

Operating Systems

Assignment Project Exam Help

<https://powcoder.com>

Lecture 1b

Add WeChat powcoder

Previous Lecture

1

A brief introduction to operating systems

- A bit of history:
Assignment Project Exam Help
○ How operating systems came about and developed over time
<https://powcoder.com>
- A few basics about operating systems
Add WeChat powcoder
 - They offer a virtual machine abstraction to work with diverse hardware
 - They make computers easier to program
 - They manage resources for programs
 - They offer protection for programs (and their users), and themselves

Operating system architectures

- Abstractions
- Basic design principles
- Basic architectures

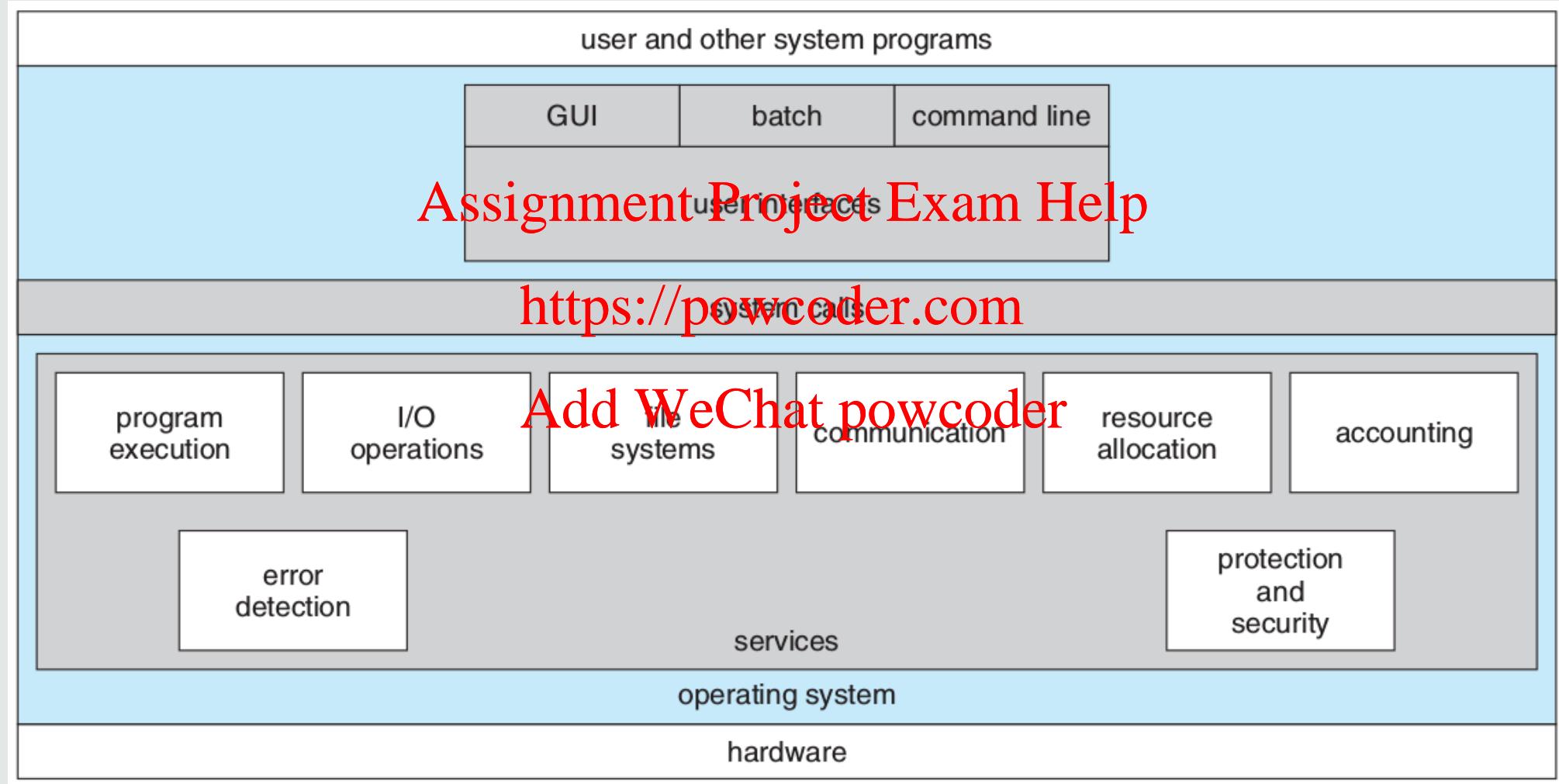
Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Abstractions: Overview

3



Abstractions: Overview

4

Let's talk about:

- Processes
- Virtual memory
- Files
- System call interface

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Process abstraction

A process is a program in execution

- Operating system duties:
 - Process creation:
 - Handle concurrency
 - Scheduling
 - Coordination of resource requests
 - Synchronisation
 - Signalling of events (e.g. I/O)
 - Inter-process communication (IPC)

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Image Name	CPU	CPU Time	Memory (Privat...)	Base Pri	Description
AcroRd32.exe ...	00	0:00:05	15,520 K	Normal	Adobe Reader
AcroRd32.exe ...	00	0:00:14	56,396 K	Normal	Adobe Reader
avgtray.exe *32	00	0:00:11	2,148 K	Normal	AVG Tray Monitor
BTTray.exe	00	0:00:00	8,656 K	Normal	Bluetooth Tray Application
chrome.exe *32	00	0:00:04	21,292 K	Below Normal	Google Chrome
chrome.exe *32	00	0:00:00	13,832 K	Normal	Google Chrome
chrome.exe *32	00	0:00:03	20,252 K	Below Normal	Google Chrome
chrome.exe *32	00	0:01:35	91,152 K	Normal	Google Chrome
chrome.exe *32	00	0:00:04	64,700 K	Normal	Google Chrome
chrome.exe *32	00	0:00:00	10,040 K	Normal	Google Chrome
chrome.exe *32	00	0:00:00	9,132 K	Normal	Google Chrome
chrome.exe *32	00	0:00:08	42,232 K	Normal	Google Chrome
concentr.exe *32	00	0:00:00	2,868 K	Normal	Citrix online plug-in Connect...
	00	0:00:00	2,726 K	Normal	

Process list in Windows 7 (Task manager)

