Khóa học : “Basic Embedded Linux”

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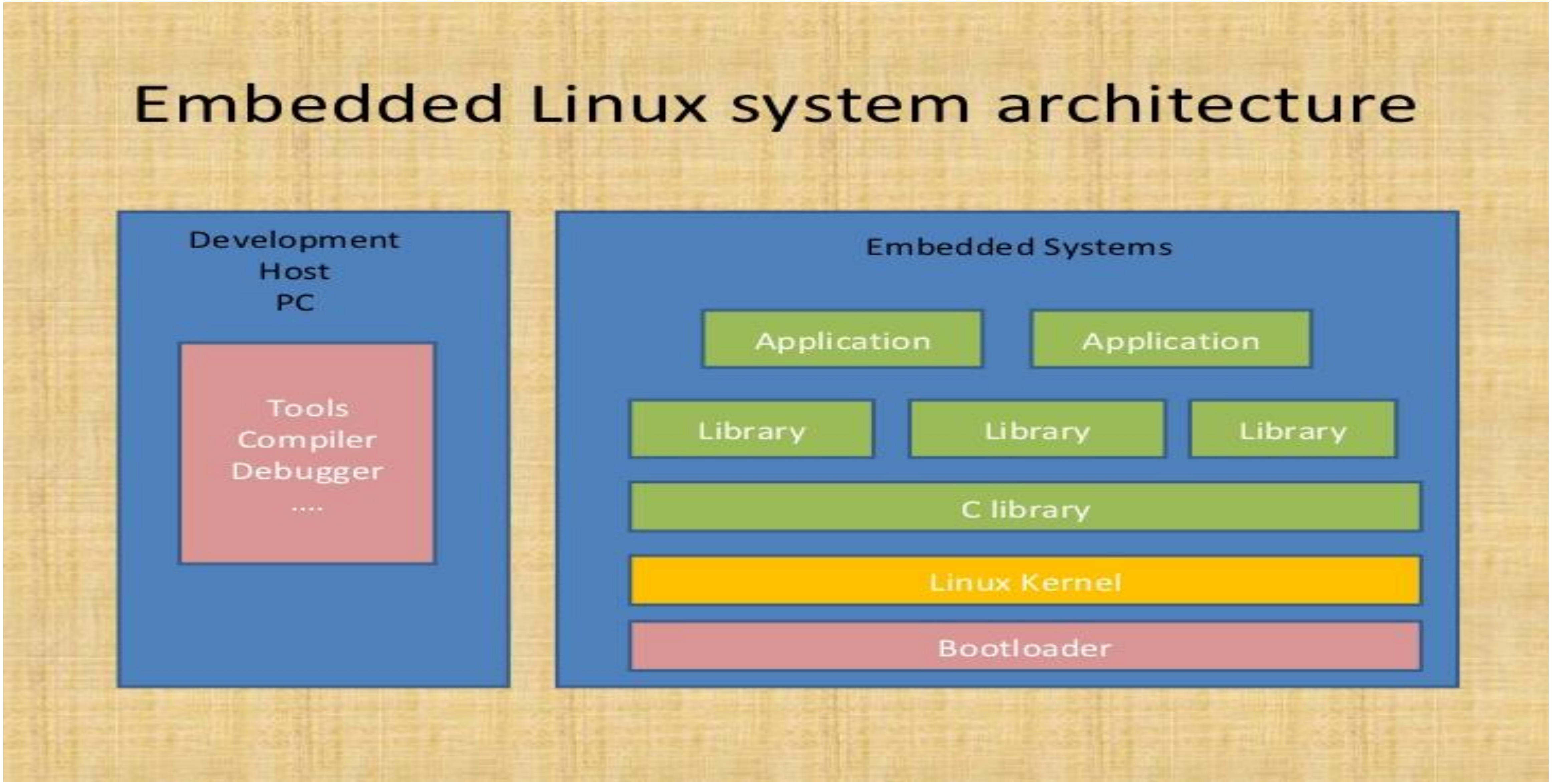
Linux Knowledge Base



Embedded Linux system architecture

Development Host PC

- Tools
- Compiler
- Debugger
- ….

