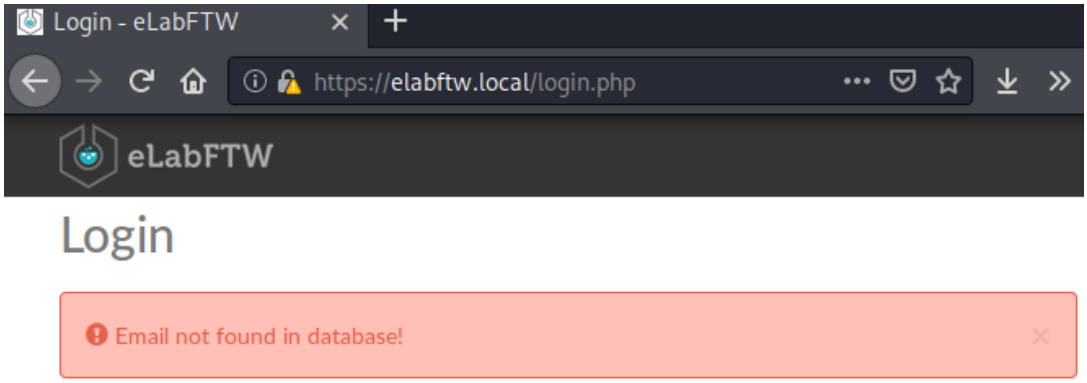
The brute-force protection on *elabFTW* can be bypassed because the attacker has control over the request header sent to the application. Meanwhile the application itself has to track failed login attempts through the request header and then stored in the session that was created by the default framework function.

Saving data in the sessions are common practices in web developments however, for this specific case it's better to have more strict implementation. Looking at the source code *elabFTW* maintainer opt out to block the request by ip and instead, use a combination of remote ip-address concat with browser *user-agent* and encrypted using *md5*. This implementation is also obvious to bypass just by changing the browser *user-agent* because the attacker has control over the browser.

The *elabFTW* already has what it needs to prevent this attack, again looking at the source code the application is already logging the failed attempt in the database. By adding a function to query and extract the log based on the ipaddress and the failed attempt message, the result can be counted and validated if it's already reached the attempt limit to be banned.

5 Appendix A: Account Enumeration

Valid email account is needed to perform successful brute-force attacks on this application. Surprisingly the **reset password** form page response can be used to determine if the email exists using *wfuzz*.




```
kali@kali:~$ wfuzz -c -L -u
↪  "https://elabftw.local/app/controllers/ResetPasswordController.php" -d
↪  "email=FUZZ@elabftw.local&Submit=" -b "PHPSESSID=FUZZ" -w names.txt --hs 'Email not found'
```

```
********************************************************
* Wfuzz 2.4.5 - The Web Fuzzer                         *
********************************************************

Target: https://elabftw.local/app/controllers/ResetPasswordController.php
Total requests: 23

=====================================================================
ID           Response   Lines    Word     Chars       Payload
=====================================================================

000000004:   200        126 L    372 W    4447 Ch     "administrator"
000000013:   200        126 L    372 W    4448 Ch     "adrian"
000000018:   200        126 L    372 W    4448 Ch     "benjamin"
000000023:   200        126 L    372 W    4448 Ch     "caitlyn"

Total time: 1.766739
Processed Requests: 23
Filtered Requests: 19
Requests/sec.: 13.01833

kali@kali:~$
```