

CSGE602055 Operating Systems

CSF2600505 Sistem Operasi

Week 08: Scheduling

Rahmat M. Samik-Ibrahim

University of Indonesia

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

Always check for the latest revision!

REV160 04-Sep-2018

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 | Ch. 1, 18 |
| Week 01 | 13 Sep - 19 Sep 2018 | Overview 2 & Scripting | Ch. 1, 2 |
| Week 02 | 20 Sep - 26 Sep 2018 | Security, Protection, Privacy, & C-language | Ch. 16, 17 |
| 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 | 20 Oct - 27 Oct 2018 | MidTerm (UTS): TBA | |
| 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 | Disks, BIOS, Loader, & Systemd | Ch. 11 |
| Week 10 | 29 Nov - 05 Dec 2018 | I/O & Programming | Ch. 12 |
| Reserved | 06 Dec - 14 Dec 2018 | | |
| Final Extra | 15 Dec - 22 Dec 2018 12 Jan 2019 | Final (UAS): TBA Extra assignment | This schedule is 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](http://rms46.vlsm.org/2/196.pdf), ..., [205.pdf](http://rms46.vlsm.org/2/205.pdf)
- ☐ **Text Book:** any recent/decent OS book. Eg. **(OSC10)** Silberschatz et. al.: **Operating System Concepts**, 10th Edition, 2018.
- ☐ Encode your **QRC** with image size of approximately 250x250 pixels:
"OS182 CLASS ID SSO-ACCOUNT Your-Full-Name"
Special for **Week 00**, mail your **embedded** QRC to:
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

- 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 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

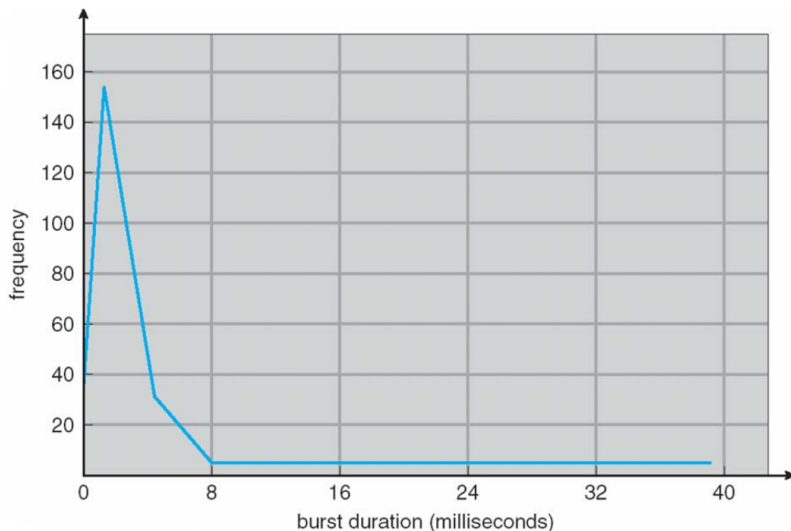
- Compare and contrast the common algorithms used for both preemptive and non-preemptive scheduling of tasks in operating systems, such as priority, performance comparison, and fair-share schemes. [Usage]
- Describe relationships between scheduling algorithms and application domains. [Familiarity]
- 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)?



©2013 Silberschatz, Galvin and Gagne Operating System Concepts – 9th Edition

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.

The End

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