Embedded Systems

Application	Application	
Library	Library	Library

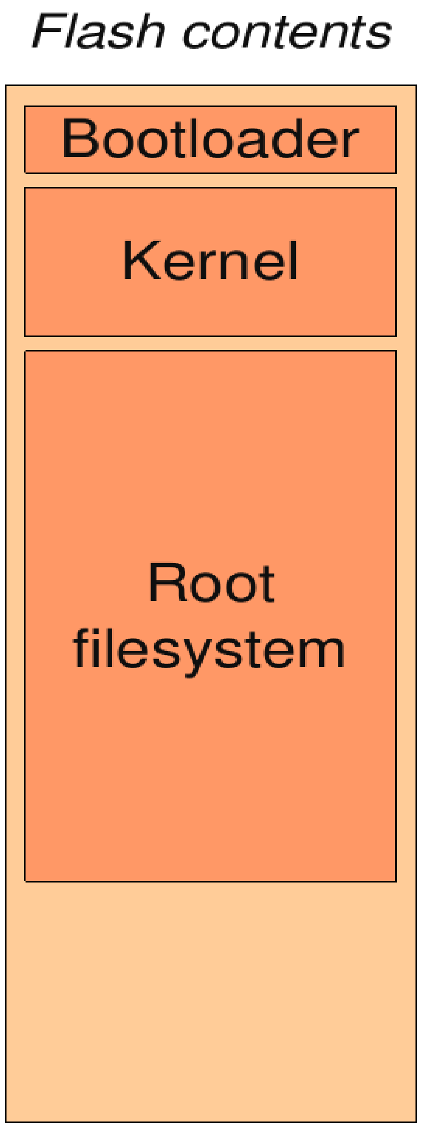
- C library
- Linux Kernel
- Bootloader

Software Components

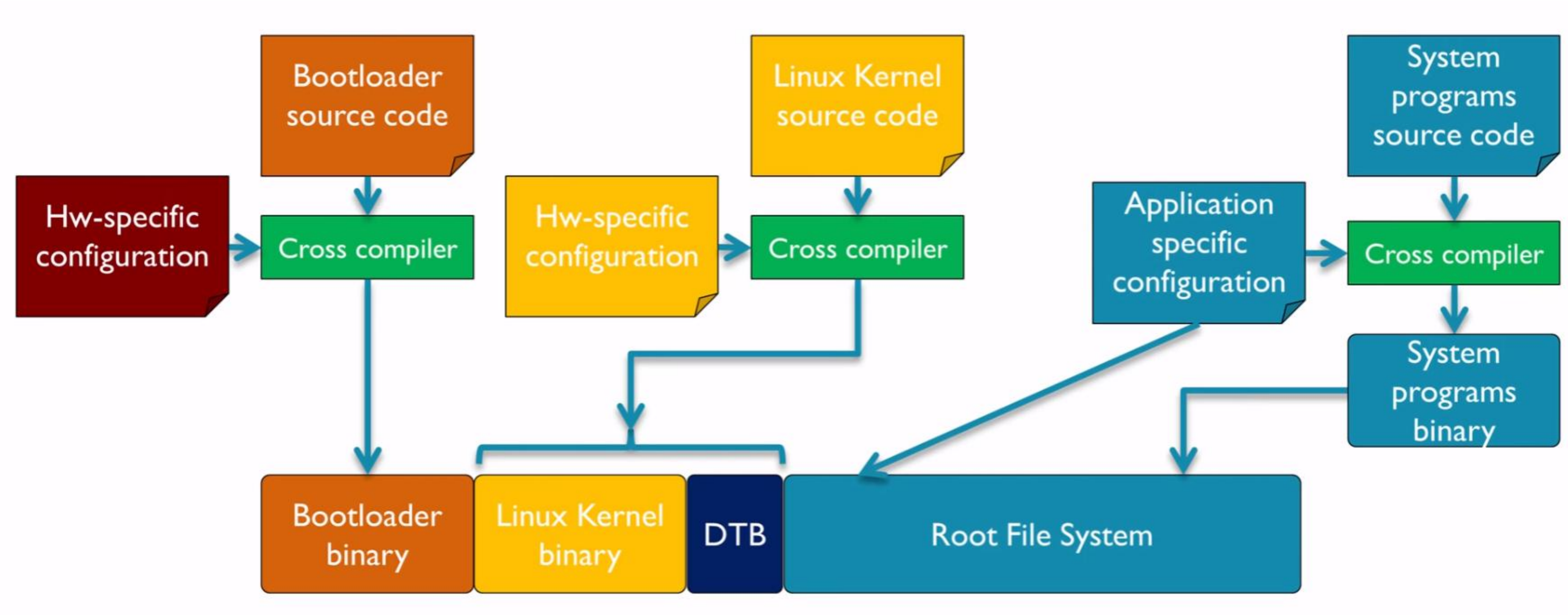
- **Cross compilation toolchain**
  - Compiler that runs on the development machine, but generates code for the target
- **Bootloader**
  - Started by the hardware, responsible for basic initialization, loading and executing the kernel
- **Linux Kernel**
  - Contains the process and memory management, network stack, device drivers and provides services to userspace applications
- **C library**
  - The interface between the kernel and the userspace applications
- **Libraries and applications**
  - Thirdparty or inhouse

