Spring 2025

Cyber Security Fundamentals (INFT-3508 - 20332)

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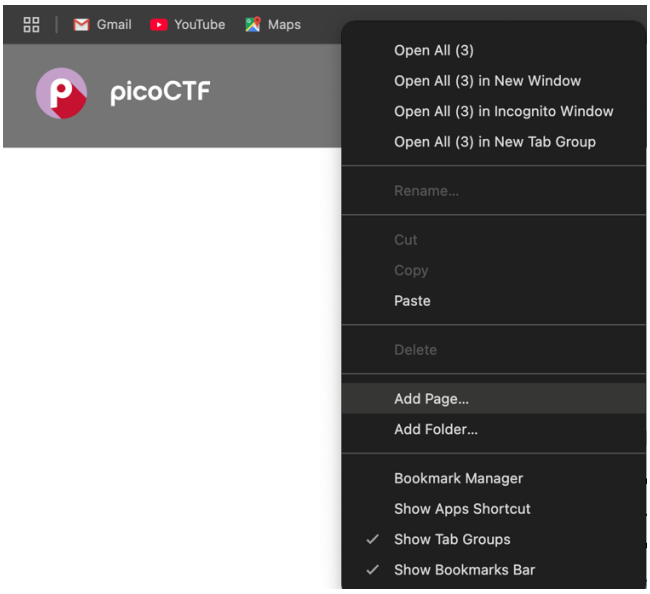
Homework 2

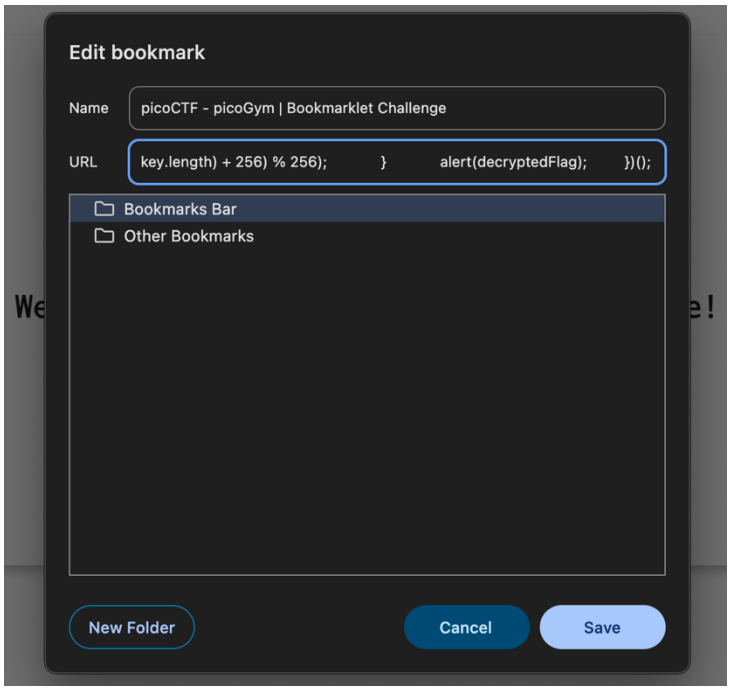
1. **Bookmarklet**

In this task, we need to click “Launch instance” to see the instructions. After clicking we can see the javascript code. Here, we need to copy the code first.

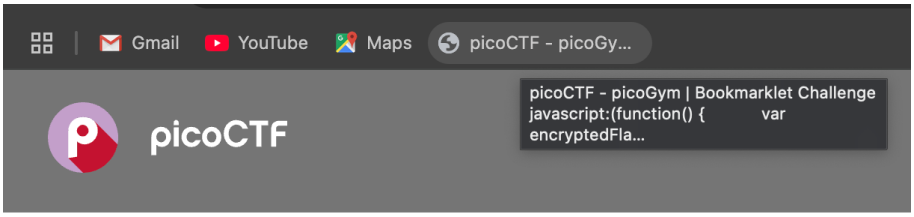
Then, we go to the “Bookmarklet” part of our page and add a page.



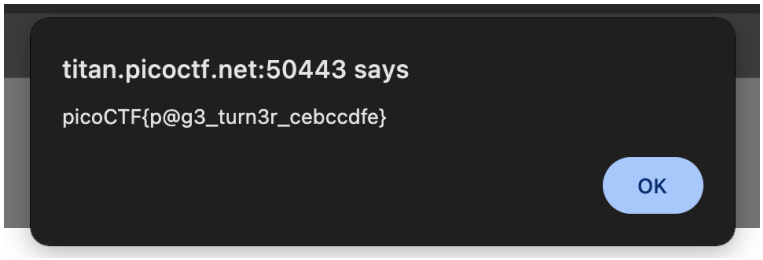
After this step, we paste the link we copied to the “URL” section.



It will be visible like this in the “Bookmarklet” section.

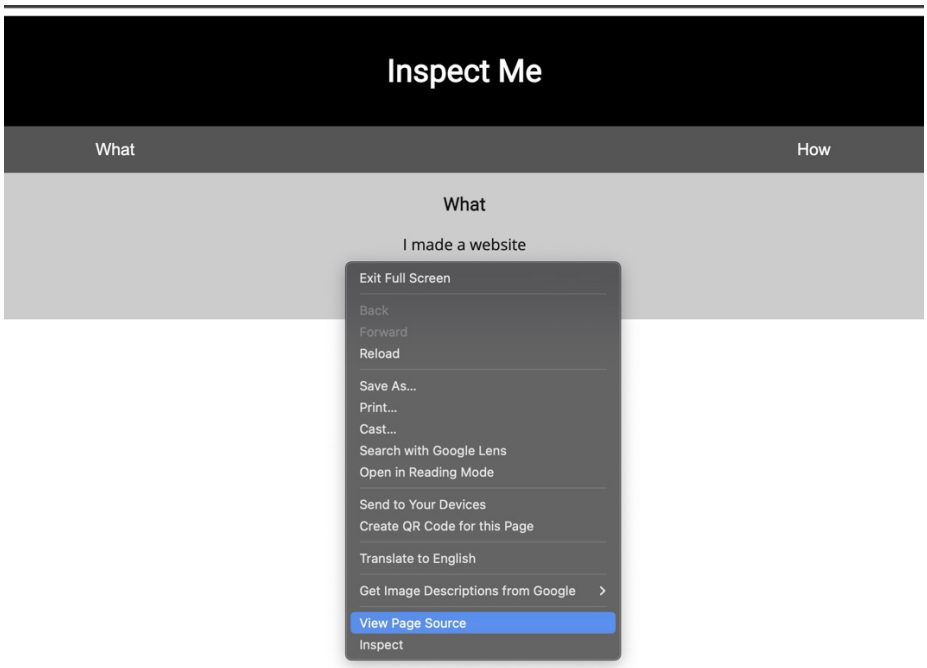


When we click on this it will display the flag itself.



