

Operating Systems

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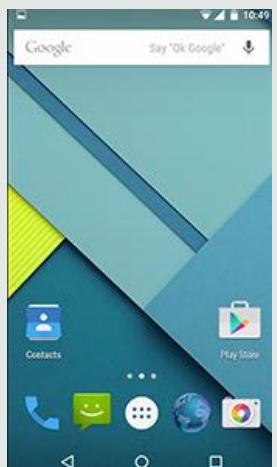
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Lecture 1a

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Operating System – What's that again?

1

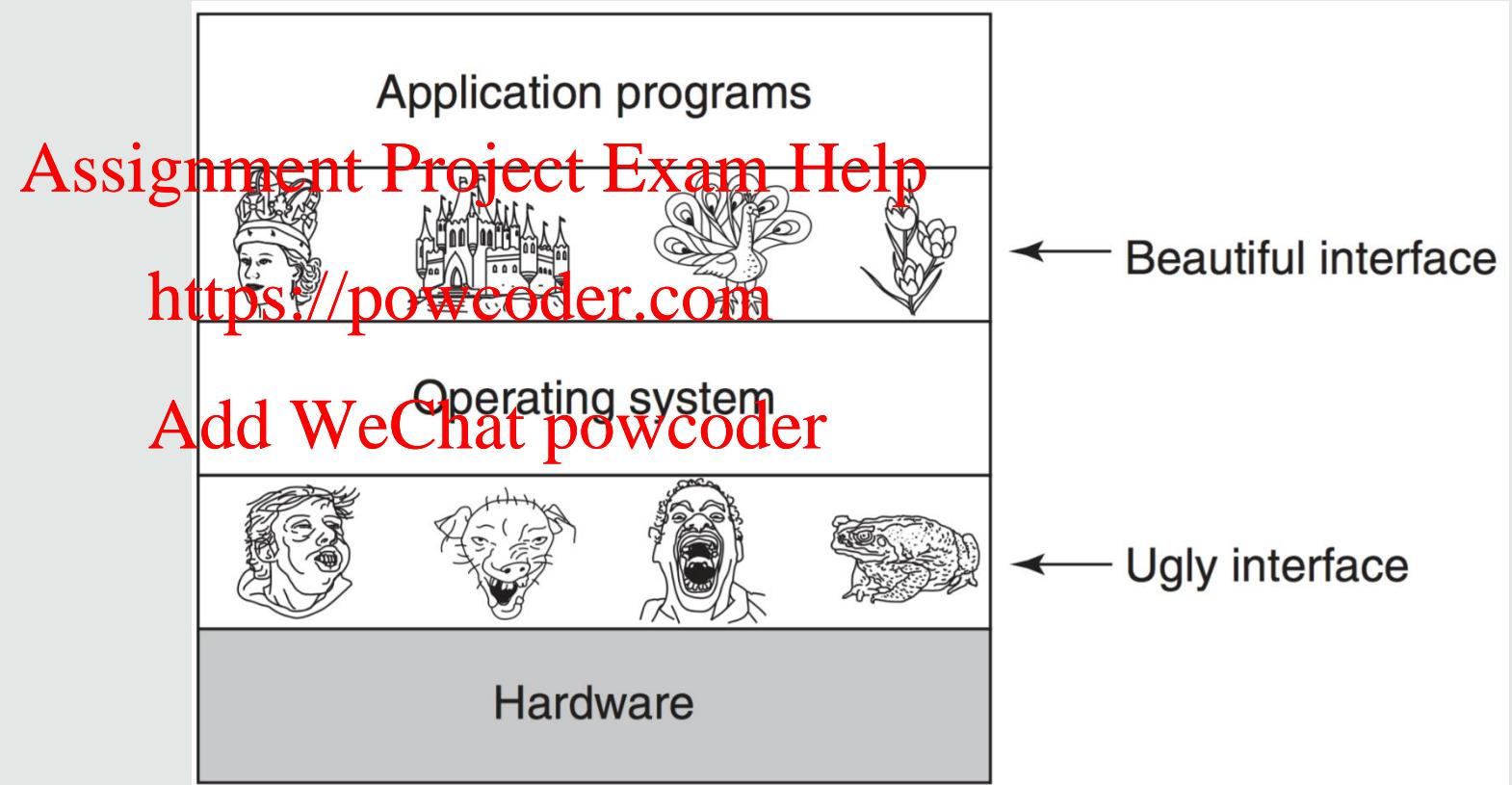


- A piece of software (virtual machine)
 - Provides abstractions from the hardware
 - Provides the basic services for running other programs
- Assignment Project Exam Help**
- Gives us a user interface (the shell or GUI)
 - Provides a programming interface (e.g., system calls)