Virtual memory abstraction

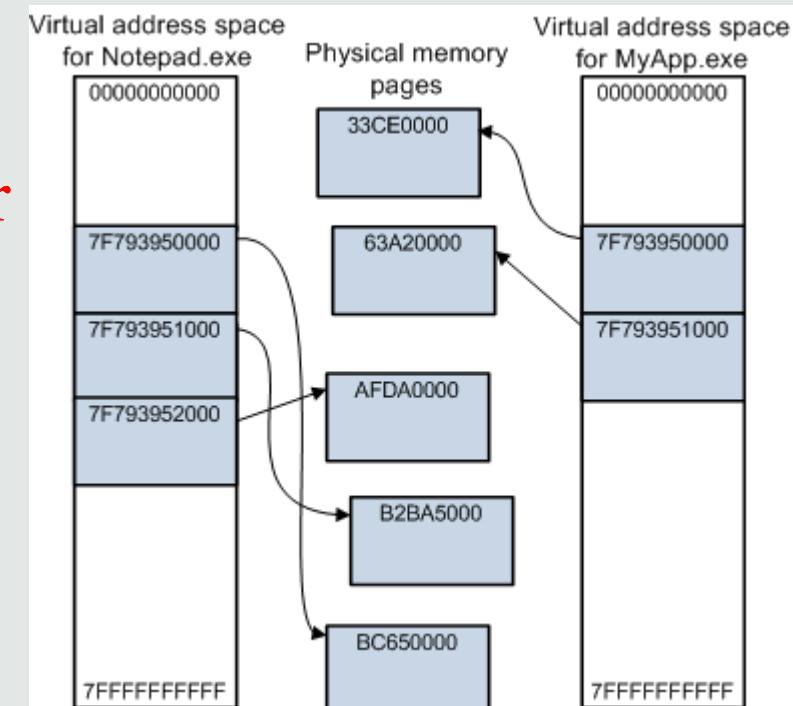
6

Memory can be provided to processes irrespective of the actual organisation and size of the physical memory available.

Virtual Memory provides each process with its own address space.

- Operating system duties: <https://powcoder.com>
 - Address translation
 - Memory management:
 - CPU can only address main memory
 - Data is only partially in memory (paging)
 - Memory protection
 - Process can only access its “own” memory segments
 - Provision of shared memory

Add WeChat powcoder



Virtual address spaces (Source: microsoft.com)

File abstraction

7

Files provide persistent storage of data

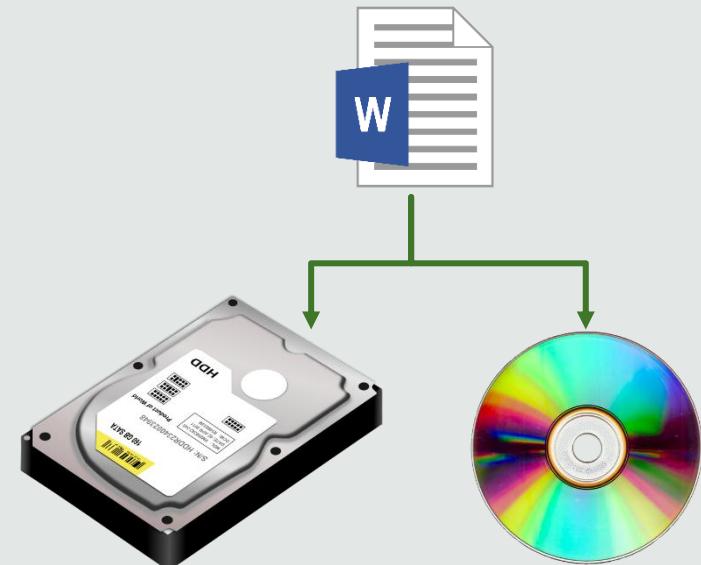
Files have names and can be hierarchically organised

The operating system ~~Assignment Project Exam Help~~ manages files in various ways

Files are accessed as sequences of bytes (allows consistency checking)
<https://powcoder.com>

- Operating system duties: **Add WeChat powcoder**

- Provide a uniform interface for different devices
- Manage efficient access (e.g. caching)
- Protect storage device from being damaged/corrupted
- In UNIX systems I/O devices are files



System call interface

The SCI contains the functions the **kernel** provides for

- Process control
- File management
- System information (date, time, etc.)
- Inter-process communication

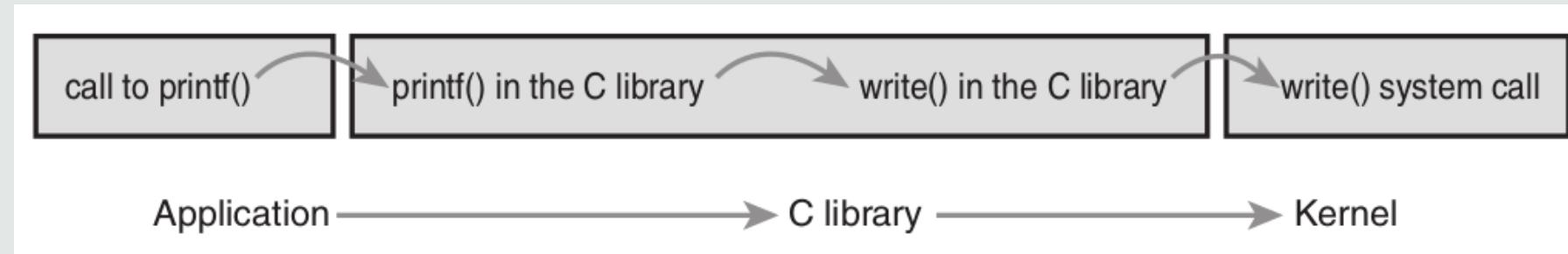
E.g.

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

- Win32 API: windows.h, Unix API (POSIX, IEEE Std 1003): unistd.h



For programming languages, these calls are wrapped by libraries

A few examples: Windows and Unix

9

	Windows	Unix
Process Control	CreateProcess() ExitProcess() WaitForSingleObject()	fork() exit() wait()
File Manipulation	CreateFile() ReadFile() WriteFile() CloseHandle()	open() read() write() close()
Device Manipulation	SetConsoleMode() ReadConsole() WriteConsole()	ioctl() read() write()
Information Maintenance	GetCurrentProcessID() SetTimer() Sleep()	getpid() alarm() sleep()

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder
CloseHandle()

SetConsoleMode()
ReadConsole()
WriteConsole()