1. Insp3ct0r

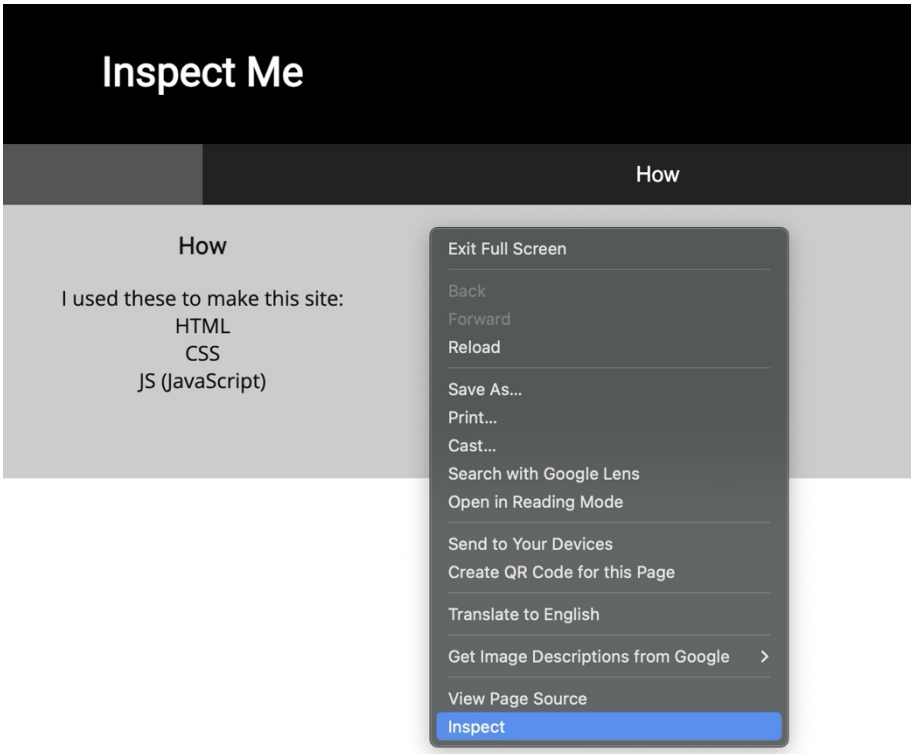
The first step is to click on the link provided in the task description. Once we click the link, a webpage will open displaying the text “Inspect Me”. It has two parts – What and How. First, we right-click anywhere on the “What” page, and from the context menu that appears, select “View Page Source.” This option allows us to view the HTML code behind the webpage, which helps in analyzing or understanding how the content is structured and possibly where hidden information is located.



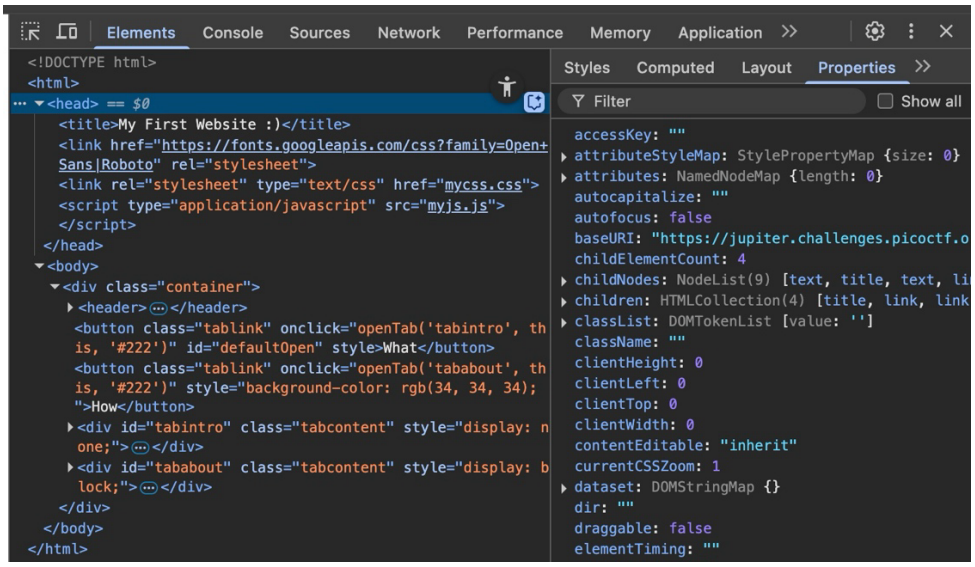
Here we will see the first part of the flag (written in green color).

```
      <button class="tablink" onclick="openTab('tabintro', this, '#222')" id="defaultOpen">What</button>
      <button class="tablink" onclick="openTab('tababout', this, '#222')">How</button>

      <div id="tabintro" class="tabcontent">
    <h3>What</h3>
    <p>I made a website</p>
      </div>

      <div id="tababout" class="tabcontent">
    <h3>How</h3>
    <p>I used these to make this site: <br/>
      HTML <br/>
      CSS <br/>
      JS (JavaScript)
    </p>
    <!-- Html is neat. Anyways have 1/3 of the flag: picoCTF{tru3_d3 -->
      </div>

    </div>

  </body>
</html>
```

To find the next parts of the flags we need to inspect the other part of the page which is “How”.



After clicking the “Inspect”, we will be directed to a page that looks like this:



We need to examine the <head> section of the HTML code.

Why? Because the <head> section contains important resources such as CSS and JavaScript files. These external files can include hidden parts of the flag, which are essential for solving this challenge.

In this case, we notice a reference to a CSS file name “mycss.css” in the <head section>. To view the content of this file, we can manually open it by pasting its full path in the browser’s address bar. To do that, take the original URL of the challenge and append “mycss.css” to the end of it. The final URL should look like this: https://jupiter.challenges.picoctf.org/problem/44924/mycss.css

When pressing enter to load the file and examine its contents, we will see the second part of the flag (2/3) at the end of the code.

