# Security Quiz

- Connect to kahoot.it
  - Enter Pin: xxxx (will come when I start the quiz)
- FAQ
  - Questions appear on full screen
  - You press the answer (based on color, symbol) on your device
  - The faster you press the correct answer, the more points
  - Sometimes, several answers may be correct

- Good luck!

# UNIX security

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## Outline

- UNIX security ideas
- Users and groups
- File protection
- Setting temporary privileges
  - Permission bits
  - Program language components
- Examples

# UNIX security ideas

- Memory protection for processes
  - Processes have own virtual address space
  - Communication with hardware is done through the operating system
- Files are protected between users
  - The “everything is a file” concept implies that same mechanisms apply for all objects
- Maintenance is carried out by a “reliable” system administrator
  - Also known as root, or superuser

# Users and groups

- A user name is internally represented by a user identifier, or UID
  - Special user names are used for system functions, such as root, guest and apache
  - UNIX *id* command show UID
  - UIDs are stored in file */etc/passwd* with username, preferred shell
  - Your system privileges depends on UID
- Group id, or GID is used to identify *groups* of users
  - UNIX *groups <username>* shows the groups that <username> belongs to

# Users and groups (2)

- /etc/passwd file entry for user root:
  - root:AAencryptedpw:0:0:root:/root:/bin/bash
- Special user names
  - UNIX comes with special users for administrative purposes: the superuser, or root.
    - As root you can log users out and in, shutdown the computer, start and run network services, run all programs, view all files for all users
    - As root: ***most security restrictions are bypassed*.**
    - “Hacking root” provides an attacker with unrestricted privileges to a system…**BAD!**

# Users and groups (3)

- Sometimes a user need to perform actions as *another* user
  - UNIX *su* command (substitute user / switch user)
    - User enter username and *password* for account. User ***becomes*** the other user until log out
  - UNIX *sudo* command
    - Run a ***single*** command usually limited for root (perm. in sudoers file)
    - Users enter their own password (typically) and the access is logged.
  - Executable files with SUID bit set
    - Operating system lets user perform the desired operation with the privileges of the ***owner*** of the object. When execution finished, user assumes ordinary privileges.
  - Using the setuid() function call

# Users and groups (4)

- Real and effective UIDs
  - Each user has at any given point in time two (sometimes three) different UIDs
  - Real UID, or RUID is assigned to user when logging in. Used to identify unique user and *remain unchanged*
  - Effective UID, or EUID is initially same as RUID, but changes to *owner* of file during execution of files with the SUID flag set (SUID files).
    EUID changes back to RUID after execution

## File Protection

- UNIX file system controls which users can access what items and how
- Simply put: *Everything visible to a user can be represented as a “file”*
  - Each “file” has at least one name, an owner and access rights
  - Running UNIX ***ls*** command reveals information about files and directories

## File Protection (2): Example

```
>>ls –l /home/ulf/example.txt
```

```
-rw-r--r– 1 ulf ulfgrp 1024 Sep 1 11:00 example.txt
```

| | |
|---|---|
| - | file type |
| rw-r--r-- | file permissions (owner, group, other) |
| 1 | # names of the file |
| ulf | owner |
| ulfgrp | group |
| 1024 | file size |
| Sep 1 11:00 | modification date and time |
| example.txt | name |

## File Protection (3)

- File permissions indicate ***who*** that can do ***what*** on a specified object.
- 9 characters grouped in 3 *classes* and 3 *kinds* of permissions
- Classes:

| | | |
|---|---|---|
| Owner | = | The file’s owner |
| Group | = | Users in the file’s group |
| Other | = | Everybody else (except the superuser) |

- Kinds:

| | | |
|---|---|---|
| r | = | Class has *read* access to file, |
| w | = | Class has *write* access to file, |
| x | = | Class has *execute* access to file |

## File Protection (4)

- Example:
  - Who can access file a.txt, and in what way:

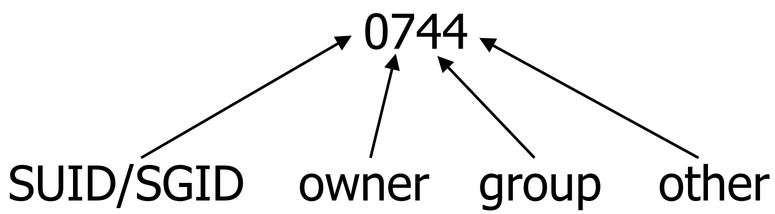
```
- rwx r-- --- usrOne grpTwo a.txt
```

Answer:
usrOne has read, write and execute access to a.txt
grpTwo has read access to a.txt
other has *no* access to a.txt

(superuser has full access to a.txt)

# File Protection (5)

- UNIX ***chmod*** command is used to change file access permissions – 2 different modes
  - Octal file permissions
    - Four octal numbers are used as follows:



When calculating: r adds 4, w adds 2 and x adds 1 to total.

Example: What is the result (in octal) of setting r,w,x for owner, r for group and r for other for non SUID file?

