SCHEDULE (published)

Saturday, December 12, 2020 7:16 PM

WEEK	DATE	AHEAD OF TIME	ONLINE DISCUSSION (lectures will always be discussed)	ASSIGNMENT DUE
0.Wed	2020-08-26	**Philosophy** ~ Where are we? | Intended audience | Goals vs non-goals | Course overview | Relation with other courses **Overview: A YouTube video** Survey link	No online meeting	
0.Mon	2020-08-31	**OS structures** ~ What's kernel | Process overview | Memory overview | File overview | IO overview **Overview:** *(**PDF**: handout - skim this first; **pptx**: slideshow with key slides narrated, in case you have doubts on them)* 010 OS structure v1.pdf 010 OS structure v1.pptx **Watch:** Eben Upton on the Raspberry Pi 3 (A YouTube video)	Course logistics; p1 overview & exp0/1	
1.Wed	2020-09-02	**Overview:** *(**PDF**: handout - skim this first; **pptx**: slideshow with key slides narrated, in case you have doubts on them)* **User programming (a)** ~ API&libs | Process memory layout | Process lifecycle | IPC&Signal 020a programming.pdf 020a programming.pptx **User programming (b)** ~ linking & loading | elf | binutils 020b linking binaries.pdf 020b linking binaries.pptx **User programming (c)** ~ some C tricks | dev workflow 020c c & shell refreshment v1.pdf 020c c & shell refreshment v1.pptx **Read:** Two short articles reading - zombie.pdf reading - Signals in Linux.pdf	p1 exp1/2	survey due; p1 exp0
1.Mon	2020-09-07	**The kernel** ~ CPU protection mode | privileges | interrupts | syscalls **Overview:** *(**PDF**: handout - skim this first; **pptx**: slideshow with key slides narrated, in case you have doubts on them)* kernel abs separation v2.pptx kernel abs separation v2.pdf **Skim:** fundamentals_of_armv8_a_100878_0100_en.pdf	p1 exp2/3	p1 exp1
2.Wed	2020-09-09	**Arm hardware primer** ~ Rpi3 | Armv8 exception levels | Armv8 registers | Armv8 instructions | Timer&UART **Overview:** *(**PDF**: handout - skim this first; **pptx**: slideshow with key slides narrated, in case you have doubts on them)* 025 armv8.pptx 025 armv8.pdf **Skim:** reading - aarch64 exception model.pdf reading - aarch64 generic timer.pdf	p1 exp2/3	p1 exp2
2.Mon	2020-09-14	**Armv8 assembly ~** common use of instructions | GNU assembler | GCC inline assembly | linker scripts **Overview:** 027 armv8 asm.pptx **Read:** Slides on ARMv8 assebmly. Informative & nicely-made. From Princeton CS217. ++ princeton 13_Assembly1.pdf ++ princeton 14_Assembly2.pdf ++ princeton 15_AssemblyFunctions.pdf ++ princeton 16_MachineLang (has linking).pdf (the instruciton encoding is for you to skim; the linking part is more useful) **Skim:** ARM inline assembly (examples using ARMv7, but applies to ARMv8) gnu-arm-directives.pdf ++ ARM GCC Inline Assembler Cookbook.pdf	Armv8; p1 exp3/4	
3.Wed	2020-09-16	**Kernel protection** ~ Dual-mode CPU | Syscalls | Interrupts **Context switch** ~ Process state | Voluntary & involuntary switch | fork() internals 050 context switches v1.pptx **Read:** Two ARM documents descripting arch support for VM. Well written. You may skip register details. armv8_a_address translation_100940_0100_en.pdf	p1 exp4/5	p1 exp3 (extended to Fri, Sept 18) ~~p1 exp4a~~