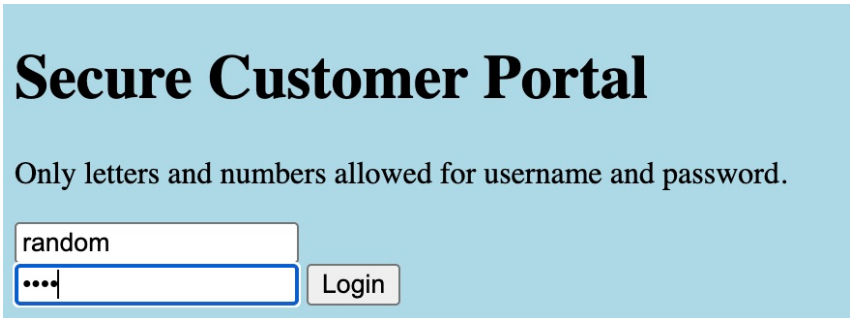
```
#tabintro { background-color: #ccc; }
#tababout { background-color: #ccc; }

/* You need CSS to make pretty pages. Here's part 2/3 of the flag: t3ct1ve_0r_ju5t */
```

Now only the third part of the flag remains to be found. Since we have already found the second part of the flag in the CSS file, it is logical to check the JavaScript file, next to find the last part. To proceed, we follow the same steps we used for the CSS file. The full URL should look like this: https://jupiter.challenges.picoctf.org/problem/44924/myjs.js

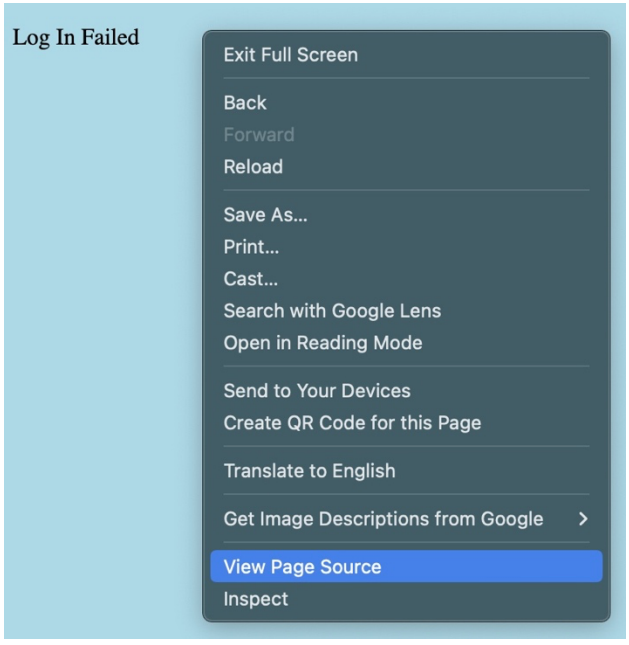
```
    document.getElementById(tabName).style.display = "block";
    if(elmnt.style != null) {
        elmnt.style.backgroundColor = color;
    }
}

window.onload = function() {
    openTab('tabintro', this, '#222');
}

/* Javascript sure is neat. Anyways part 3/3 of the flag: _lucky?f10be399} */
```

2. Local Authority

The first step of the assignment is to click on the “Launch Instance” button. Once it launches, we will see a brief problem statement which will be a link to a login page of a website that we need to access. On this age, we are asked to enter a username and password, but these credentials are not provided in the instructions.



To explore further, we can try entering a random username and password, which will result in an error message such as “Login failed.” However, this does not mean we have reached the end. In fact, it is a hint that we should investigate how the website is functioning behind the scenes. To do this, right-click anywhere on the page and select “View Page Source.” This action allows us to see the HTML code that was used to create the web page.



While examining the source code, we notice a line like this: **<script src="secure.js"></script>.**

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <link rel="stylesheet" href="style.css">
    <title>Login Page</title>
  </head>
  <body>
    <script src="secure.js"></script>
```

This line tells the browser to load an external JavaScript file called “secure.js.” The src=”secure.js” means that the web page is importing a script from that file to perform a specific logic, which can possibly include the login information.

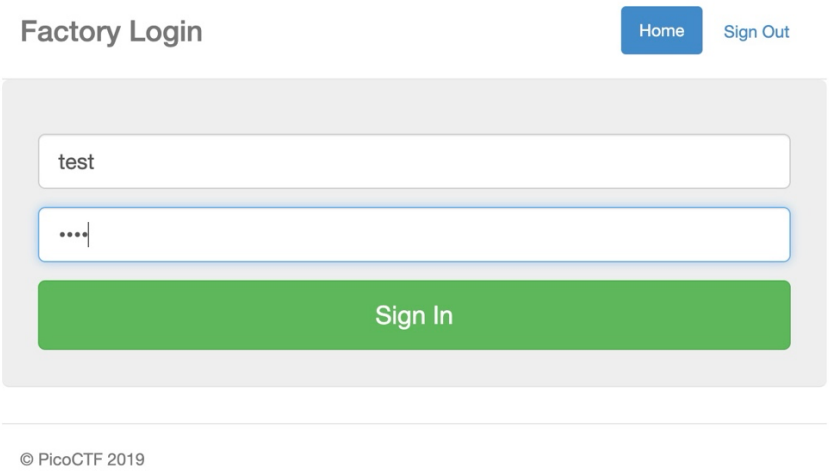
We can click on the link “secure.js” to view its contents. Inside this JavaScript file, we find the actual username and password in the code. The Username is “admin”, and the Password is “strongPassword098765.”

