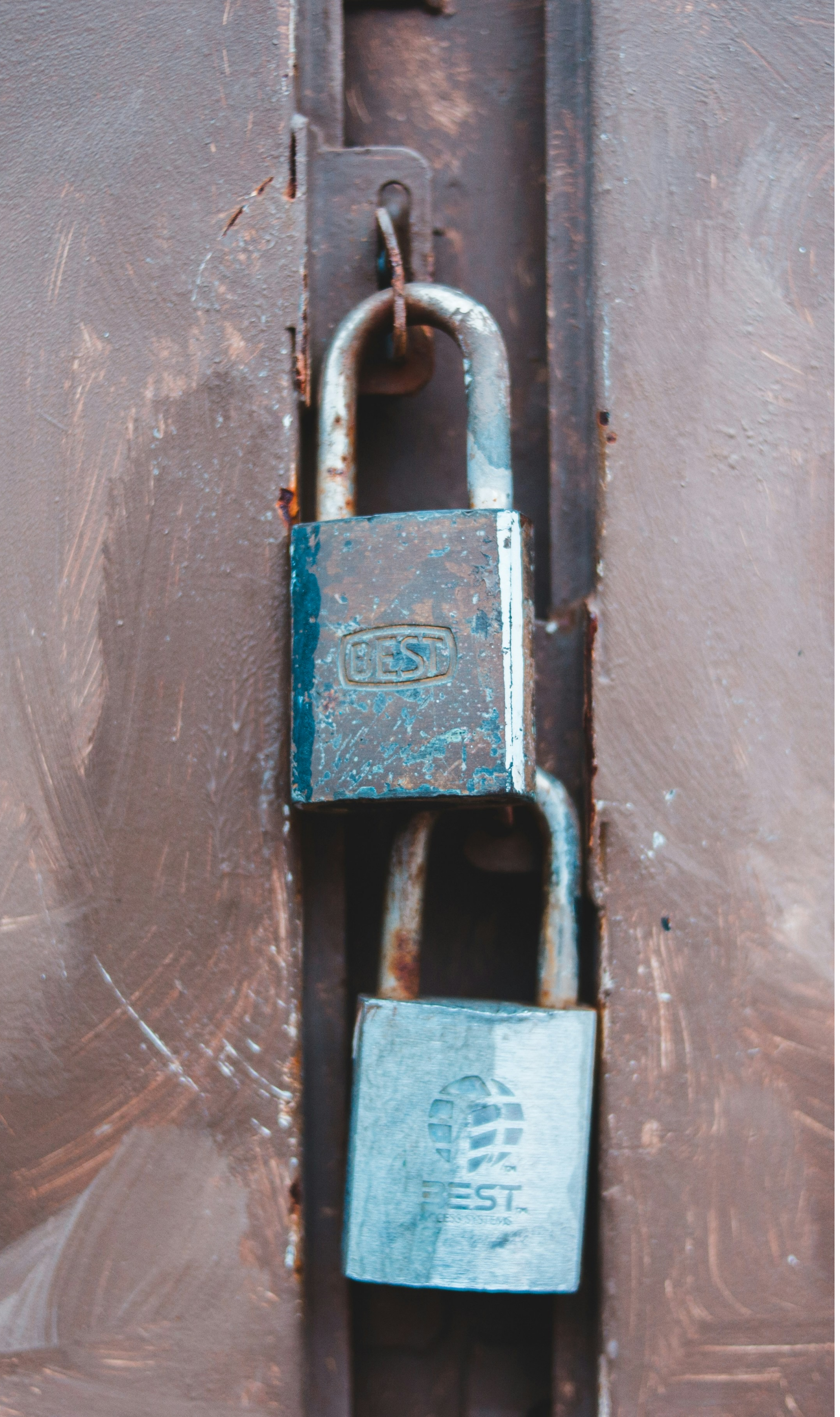


Introduzione alle Applicazioni Web

Authentication

Juan Pablo Sáenz

Goals

- Understand the concept of **sessions** in web applications
- Learn how **Flask-Login** manages user authentication
- Implement **login**, **logout**, and **user session persistence**
- **Protect routes** to restrict access to authenticated users
- Handle user loading and session management properly

