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Course: Application security

Excercise: User registration process

The component for user registration and log in is made using flask for python and postgresql. The purpose of the component is to register new users into the database and validate them on log in. It requests users username and e-mail. The passwords are hashed and salted with bcrypt library.

Functional requirements

- FR1 Account creation by entering username, email and password.
- FR2 System should validate input formats and prevent duplicate emails and usernames.
- FR3 Activation token should be generated for every new user and sent via email.
- FR4 Account is activated after valid token is used, before that there is no access.
- FR5 User can request new activation token.
- FR6 User should be able to login using either username or email and password.
- FR7 Information is stored in a PostgreSQL database.

Nonfunctional requirements

- NFR1 Passwords should be hashed using bcrypt and stored as hashes.
- NFR2 Activation token should be generated using cryptographically secure random values.
- NFR3 Response time from the forms should be minimal.
- NFR4 Activation tokens expire after 24 hours.
- NFR5 Error message should not reveal sensitive information.
- NFR6 Emails and usernames should be unique, enforced by the database.

Implementation

```
@app.route("/register", methods=["POST"])
def register_post():
    username = request.form["username"]
    email = request.form["email"]
    password = request.form["password"]
    password_r = request.form["password_r"]

    if not re.match(email_pattern, email):
        return render_template("register.html", error="Invalid email format.")

    if re.match(username_pattern, username):

        conn = get_db_connection()
        cur = conn.cursor()

        cur.execute("SELECT * FROM users WHERE username = %s OR email = %s", (username, email))
        user = cur.fetchone()

        cur.close()
        conn.close()
    else:
        return render_template("register.html", error="Passwords must contain at least 1 upper case letter,"
                                                       "1 special character and be at least 8 characters long."
                                                       "Usernames can only contain letters, numbers and underscore.")
```

During registration we first check if email and username is valid, then, if it is, we check if username or e-mail is already taken.

```

if not user:
    if password == password_x:

        if re.match(password_pattern, password):

            hashed = hash_password(password)

            conn = get_db_connection()
            cur = conn.cursor()

            token, expiry = send_token(email)

            cur.execute(
                """INSERT INTO users (username, email, password_hash,
                    activation_token, activation_token_expiry) VALUES (%s, %s, %s, %s, %s)""",
                (username, email, hashed, token, expiry)
            )
            conn.commit()
            cur.close()
            conn.close()
            return "Register successful!"

    else:
        return render_template("register.html", error="Passwords must contain at least 1 upper case letter,"
                                                       "1 special character and be at least 8 characters long."
                                                       "Usernames can only contain letters, numbers and underscore.")

else:
    return render_template("register.html", error="Passwords are not matching.")

else:
    return render_template("register.html", error="Unable to create account. Try again with different data.")

```

If the username and e-mail are not taken we proceed. Password and repeated password must match. Finally if the password matches our regex for requirements the user is added to the database, but the account is not yet activated.

```

password_pattern = r'^(?=.*[A-Z])(?=.*[0-9])(?=.*[@#$%^&*(),.?":{}|<>]).{8,}$'
username_pattern = r'^[A-Za-z0-9_]{3,}$'
email_pattern = r'^[\w\.-]+@[^\w\.-]+\.\w+$'

```

Theese regexes define username, e-mail and password requirements.

```

@app.route("/activate")
def activate():
    token = request.args.get("token")

    conn = get_db_connection()
    cur = conn.cursor()

    cur.execute("""
        UPDATE users
        SET isActivated = TRUE, activation_token = NULL, activation_token_expiry = NULL
        WHERE activation_token = %s
        AND activation_token_expiry > NOW()
        RETURNING id
    """, (token,))

    result = cur.fetchone()
    conn.commit()
    cur.close()
    conn.close()

    return "Activation successful!" if result else "Invalid or expired token."