```
function checkPassword(username, password)
{
  if( username === 'admin' && password === 'strongPassword098765' )
  {
    return true;
  }
  else
  {
    return false;
  }
}
```

After successfully logging in with these values, the system will display the flag.

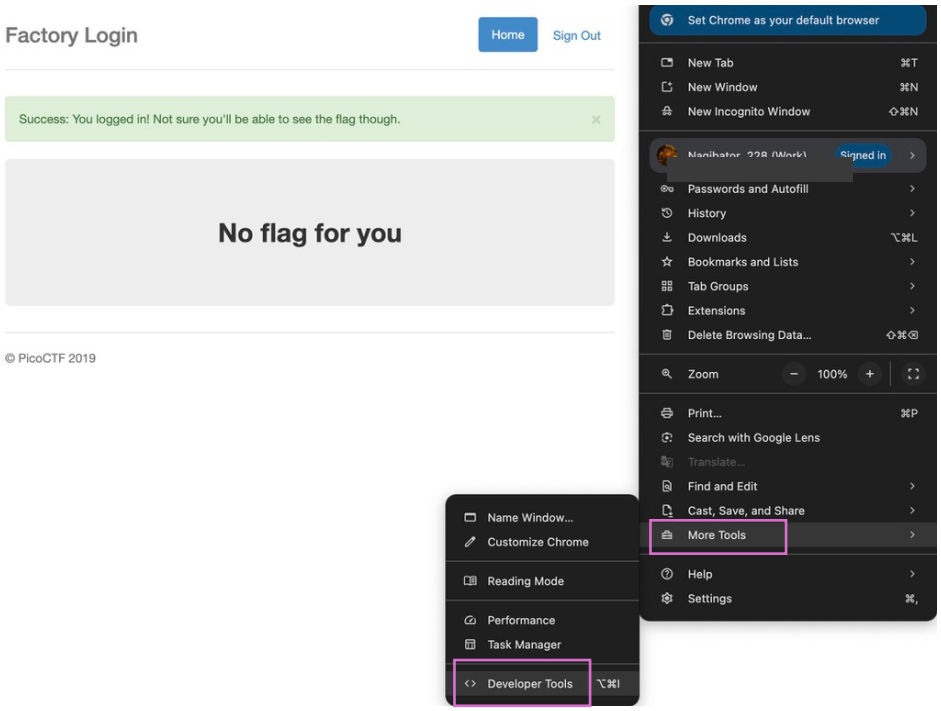
3. Logon

The first step of the task is to click on the “Launch Instance” button again. Once the instance loads, a brief problem statement appears, which includes a link to a webpage. This page turns out to be a login page. Since we do not know the username or password, we just enter something random. Even if we log in without entering any username and password at all, it still lets us log in.

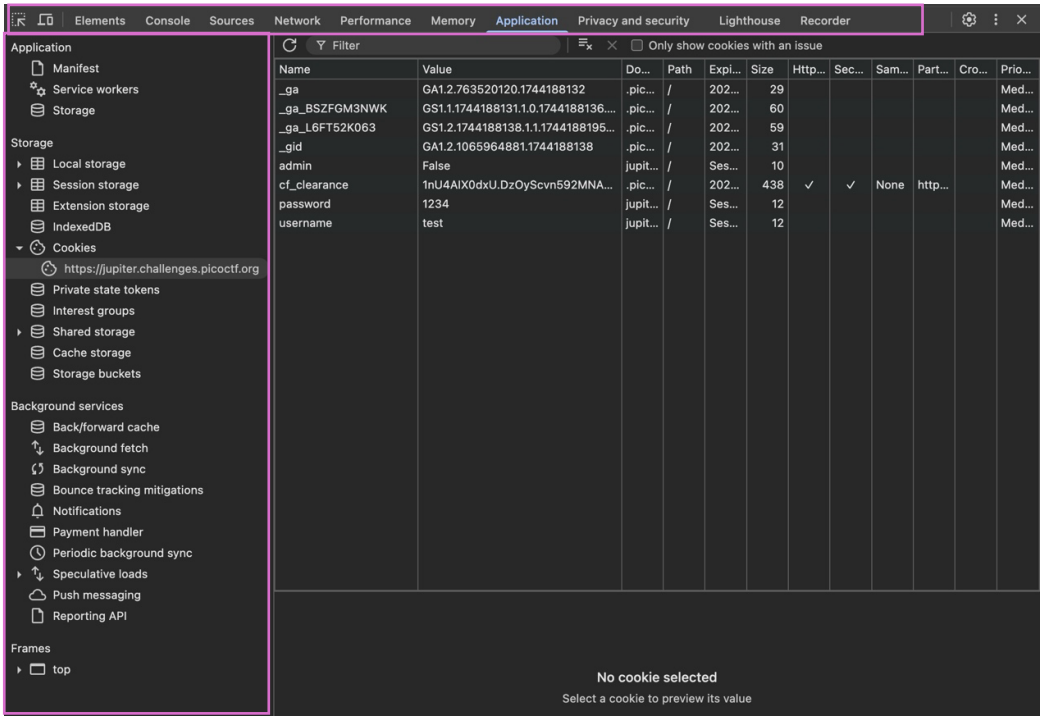


After this step, the website displays messages like: “Success: You logged in! Not sure you'll be able to see the flag though.” And “No flag for you.” These messages indicate that while the login was accepted, the actual goal, which is finding the flag is not straightforward. It hints that the flag may be hidden somewhere within the inner parts of the page. I noticed four different links in the source code, so I explored each of them, hoping to find some useful information. However, none of them helped, and I could not find any mention of the flag or anything that looked relatable. Since this method did not lead to a result, the next step was to use Developer Tools.

Developer Tools, often called DevTools, provide a much deeper look into how a webpage functions which means they let us view JavaScript files, examine data stored in cookies or local storage, and even what scripts are running in the background. They are especially useful for examining dynamic content that does not appear in the static source code.

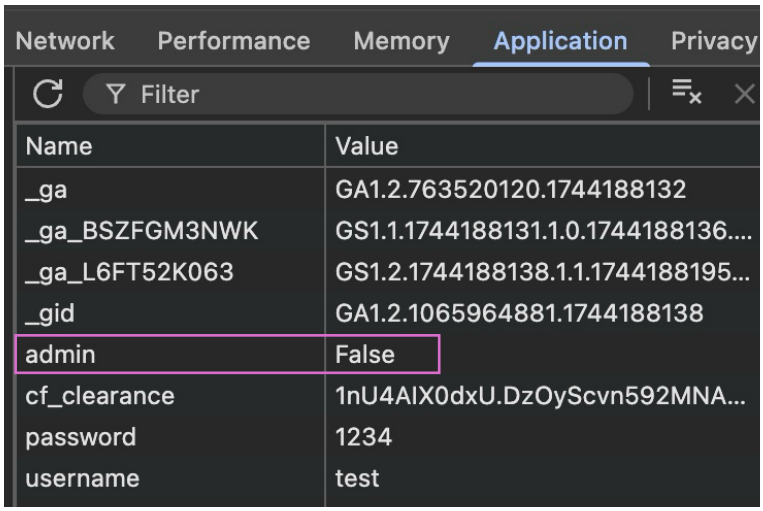


To access Developer Tools, we can click the three vertical dots in the top-right corner of the browser window, near the address bar. From there, we go to “More Tools” and then choose “Developer Tools.”. Alternatively, there are shortcuts like F12 or Ctrl+Shift+I on Windows, or Cmd+Option+I on Mac.

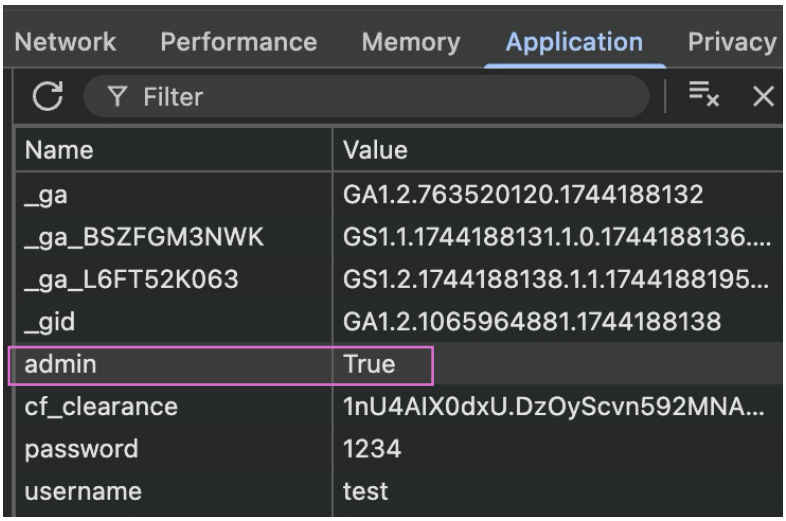


In Development Tools, we will see Main Navigation (top tabs), which are Elements, Console, Sources, Network, and Application. We need to choose the Application tab because it lets us view cookies, local storage, and session storage which often store login tokens. It is basically useful for seeing what data the site stores in our browser and debugging app behavior.

Additionally, there is a sidebar (Application Sections). Here we need to go to the "Cookies" section which includes the website http://jupiter.challenges.picoctf.org:15796 because it shows all cookies saved by that website. Because cookies store login info, user sessions, and additional tokens, by clicking on it, we can see what this site remembered about us and find issues with login or sessions.



