

CSGE602055 Operating Systems

CSF2600505 Sistem Operasi

Week 08: Scheduling

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Always check for the latest revision!

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Operating Systems 2020-1

(A, B, C, D, E) from HOME

Week	Schedule	Topic	OSC10
Week 00	27 Jan - 02 Feb 2020	Overview 1, Virtualization & Scripting	Ch. 1, 2, 18.
Week 01	03 Feb - 09 Feb 2020	Overview 2, Virtualization & Scripting	Ch. 1, 2, 18.
Week 02	10 Feb - 16 Feb 2020	Security, Protection, Privacy, & C-language	Ch. 16, 17
Week 03	17 Feb - 23 Feb 2020	File System & FUSE	Ch. 13, 14, 15
Week 04	24 Feb - 01 Mar 2020	Addressing, Shared Lib, & Pointer	Ch. 9
Week 05	02 Mar - 08 Mar 2020	Virtual Memory	Ch. 10
Reserved	09 Mar - 13 Mar 2020	Q & E	
MidTerm	14 Mar 2020 (13:00-15:30)	MidTerm (UTS)	Subject to change.
Week 06	05 Apr - 11 Apr 2020	Concurrency: Processes & Threads	Ch. 3, 4
Week 07	12 Apr - 18 Apr 2020	Synchronization & Deadlock	Ch. 6, 7, 8
Week 08	19 Apr - 25 Apr 2020	Scheduling + W06/W07	Ch. 5
Week 09	26 Apr - 02 May 2020	Storage, Firmware, Bootldr, & Systemd	Ch. 11
Week 10	03 May - 09 May 2020	I/O & Programming	Ch. 12
Reserved	10 May - 16 May 2020	Q & A	
Final	08 Jun - 19 Jun 2020	Final (UAS)	This schedule is subject to change.
Extra	TBA	Extra assignment confirmation	

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**
 - ☐ **All In One** — BADAk.cs.ui.ac.id:///extra/ (**FASILKOM only!**).
 - ☐ **Download Slides and Demos from GitHub.com**
<https://github.com/UI-FASILKOM-OS/SistemOperasi/>
 - ☐ **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).
- ☐ **Try Demos**
 - ☐ Your own Ubuntu system.
 - ☐ Ubuntu on VirtualBox, or VMWare, or ...
 - ☐ Windows Subsystem for Linux (**Windows 10 only!**).
 - ☐ SSH to BADAk.cs.ui.ac.id (**FASILKOM only!**).

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)?



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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.

The End

- ☐ This is the end of the presentation.
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