COS 318 PROJECT 2
NON-PREEMPTIVE SCHEDULING

Outline

- Project is due at 23:59 on October 13
- Design reviews are 19:00 - 22:00 on Oct 6. Sign up !
- Today: go through the project, get you started
- Next time: design review summary, Q/A

Overview

* Target: Building a kernel that can switch between executing different tasks (task = process or kernel thread)
* Read the spec on course website
* Your grade will be determined partly on whether you handle subtle issues correctly. So don't overlook any aspect.

What you need to deal with?

* Process Control Block (PCB)
* Context switching procedure
* System call mechanism
* Stacks
* Mutual Exclusion

Process Control Block

- kernel.h
- What should be in PCB?
  - pid, stack?
  - next, previous?
- What else?

Processes Example

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go_to_class ();

yield();

go_to_precept();

yield();

design_review();

yield();

coding();

exit();

Life

have_fun();

yield();

play();

yield();

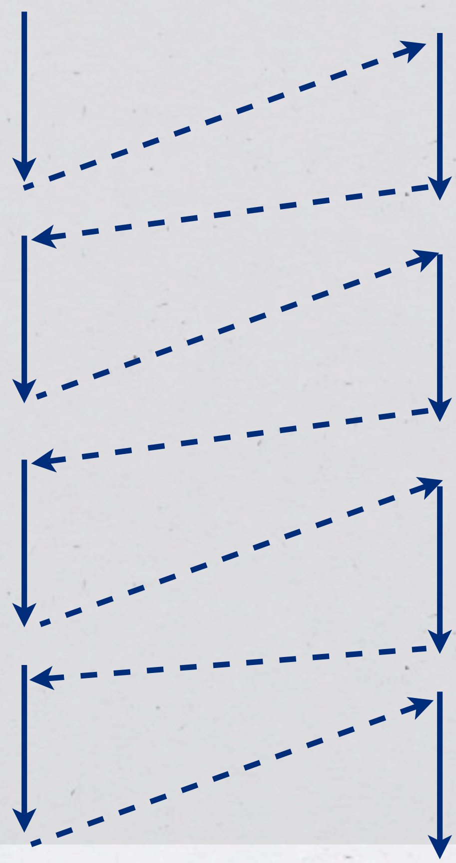
do_stuff();

yield();

......

Control Flow

COS 318	Real life
go_to_class ();	have_fun();
yield();	yield();
go_to_precept();	play();
yield();	yield();
design_review();	do_stuff();
yield();	yield();
coding();	……
exit();	



What is yield()?

- yield(): switch to another task
- For a task itself, it is a normal function call:
  - Push a return address on the stack
  - transfer control to yield()
- yield():
  - do_stuff();
  - return
- Task calling yield() has no knowledge of what do_stuff() is

Isolation

- Task must have their own:
  - registers
  - stack
  - ...... (for future assignments)
- Two techniques to achieve isolation
  - Division in space: allocate separate resources
  - Division in time: save and restore contexts
- Which one apply here?

Stack and Registers

- Allocate separate stacks in _start()
- yield():
  - save registers, including %esp
  - do_stuff()
  - restore registers
  - return
- Where are registers stored?
  - In the process control block (PCB)

The Secret Business Plan

COS 318

go_to_class ();

yield();

....

yield returns

design_review();

yield();

....

overlapped calls?

Real life

....

yield returns

have_fun();

yield();

....

yield returns

do_stuff();

yield();

No, they are not

* yield() calls appear to be overlapped
* Yet yield returns immediately to a different task, not the one that calls it
* Secret plan of yield()?
    * save registers
    * find the next task T
    * restore that task T's saved registers
    * return to task T

Find the Next Task

- The kernel must keep track of which tasks have not exited yet
- The kernel should run the task that has been inactive for long
- What is the natural data structure?
- Please explain your design in the design review

Threads and Processes

- To yield, requires access to the scheduler's data structures
- Kernel threads have access
  - scheduler.c : do_yield()
- User processes should not, but do for this project temporarily
- How should they get access?