Here we can see the username, password, and other details. The site has saved my login credentials with the username set to test and password as 1234. Moreover, there is another cookie named as admin, which is set to "False." This indicates that I am recognized as a regular user, not someone with administrative access (not authorized). Because of this, certain content like a hidden flag is not being displayed on the page.



Now that we understand the reason, we can take a simple step to bypass this restriction. By manually changing the value of the admin cookie from "False" to "True", we can make the website believe that I am an admin user. Once this change is made, all we need to do is refresh the page. After refreshing, the page reloads with admin-level access, and the hidden flag becomes visible.

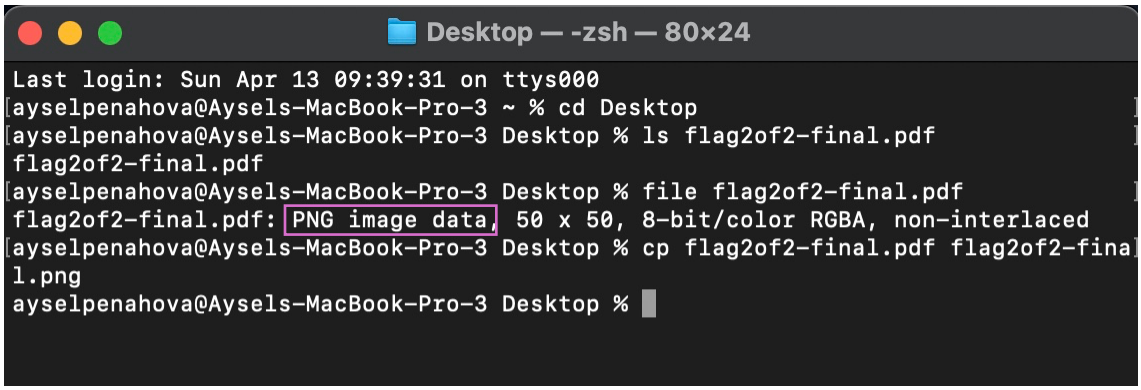
4. Mod 26

Cryptography is the process of transforming information to make it unreadable to unauthorized people. ROT13 is a simple encryption method where each alphabet letter is shifted 13 places forward. For example, the letter "A" becomes "N", and "B" becomes "O". If we apply this method to the "**cvpbPGS{arkg_gvzr_V'yy_gel_2_ebhaqf_bs_ebg13_Ncualgvd}**, each letter will be replaced by the letter 13 places forward. The decoded text will be "**picoCTF{next_time_I'll_try_2_rounds_of_rot13_Aphnytiq}**"

5. Secret of the Polyglot

In this task, we are asked to extract all the information from a given file. After downloading the file mentioned in the instructions, we received a PDF named "flag2of2-final.pdf". When I opened it, I saw a piece of text that looked like the last part of a flag, which was "**1n_pn9_&_pdf_53b741d6}".** However, the first part of the flag was missing.

There was a hint which suggested opening the file in different ways, therefore I decided to use the terminal. First, I used the "cd Desktop" command to navigate to the Desktop, where the file was saved. After this command, I used "ls flag2of2-final.pdf" to confirm the file was there. Then, we need to inspect the actual file. Therefore, I used the "file flag2of2-final.pdf" command.



Although the file had a ".pdf" extension, the "file" command revealed that it was actually a PNG image, not a real PDF. To reveal its contents more clearly, I used the "cp flag2of2-final.pdf flag2of2-final.png". This command makes an exact duplicate of flag2of2-final.pdf but names it "flag2of2-final.png". If you are using macOS, you can also use the" sips -s format png flag2of2-final.pdf --out flag2of2-final.png" command. This command converts the PDF into a PNG image unlike cp, which copies without conversion.

Now we can see the first part of the flag: "**picoCTF{f1u3n7-".**

6. Verify

