

CSc 360

Operating Systems

Virtual Machines

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1

Machine virtualization

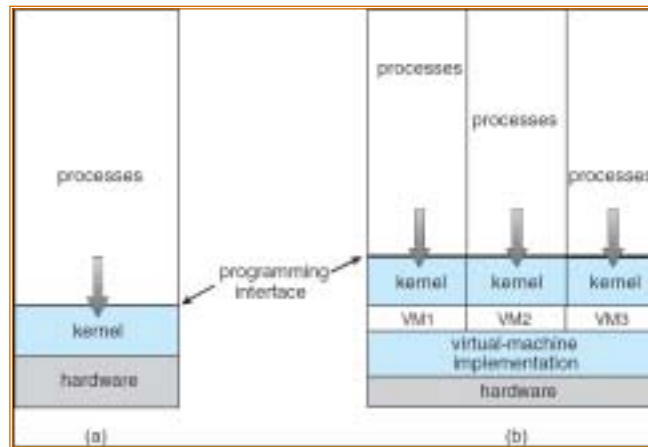
- Run any software on hardware/software
 - layered structure!
 - E.g.,
 - run Linux and Windows on the same computer
 - run Windows OS on Linux OS
 - run Windows application on Linux OS
 - run Linux/x86 on PowerPC
 - run Java on JVM
- Virtual machine: hardware + some software

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2

Real vs virtual



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3

Why virtualization?

- Run “old” software
 - binary compatibility
- Try new software
 - buggy, unknown (system) software
- Hardware/software independence
 - JVM
- Simulation and emulation
 - system research and development

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4

What to be virtualized?

- CPU
 - CPU scheduling
- memory
 - virtual memory
- storage
 - file system
- I/O
 - network interface

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5

How to virtualize?

- Virtual machine monitor (VMM)
 - coordinate and virtualize resources
- Binary translation
 - static, dynamic, feedback directed
- Hardware support
 - normal and privileged mode
- Software support
 - traps, interrupt handlers, system calls

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Wine

- Windows emulator
 - open source implementation of Windows API
 - also be able to use native Windows DLL
 - binary interpreter
 - program loader
 - for many Windows applications
- Another example, driver loader
 - wrapper for Windows NDIS drivers

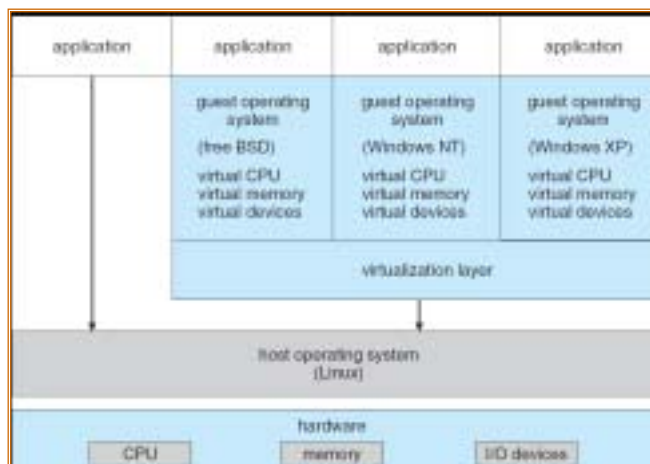
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7

VMware

- Host OS
- Guest OS
 - CPU
 - memory
 - file
 - I/O



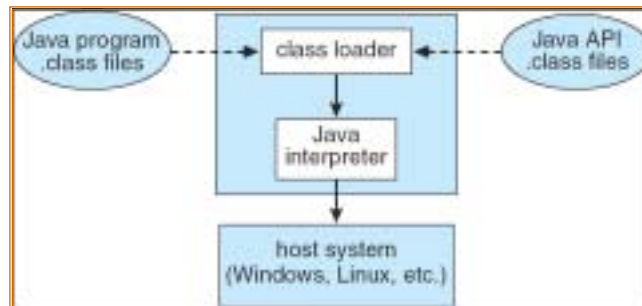
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JVM

- Class loader
- Class verifier
- Interpreter



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9

OS: from program to process

- OS on media
 - CDROM, DVD, or on the 'Net
- OS installation
 - OS generation
 - CPU, memory, disk, I/O, network, etc.
- Customization
 - for a particular hardware platform
- Optimization

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10

System boot

- Power on
 - CPU PC loaded a predefined address (ROM)
- BIOS POST (power on self test)
- Look for bootstrap
 - in ROM or on disk
 - hard disk: master boot record (MBR)
 - boot sector on bootable partition
- Look for kernel

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11

This lecture

- Virtual machine
 - where virtualization can happen?
 - below application: application binary interface
 - below OS: instruction set architecture
 - how to virtualize?
- Explore further
 - how can a process detect whether it is running on a real machine or a virtual machine?

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12

Next lecture

- Process
 - read OSC7 Chapter 3 (or OSC6 Chapter 4)