Midterm Exam – Operating System 111 Autumn (作業系統 CSIC30015)

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5 1. Please briefly describe the role of the operating system.

Ans (5pts):

Operation system is used to connect hardware and software, describe file system to hardware understandable format, manage and require hardware run process accordingly

9 Please point out three challenges without the support of the operating system.

Ans (9pts, 3 pts for each):

Unreadable to file system data

Manage and require hardware run process accordingly or interrupt

Translate virtual address to phsical address

1 2. What is Linux Kernel?

Ans (2pts): a process manager

It is a part of process combine of C & Assembly code.

X

2.5 Who runs the kernel and when will the kernel be run?

Ans (5pts):

process CPU will run kernel, when process call C library from kernel, it will run system call from kernel. Also, kernel will call another system call from kernel if it need. e.g. page fault.

2.5 3. What is a process?

Ans (5pts):

process is active/running program from memory related resources

0 What is a thread (The answer shall be more than a lightweight process.)?

Ans (5pts):

thread is a process running by a CPU, it used to divide process queue to different CPU and run it parallelly/pipelining.

0 4. Please list two design criteria (one word for each criteria is enough) when designing a process scheduler.

Ans (4pts):

priority and balance (0) Both are strategies

Please briefly describe the challenges of O(N) and O(1), which are two process schedulers in Linux Kernel 2.4 and 2.5.

0

Ans (6pts, 3pts for each, 1 or 2 sentences for each answer):

O(N) : Need to wait current process complete, urgent process will wait to long if suddenly added.
O(1) : all process run the same interval, no priority consideration, urgent process should run longer

4

In Linux kernel 2.6, kernel allocates different amount of time slice to processes with different priority (or Nice values), as shown in the table below. Please point out two challenges for low-priority processes under this allocation strategy.

Nice Value	-20	-19	-18	-17	-16	-15	-14
Time Slice (ms)	800	780	760	740	720	700	680
Nice Value	13	14	15	16	17	18	19
Time Slice (ms)	35	30	25	20	15	10	5

Ans (4pts, 2pts for each):

, swap too fast ✓ if there are many low priority processes
No balance, time slice different between low priority is huge (eg. 0 & 5)

3

5. What is the process context?

Ans (5pts):

PID, Page Table, State ? hardware registers + kernel data structure
The information from process.

5

What is the goal of doing the context switch?

Ans (5pts):

switch to another process which need to run by CPU.

5

How the context switch works (shall include two main operations)?

Ans (5pts):

struct_mm : switch memory address accordingly
struct_to : switch state of process

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0 6. What is the purpose of system calls?

Ans (5pts):

build common use library for user and kernel use, (eg printk, page fault, etc)

1 Please briefly describe the interrupt procedure between a hardware device and the CPU.

Ans (5pts):

A non sleep block need to keep monitor interrupt and ask CPU to do action like stop running or something else.

[hardware] → [south bridge] → [ALIC CPU] ✗

10 Interrupt handlers usually comprise two parts, that is top halves and bottom halves. Please briefly describe the purpose of both parts:

Ans (10pts, 5pts for each):

Top: critical and immediate interrupt and run

bottom: Not critical, can be wait / defter to process after current process

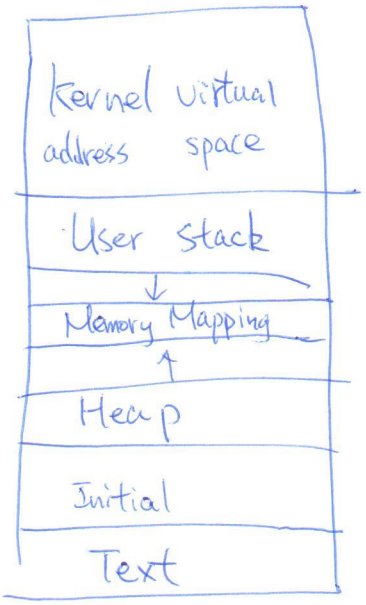
1 7. What is slab layers in Linux? What is the goal (or the main idea) of slab layers?

Ans (10pts, 5pts for each):

slab layers is to provide contiguous physical page for memory, it used to allocate memory for small and contiguous page. ✗

10 8. Given a 32-bit system, please draw a conceptual layout of a process address space (or virtual address space). The process address space shall include 5 sections: (1) User Stack (2) Heap (3) Memory Mapping (4) Text (5) kernel virtual address space.

Ans (10pts, 2pts for each):



3

9. What is the purpose of page tables?

Ans (3pts):

To map virtual page address to physical one.

2

Do all processes in a system share a page table? (Please answer yes or no)

Ans (2pts):

No

7

Please briefly describe when will CPU raise a minor page fault and when will it raise a major page fault.

Ans (10pts, 5pts for each):

Major: the data need to access not in Memory, need to access next level storage device.

Minor: the data need to access in memory, but don't know where it is.?

5

10. Modern x86 systems usually adopt multi-level page tables. How many levels are there on the system where the page size, virtual address space size and the page table entry size are set to 4KB, 2^{52}B, 8B, respectively.

2^{12} 2^{3}

Ans (5pts):

$2^{12}/2^{3} = 2^{9}$

$2^{52}/2^{9} = 2^{43}$

$2^{43}/2^{9} = 2^{34}$

$2^{34}/2^{9} = 2^{25}$

$2^{25}/2^{9} = 2^{16}$

$2^{16}/2^{9} = 2^{7} < 2^{12}$

5 level #

64
48
39
30
21
12