```
apanahova16022-picoctf@webshell:~$ ssh -p 56575 ctf-player@rhea.picoctf.ne
t
ctf-player@rhea.picoctf.net's password:
Welcome to Ubuntu 20.04.3 LTS (GNU/Linux 6.8.0-1021-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

This system has been minimized by removing packages and content that are
not required on a system that users do not log into.

To restore this content, you can run the 'unminimize' command.

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.
```

In this task, we start by connecting to a remote server using SSH. The command “ssh -p 52706 ctf-player@rhea.picoctf.net” tells our system to securely log into the server at rhea.picoctf.net using port 565775 and the username ctf_player. After entering the password, we are successfully logged into the server. When we type the password, no characters appear on the screen. It is hidden because of the security.

```
ctf-player@pico-chall$ ls
checksum.txt  decrypt.sh  files
```

Once inside the server, we need to check the contents of the current directory with the “ls” command. It shows three items. A file named “checksum.txt”, a script named “decrypt.sh”, and a folder named “files”.

```
ctf-player@pico-chall$ cat checksum.txt
fba9f49bf22aa7188a155768ab0dfdc1f9b86c47976cd0f7c9003af2e20598f7
```

Next, we open “checksum.txt” because it is indicated in the instructions using “cat checksum.txt”. The cat command stands for “concatenate” and is often used to display the contents of the file directly in the terminal. When running this, the terminal prints out a long string of characters. That string is a SHA-256 checksum. SHA-256 is a type of mathematical

formula that takes some input like the contents of a file and produces a string of characters that looks very random. In the case of SHA-256, it always gives a 64-character log string, no matter how big or small the file is. This 64-character result is called a checksum, which acts like a unique ID for the contents of that file. Every file has a unique SHA-256 checksum. If we find a file that exact checksum, we have found the correct one.

```
ctf-player@pico-chall$ sha256sum files/* | grep fba9f49bf22aa7188a155768ab
0dfdc1f9b86c47976cd0f7c9003af2e20598f7
fba9f49bf22aa7188a155768ab0dfdc1f9b86c47976cd0f7c9003af2e20598f7  files/87
590c24
```

To search for the file that matches this checksum, we run a command that calculates the SHA-256 checksums for all the files inside the "files" folder – " sha256sum files/* ". "files/*" means applying the command to all the files inside the "files" directory. However, this command will give us a full list. We do not need to scroll through hundreds of lines looking for a match manually. Therefore we add "grep" and copy and paste the checksum (the one from checksum.txt) right after it. This is done by using the | symbol, which connects the two commands. The full version of the command looks like "**sha256sum files/* | grep fba9f49bf22aa7188a155768ab0dfdc1f9b86c47976cd0f7c9003af2e20598f7**"

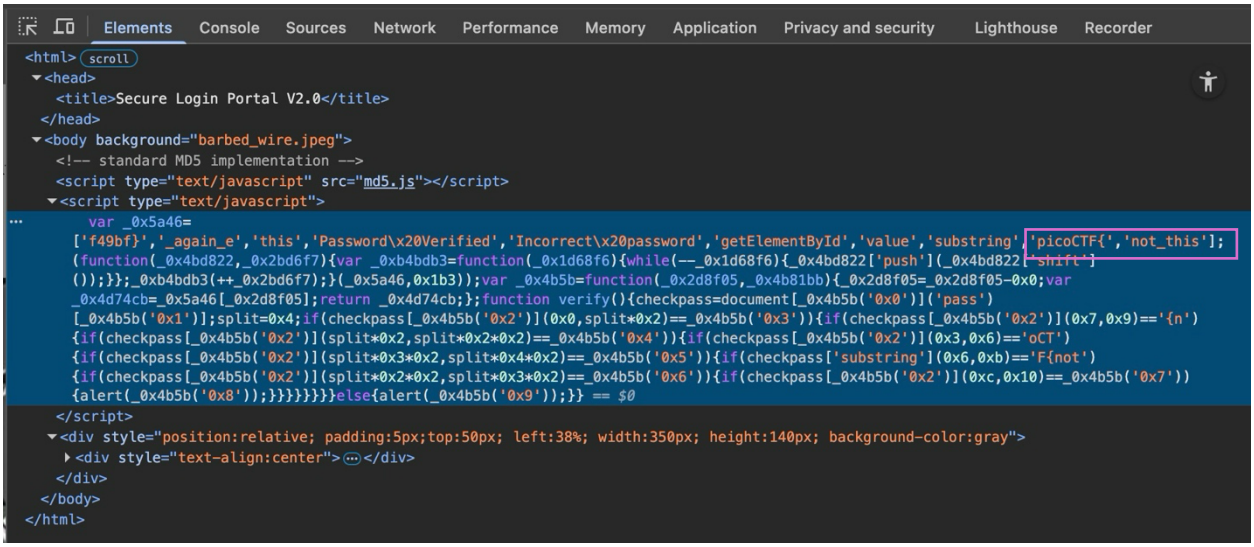
One of the files inside the files folder, named "87590c24", has the exact same checksum. That means this is the file that we needed.