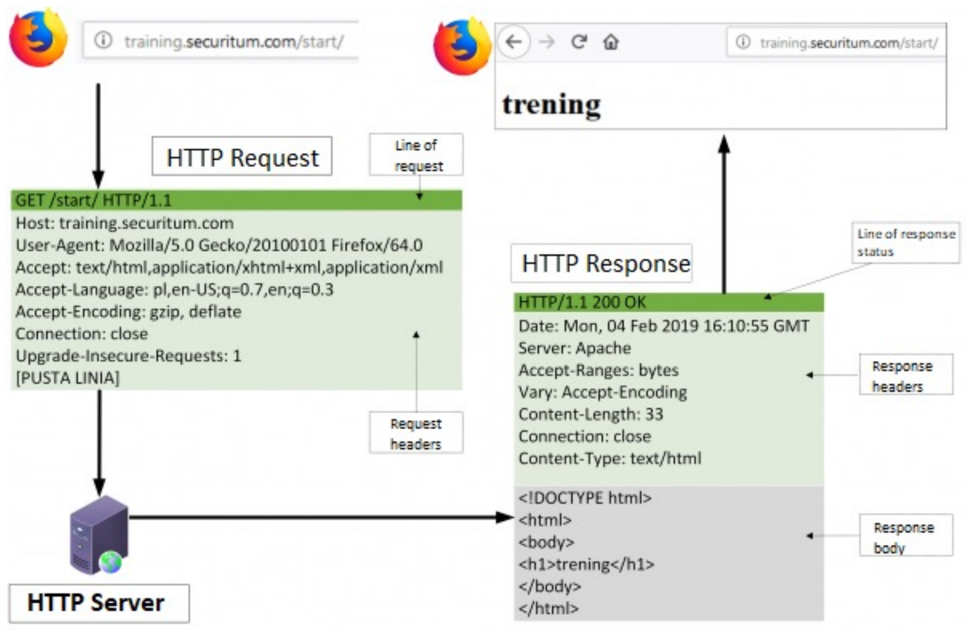
Sessions

HTTP is **stateless**

- **Each request is independent** and does not retain information from previous interactions

However, web applications often need to maintain information across multiple requests

- In an online shop, when we add a book to the shopping cart, we expect it to stay there
- As we browse other pages, our shopping cart (**«state»**) should be remembered



```
GET /start/ HTTP/1.1
Host: training.securitum.com
User-Agent: Mozilla/5.0 Gecko/20100101 Firefox/64.0
Accept: text/html,application/xhtml+xml,application/xml
Accept-Language: pl,en-US;q=0.7,en;q=0.3
Accept-Encoding: gzip, deflate
Connection: close
Upgrade-Insecure-Requests: 1
[PUSTA LINIA]
```

```
HTTP/1.1 200 OK
Date: Mon, 04 Feb 2019 16:10:55 GMT
Server: Apache
Accept-Ranges: bytes
Vary: Accept-Encoding
Content-Length: 33
Connection: close
Content-Type: text/html

<!DOCTYPE html>
<html>
<body>
<h1>trening</h1>
</body>
</html>
```

Sessions

A session is a **temporary and interactive exchange** of data between two or more parties (e.g., devices)

