CSGE602055 Operating Systems
CSF2600505 Sistem Operasi
Week 09: Storage, BIOS, Loader, & Systemd

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https://os.vlsm.org/
Always check for the latest revision!

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Operating Systems 2018-2 (Room 3114)
R/M (Tu/Th 13-15) | I (Tu/Th 15-17)

Week	Schedule	Topic	OSC10
Week 00	04 Sep - 12 Sep 2018	Overview 1, Virtualization & Scripting	Ch. 1, 2, 18.
Week 01	13 Sep - 19 Sep 2018	Overview 2, Virtualization & Scripting	Ch. 1, 2, 18.
Week 02	20 Sep - 26 Sep 2018	Security, Protection, Privacy,	Ch. 16, 17
		& C-language	
Week 03	27 Sep - 03 Oct 2018	File System & FUSE	Ch. 13, 14, 15
Week 04	04 Oct - 10 Oct 2018	Addressing, Shared Lib, & Pointer	Ch. 9
Week 05	11 Oct - 17 Oct 2018	Virtual Memory	Ch. 10
Reserved	18 Oct - 19 Oct 2018		
Mid-Term	24 Oct 2018	MidTerm (UTS): 09:00 - 11:30	
Week 06	30 Oct - 05 Nov 2018	Concurrency: Processes & Threads	Ch. 3, 4
Week 07	06 Nov - 12 Nov 2018	Synchronization & Deadlock	Ch. 6, 7, 8
Week 08	13 Nov - 21 Nov 2018	Scheduling	Ch. 5
Week 09	22 Nov - 28 Nov 2018	Storage, BIOS, Loader, & Systemd	Ch. 11
Week 10	29 Nov - 05 Dec 2018	I/O & Programming	Ch. 12
Reserved	06 Dec - 14 Dec 2018		
Final	19 Dec 2018	Final (UAS): 09:00 - 11:00	This schedule is
Extra	12 Jan 2019	Extra assignment	subject to change.

The Weekly Check List

- ☐ **Resources**: `https://os.vlsm.org/`
    - ☐ **(THIS) Slides** — `https://github.com/UI-FASILKOM-OS/SistemOperasi/tree/master/pdf/`
    - ☐ **Demos** — `https://github.com/UI-FASILKOM-OS/SistemOperasi/tree/master/demos/`
    - ☐ **Extra** — `BADAK.cs.ui.ac.id:///extra/`
    - ☐ **Problems** — `rms46.vlsm.org/2/195.pdf, 196.pdf, ..., 205.pdf`
- ☐ **Text Book**: any recent/decent OS book. Eg. (**OSC10**) Silberschatz et. al.: **Operating System Concepts**, 10th Edition, 2018.
- ☐ Encode your **QRC** with size upto 7cm x 7cm (ca. 400x400 pixels): **"OS182 CLASS ID SSO-ACCOUNT Your-Full-Name"**
- ☐ For **Week 00**, send your **embedded** QRC **before the** 2nd **lecture** `mailto:operatingsystems@vlsm.org`
  With Subject: OS182 CLASS ID SSO-ACCOUNT Your-Full-Name
- ☐ Write your Memo (with QRC) **every week**.
- ☐ Login to badak.cs.ui.ac.id via kawung.cs.ui.ac.id for at least **10 minutes** every week. Copy the weekly demo files to your own home directory.
  Eg. (Week00): `cp -r /extra/Week00/W00-demos/ W00-demos/`

Agenda

- Storage
- Storage Arrays
- BIOS
- Loader
- Systemd

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[1]Source: ACM IEEE CS Curricula 2013

- Storage [Usage]
- Storage Arrays [Usage]
- BIOS [Usage]
- Loader [Usage]
- Systemd [Usage]

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[1]Source: ACM IEEE CS Curricula 2013

Week 09: Storage, BIOS, Loader, & Systemd

- Reference: (OSC10-ch11)
- Mass-Storage Structure
  - Obsolete: Magnetic Tape, Disket
  - Until When?: Magnetic Disk, DVD
  - Until When?: Mechanical Disk Arm Scheduling
  - Solid-State Disks (SSD)
  - (What is a) Flash Disk
- Attached-Storage
  - Host-Attached Storage: via I/O
  - Network-Attached Storage (NAS): via distributed FS
  - Storage Area Network (SAN): dedicated Network

Storage Management

- Formating
  - Low Level (Physical)
  - High Level (FS)
- Boot Block
- Disk Partition
  - "MBR"-scheme
    - upto 4 primary partition
    - upto 2 TB disk
  - "GPT"-scheme
    - "unlimited" partition
    - "unlimited" disk
    - redundancy
- Swap Space Management: On Partition or FS?