```
ctf-player@pico-chall$ ./decrypt.sh files/87590c24
picoCTF{trust_but_verify_87590c24}
```

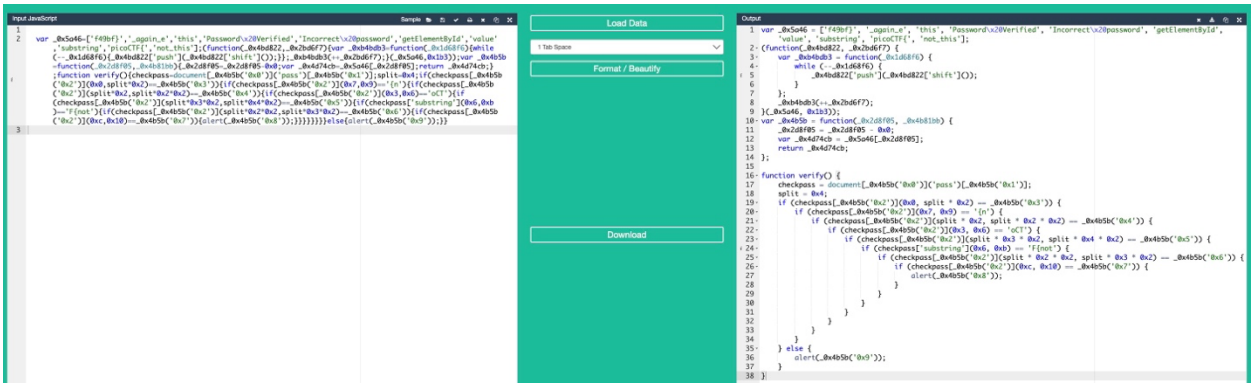
Finally, we use a script named decrypt.sh and pass it the path to the matching file with the command "./decrypt.sh files/87590c24". This command processes the file and outputs a flag in the picoCTF format.

7. Client-side-again

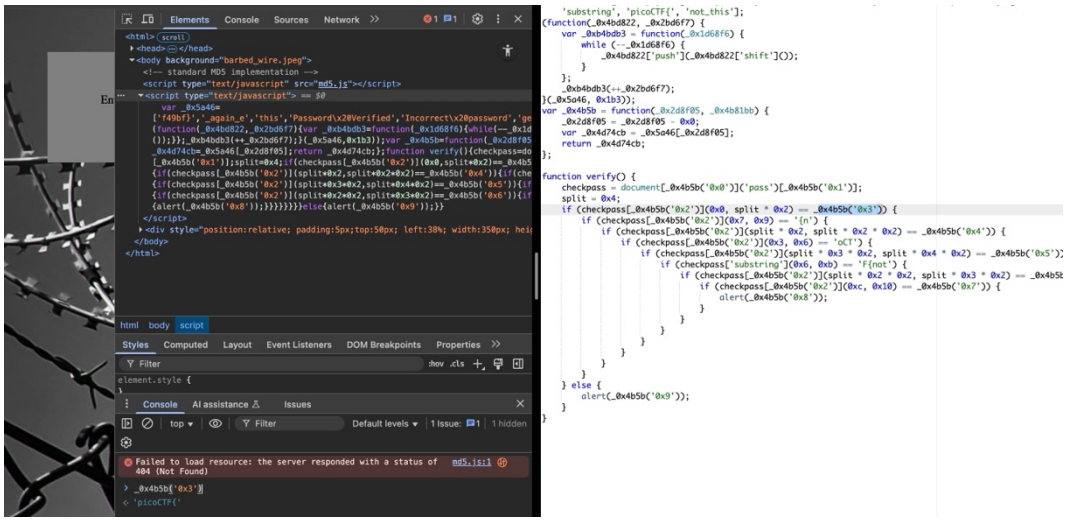
In this task, after clicking the provided link, a webpage opens. The first step that should do is to inspect the website to see if there are any hidden details or messages that might help us find the flag. To do this, we right-click anywhere on the page and select “Inspect” from the menu. This opens the browser’s developer tools.



Inside the Inspect, we look through the head section of the page and notice a very long and complex line of JavaScropt code. Even though it looks confusing at first, we can see the term “picoCTF” inside it, which tells us this code is probably important and might contain the flag.

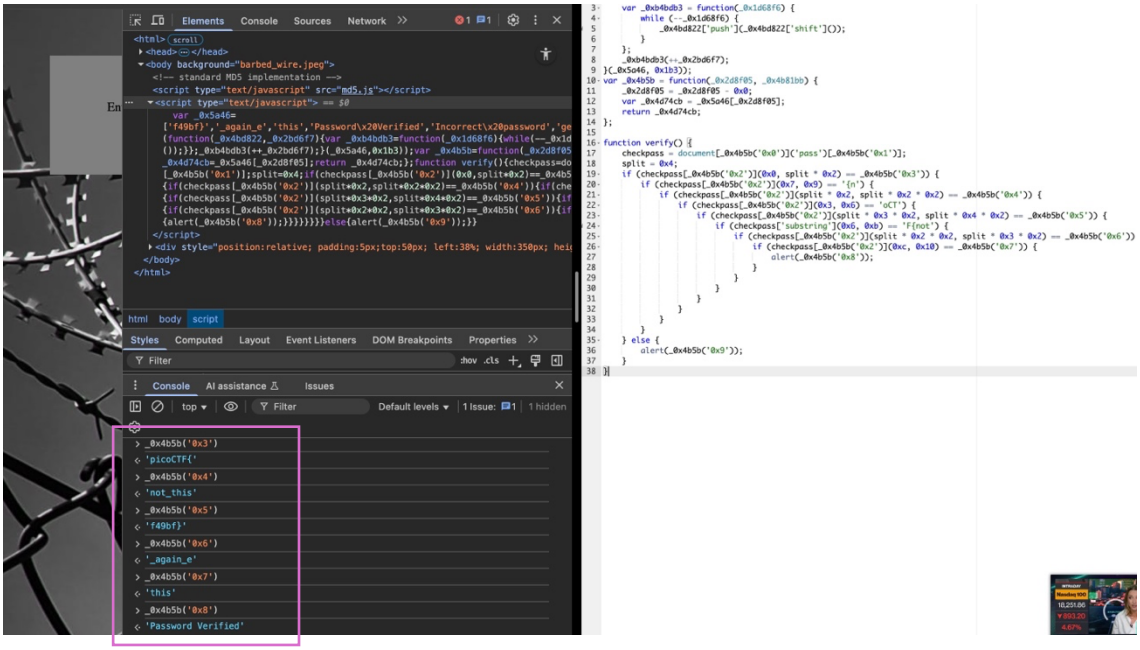


Since the code is compressed into one long unreadable line, we can make it more readable using an online “beautifie” tool. I used “https://jsonformatter.org/jsbeautifier”. After pasting the code there and “beautifying” it, the structure became much clearer.



While exploring the formatted code, I found a “function verify() {}” part of the code, which includes several checkpass function calls. Each of these seems to refer to something like “_0x4b5b(‘0x3’)”, “_0x4b5b(‘0x4’)”, “_0x4b5b(‘0x5’)”, and so on. These calls all use the same base function (_0x4b5b), but with different values inside the parentheses. Therefore, each of these might represent a different part of the flag.

I went back to the website and opened the Inspect tool again. This time in the Console tab at the bottom, I tried running “_0x4b5b(‘0x3’)”, which is the first value used in the verify() function. It returned the beginning of the flag –“picoCTF{“, confirming that this function helps decode the flag.



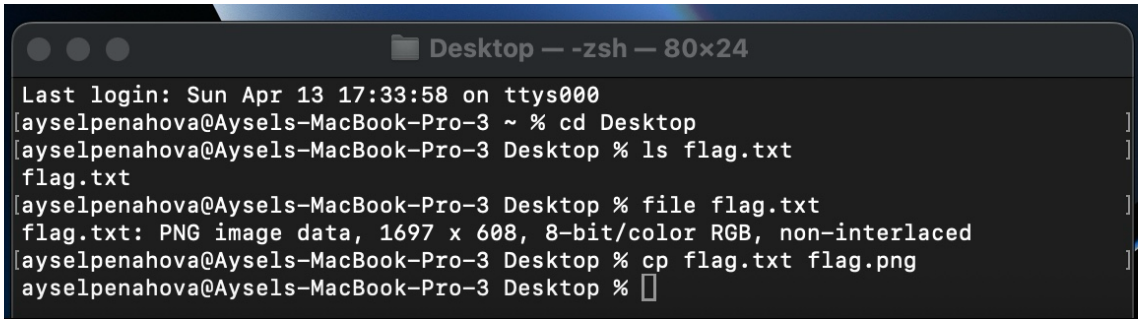
After that, I continued running the next values in order, like "_0x4b5b('0x4')", "_0x4b5b('0x5')", and so on, up to "_0x4b5b('0x8')". Each one revealed the next piece of the flag. I did not run "_0x4b5b('0x9')" because that part appears in an "else" block in the code.