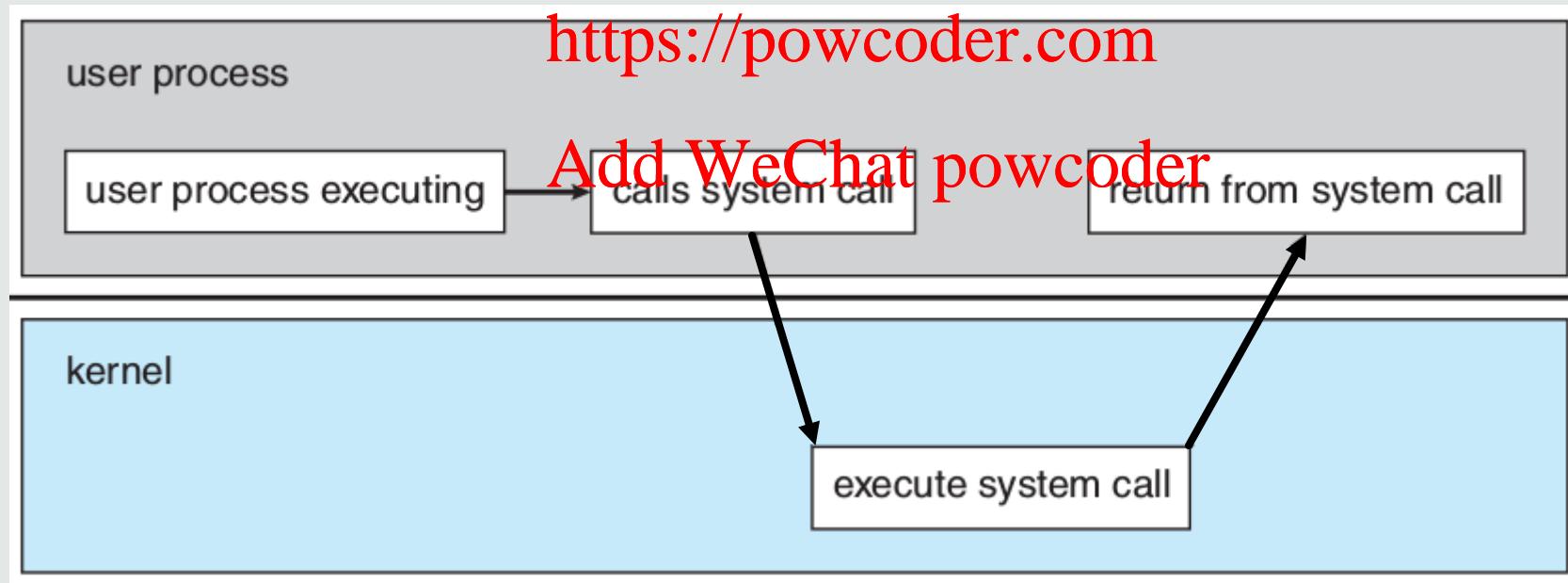
GetCurrentProcessID()
SetTimer()
Sleep()

How can we protect the OS?

10

Kernel Mode vs User Mode

- In principle, system calls execute in kernel mode



How to implement protection?

11

Kernel Mode vs User Mode

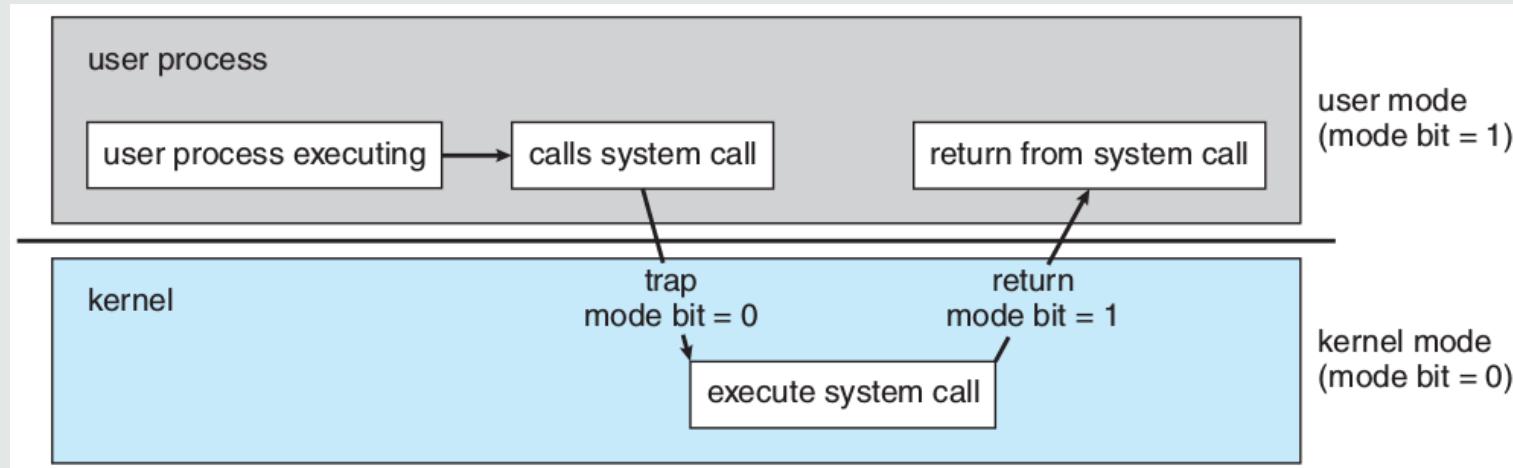
- How to implement security for kernel mode?

Assignment Project Exam Help

- Requires hardware support
- Disallows certain instructions in user mode
- trap instruction / exception: software-initiated interrupt