It involves **one or more messages** sent in each direction

Typically, **one party maintains the application state** during the session

A session has a **defined beginning** and **ends** at a later point

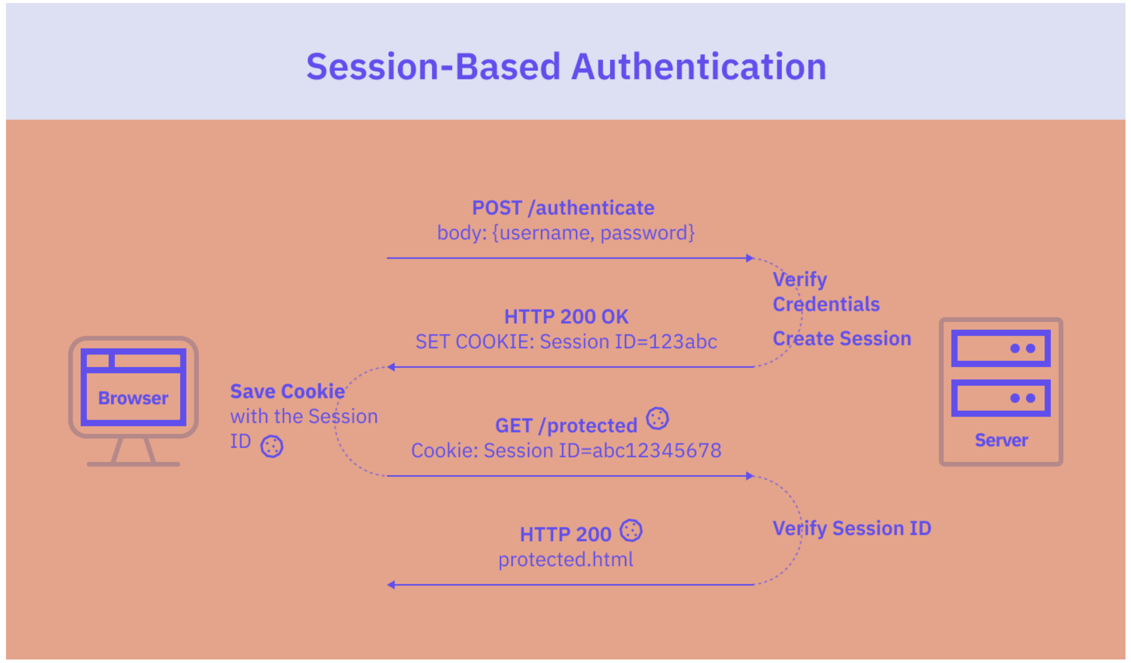
Session-Based Authentication

1. The user fills out a **form** with a username and password in the **client** application

2. The **client** validates the input and, if valid, sends it to the **server** through a **POST request**

3. The **server** receives the request, checks if the user exists, and verifies the password using **cryptographic hashes**

4. If the user is not found or the password does not match, the **server** responds with an error message like "Wrong username and/or password"


Session-Based Authentication
POST /authenticate
body: {username, password}
Verify Credentials
Create Session
HTTP 200 OK
SET COOKIE: Session ID=123abc
Browser
Save Cookie with the Session ID
GET /protected
Cookie: Session ID=abc12345678
Server
Verify Session ID
HTTP 200
protected.html

https://www.criipto.com/blog/session-token-based-authentication

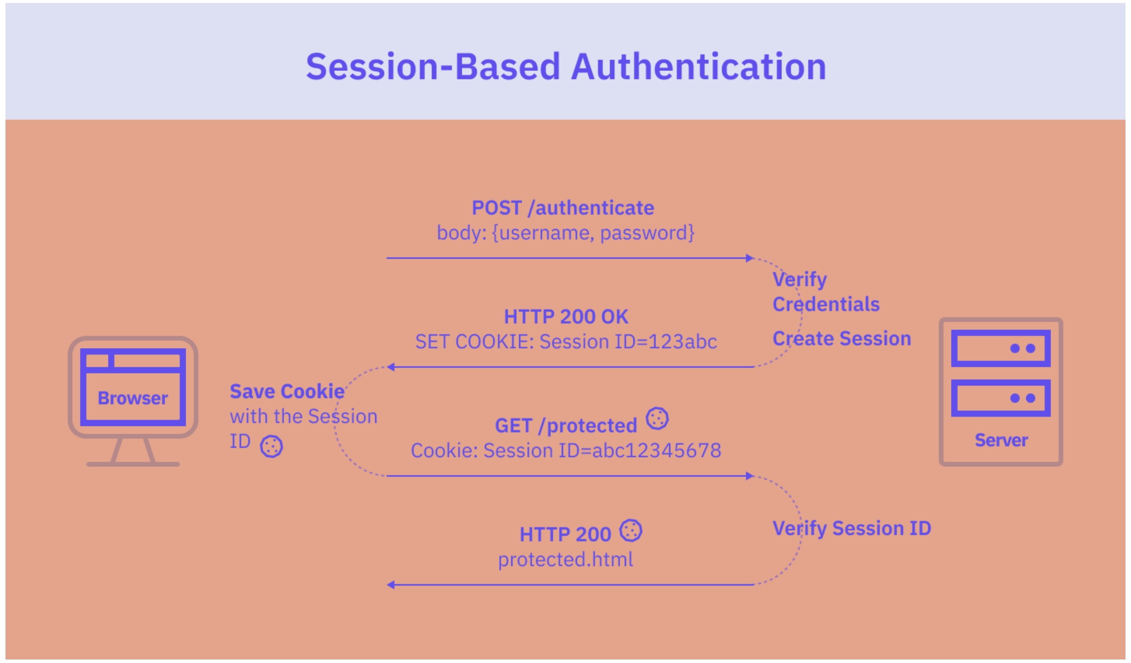
Session-Based Authentication

5. If the credentials are correct, the **server** generates a **session ID**

6. The session ID, along with some user information retrieved from the **database**, is stored in the server's session storage

7. The **server** sends back an **HTTP response** containing a **cookie** with the **session ID**

8. The **browser** receives the **cookie**, stores it automatically, and the **web application** handles the response (e.g., displaying a "Welcome!" message)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SET COOKIE: Session ID=123abc
Browser
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GET /protected
Cookie: Session ID=abc12345678
Server
HTTP 200
protected.html
Verify Session ID