Root filesystem

- In a Linux system, several filesystems are mounted and create a global hierarchy of files and directories
- A particular filesystem, the root filesystem, is mounted as /
- On embedded systems, this root filesystem contains all the libraries, applications and data of the system
- Therefore, building the root filesystem is one of the main tasks of integrating embedded Linux components into a device
- The kernel is usually kept separate

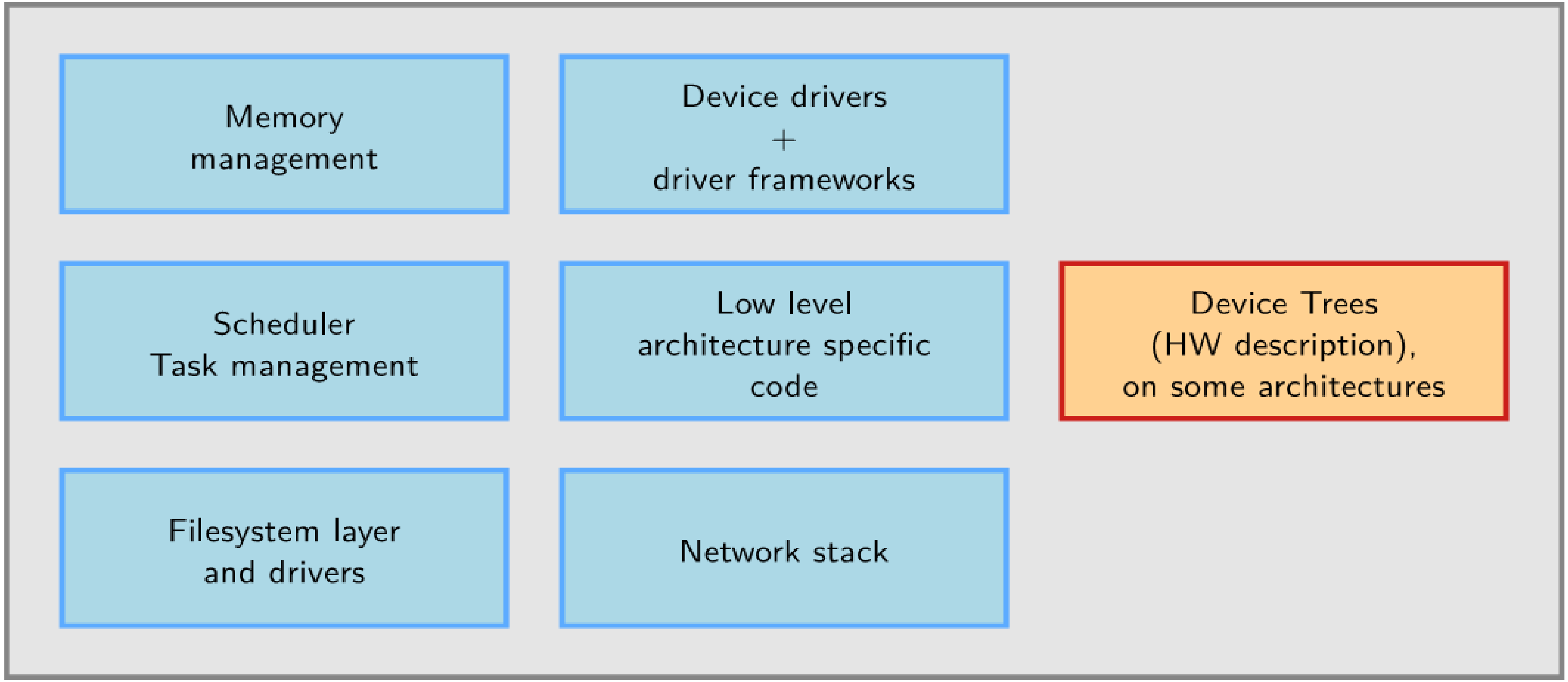


Embedded Linux architecture



Inside Linux kernel

Linux Kernel



Memory management

Device drivers + driver frameworks

Scheduler Task management

Low level architecture specific code

Device Trees (HW description), on some architectures

Filesystem layer and drivers

Network stack

🟦 Implemented mainly in C, a little bit of assembly.