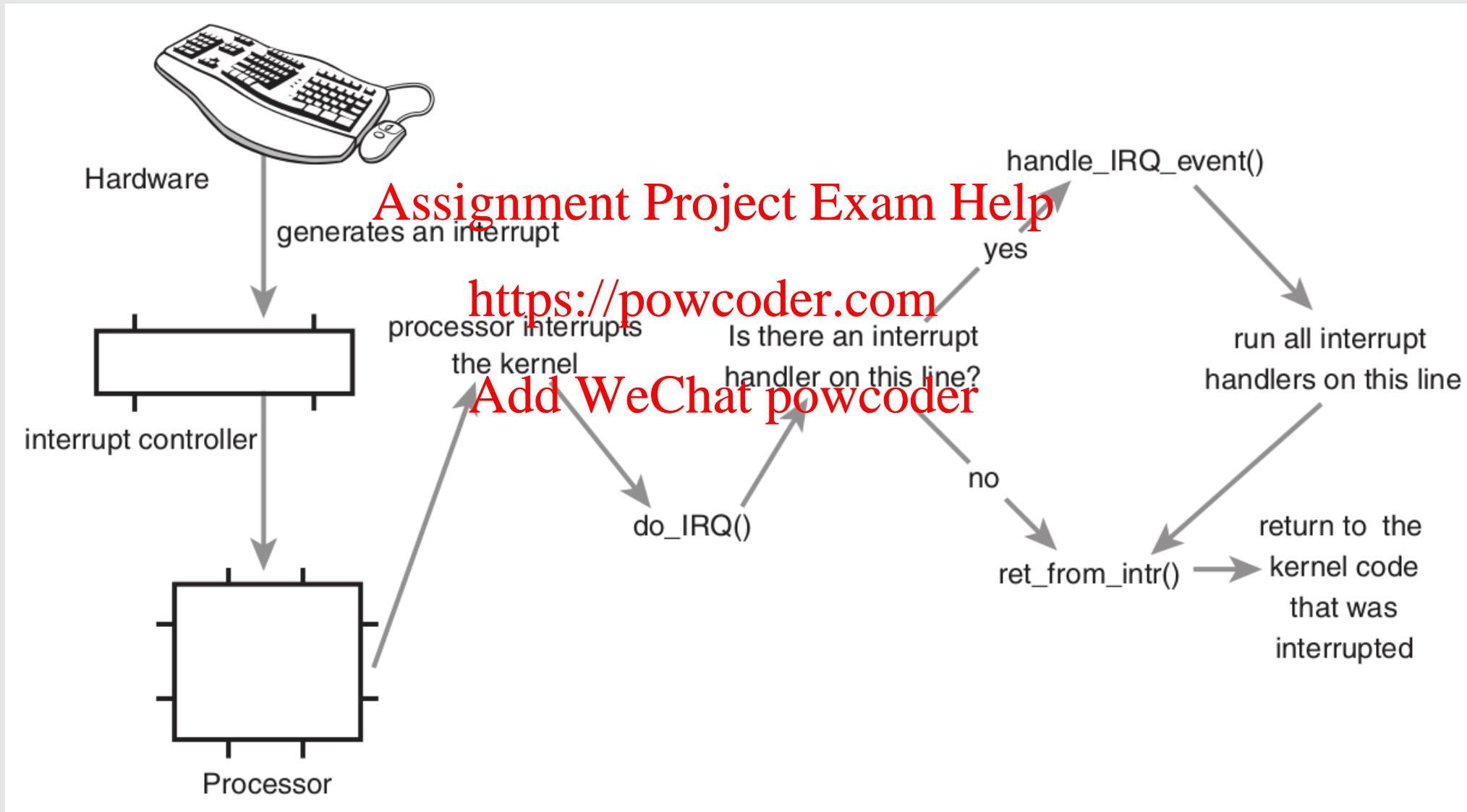
<https://powcoder.com>

Add WeChat powcoder



Quick recap: Interrupts

12



UNIX SC **read (fd, buffer, size)**

- fd: The file to read from (file handle) **Assignment Project Exam Help**
- buffer: Memory address to store the data in **https://powcoder.com**
- size: number of bytes to be read **Add WeChat powcoder**
- Returning a number ≥ 0 : bytes read
- Returning -1: there was a problem!

System call example

14

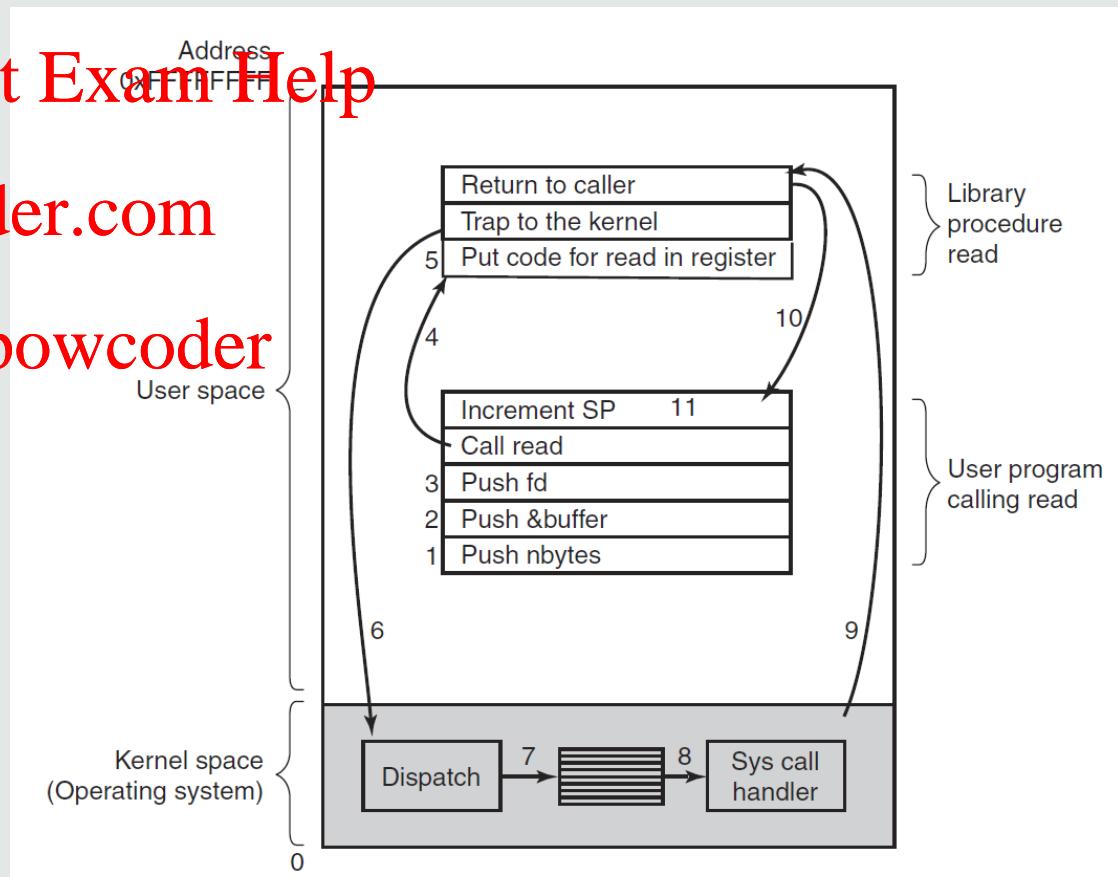
UNIX SC **read (fd, buffer, size)** - sequence

- 1, 2, 3: Push parameters onto system stack
- 4: Call the library procedure *read*
- 5, 6: Place this system call in a special register and call trap to switch modes
- 7, 8: Run correct system call handler
- 9: Pass control back to the user space procedure
- 10: Return to user program
- 11: Increment stack pointer
- ... next instruction

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder



Why the need for an architecture?