https://www.criipto.com/blog/session-token-based-authentication

Sessions: Session ID

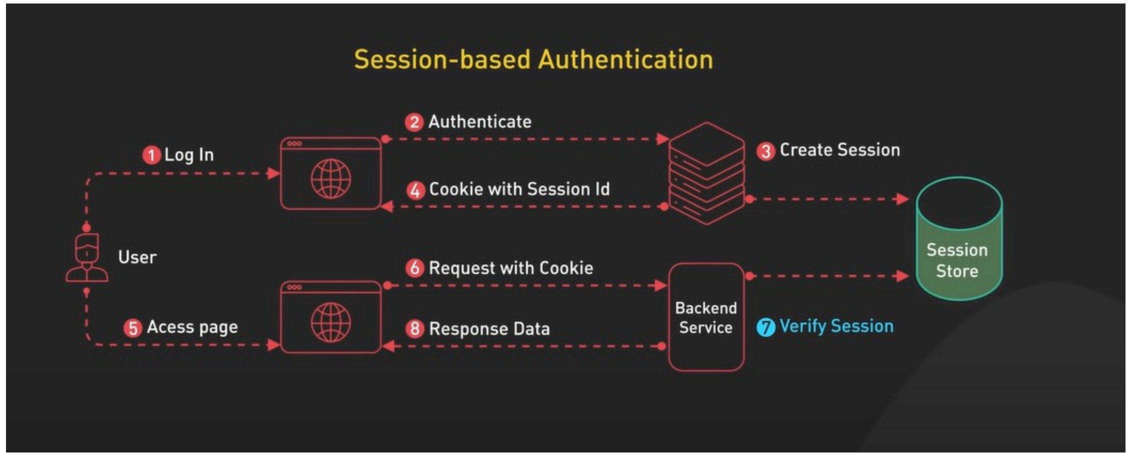
A **unique identifier assigned by the server** to maintain a session with the client

- It allows the server to **recognize the client** across multiple HTTP requests as authenticated

After authentication, the **server** sends a **session ID** to the **client**

The client sends the session ID back to the server with **every request** during the session

- Stored on the client side
- **Sent automatically** with each request, typically via **cookies** 🍪



https://levelup.gitconnected.com/understanding-web-authentication-session-based-authentication-vs-json-web-tokens-jwts-11871084f3ec

Sessions: Cookies 🍪

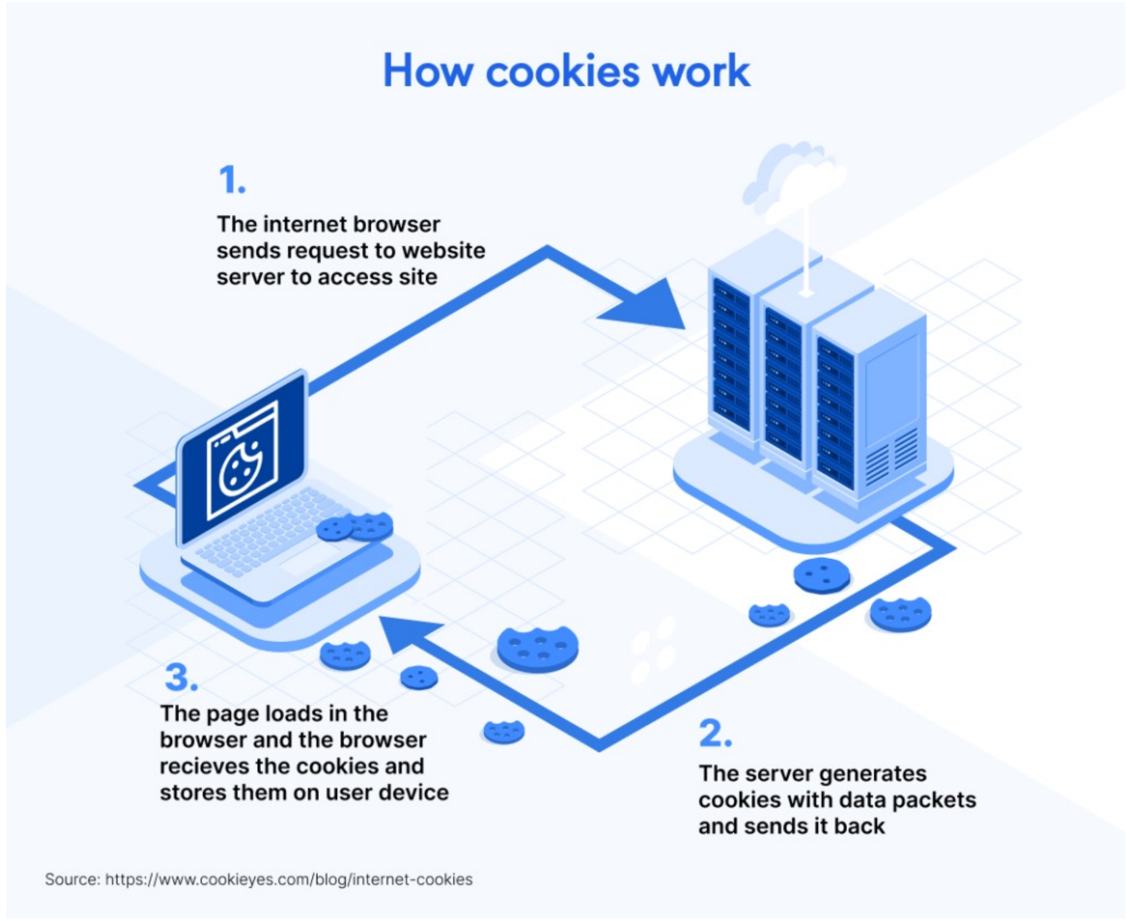
A **small piece of information** stored by the **browser** in its internal cookie storage