🟧 Written in a Device Tree specific language.

Linux kernel source

- The kernel sources are available from *http://kernel.org/pub/linux/kernel* as full tarballs (complete kernel sources) and patches (differences between two kernel versions).
- However, more and more people use the git version control system. Absolutely needed for kernel development!
  - Fetch the entire kernel sources and history

    git clone git://git.kernel.org/pub/scm/linux/kernel/git/torvalds/linux.git
  - Create a branch that starts at a specific stable version

    git checkout -b <name-of-branch> v3.11
  - Web interface available at http://git.kernel.org/cgit/linux/kernel/git/torvalds/linux.git/tree/.
  - Read more about Git at http://git-scm.com/

Linux kernel size

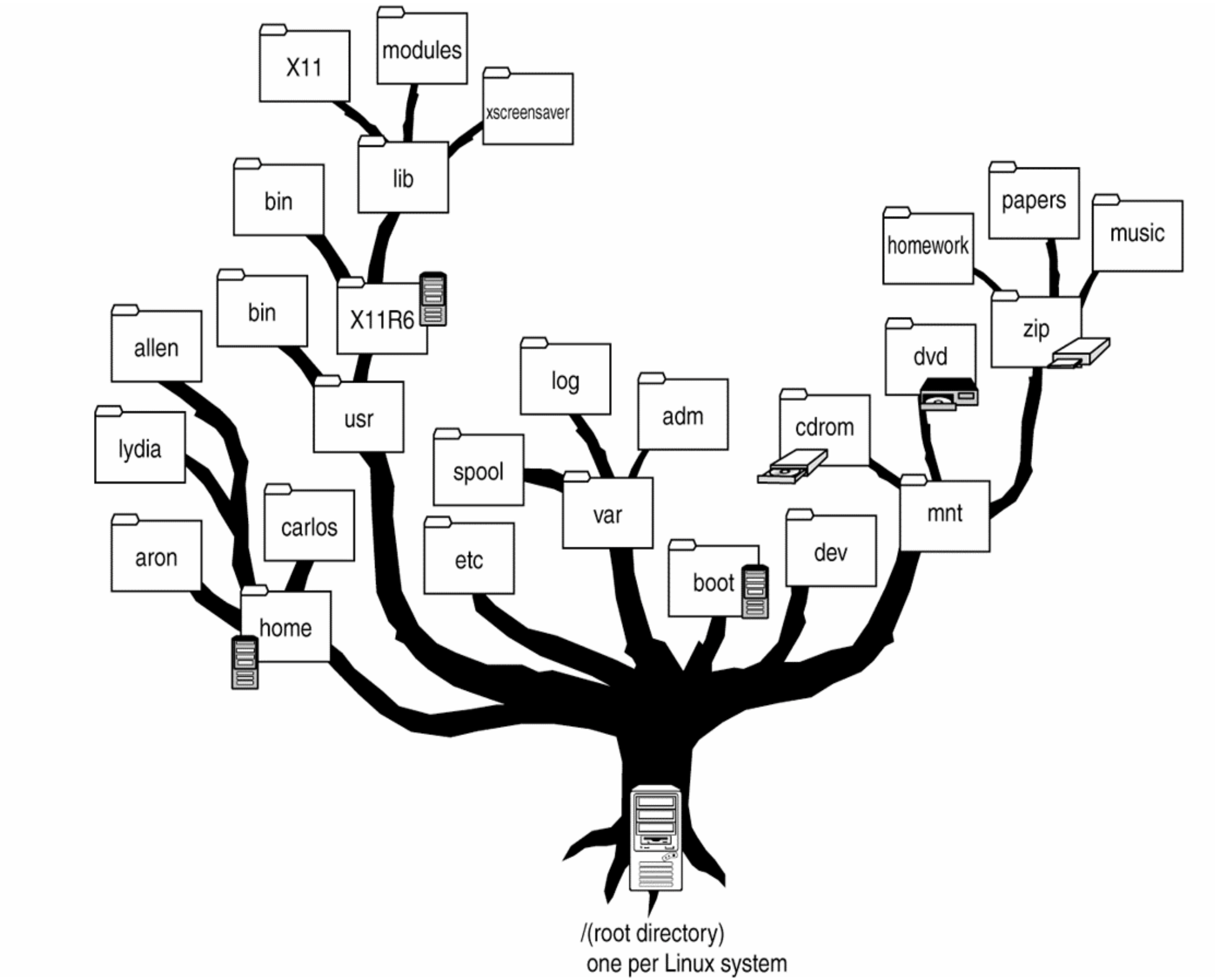
As of kernel version 3.10.