- Modern operating systems tend to be complex because
 - They provide many services and have many functions
 - There is a wide range of hardware that must be supported

Add WeChat powcoder

Architectures help us cope with complexity

Separation of interface and implementation

- Interfaces should be simple, complete, and stable;
A published interface is hard to change
- Encapsulation: keep internal details opaque
E.g. indirection via naming

<https://powcoder.com>
Add WeChat powcoder

Separation of policy and mechanism

- Policy: The what
- Mechanism: The how
- Mechanism should be general and efficient
- Orthogonality: concepts can be combined independently

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Portability

- Hardware abstraction layer
- Word sizes, endianness, alignment, time, etc.

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Coherence

- Adherence to coding conventions
- Operating systems are huge software development projects that often stretch over many years

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Languages used

- IBM 360: Assembly language
- MULICS: PL/1
- Linux, Windows: Mostly C (plus small parts in Assembly language)

Assignment Project Exam Help

<https://powcoder.com>

Why not just implement everything in Assembly language?

Add WeChat powcoder

Layers

- Each layer provides a service interface
- Higher layers use services of lower layers

Assignment Project Exam Help
<https://powcoder.com>
Add WeChat powcoder

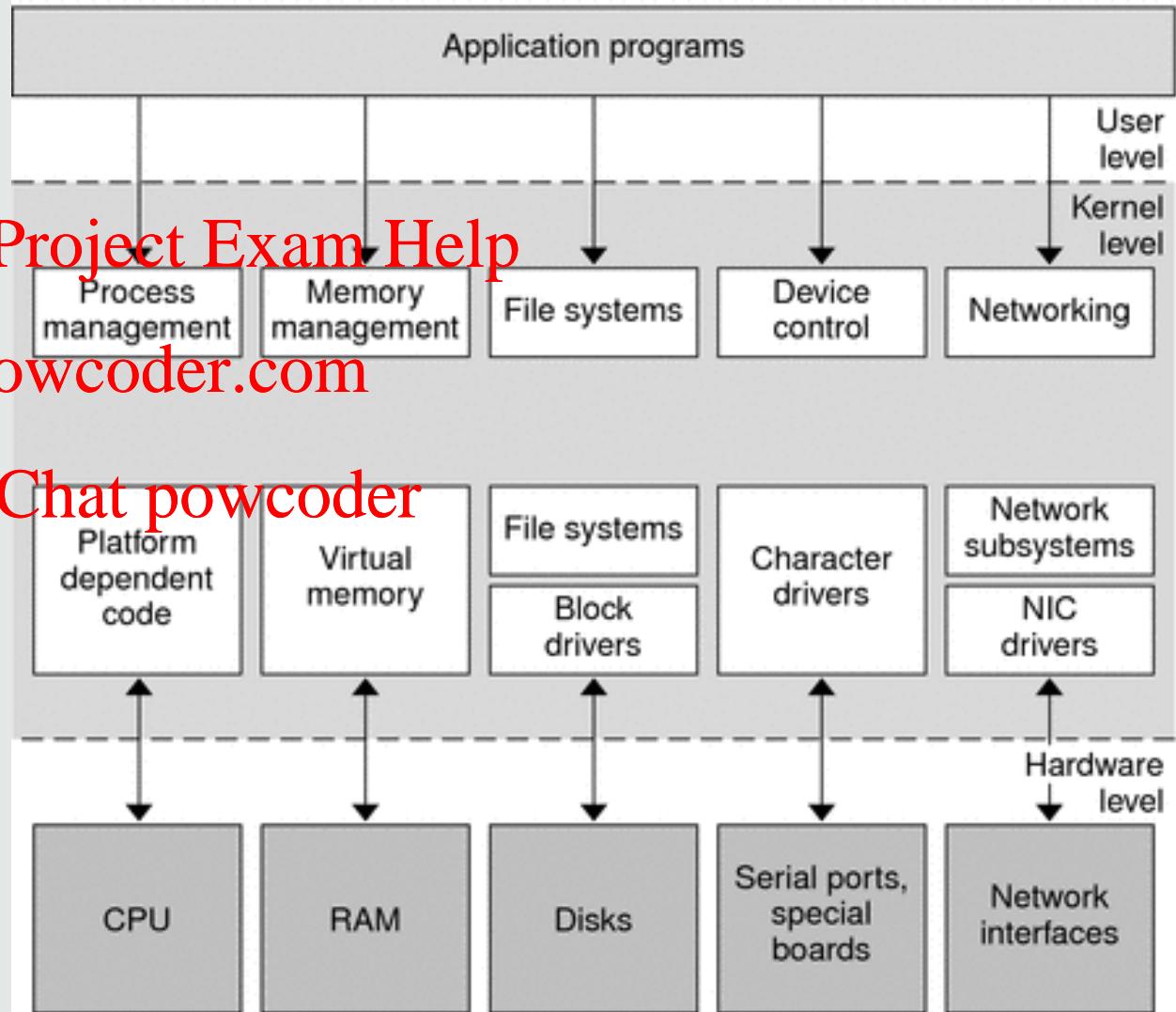
7	System call handler			
6	File system 1	File system m
5	Virtual memory			
4	Driver 1	Driver 2	...	Driver n
3	Threads, thread scheduling, thread synchronization			
2	Interrupt handling, context switching, MMU			
1	Hide the low-level hardware			

Modules

- Each module provides a service interface
- Modules support encapsulation and can be replaced and changed easily
- Potentially complex dependencies