		LearnTheArchitecture-MemoryManagement-101811_0100_00_en.pdf		
3.Mon	2020-09-21	**Address translation** ~ Intro&Usage | Pagetable | MMU&TLB lec 59 translation, MMU_v2.pptx **Read:** Memory Layout on AArch64 Linux — The Linux Kernel documentation.pdf	p1 exp5	~~p1 exp4a~~ (extended to Wed, Sept 23)
4.Wed	2020-09-23	**Virtual memory** ~ Memory maps | Demand paging | Page faults 060 lec vm v1.pptx **Skim**: A short article describing process addr space in ARM64 Linux. Memory Layout on AArch64 Linux — The Linux Kernel documentation.pdf	p1 exp5	p1 exp4a ~~p1 exp4b~~ (extended to Thu, Sept 24)
4.Mon	2020-09-28	**Memory 101** ~ What's on DIMMs? | Channels | NUMA | 3D memory 065 mem 101.pptx Skim: "What Every Programmer Should Know About Memory?" A long, informative article, which motivates our lecture. Some contents outdated (2007). Mostly FYI. cpumemory book.pdf	p1 exp6	~~p1 exp5~~
5.Wed	2020-09-30	**Memory allocation ~** Malloc | fragmentation | buddy | GC | security issues 070 mm.pptx	p1 exp6	p1 exp5
5.Mon	2020-10-05	**Containers** ~ Intro | Docker | Kernel support | LXC&Comparison 080 container.pptx	p1 exp6	
6.Wed	2020-10-07	**Virtual Machines** ~ Intro & Usage | Structures | CPU | mem/irq/IO | Case study 085 virtual machines.pptx	p1 exp6	p1 exp6 (extended to Oct 9 Fri)
6.Mon	2020-10-12	**Trusted execution environments** ~ Intro & Usage | SGX | TrustZone | OPTEE **Read:** A tutorial (slide deck) on TrustZone. Informative. A bit dated (2013) ++ tz ccs 2013 tutorial-slides.pdf **Skim:** A survey paper on TrustZone ecosystem. Very thorough! 2019 Demystifying Arm TrustZone A Comprehensive Survey.pdf A case of hacking TrustZone (a Samsung device). Cool. ++ us-19-Peterlin-Breaking-Samsungs-ARM-TrustZone.pdf Security and Crypto of SGX +++ us-16-Aumasson-SGX-Secure-Enclaves-In-Practice-Security-And-Crypto-Review.pdf	p2 overview	
7.Wed	2020-10-14	**CPU scheduling** ~ Intro & Usage | CFS | Core waste lec sched v0.pptx	p2 exp1/2	p2 exp1: race & sync (extended to Oct 15 Thu)
7.Mon	2020-10-19	**Synchronization** ~ Race | Locks | Condition vars | Producers/consumers | Readers/writers | RCU **Skim:** Good slides from Umich 23-inside_sem.pptx 24-using_sem.pptx 25-condition.pptx 26-deadlock.pptx	p2 exp1/2	
8.Wed	2020-10-21	**The art & pitfalls of benchmark** **Skim:** Wonderful slides from UCLA CS lecture_11.pdf	p2 exp2	
8.Mon	2020-10-26	**Scalability** ~ Parallelism | Scale-up vs out **Trusted execution environment** ~ ARM TrustZone ++ us-19-Peterlin-Breaking-Samsungs-ARM-TrustZone.pdf	p2 exp2	p2 exp2: scalability (extended to Oct 30 Fri)
9.Wed	2020-10-28	**Filesystem Abstractions: file/dir/permission** ~ Files | Dirs | Permissions **Overview:** 130 fs abs.pptx	p3	
	2020-10-30			p2 exp2: scalability
9.Mon	2020-11-02	**Storage Devices: tape/disk/flash/NVM** ~ Disks | SSD | NVM **Overview:** 140 storage dev.pptx	p3	
10.Wed	2020-11-04	**A whirlwind tour of Linux storage stack** ~ VFS | pagecache | mmap | Case study - LMDB **Overview:** 150 storage stack, vfs, pagecache, mmap.pptx	p3	p3 exp1
10.Mon	2020-11-09	**Simple filesystems: FAT/Ext2** ~ Intro | FAT | Ext2 | Dir internals | Inspect Ext2 **Overview:** 160 simple fses.pptx	p3	~~p3~~ p3 exp2
11.Wed	2020-11-11	**Journaling filesystems: Ext3/4** ~ Intro | Just be careful | Copy-on-write | Redo | Ext3 | Undo etc	p4 overview	

11.Mon	2020-11-16	**RAID** ~ Intro | RAID0/1/10/5/6 | SSD Benchmarks | HDD Benchmarks & perf takeaway | Usage | Implementation	p4 exp1/2	p3 exp3 **optional:** p4 exp1: fs interpretation **Note: students who earn p4 credits must meet this deadline**
12.Wed	2020-11-18	**Network filesystem** ~ Intro | Transparency & stateless | Caching | Security | SMB/SSHFS & Comparisons	p4 exp2	
12.Mon	2020-11-23	**Linux graphics stack** ~ Need for sharing | X Windows | Indirect or direct rendering? | OpenGL lib - Mesa | Compositing | Case study & Android (No in-person instruction or assessments after November 24, per the University policy)	p4 exp2	~~p3 exp4~~
13.Wed	2020-11-25	Online office hours for project Q&A		p3 exp4
13.Mon	2020-11-30	Online office hours for project Q&A		
14. Wed	2020-12-02	Online office hours for project Q&A		
14. Mon	2020-12-07	Online office hours for project Q&A		
15. Wed	2020-12-09	Online office hours for project Q&A		
	2020-12-11	(the last day of the exam week)		p3 exp5 **optional:** p4 exp2: consistency **optional:** p4-lite