By collecting all the valid pieces from the main checkpass calls, I was able to logically decode the full flag: **picoCTF{not_this_again_ef49bf}**

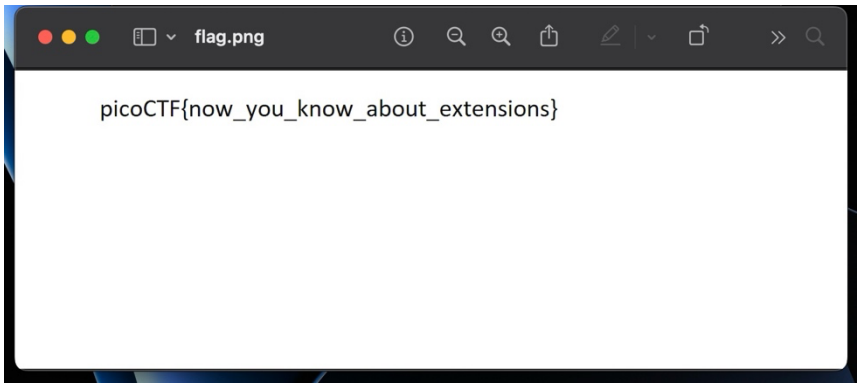
8. Extensions

This task is similar to the "Secret of the Polyglot" challenge, where the key idea is to recognize that a file may not actually be what it appears based on its name or extension.

After downloading the file provided in the instructions, we see that it is named as "flag.txt". At first sight, it seems to be a txt file. However, based on the challenge description, we already suspect that it is not a real txt file, but actually, some other file type that has been renamed as a .txt extension.



To figure out what kind of file it really is, I used a few commands in my terminal. First, I navigated to the folder where I saved the file (Desktop) by using the "cd" command. Then i ran "ls flag.txt" to check whether the file is there or not. Next, to inspect the actual type of the file, I used the command "file flag.txt". Even though the file was named "flag.txt", the output showed that it was actually a PNG image.



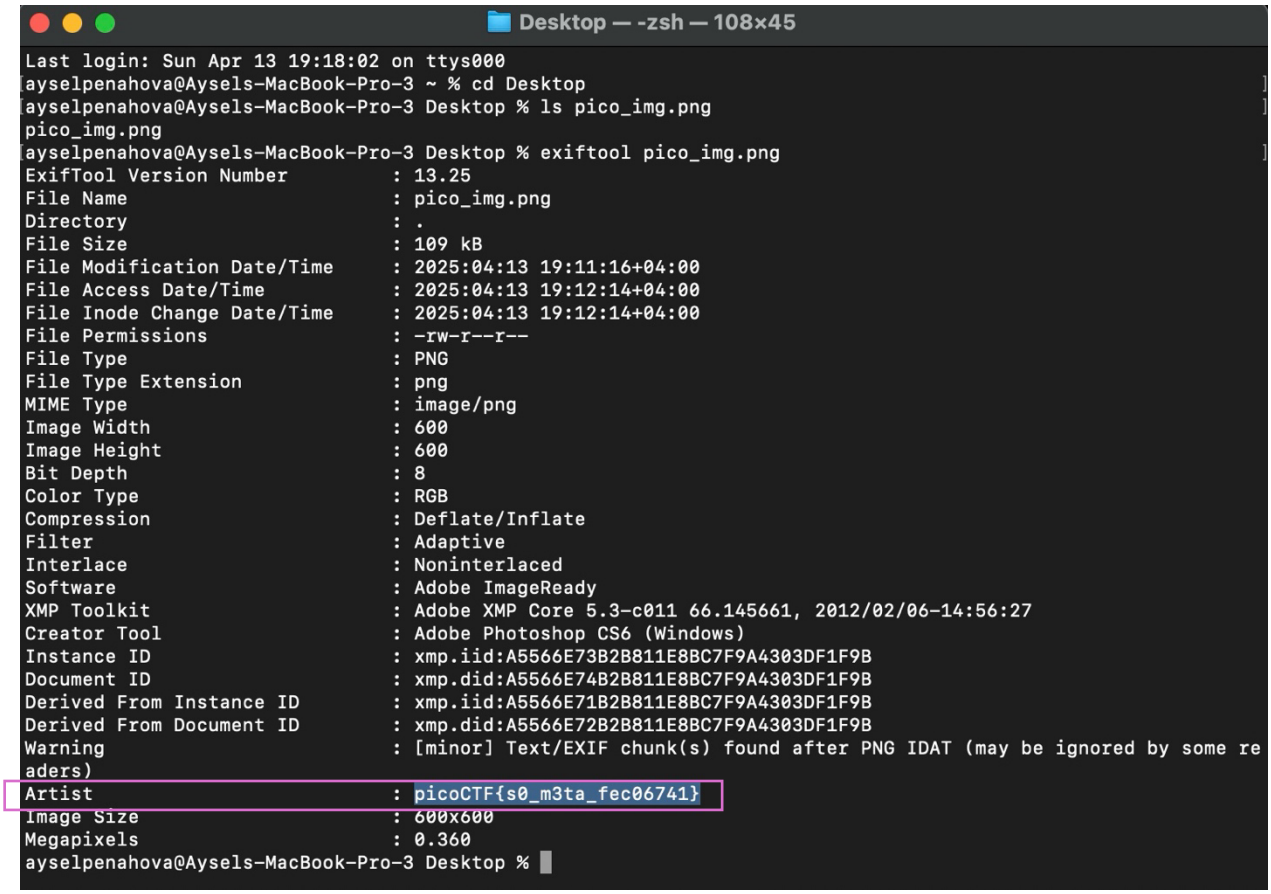
Since the file is really an image, we need to give it the corrected extension so that it can be opened properly. To do that, I made a copy of the file and renamed it with a .png extension using the “cp flag.txt flag.png”.

Now, when we open “flag.png”, we will be able to see the hidden flag.

9. So Meta

In this task, we need to search for the image’s metadata to find the flag. Therefore I open the terminal and access the file using the “cd” command. Then, “ls” to check whether the file is there or not.

Now, here comes the important part, which is checking the metadata. Metadata is hidden information stored inside a file. For images, it can include information like creation date, software, some notes, etc. To look at the metadata, we need to use the tool called “exiftool”. This command helps to scan the file and print out all the metadata that is inside the image. When I first tried to use the “exiftool” command in my terminal, I got a message that this command is not found. To fix this, I used “Homebrew”, which is a package manager for macOS. With the help of this package I installed “exiftool”.



As we can see from the screenshot, there is a field called “Artist”, where the flag is hidden.