Assignment Project Exam Help
<https://powcoder.com>

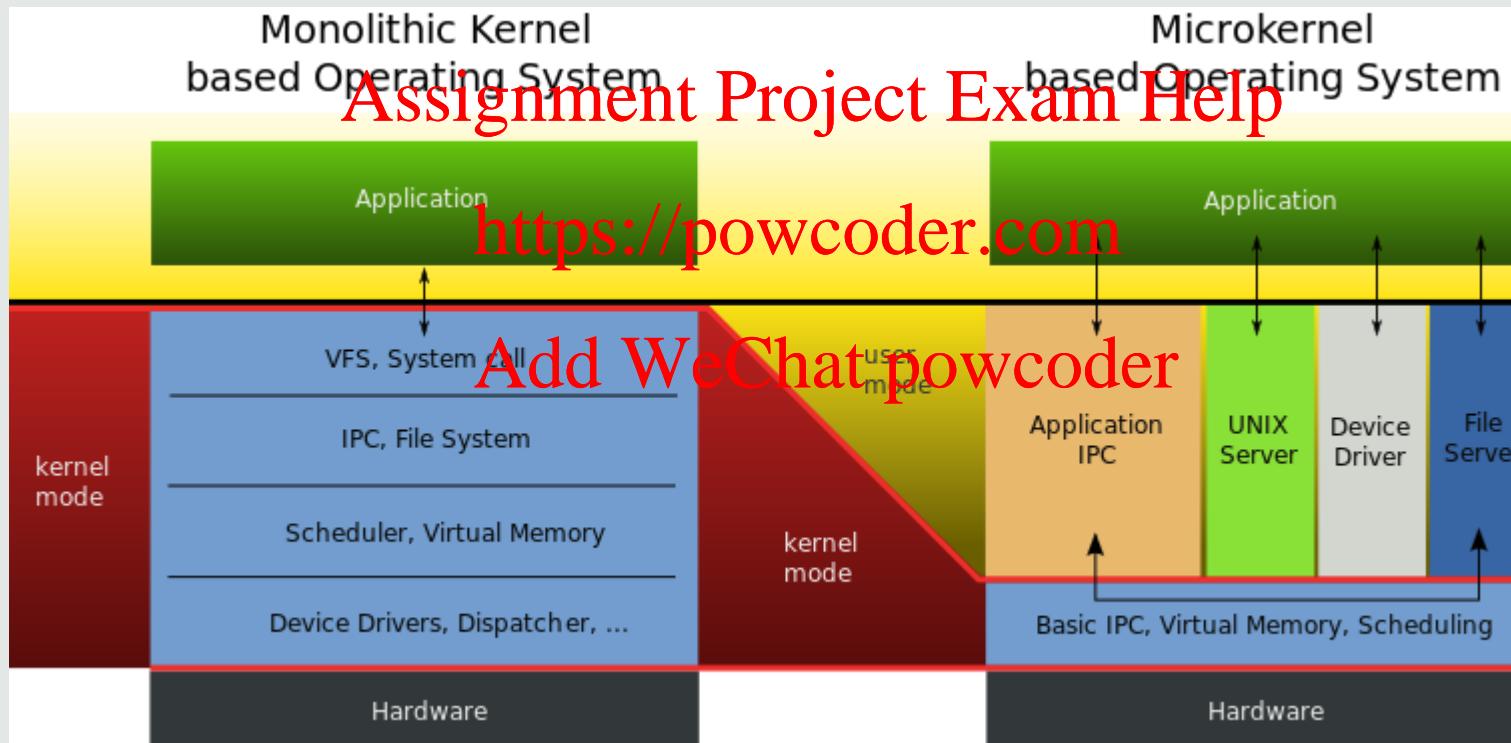
Add WeChat powcoder



Monolithic Kernel vs. Microkernel

23

Overview



Entire operating system runs in kernel mode

- All components can talk directly to each other
- Extending the operating system can be difficult
- Good performance but errors can be difficult to trace

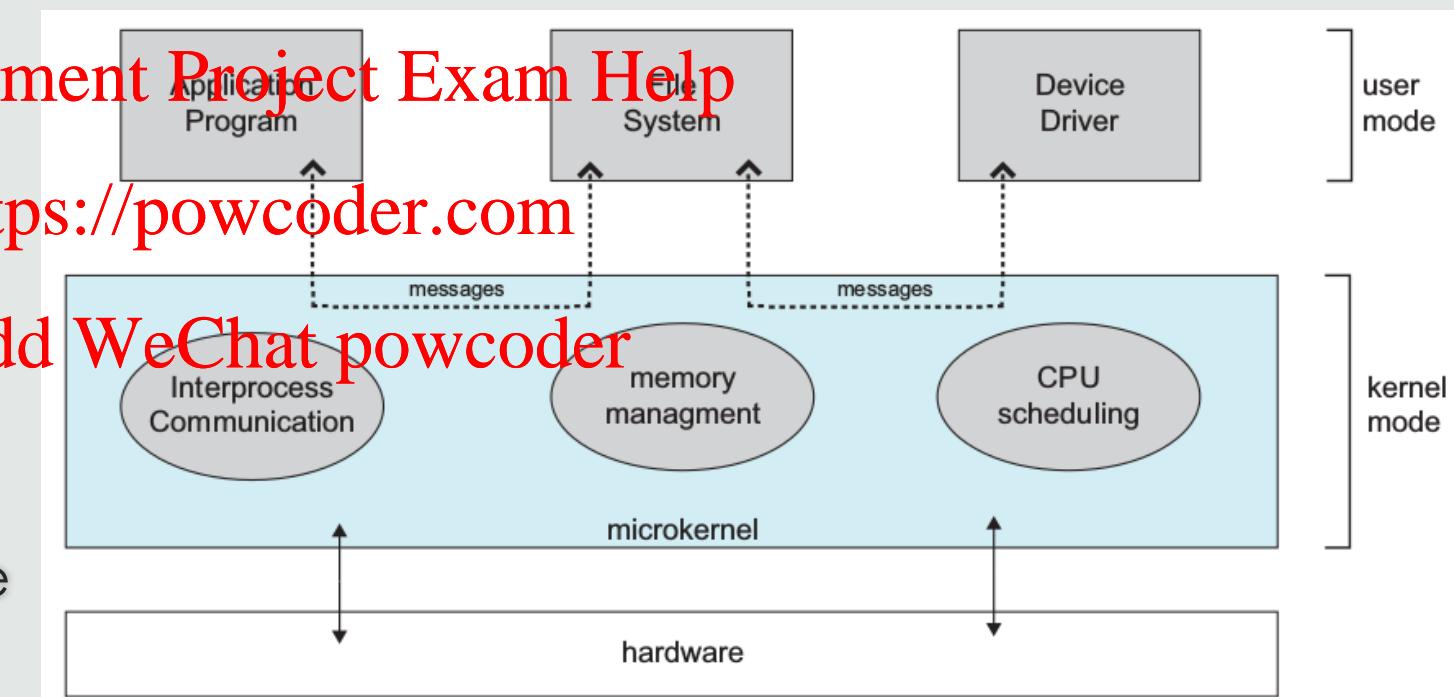
Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Kernel provides minimal services

