

CSGE602055 Operating Systems

CSF2600505 Sistem Operasi

Week 08: Scheduling

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<https://os.vlsm.org/>

Always check for the latest revision!

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Operating Systems 202³) — PJJ from HOME

ZOOM: International [Tue 08-10] — A/Matrix [Tue 10-12]

| Week | Schedule & Deadline ¹⁾ | Topic | OSC10 ²⁾ |
|---------|-------------------------------------|---|---------------------|
| Week 00 | 15 Sep - 21 Sep 2020 | Overview 1, Virtualization & Scripting | Ch. 1, 2, 18. |
| Week 01 | 22 Sep - 28 Sep 2020 | Overview 2, Virtualization & Scripting | Ch. 1, 2, 18. |
| Week 02 | 29 Sep - 05 Oct 2020 | Security, Protection, Privacy, & C-language. | Ch. 16, 17. |
| Week 03 | 06 Oct - 12 Oct 2020 | File System & FUSE | Ch. 13, 14, 15. |
| Week 04 | 13 Oct - 19 Oct 2020 | Addressing, Shared Lib, & Pointer | Ch. 9. |
| Week 05 | 20 Oct - 26 Oct 2020 | Virtual Memory | Ch. 10. |
| Week 06 | 27 Oct - 16 Nov 2020 29 Oct 2020 | Concurrency: Processes & Threads Maulid Nabi | Ch. 3, 4. |
| Week 07 | 17 Nov - 23 Nov 2020 | Synchronization & Deadlock | Ch. 6, 7, 8. |
| Week 08 | 24 Nov - 30 Nov 2020 | Scheduling + W06/W07 | Ch. 5. |
| Week 09 | 01 Dec - 07 Dec 2020 | Storage, Firmware, Bootloader, & Systemd | Ch. 11. |
| Week 10 | 08 Dec - 16 Dec 2020 | I/O & Programming | Ch. 12. |
| | 09 Dec 2020 | Pil Kada | |

¹⁾ The **DEADLINE** of Week 00 is 21 Sep 2020, whereas the **DEADLINE** of Week 01 is 28 Sep 2020, and so on...

²⁾ Silberschatz et. al.: **Operating System Concepts**, 10th Edition, 2018.

³⁾ This information will be on **EVERY** page two (2) of this course material.

STARTING POINT — <https://os.vlsm.org/>

- **Text Book** — Any recent/decent OS book. Eg. (**OSC10**) Silberschatz et. al.: **Operating System Concepts**, 10th Edition, 2018. See also <http://codex.cs.yale.edu/avi/os-book/OS10/>.
- **Resources**
 - **SCELE** — <https://scele.cs.ui.ac.id/course/view.php?id=3020>. The enrollment key is **XXX**.
 - **Download Slides and Demos from GitHub.com**
<https://github.com/UI-FASILKOM-OS/SistemOperasi/>:
os00.pdf (W00), os01.pdf (W01), os02.pdf (W02), os03.pdf (W03),
os04.pdf (W04), os05.pdf (W05), os06.pdf (W06), os07.pdf (W07),
os08.pdf (W08), os09.pdf (W09), os10.pdf (W10).
 - **Problems** — <https://rms46.vlsm.org/2/>:
195.pdf (W00), 196.pdf (W01), 197.pdf (W02), 198.pdf (W03),
199.pdf (W04), 200.pdf (W05), 201.pdf (W06), 202.pdf (W07),
203.pdf (W08), 204.pdf (W09), 205.pdf (W10).
- **Build your own Virtual Guest**
<https://osp4diss.vlsm.org/>

Agenda

- 1 Start
- 2 Schedule
- 3 Agenda
- 4 Week 08
- 5 Scheduling
- 6 CPU Burst: How Long (When)?
- 7 MultiProcessor Scheduling
- 8 The Two State Model
- 9 Week 08: Check List
- 10 The End

Week 08 Scheduling: Topics¹

- Preemptive and non-preemptive scheduling
- Schedulers and policies
- Processes and threads
- Deadlines and real-time issues

¹Source: ACM IEEE CS Curricula 2013

Week 08 Scheduling: Learning Outcomes¹

- Compare and contrast the common algorithms used for both preemptive and non-preemptive scheduling of tasks in operating systems, such as priority, performance comparison, and fair-share schemes. [Usage]
- Describe relationships between scheduling algorithms and application domains. [Familiarity]
- Discuss the types of processor scheduling such as short-term, medium-term, long-term, and I/O. [Familiarity]
- Describe the difference between processes and threads. [Usage]
- Compare and contrast static and dynamic approaches to real-time scheduling. [Usage]
- Discuss the need for preemption and deadline scheduling. [Familiarity]
- Identify ways that the logic embodied in scheduling algorithms are applicable to other domains, such as disk I/O, network scheduling, project scheduling, and problems beyond computing. [Usage]

¹Source: ACM IEEE CS Curricula 2013

Week 08: Scheduling

- Reference: (OSC10-ch05 demo-w08)
- Scheduling
 - Basic Concepts
 - **WARNING:** It's just a BURST
 - IO Burst
 - CPU Burst
 - CPU Burst vs. Freq (See next slide)
 - Criteria: Utilization, throughput, {turnaround, waiting, response} time.
 - (Burst) Algorithm
 - FCFS, SJF, RR, Priority, Multilevel Queue.
 - Preemptive / Non-preemptive (Cooperative) Scheduling
 - I/O Bound / CPU Bound Processes
- Thread Scheduling
 - User-level → Process-Contention Scope (PCS): many to many/one.
 - Kernel-level → System-Contention Scope (SCS): one to one.
- Standard Linux Scheduling
 - Completely Fair Scheduler (CFS).
 - Real Time Scheduling.

CPU Burst: How Long (When)?



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MultiProcessor Scheduling

- Asymmetric Multiprocessing vs. Symmetric Multiprocessing (SMP).
- Processor Affinity: soft vs. hard.
- NUMA: Non-Uniform Memory Access.
- Load Balancing
- Multicore Processors
- Real Time Scheduling: Soft vs. Hard.
- Big O Notation
 - $O(1)$
 - $O(\log N)$
 - $O(N)$

The Two State Model

- CPU State – I/O State – CPU State – ...
 - n : processes in memory.
 - p : I/O time fraction.
 - p^n : probability n processes waiting for I/O.
 - $1 - p^n$: CPU utilization of n processes.
 - $\left[\frac{(1-p^n)}{n} \right]$: CPU utilization of ONE processes.
- Example: $p = 60\% \Rightarrow$ **CPU Utilization Per Process:** $\left[\frac{1-(60\%)^n}{n} \right]$

| CPU Utilization | Multiprogramming (%) | | | | |
|-----------------|----------------------|----|----|----|----|
| N | 1 | 2 | 3 | 4 | 5 |
| Per Process | 40 | 32 | 26 | 21 | 18 |

- For 5 concurrent processes:
If total time is 100 seconds; for each process, the CPU time will be 18 seconds.

Week 08: Check List (Deadline: Monday, 30-Nov-2020).

- ☐ **Starting Point:** <https://os.vlsm.org/>
- ☐ Week 08: Assignment (more details in **os08.pdf**).
 - ① Read: (OSC10 chapter 05)
 - ② TBA.
- ☐ The "Assignment Day" is every Thursday morning.
- ☐ This page is <https://os.vlsm.org/Slides/check08.pdf>.

The End

- ☐ This is the end of the presentation.
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 - This is the end of the presentation.