- `drivers/`: 49.4%
- `arch/`: 21.9%
- `fs/`: 6.0%
- `include/`: 4.7%
- `sound/`: 4.4%
- `Documentation/`: 4.0%
- `net/`: 3.9%
- `firmware/`: 1.0%
- `kernel/`: 1.0%
- `tools/`: 0.9%
- `scripts/`: 0.5%
- `mm/`: 0.5%
- `crypto/`: 0.4%
- `security/`: 0.4%
- `lib/`: 0.4%
- `block/`: 0.2%
- ...

Linux Directory Structure

- Linux Directory Structure is organized like a tree Structure with root on the top
- All Directories and Files are stored under root directory (/)
- Root is the the first directory mounted by the kernel
- The scripts and programs contained in the files stored under root are responsible for starting up the reminder of the system
- Kernel Image is stored under root directory
- If any one gain access to root directory will become super user to access the complete file system

Linux Directory Structure



Linux Directory Structure

/ This is the root of all the directories in the system. This is the top of the directory tree.

/bin/ This is the location of most of the basic commands, these are available to all system users.

/boot/ This is the location of the kernel images and configuration files, when the system boots, it finds the core of the system in here.

/dev/ This directory holds the files that represent all the hardware devices on the system.

/etc/ This directory contains the configuration files forthe system, things such as network configuration, user profiles, and what happens when a user logs in are all controlled in this directory.

/root/ This is the user directory for the user named ‘root’.

/home/ Each user gets a personal directory on the system; this is the location for all the directories for the users.

/lib/ Collections of libraries for applications are typically stored in here.

/lost+found/ When the system tries to recover corrupt files, they will be stored in here.

Linux Directory Structure

/mnt/ Other file systems from external sources are located in here when they are ‘mounted’ on the system.

/media/ same as mnt. Available only in 2.6.xy and above

/opt/ In this directory, tools installed by a system administrator that weren’t part of the original distribution can be found.

/proc/ System information can be found in this directory. Examples include which modules have been loaded into the kernel, and detailed information about the CPU.

/sbin/ Similar to the /bin/ directory, this directory includes programs and tools. These tools however, are typically only available to the administrator or ‘root’ user.

/sys/ System device controls can be found in here.

/tmp/ This is where temporary files are stored on the system.

/usr/ The tools found in here are the non-essential ones.The essential ones can be found in /bin or /sbin

/usr/local/ This is another location for installation of tools that weren’t part of the initial distribution, instead of /opt/.

/var/ This directory contains data such as system logs, mail and printer spool directories.

File Permissions

- There are three levels of file permissions for each group
- Linux provides three groups of users on files
  - User (Owner)
  - Group
  - Others
- Each group of users will have three types of file access permissions
  - Read (r)
  - Write (w)
  - Execute (x)

File Permissions

- The access permissions are indicated as follows:
  - -rwxrwxrwx file1
  - -rwx --x –x file2
  - drwxrw-rw- file3
  - crwxrwxrwx cdr1
  - brw-rw-rwx bx1
    - General format:

      Filetype User group others

      - - -   - - -   - - -
    - Ex: d rwx r - - r - -- r – x - - x - - x
    - The first bit indicates the file type

File Permissions

- Specifying the corresponding bit in the file permission:
- Ex:
  - chmod u+x file
  - chmod g+r file
  - chmod u+rw file
  - chmod ug+rx file
  - chmod ugo-rw file
  - chmod ugo+x file

File Permissions

Specifying the octal number

- Permissions for each group can be represented as octal number
- If bit is set to 1- the corresponding permission is granted
- If bit is set to 0 – the corresponding permission is not granted
- EX:
  - chmod 444 file – Grant all group read permissions only
  - chmod 777 file – Grant all group all three permissions
  - chmod 711 file – Grant user all three permissions, group and others only with execute permission

File Permissions

Conclusion

- Linux is a powerful open source operating system
- Linux is a multi-user system
- the super user is named ‘root’
- Everything in Linux is a file
- Linux has a kernel and the user interacts with a shell
- Every character except a ‘/’ is a legal filename character
- A user has a home directory where he/she is the owner of the files within that directory

Questions?