System Calls

- To make a system call, a process:
  - pushes the call number and arguments onto its stack
  - interrupt/trap mechanism (later assignment), which elevates privileges and jumps into the kernel in a controlled manner
- In his project, processes have elevated privileges all the time
- Two system calls : yield() and exit()

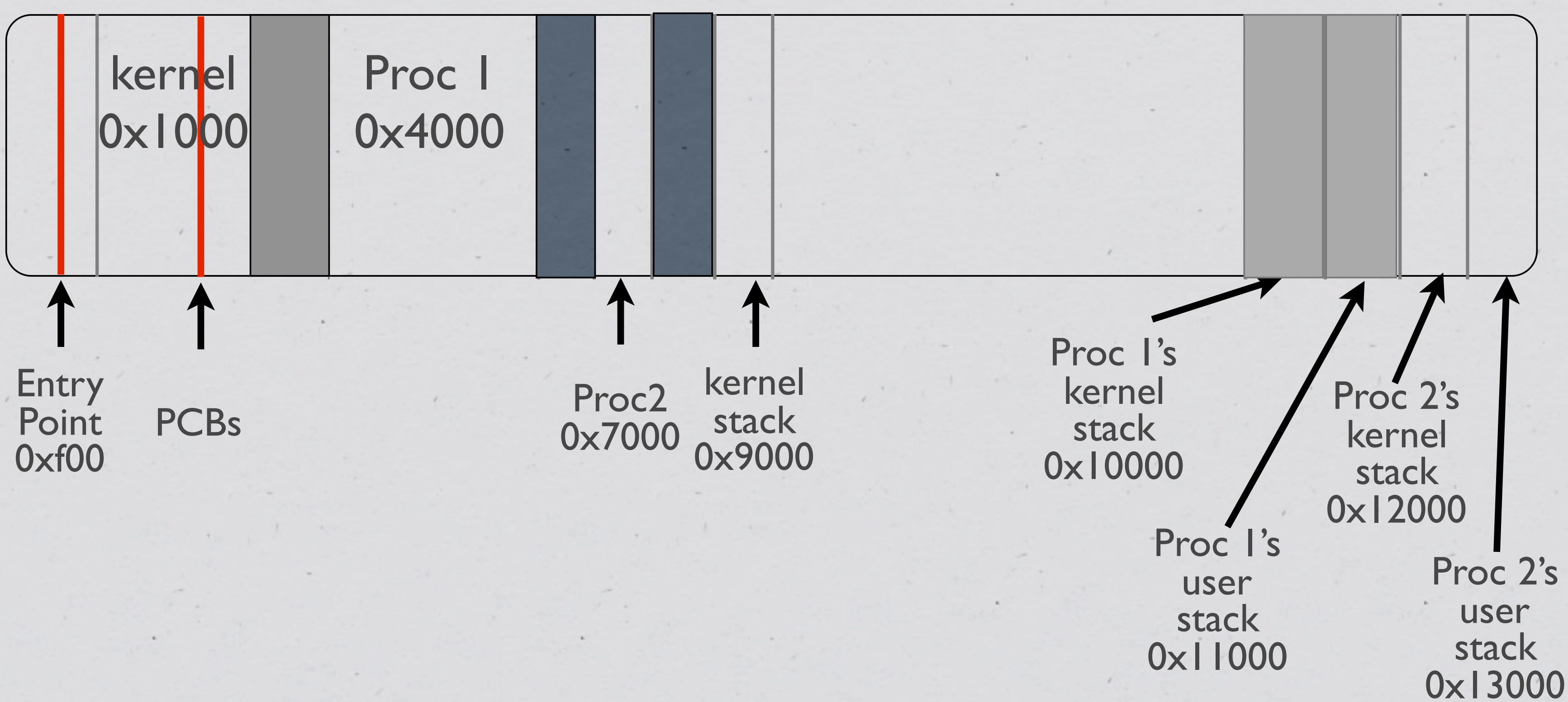
entry.s: kernel_entry()

- kernel.c :
  - _start() stores the address of kernel_entry() at ENTRY_POINT (0xf00)
- Processes make system calls by:
  - loading the address of kernel_entry from 0xf00
  - passing the system call number to kernel_entry
- kernel_entry must save the registers and switch to the kernel stack, and reverse the process on the way out

Kernel and User Stack

- Processes have two stacks
  - user stack : for process to use
  - kernel stack : for kernel to use when executing system calls on behalf of the process
- Kernel thread has only one: kernel stack
- Suggestion: put them in memory 0x10000 - 0x20000
  - 4kb stack should be enough
  - upper limit = 640k (0xa000)

Memory Layout



Mutual Exclusion

- The calls available to threads are
  - lock_init(lock_t *)
  - lock_acquire(lock_t *) : check lock, block itself if cannot get it
  - lock_release(lock_t *)
- The precise semantics we want are described in the project spec
- There is exactly one correct trace

Timing a Context Switch

- util.c : get_timer() returns the number of cycles since boot
- There is only one process for your timing code, but it is given twice in tasks.c
  - use a global variable to distinguish the first execution from the second

Design Review Requirement

- Sign up for 10 minutes meeting with TA on project website
- Data structure design
- Context switching
- system calls design
- mutual exclusion design
- Please draw pictures and write your idea down (1 piece of paper)
- See project website for more details

QUESTIONS?