 - Protects any running programs (including itself)



Operating System – What's that again?

2

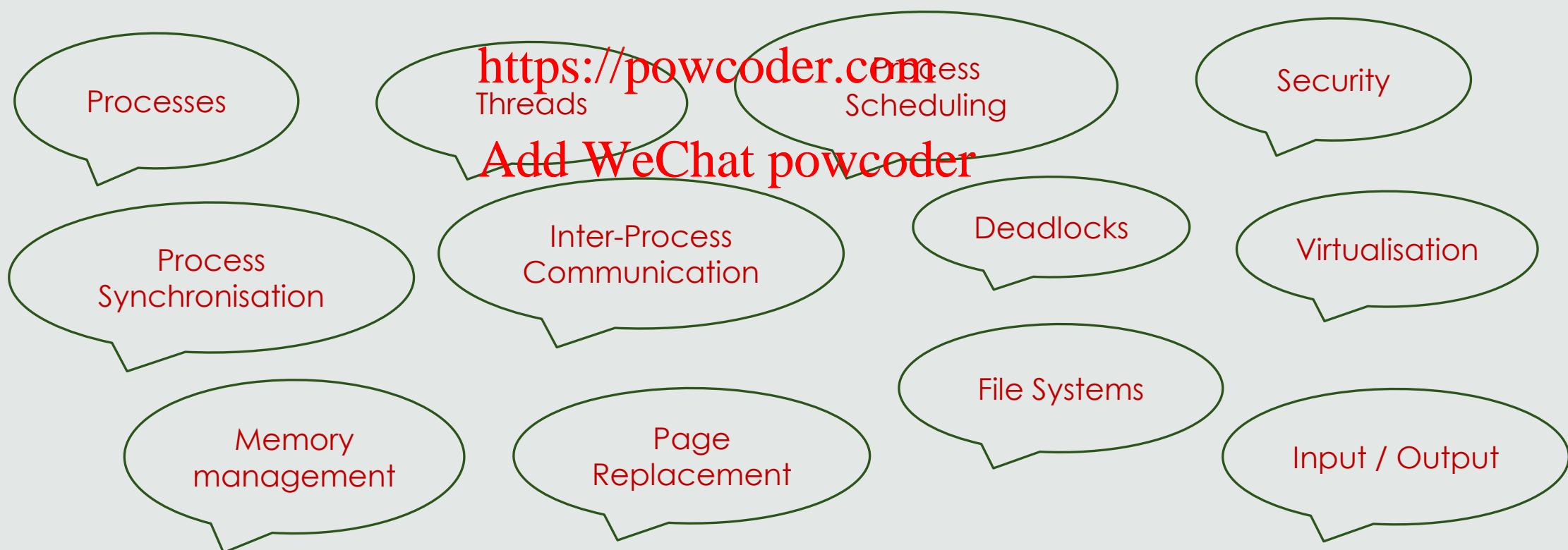


Module Overview

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- Identify the main components of an operating system; understand their basic function.
- Understand and critically assess concepts and processes related to these components.
- Implement some operating system functions in software

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Module Prerequisites

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- Introduction to Computer Systems
- Programming Concepts
- Further programming