RAID: Redundant Array of In* Disks

- RAID 0, 1, 5, 6, 10, 100
- Note (http://www.commodore.ca/windows/raid5/raid5.htm):
    - RAID was created to enhance data performance, reliability and availability.
    - Striping, parity checking and mirroring are three primary functions of RAID systems.
    - RAID performs its functions transparent to the operating system.
    - Systems are typically defined by ranks consisting of five disks each connected to one or two Disk Array Controllers.
    - Different RAID levels provide varying degrees of speed and data protection.
- Problems with RAID
- Stable-Storage Implementation

BIOS, Boot, & Systemd

- Firmware
  - BIOS: Basic Input Output System.
  - UEFI: Unified Extensible Firmware Interface.
  - ACPI: Advanced Configuration and Power Interface.
- Operating System (Boot) Loader
  - BOOTMGT: Windows Bootmanager / Bootloader.
  - LILO: Linux Loader.
  - GRUB: GRand Unified Bootloader.
- Operating System Initialization
  - Init (legacy)
  - UpStart
  - Systemd

Legacy BIOS

- Check Settings.
- Initialize CPU & RAM.
- POST: Power-On Self-Test.
- Initialize ports, LANS, etc.
- Load a Boot Loader.
- Handover to the Boot Loader.
- Provides "Native" (obsolete) Drivers only (not loadable).
- Provides "INT" services .
- Limitation.
    - Technology of 1970s.
    - 16 bits software.
    - 20 bits address space (1 MB).
    - 31 bits disk space (2 TB).

BIOS

Figure: BIOS

UEFI

- A Firmware Specification, not an Implementation!
- No (INT) service after boot.
- HII: Human Interface Infrastructure.
- Protected Mode.
- Flexible.
    - Technology of 2000s.
    - writen in C.
    - (third party) loadable drivers and tools.
    - Emulate Legacy BIOS transition (MBR block, INT service).
    - UEFI Shell: environment shell for diagnostic (no need for DOS).
- Problems
    - Who controls the Hardware?
    - Is "Secure Boot" a good thing?
    - How about a **NASTY/LOCKING/TROJAN** UEFI implementation?
    - Different **DRIVERS**.

UEFI

Figure: UEFI

Platform Initialization (PI) Boot Phases

Figure: UEFI Boot Process[1].

# Operating System (Boot) Loader

- General
  - How/Where to start the operating system?
  - What to do?
  - How many ways to boot?
  - How many types of OS?
- Disk Partition
  - MBR: Master Boot Record (1983).
  - GPT: GUID (Globally Unique Identifiers) Partition Table (2010s).
- GRUB: GRand Unified Boot system
  - Stage 1: a small boot.img inside the MBR.
  - Stage 1.5 (core.img): FS drivers after MBR.
  - Stage 2: Kernel Selection: Windows, Linux, BSD, etc.
- GRUB2
  - More flexible than GRUB legacy.
  - More automated than GRUB legacy.
  - Accept MBR and GPT.
  - Stage 1.5 (core.img): generated from diskboot.img.
  - No 1024 cylinder restriction.
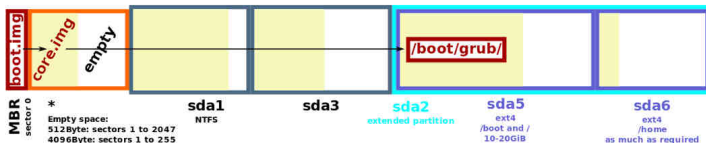
Figure: GRUB[1].

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[1]Source Shmuel Csaba Otto Traian 2013

init (SYSV legacy)

- File: /etc/inittab.
- Folders: /etc/rcX.d — X = runlevel.
    - Seven (7) different runlevels:
        - 0 (shutdown).
        - 1 (single-user/admin).
        - 2 (multi-user non net).
        - 3 (standard).
        - 4 (N/A).
        - 5 (3+GUI).
        - 6 (reboot).
    - SXX-YYY: Start
    - KXX-YYY: Kill.
- One script at a time in order.
- dependency is set manually.

UpStart - Ubuntu

- Developer: Ubuntu.
- Folder: /etc/init/.
- Control: initctl.
  - initctl list – listing all processes managed by upstart.
- better support for hotplug devices.
- cleaner service management.
- faster service management.
- asynchronous.

The All New "systemd"

- Replaces (SYSV) init and UpStart.
    - better concurrency handling: Faster!
    - better dependencies handling: No more "S(tarts)" and "K(ills)".
    - better crash handling: automatic restart option.
    - better security: group protection from anyone including superusers.
    - simpler config files: reliable and clean scripts.
    - hotplug: dynamic start/stop.
    - supports legacy systems (init).
    - overhead reducing.
    - unified management way for all distros.
    - bloated: doing more with more resources.
    - linux specific: NOT portable.

systemctl

```
for II in         \
   'systemctl list-unit-files | head -8; echo "(...)";
       systemctl list-unit-files| tail -8' \
   'systemd-analyze blame | wc -l; echo "===";
       systemd-analyze blame | head -15' \
   'systemctl --full  | wc -l; echo "===";
       systemctl --full  | head -10' \
   'systemctl list-units  | wc -l; echo "===";
       systemctl list-units  | head -10' \
   'systemctl list-units |grep .service|wc -l;echo "===";
       systemctl list-units|grep .service|head -10' \
   'systemctl list-units  | grep ssh.service' \
   'systemctl status ssh.service' \
   'systemctl is-enabled ssh' \
   'journalctl' \
   'journalctl -b' \
do
...
```

The End

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