Authentication Flaws

❌ Typical Flaws in Authentication

- Permits brute force or other automated attacks
- Permits default, weak, or well-known passwords
- Uses weak or ineffective credential recovery and forgot-password processes (e.g. "knowledge-based answers")
- Uses plain text, encrypted, or weakly hashed passwords
- Has missing or ineffective multi-factor authentication
- Exposes Session IDs in the URL
- Does not rotate Session IDs after successful login
- Does not properly invalidate Session IDs

Risk Rating

Broken Authentication

Exploitability	Prevalence	Detecability	Impact	Risk
🔴 Easy	🔶 Common	🔶 Average	🔴 Severe	A2
(3	+ 2	+ 2) / 3	* 3	= 7.0

Exercise 4.1 (📌)

1. Watch How To Keep Your Passwords Safe 📺
2. Log in with MC SafeSearch's user account (⭐⭐)

⚠️ *Do **not** use SQL Injection for authentication bypass!*

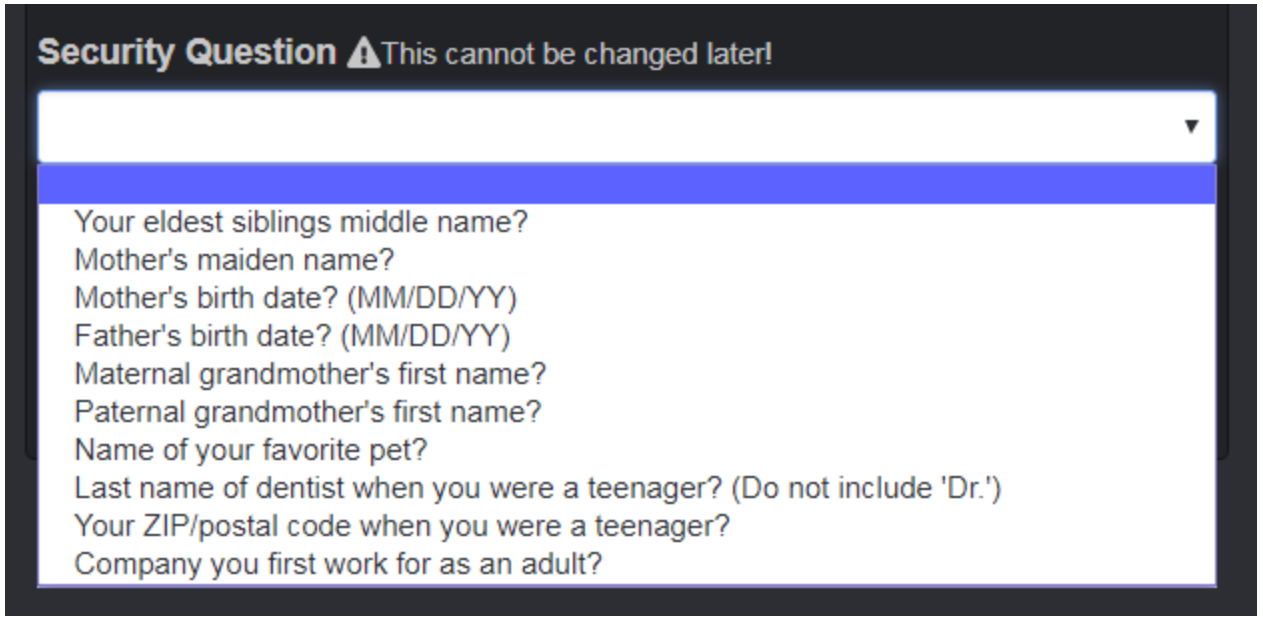
Exercise 4.2 (📌)

1. Identify all flaws in the generator of the following session IDs

#	Session ID	#	Session ID
1	h5kek4z9ha1rtrf	7	po953ld7hg2awi9
2	gj75l3k7hb15rtr	8	t6zhj2n5hh27bn0
3	l8l65k45hc1rw7i	9	iu345r53hi2aw34
4	p05jrj53hd1i039	10	o0z43411hj2njkl
5	5urltda1he1bn46	11	9por42o9hk3dfrz
6	j5le97h9hf2yq3h	...	...

Exercise 4.3 (📌)

1. Pick one Security Question and explain how 💪 it is against attacks.
2. What would you recommend to pick as an answer? Assume that the risk of compromise is full takeover of your user account.



