



# Operating System Concepts

Che-Wei Chang

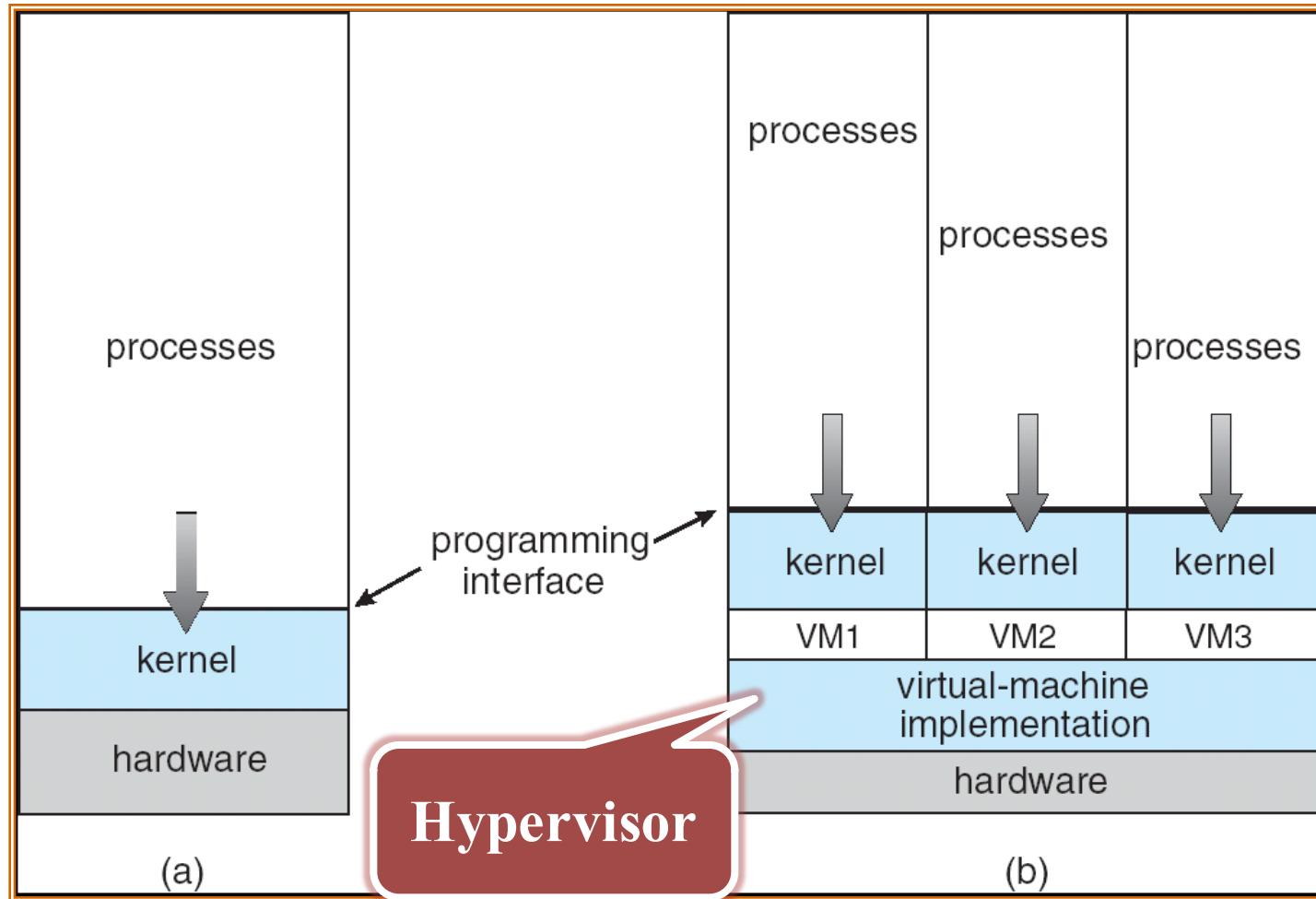
[chewei@mail.cgu.edu.tw](mailto:chewei@mail.cgu.edu.tw)

Department of Computer Science and Information  
Engineering, Chang Gung University