- It allows the browser to **retain information across different requests** and **sessions** (e.g., **session IDs**, preferences, tracking)

The browser **automatically saves** cookies received from the server

Cookies are **automatically sent** back to the server with every request to the same **domain** and matching **path**

⚠️ Sensitive information should never be stored in cookies!


How cookies work
1. The internet browser sends request to website server to access site
2. The server generates cookies with data packets and sends it back
3. The page loads in the browser and the browser recieves the cookies and stores them on user device
Source: https://www.cookieyes.com/blog/internet-cookies

Sessions: Session ID and Cookies 🍪

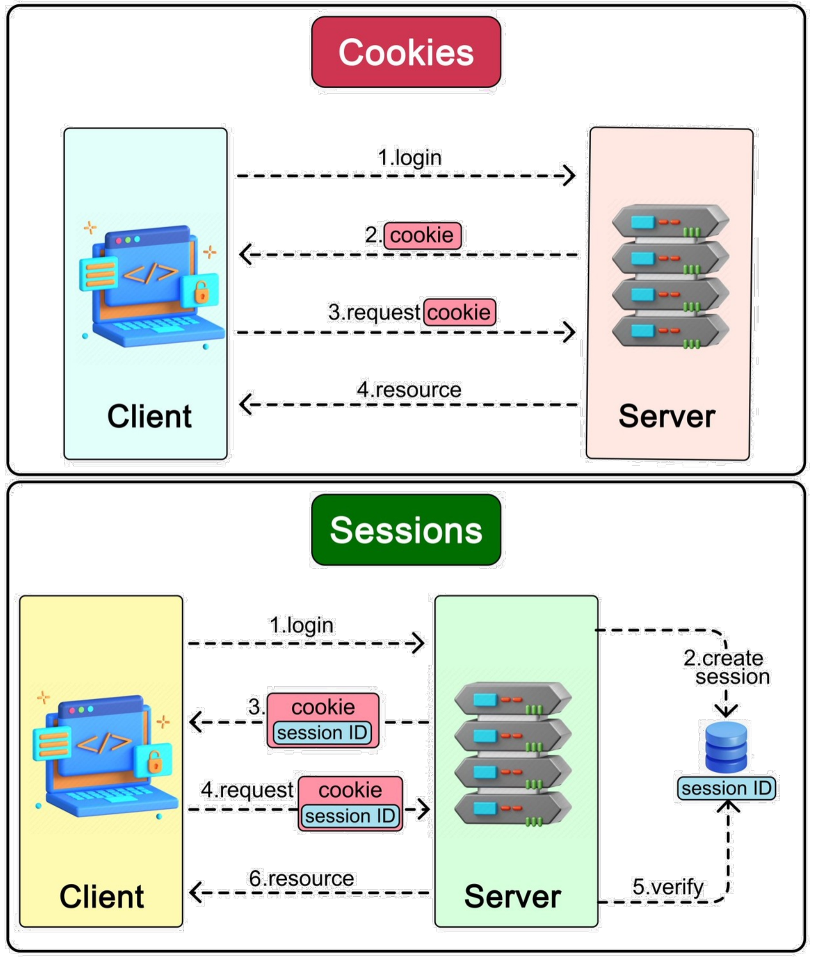
A **Session ID** is just a piece of data

- A **unique identifier** that the server uses to recognize a user across multiple HTTP requests

