Week 2

xv6 and System Calls

Review

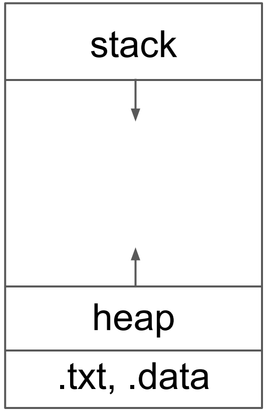
What is context switching? When does it happen?

- Context switching happens if a new task will be scheduled when the current running one has not finished yet (preemption)
- It stores the current running context so that the preempted task can be resumed later
    - It saves the registers, memory maps, etc
- Used widely for multitasking (process / threads) and interrupt handling
    - Switching between kernel and user process (e.g., exception handling) does not necessarily incur a complete context switch

Review

What is the kernel stack?

- A fix-sized memory region managed by kernel for each running process
- Used for the function call stack when running in kernel mode
- Stores registers from the userspace during system calls



Virtual (user) memory space

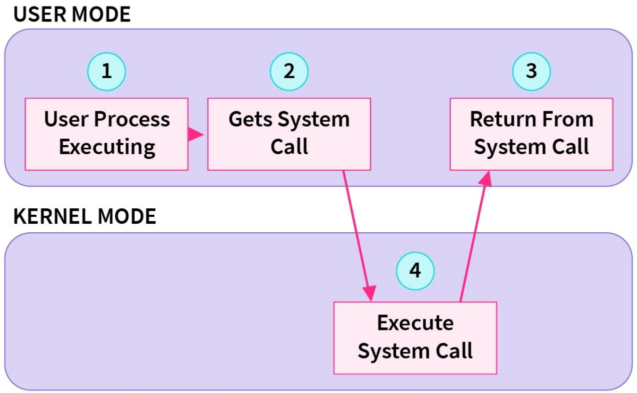
kernel stack

In kernel memory space

System Calls

What is a system call?

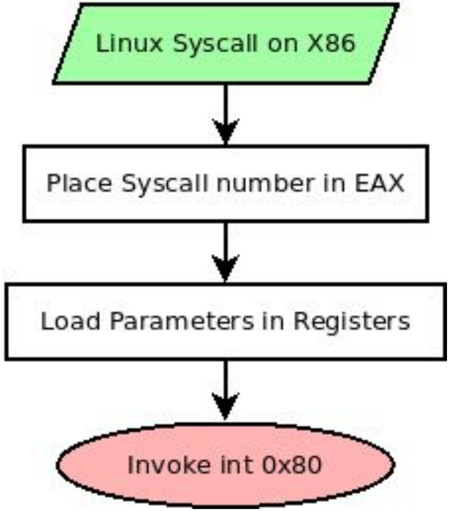
- Ways through which user programs request services from kernel
- Running processes will yield the CPU to kernel to fulfill the request (i.e. blocking / synchronous)
- E.g., getpid(), read() and write(), send() and recv(), fork(), etc.



System Calls

What is an interrupt?

- Event through which kernel is awaken
- Can be triggered by both hardware devices (disk, NIC, etc) and programs
- An interrupt number is passed to kernel to indicate the reason for interrupt
- Used to implement system calls in many operating systems
  - Linux and xv6 (on x86 architecture) uses `int 0x80` for system calls
- Trap vs Interrupt:
  - Trap is a different event used to implement system calls in older OS
  - The term is kept to refer to software-generated events
    - This include system calls and exceptions
  - Trap are often synchronous, while interrupts are mostly asynchronous



Linux Syscall on X86

Place Syscall number in EAX

Load Parameters in Registers

Invoke int 0x80

System Calls

What is the trap function?

- Kernel function that handles trap (also called trap handler)
- It checks the trap number to decide what to do

Note: In xv6 (and many other OS), the trap handler handles more than just traps: it also handles some hardware interrupts like timer interrupts.

System Calls

What is a system call table?

- Mapping from the system call number to the corresponding handler

xv6 Demo

- xv6 is a simple UNIX-like operating system.
- ~cs537-1/public/xv6.tgz
    - First copy it to your working directory: `cp ~cs537-1/public/xv6.tgz [dest]`
    - Then extract the source code: `tar -xvf xv6.tgz`
- `make qemu-nox` to compile and run xv6; ctrl+a, x to stop xv6.