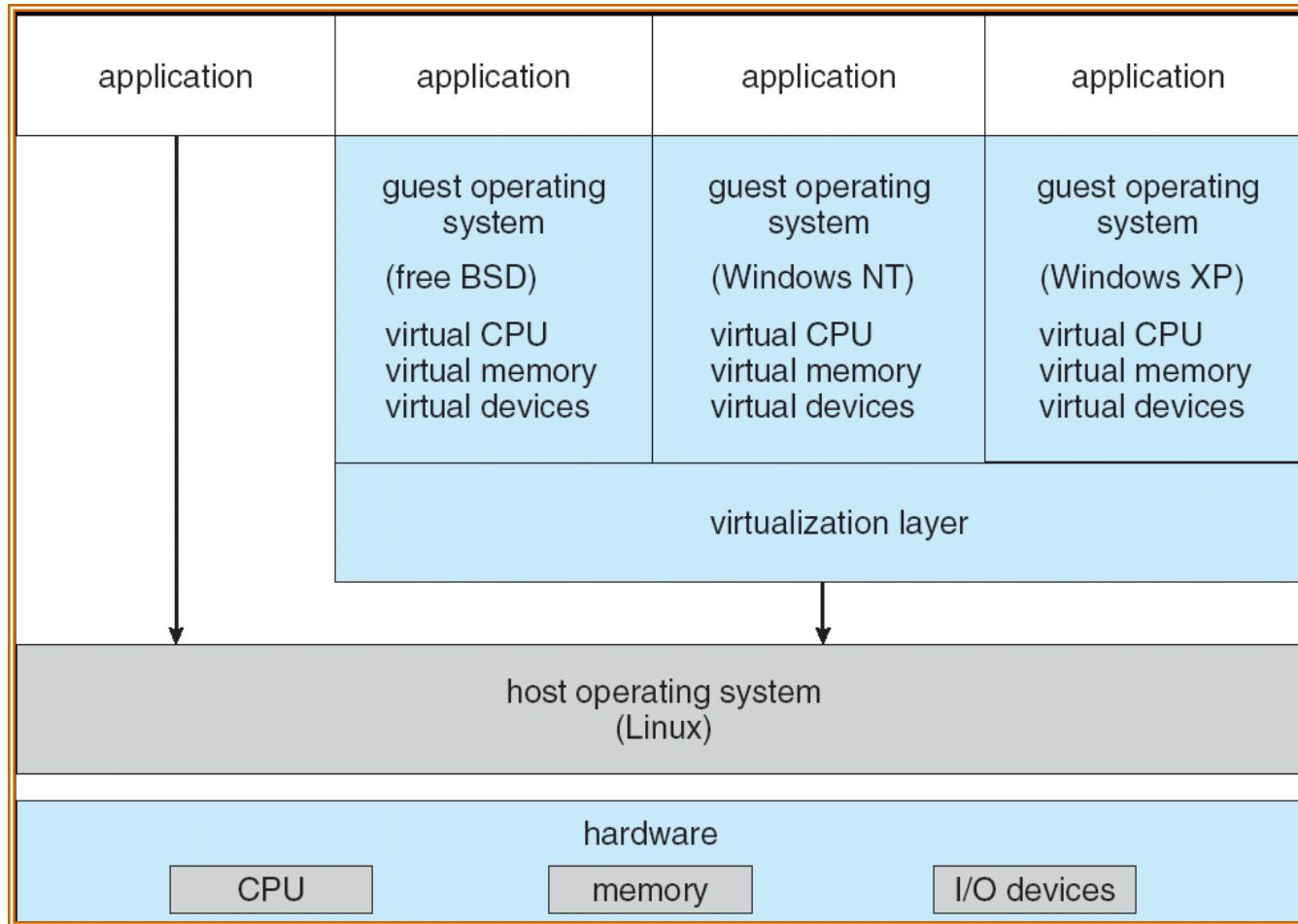


# Final Project– Exercise on Virtual Machines

# Virtual Machines on Hypervisor



# Virtual Machines on Host OS



# VM Managers

- ▶ Oracle VirtualBox
- ▶ VMWare Player
- ▶ Parallels Desktop for Mac
- ▶ QEMU (Quick EMULATOR)



# Project Details– Build a Linux Kernel Module

# Commands to Download Tools

## ► On Ubuntu12.04

- *sudo apt-get update*
- *sudo apt-get install make*
- *sudo apt-get install build-essential*
- *sudo apt-get install vim*
- *sudo apt-get install linux-headers-\$uname -r)*

# Makefile

```
obj-m = hello.o
```

```
KVERSION = $(shell uname -r)
```

```
all:
```

```
    make -C /lib/modules/$(KVERSION)/build M=$(PWD) modules
```

```
clean:
```

```
    make -C /lib/modules/$(KVERSION)/build M=$(PWD) clean
```

Note: You have to use “tab” instead of “space” in the Makefile

# hello.c

```
#include <linux/init.h>
#include <linux/module.h>
#include <linux/sched.h>
MODULE_LICENSE("Dual BSD/GPL");
static int hello_init(void)
{
    return 0;
}
static void hello_exit(void)
{
    printk(KERN_ALERT "Goodbye, cruel world\n");
}
module_init(hello_init);
module_exit(hello_exit);
```

# Compile and Use It

- ▶ *make*
- ▶ *sudo insmod hello.ko*
- ▶ *sudo modprobe hello.ko*
  - try to also load other modules for undefined symbols
- ▶ *sudo rmmod hello*
- ▶ *dmesg*

# Requirements

- ▶ Install a virtual machine on your computer
- ▶ Install Linux and Windows 10 (or any Windows OS) on the virtual machine
- ▶ Implement a device driver
  - Print “Hi, I am Student-ID” to the kernel buffer when inserting the module
  - Print “Bye!” to the kernel buffer when removing the module
  - Hint: you can use the command *dmesg* to read the buffer

# Report

1. The steps for your implementation
  2. The problem you met, and how you solved it
  3. The bonus you have done
  4. **The reference of this project**
- 
- ▶ The report is limited within 4 pages (Word or PDF)

# Grading

- ▶ Implementation
  - The VM: 20%
  - The OS: 20% (10% for each)
  - The kernel module: 20%
- ▶ Report
  - 35% (Baseline is 20%)
- ▶ Bonus
  - Recompile and install the Linux kernel on the VM: 20%
  - Implement and test a system call on the Linux kernel: 20%

# Submission

- ▶ Project deadline: at 17:00 on 2018-12-26  
**→NO DELAY!**
  - ▶ Send your report and the compiled kennel module to TA: 王宥憲 <kf200660306@gmail.com>  
**→Not the source files**
  - ▶ The title of the email: OS Project of StudentID
  - ▶ The title of the report: OS\_StudentID\_Name
  - ▶ The title of the driver: Module\_StudentID.ko
  - ▶ **Point deduction for wrong format: 10%**
- DEMO might be requested**