```

Users will get an e-mail with the activation link. If the link is clicked within the next 24 hours the account will be activated.

```
@app.route("/login", methods=["POST"])
def login_post():
    username = request.form["username"]
    password = request.form["password"]

    password_pattern = r'^(?=.*[A-Z])(?=.*[0-9])(?=.*[@#$%^&() . ? : {} | <>]).{8,}$'
    username_pattern = r'^[A-Za-z0-9_]{3,}$'

    if re.match(username_pattern, username) or re.match(email_pattern, username):
        conn = get_db_connection()
        cur = conn.cursor()

        cur.execute("""
            SELECT password_hash, isActivated, email, activation_token
            FROM users
            WHERE username = %s OR email = %s
        """, (username, username))
        user = cur.fetchone()

        cur.close()
        conn.close()
    else:
        return render_template("login.html", error="Invalid username or password")

    if user and check_password(password, user[0]):
        if not user[1]: # isActivated is FALSE
            return render_template("login.html",
                                  error="Please activate your account first.",
                                  resend_token=user[3],
                                  email=user[2])
        return "Login successful!"
    else:
        return render_template("login.html", error="Invalid username or password")
```

During log in procedure again we first check the validity of the username or e-mail before we insert it in a SQL queury. If the given password has the same hash as the hash stored in a database the password is correct. We also check if the account is activated.

Tech stack

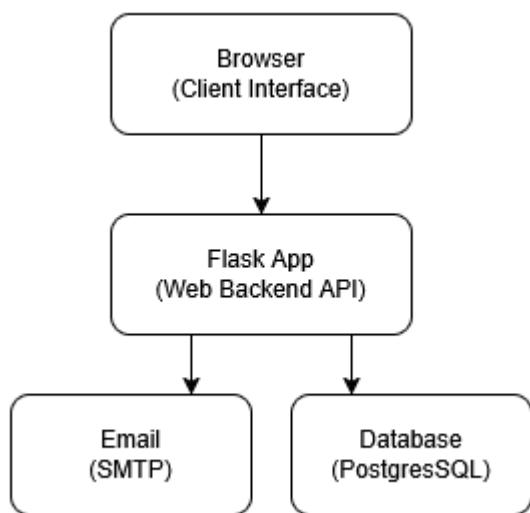
Frontend uses HTML5 and Jinja2 templates (form Flask).

Backend uses following Python libraries:

- Flask: used for routing, request handling, input validation, password hashing, token generation, sending emails, template rendering
- bcrypt: password hashing
- secrets: random token generation
- re: regex validation
- smtplib: email sending
- dotenv: storing sensitive passwords (e.g. email)

Database layer consists of PostgreSQL and psycopg2 which is used for communication with the database.