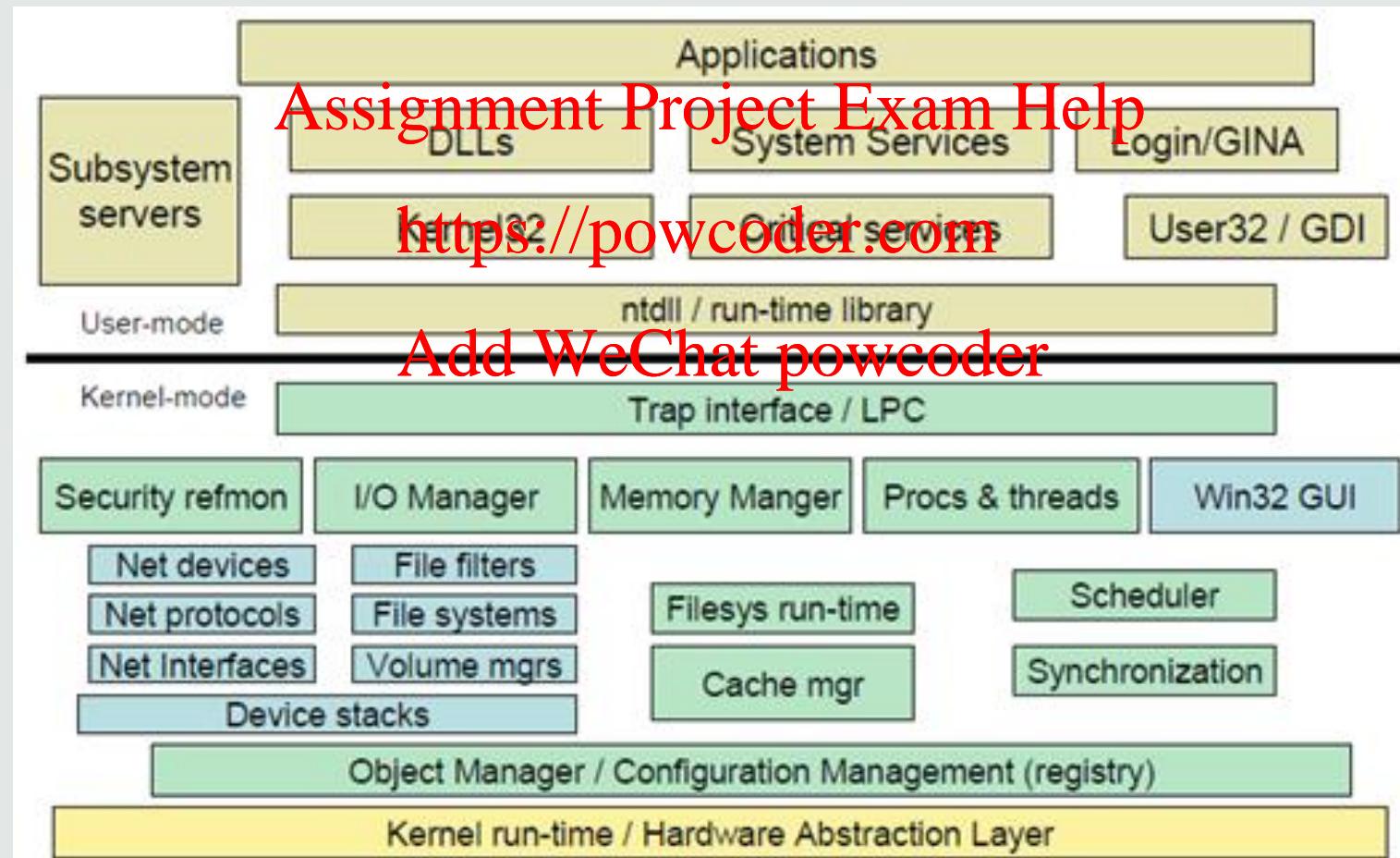
- A lot of message-passing communication (impact on performance)
- Very general mechanisms that allow a wide range of policies to be implemented
- Modules run in user mode
- Extensible, portable, scalable



What type of architecture is this?

26

Example: Windows NT



What type of architecture is this?