A **Cookie** is a storage mechanism in the **browser**

- A way to store small pieces of data like the Session ID

The Session ID is typically **stored inside** a cookie



https://blog.bytebytego.com/p/ep90-how-do-sql-joins-work

Sessions: Cookie attributes 🍪

`name` (mandatory): the name of the cookie

- Example: `SessionID`

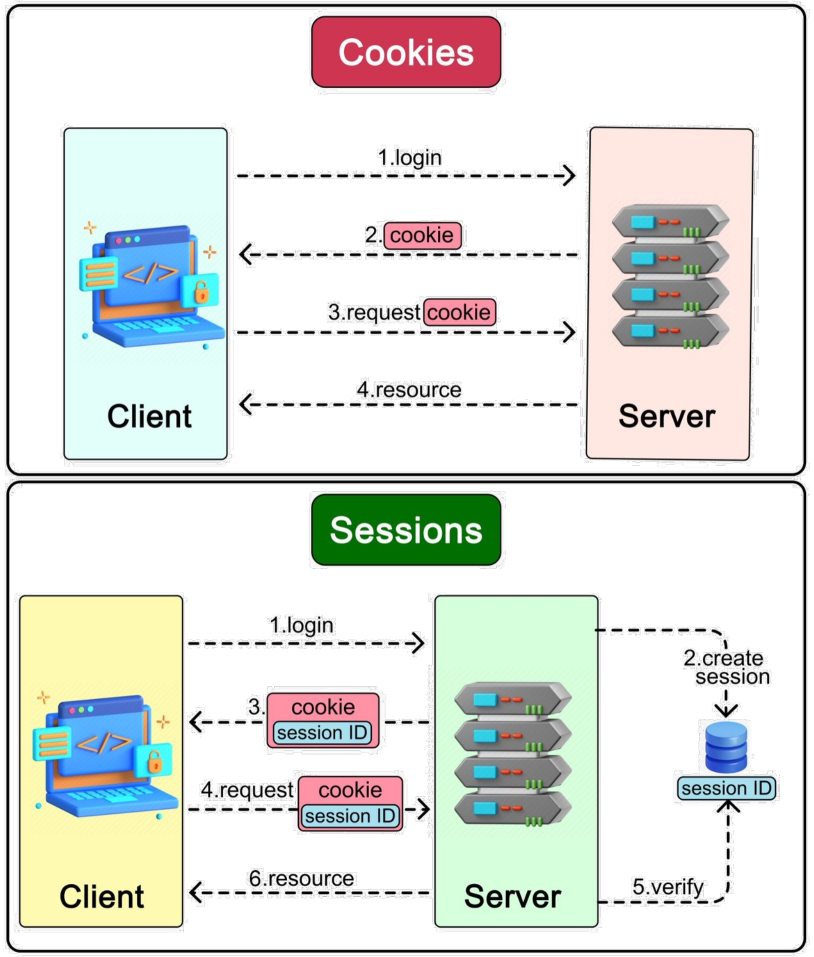
`value` (mandatory): the value stored in the cookie

- Example: `94$KKDEC3343KCQ1!`

`secure`: If set, the cookie is sent only over **HTTPS**

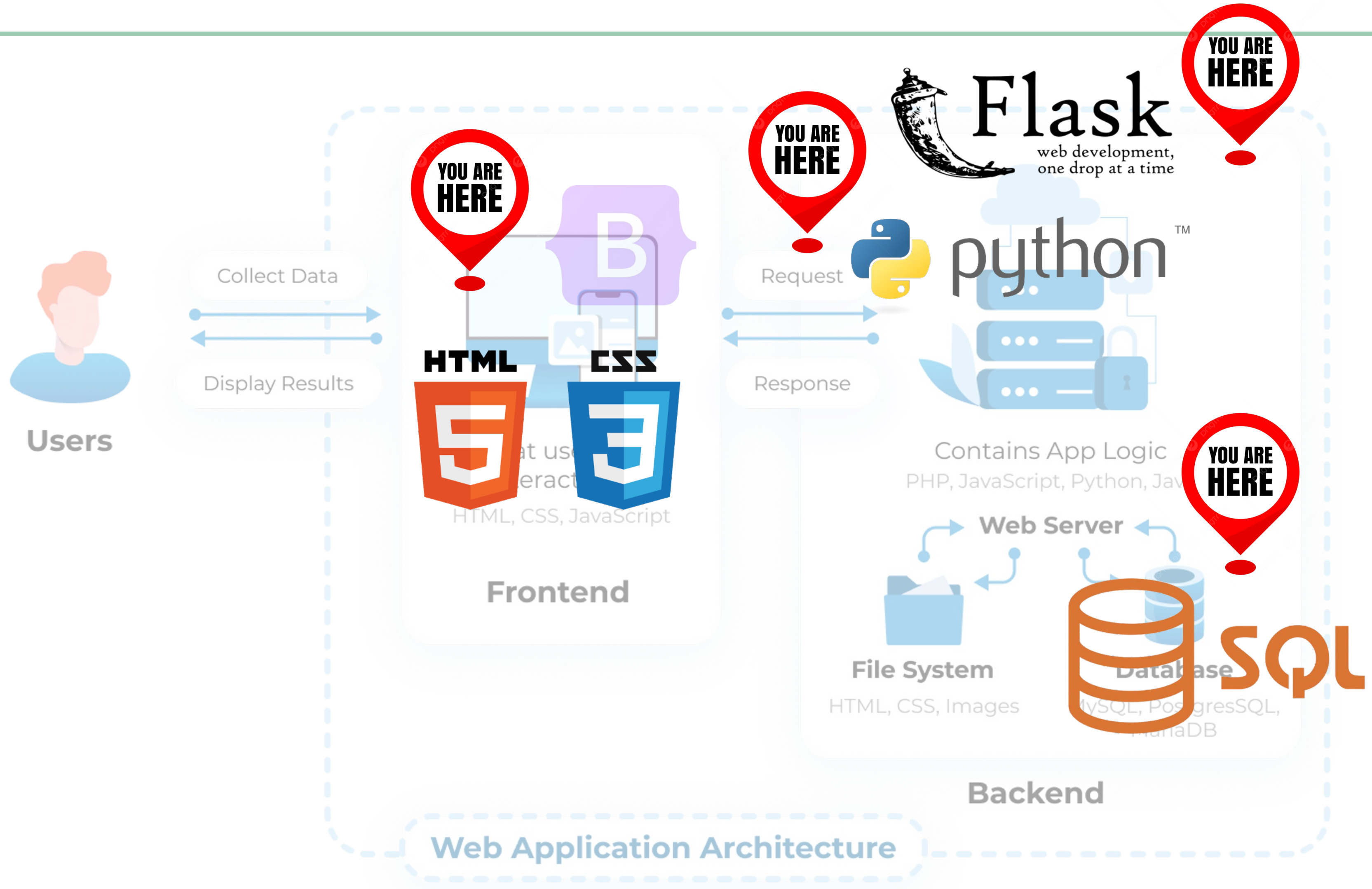
`httpOnly`: If set, the cookie cannot be accessed via **JavaScript**

