

Securing Applications and Data

AP Cybersecurity ■ Unit 5

AP Cybersecurity



Securing Applications and Data

What we will cover

- 1 Injection attacks
- 2 Data states & access control
- 3 Linux permissions
- 4 Symmetric cryptography
- 5 Asymmetric cryptography
- 6 Protecting & detecting

1 Injection

The biggest danger is unchecked user input

When a program does not check what a user types, an adversary can slip in commands – an **injection attack** 注入攻击. **Data validation** 数据验证 is the defence.

SQL injection 数据库注入
SQL commands
into an input field
log: OR 1=1 and --

Cross-site scripting 跨站脚本
script that runs in an-
other user's browser
log: <script> tags

Buffer overflow 缓冲区溢出
more data than the
buffer 缓冲区 holds
log: unusually long input

Directory traversal 目录遍历
../ to reach files
outside the folder
log: ../ sequences

Rate data risk by sensitivity: unencrypted military plans are high; customer data with a weak key moderate.

2 Access control

Data states, and the laws that follow them

At rest 静态数据
– stored on a drive

In transit 传输中数据 –
moving between devices

In use 使用中数据
– being processed



Enigma machine

Four access-control models – know the decider

RBAC 基于角色的访问控制
– your role decides

RuBAC 基于规则的访问控制
– a condition decides

DAC 自主访问控制 –
the file's owner decides

MAC 强制访问控制 –
a central admin decides

The **Bell-LaPadula** model summarises MAC as “write up, read down”.

Linux permissions – add 4 + 2 + 1

Each file has read (4), write (2) and execute (1) for three groups: the owner, the group, and others.

`chmod 750 = owner rwx (7),
group r-x (5), others nothing
(0).`

Example: `chmod 740 report.txt`

read = 4 write = 2 execute = 1



read/write/execute for owner, group, others

Worked example – setting a permission

Only the principal may read *and* edit; her staff group may read; no one else may touch it

owner read+write = 4 + 2 = 6
group read = 4
others nothing = 0

`chmod 640 file`

The listing then shows `-rw-r-----`.

To also let the owner run it as a program, add execute:
4 + 2 + 1 = 7, giving `chmod 740`.

Practise converting both ways –
number to letters, and letters to
number.

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Cryptography

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└ Cryptography

Symmetric encryption – one shared key

Cryptography 密码学 combines **plaintext** 明文 with a **key** 密钥 to make **ciphertext** 密文.

The **keyspace** 密钥空间 is the number of possible keys. An n -bit key has a keyspace of 2^n – bigger means longer to guess.

Symmetric 对称加密 uses the same key both ways. The standard is **AES** 高级加密标准, a **block cipher** 分组密码 on 128-bit blocks.

It secures Wi-Fi, browsing and stored files. The challenge: both sides need the **same secret key** – so how do you share it safely?

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Asymmetric encryption – the key pair

A **key pair** 密钥对: a **public key** 公钥 anyone may see, and a **private key** 私钥 kept secret. They are mathematical inverses – what one locks, only the other unlocks.

Encrypt with the recipient's public key; only their private key decrypts – so no secret was ever shared in advance.

RSA and **ECC** 椭圆曲线密码学 are the common algorithms. Compare key lengths only within the same algorithm – RSA 4096 is not comparable to AES 256.

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Protect & detect

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Protecting applications

Secure by design 安全设计
security in every phase of development, not an afterthought

Secure by default 默认安全
it ships with security already enabled – safe out of the box

Input sanitization 输入清理 is the single best answer for preventing injection attacks.

Control characters 控制字符 – the single quote, double quote and semicolon – can manipulate a system, so a good program removes or rejects them before processing. One defence covers SQL injection, XSS and traversal alike.

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Detecting attacks on data

Systems perform **accounting** 审计记录 – logging who accessed what, and when.

A **honeypot** 蜜罐 is a fake file that looks valuable. Nobody has a real reason to open it – so any access is a clear sign of an attack.

Re-hash and compare: if the digest changed, the file was altered.

Weigh cost against sensitivity: honeypots are cheap; a **DLP** 数据泄露防护 service is powerful but pricey.

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Recap

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└─ Recap

Unit 5 – key takeaways

1 Read the log

OR `1=1 = SQLi`; `<script> = XSS`; `../ = traversal`

2 The decider

RBAC role, RuBAC condition, DAC owner, MAC admin

3 chmod

add `4+2+1` per group – owner, group, others

4 Two cryptos

symmetric shares one key; asymmetric solves sharing

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└─ Recap

Check yourself

- 1 A log shows `../../etc/passwd`. Which attack?
- 2 Whose key do you encrypt with to send me a secret?
- 3 What is `chmod 640` in letters?
- 4 Why is any access to a honeypot suspicious?

Answers 1. directory traversal 2. my public key 3. `-rw-r-----` 4. nobody has a real reason to open it