# File Protection (6)

- Combining kinds r, w and x and s with ‘+’, ‘=‘ and ‘-’ and classes u, g and o
  - To add write permissions for group: g+w
  - To remove read permissions for other: o-r
  - To set read access for user: u=r

- Example:

  Assuming file.txt has permissions 0744, the following two operations achieve the same result
  - >> chmod 0764 file.txt
  - >> chmod g+w file.txt

## Setting temporary permissions: SUID program

- A **SUID program** is a program for which the “s” bit is set
- Used to grant temporary privileges during execution to unprivileged user
  - Example: change the /etc/passwd file
  - What programs are SUID on your system, run

    ```
    find / -perm -4000 -print
    ```
- There are two main methods for changing the s flag through the use of permission bits and chmod
  - SUID bits in file permission.
    - SUID = chmod 4755 file.txt, or chmod u+s file
  - Result: rw**s** r-x r-x

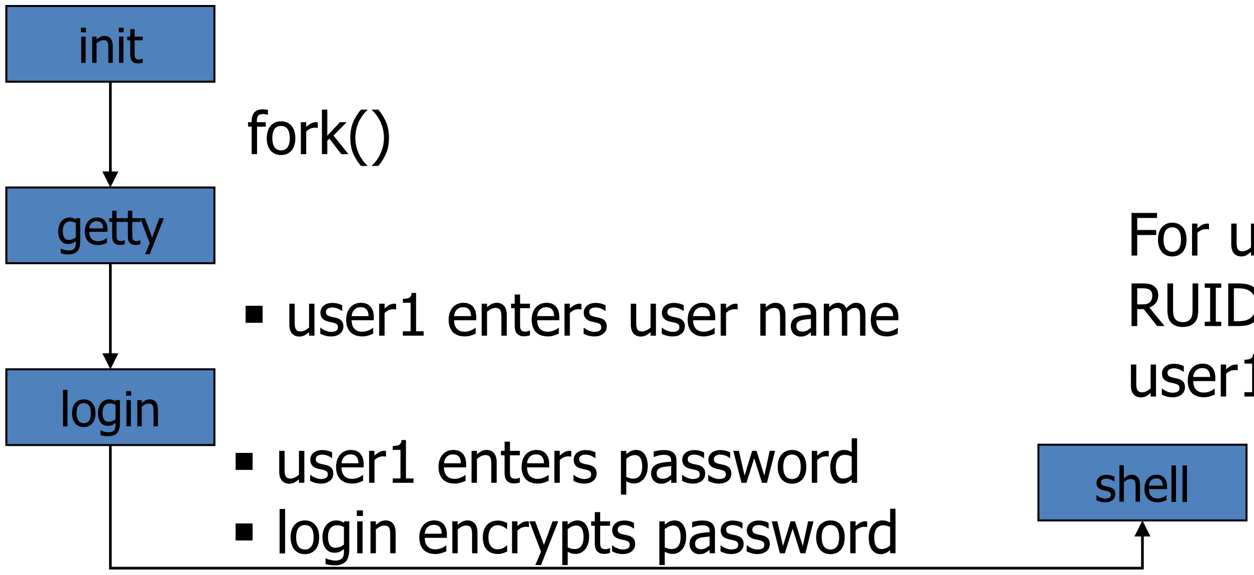
## Setting temporary permissions: SUID example

- Impact on RUID and EUID from the use of SUID
  - Repeat slide “Users and Groups (4)”
  - During execution of a SUID file, EUID changes to that of the *owner* of the SUID file. The RUID does **not** change.

# Setting temporary permissions: `setuid fcn call`

- The setuid() function call
    - >>man setuid (for help – used in Lab 1)
    - Changes the UID of the user to that of the argument of the function call
    - Non-root users can only setuid to their own UID.
    - If the caller of the setuid() function is non-root, then EUID is changed.
    - If the caller of the setuid() function is root, then RUID and EUID is changed. This is used by root to ***downgrade*** privileges for a user after the user has logged in.

# Example: UNIX login



For login proc:
RUID=EUID=0

- user1 enters user name
- user1 enters password
- login encrypts password
- compare the encrypted password with that of user1's row in /etc/passwd
- the UID and the preferred shell found
- privilege downgrade via setuid(user1 UID)

For user1 shell:
RUID=EUID=
user1 UID

# Summarizing example 1

- Example 1
  - User Alice logs in to run the SUID file /home/ulf/becomeMe.exe owned by ulf (UID 12345)

```
>>ls –l becomeMe.exe
 rwsr-xr-x ulf ce becomeMe.exe
```

If user Alice has UID=22448, what are the RUID and EUID before, during and after execution of the file `becomeMe.exe`?

## Summarizing example (2)

- Example 2
  - User Alice logs in to run the file `/home/ulf/dontbecomeMe.exe` owned by ulf (UID 12345)

```
>>ls -l dontbecomeMe.exe
rwxr-xr-x ulf ce dontbecomeMe.exe
```

If Alice has the UID 22448, what are the RUID and EUID before, during and after execution of file `dontbecomeMe.exe`?

## Solutions to examples

- Example 1
  - Before RUID=EUID=22448
  - During RUID=22448, EUID=12345
  - After RUID=EUID=22448
- Example 2
  - Before RUID=EUID=22448
  - During RUID=EUID=22448
  - After RUID=EUID=22448