`expiration date`: Specifies when the cookie should expire



`https://blog.bytebytego.com/p/ep90-how-do-sql-joins-work`

📍 Authentication: where are we?



Authentication and Authorization

Authentication: Verifies **who you are** (identity)

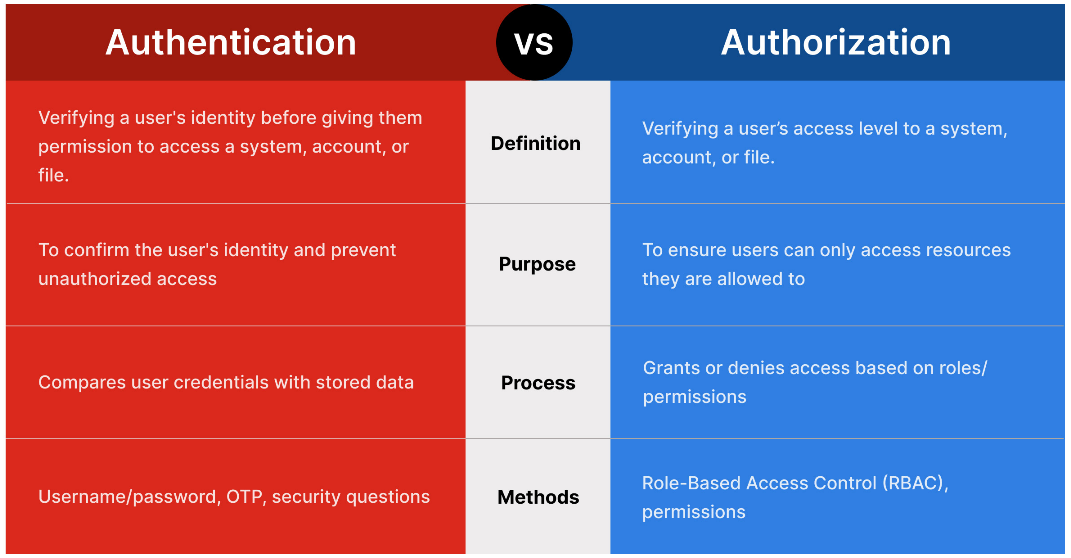
- Typically done using credentials (e.g., username and password)
- Enables a personalized user experience

Authorization: Determines **what you are allowed to access**

- Depends on the authenticated identity
- Grants permission to access resources, based on **roles**

👉 Used in conjunction to protect access to a system

Authentication vs authorization



Authentication	vs	Authorization
Verifying a user's identity before giving them permission to access a system, account, or file.	**Definition**	Verifying a user's access level to a system, account, or file.
To confirm the user's identity and prevent unauthorized access	**Purpose**	To ensure users can only access resources they are allowed to
Compares user credentials with stored data	**Process**	Grants or denies access based on roles/ permissions
Username/password, OTP, security questions	**Methods**	Role-Based Access Control (RBAC), permissions