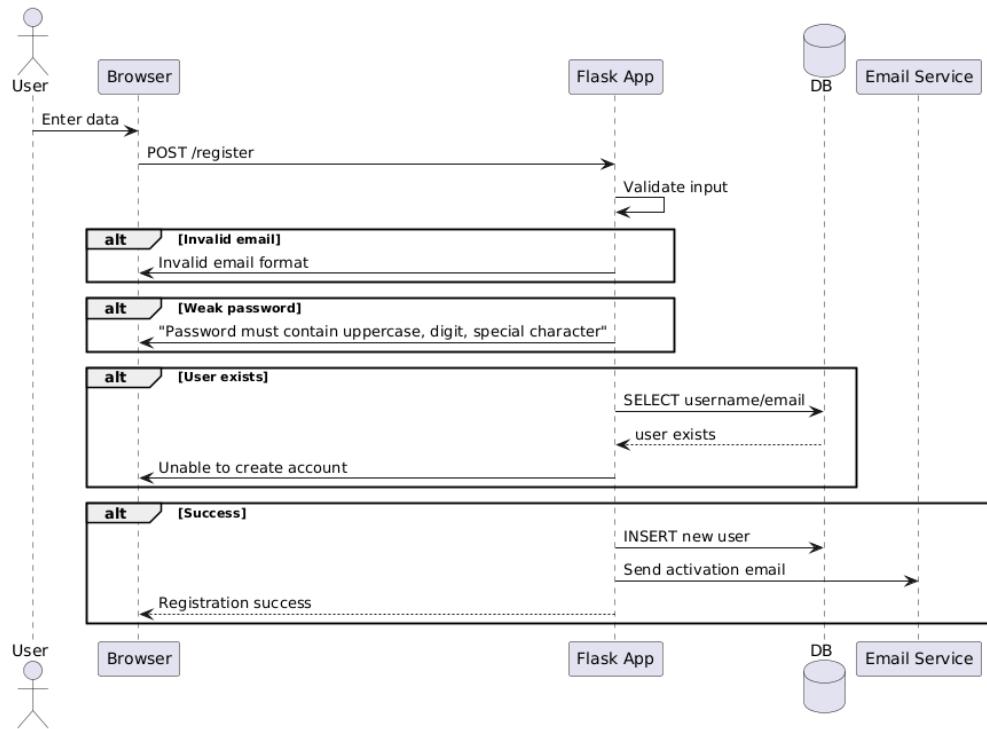
Architecture diagram



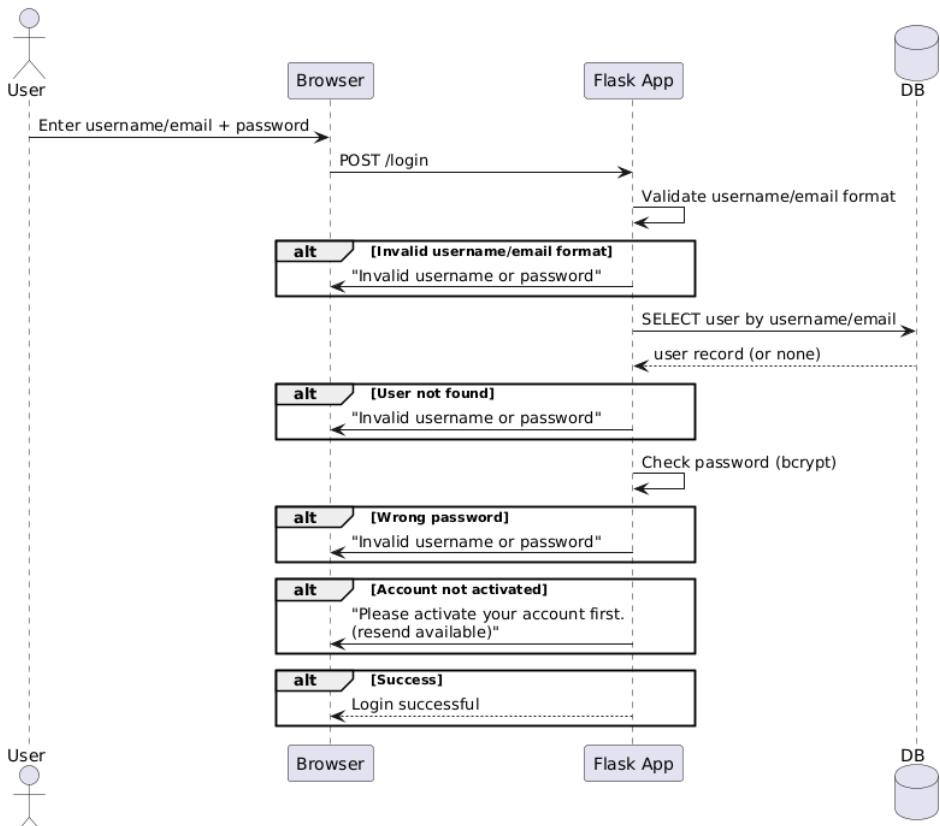
Database

Table	
PK	<u>id</u>
	username (UNIQUE, NOT NULL) email (UNIQUE, NOT NULL) password_hash (NOT NULL) is_activated (DEFAULT FALSE) activation_token activation_token_expiry created_at (DEFAULT NOW())

Registration flow



Login flow



Resend confirmation email flow