27

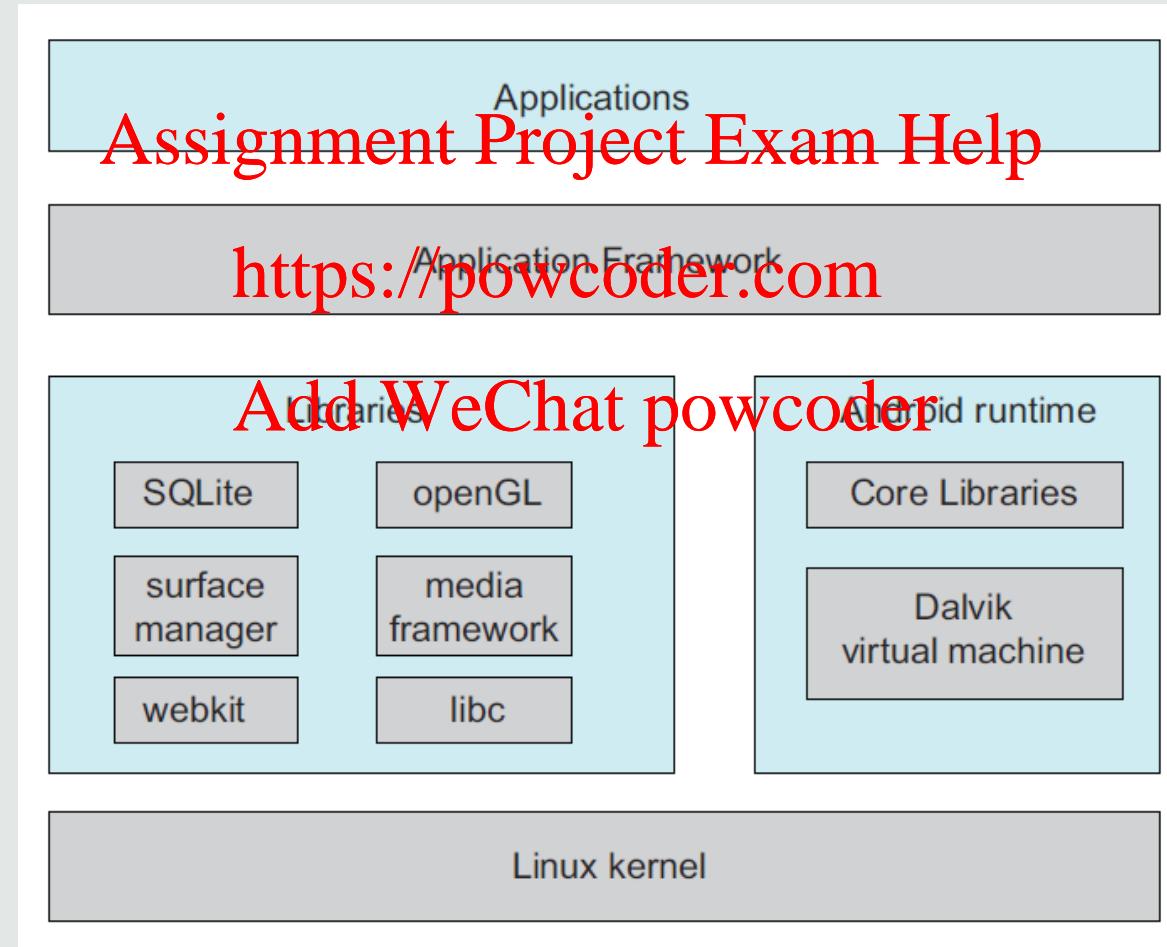
Example: UNIX



What type of architecture is this?

28

Example: Android



What type of architecture is this?

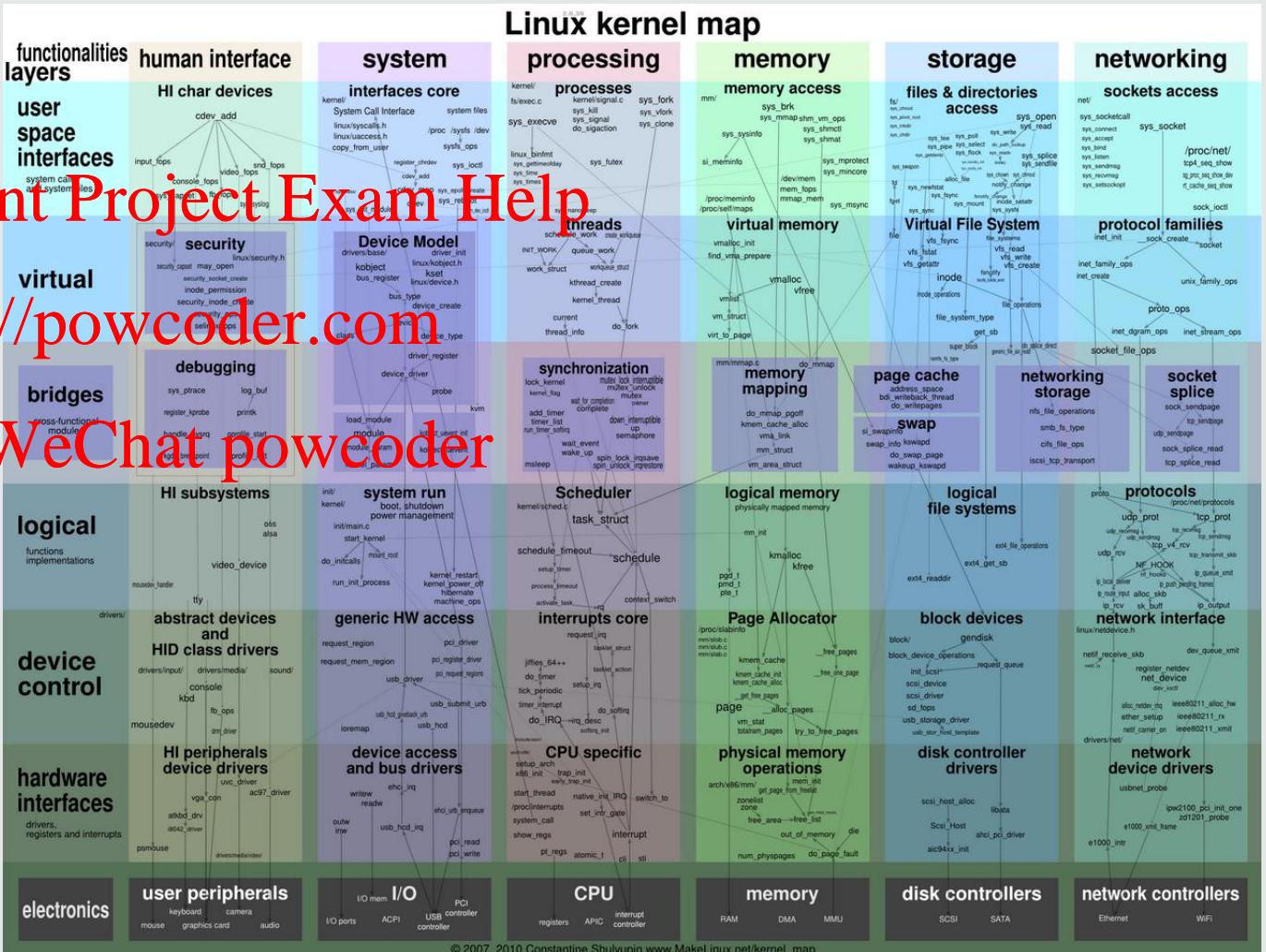
29

Example: Linux

- Interactive map of the Linux kernel (explore on Study Direct)

Assignment Project Exam Help
<https://powcoder.com>

Add WeChat powcoder



© 2007, 2010 Constantine Shulyupin www.MakeLinux.net/kernel_map

Operating system architectures

- Abstractions
 - Processes
 - Virtual memory
 - Files
 - System call interface

Assignment Project Exam Help

- Basic design principles
 - Separation of interface and implementation
 - Separation of policy and mechanism
- <https://powcoder.com>
- Add WeChat powcoder
- Portability
 - Coherence

- Basic architectures
 - Layers & modules
 - Monolithic kernels
 - Microkernels

- Tanenbaum & Bos., Modern Operating Systems

- Chapter 1

Assignment Project Exam Help

- Silberschatz et al., Operating System Concepts

- Chapter 2

Add WeChat powcoder

- For your labs next week, review the basic content on

Microarchitectures, Assignment Project Exam Help

Instruction set architectures,

Machine code and

Assembly language

<https://powcoder.com>

Add WeChat powcoder

from your Year 1 module "Introduction to Computer Systems".

- Don't forget to work on your question sheet!

- Introduction
 - Operating System Architectures
 - **Processes**
 - Threads
 - Process Scheduling
 - Process Synchronisation
 - Deadlocks
 - Memory Management
 - File Systems
 - Input / Output
 - Security and Virtualisation
- Assignment Project Exam Help**
- <https://powcoder.com>
- Add WeChat powcoder