Authentication and Authorization

Developing authentication and authorization mechanisms

- Is **complicated**, **time-consuming**, and **prone to errors**
- May require integration with **third-party systems** (e.g., Google, Facebook login)
- Involves both **client** and **server**
- Requires understanding several new concepts

💡 **Best Approach**: Follow best practices and standardized processes

Authentication in Flask

`Flask-Login` is an extension that manages user authentication and session handling in Flask applications

🔗 **`https://flask-login.readthedocs.io/en/latest/`**

Uses **sessions** to keep users logged in

Handles **login**, **logout**, and '**remember me**' functionality 🔑

Stores the active user’s ID in the **Flask session** 💾

Easily **log users in** and **out** 🚪

Restrict access to views based on login status 🚫

```
pip install flask-login
```

Flask-Login Setting Up

Flask-Login uses a **`LoginManager`**

- It defines **how to load a user** from an ID
- Where to **redirect** users when they need to **log in**

The **`SECRET_KEY`** is used to **sign session cookies**, making sure data sent by the client has not been modified

```
from flask import Flask
from flask_login import
LoginManager

app = Flask(__name__)
app.config["SECRET_KEY"] =
"arbitrary string"

login_manager = LoginManager()
login_manager.init_app(app)
```

Flask-Login Setting Up

We need to provide Flask-Login, at least, two things:

User model

- Represents what a user is in the app
- You decide what information to store for each user
- Can be based on any database system

`user_loader` callback

- Tells Flask-Login **how to load a user** from the session

Flask-Login: User model

The User model must implement the following properties for Flask-Login to work

- `is_authenticated`: Returns `True` if the user is logged in
- `is_active`: Returns `True` if the user's account is active (e.g., not suspended or deactivated)
- `is_anonymous`: Returns True if the user is not logged in
- `get_id()`: Returns a unique `str` identifier for the user (used by the `user_loader`)

Flask-Login: User model

`UserMixin` provides default implementations for the methods that Flask-Login requires

We can inherit from **`UserMixin`**

```python
from flask_login import UserMixin

class User(UserMixin):
  def __init__(self, id, name,
surname, email, password):
    self.id = id
    self.name = name
    self.surname = surname
    self.email = email
    self.password = password
```

Flask-Login: `user_loader`

We need to tell Flask-Login **how to load a user** from a Flask request and from its session

To do this, we define a **`user_loader`** callback

```
@login_manager.user_loader
def load_user(user_id):
  db_user = dao.get_user_by_id(user_id)
  user = User(id=db_user["id"],
    name=db_user["nome"],
    surname=db_user["cognome"],
    email=db_user["email"],
    password=db_user["password"],)
  return user
```

Flask-Login: `login_user()`

Logs a user in: we should pass the actual **User** object to this method

Returns **`True`** if the log in attempt succeeds, and **`False`** if it fails

```python
from flask_login import login_user

@app.route("/login", methods=["POST"])
def login():
  user_form = request.form.to_dict()

  (...)

  new = User(id=user_form["id"],
    name=user_form["nome"],
    surname=user_form["cognome"],
    email=user_form["email"],
    password=user_form["password"],)

  login_user(new)

  return redirect(url_for("profile"))
```

Flask-Login: `login_required`

Views that require users to be logged in can be decorated with the **`login_required`** decorator

```
from flask_login import login_required

(...)

@app.route("/profilo")
@login_required
def profile():
  return render_template("profile.html")
```

Flask-Login: `logout_user()`

Logs out a user: any **cookies** for the **session** will be cleaned up

```
from flask_login import logout_user

(...)

@app.route("/logout")
@login_required
def logout():
  logout_user()
  return redirect(url_for('home'))
```

Flask-Login: `current_user`

We can access the logged-in user with the **`current_user`** proxy, which is available in **every template**

```python
# app.py
from flask_login import current_user
# For instance, anywhere in the code:
post['id_utente'] = int(current_user.id)
```

```html
<!-- templates/home.html -->
{% if current_user.is_authenticated %}
  Hi {{ current_user.name }}!
{% endif %}
```

Let's see it in practice

Storing passwords in the Server

👉 **Never store plain text passwords** (e.g., in the database)

- Always **hash passwords** before storing them
- Hashing is a **one-way function**, ensuring passwords cannot be retrieved from their hash

`werkzeug.security` is a Python library that we can use

🔗 https://werkzeug.palletsprojects.com/en/stable/utils/

```
pip install werkzeug
```

```
from werkzeug.security import
generate_password_hash,
check_password_hash

(…)

new_user = {
"name": name,
"surname": surname,
"email": email,
"password":
generate_password_hash(password,
method='sha256’)
}
```

Let's see it in practice

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