Prevention

User IDs

- Use case insensitive and unique usernames/userids
- If using Email addresses as usernames, ensure RFC 5321 validity
    i. Check for presence of at least one `@` symbol in the address
    ii. Ensure the local-part is no longer than 64 octets
    iii. Ensure the domain is no longer than 255 octets
    iv. Ensure the address is deliverable

❌ *Do **not** try to invent your own RegEx to validate email addresses!*

Password Strength Controls

- **Enforce minimum password length** of at least 10 characters
- Maximum length should allow 64 characters or more
- **No periodic password resets** as users rely on predictable patterns
- Avoid password complexity rules as *all of them* are predictable
- Ban bad passwords or ones which have appeared in data breaches
  - e.g. Troy Hunt's 10GB+ list or Daniel Miesler's various lists
- Allow convenience features on password fields
  - Offer *Show Password while typing* option
  - Allow pasting from clipboard into password fields

Secure Password Recovery Mechanism

1. Gather Identity Data or Security Questions
2. Verify Security Questions
3. Lock account immediately
4. Send a Token Over a Side-Channel
5. Allow user to change password in the existing session
6. Logging

Secure Password Storage

- Do not limit character set and set long max lengths
- Use cryptographically strong credential-specific salt
- Impose infeasible verification on attacker
  - Aaptive one-way function (Argon2, PBKDF2, bcrypt or scrypt)
  - Keyed functions (e.g. HMAC)
- Design password storage assuming eventual compromise
- Upgrading your existing password hashing solution

Design for Failure

Having detected theft, a credential storage scheme must support continued operation by marking credential data as compromised:

1. Invalidate authentication shortcuts (e.g. login only with 2FA)
2. Disallow changes to security settings of user accounts
3. Load a new, stronger credential protection scheme
4. Set `tainted` / `compromised` bit until user resets credentials
5. Prompt for credential change & conduct out-of-band confirmation
6. Convert stored credentials to new scheme as user successfully log in

Other Authentication Controls

- **Transmit passwords only over TLS**
  - The "login landing page" must be served over TLS as well
- **Prevent Brute-Force Attacks** (e.g. throttling or periodic lockout)
- Require re-authentication for sensitive features
- **Offer optional 2FA / MFA**
  - Consider strong transaction authentication

Enterprise Controls

- Use centralized corporate authentication system (if in place)

Two-Factor Authentication

> Two-factor authentication adds a second level of authentication to an account log-in. When you have to enter only your username and one password, that's considered a single-factor authentication. 2FA requires the user to have two out of three types of credentials before being able to access an account. The three types are:
>
> - **Something you know**, such as a personal identification number (PIN), password or a pattern
> - **Something you have**, such as an ATM card, phone, or fob
> - **Something you are**, such as a biometric like a fingerprint or voice print [^1]

2FA Method Comparison

Method	Security	Privacy	Access	Prevalence
SMS	🔑	😎	🚪🚪🚪	🏧🏧🏧
Authenticator App	🔑🔑	😎😎😎	🚪	🏧🏧
Hardware Key	🔑🔑🔑	😎😎😎	🚪🚪	🏧

> Hardware keys win from a security perspective, they are private and unaffected by a dying or out of range phone. However, only a few services (Google, Dropbox, Facebook, Github and a few others) support the standard so far. Unless you trust your phone provider (and few providers are trustworthy), **an authenticator app is the best option**.

Password Managers

> Password managers are programs, browser plugins or web services that automate management of large number of different credentials, including memorizing and filling-in, generating random passwords on different sites etc. [^2]

		
Open Source (GPLv2)	Proprietary / Freemium	Proprietary
Local installation, optional file or cloud sync	Cloud-based	Local installation with Cloud sync

> Web applications should at least not make password managers job more difficult than necessary by observing the following recommendations:
>
> - use standard HTML forms for username and password input with appropriate `type` attributes,
> - do not artificially limit user passwords to a length "reasonable for humans" and allow passwords lengths up to 128 characters,
> - do not artificially prevent copy and paste on username and password fields,
> - avoid plugin-based login pages (Flash, Silverlight etc) [^1]

Exercise 4.4 (🏠)

1. Log in with the admin's user account (⭐⭐)
2. Reset Jim's password by answering his secret question (⭐⭐⭐)
3. Log in with Bjoern's user account (⭐⭐⭐⭐)

⚠️ *Do **not** use SQL Injection for authentication bypass!*

Exercise 4.5 (🏠)

Secure Quick Reliable Login (SQRL)

1. Read https://www.grc.com/sqrl/sqrl.htm and http://sqrl.pl/guide to learn how SQRL works
2. Prepare a convincing "sales pitch" (max. 5min) to convince your classmates and co-workers to use SQRL for secure authentication

Exercise 4.6 (*optional*)

1. Install a 2FA app on your phone (e.g. Google Authenticator or Authy)
2. Visit https://twofactorauth.org and find out what services you use offer 2FA
3. Turn 2FA on wherever possible
4. Do not forget to print (= 🖨️!) the backup codes and keep them safe

💡 *Pro tip: Print hard copies of the originally displayed QR codes for easy setup on any new phone! Just store them very securely!*