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About Myself

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Ron Grau

School of Engineering and Informatics **Assignment Project Exam Help**

Department of Informatics

<https://powcoder.com>

Office: Chichester II, 2R 209 **Add WeChat powcoder**

Office hour: Tuesday 12pm – 1pm

Friday 3pm – 4pm

(Appointments by e-mail)

E-mail: r.r.grau@sussex.ac.uk

Teaching Sessions

- **Two lectures per week (FULTON B)** – led by me

- Tuesday 11am
- Friday 11am

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- **One lab class per week (CHI1 014/015)** – led by Mohammed Alasmar

- Monday 1pm – 2pm, or
- Monday 2pm – 3pm, or
- Tuesday 1pm – 2pm, or
- Friday 9am – 10am, or
- Friday 10am – 11am

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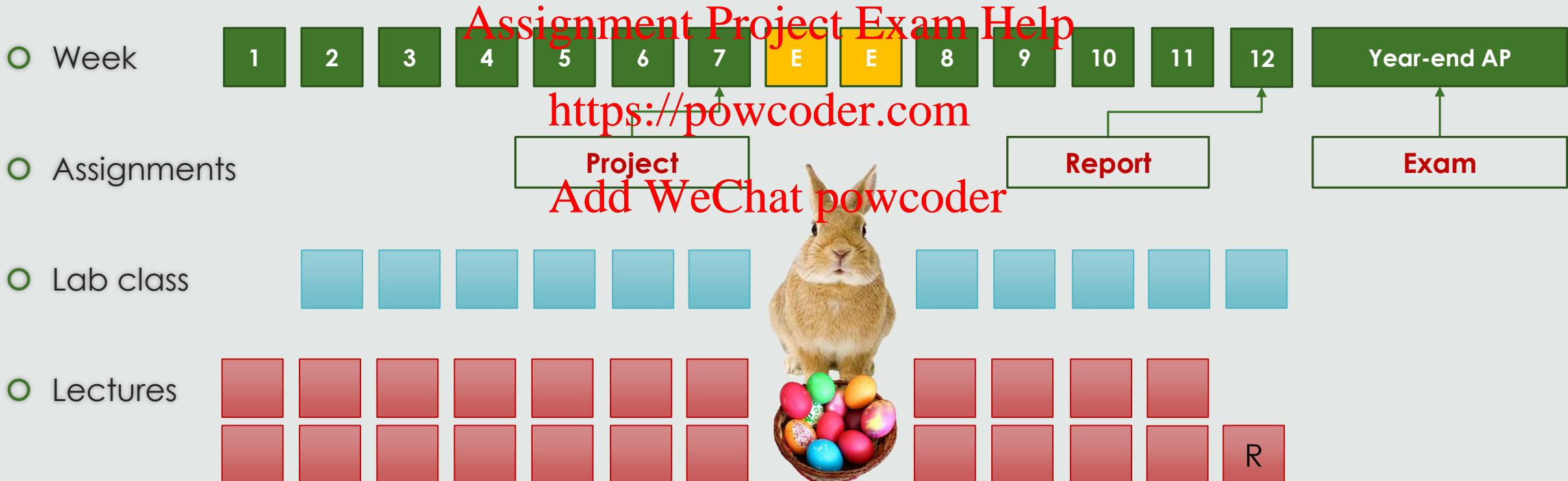
You will have been assigned to one of the above sessions – check your timetable for details.

Module Timetable

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Teaching: 6 February – 11 May

Laboratory class:
Lectures : CHI1 014/015 (Lab 2)
FULTON B



Module Assessment

- **Coursework (50% of total module marks)**

- Coursework 1 (70% share): Research project & report.
Due in week 7: Thursday 22 March, 4pm.
- Coursework 2 (30% share): Theoretical essay (1,500 words)
Due in week 12: Friday 11 May, 4pm.

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- **Unseen exam (50% of total module marks)**

- Date TBA

Make sure to always double-check assessment deadlines in Sussex Direct.

How do I pass this module?

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- The lecture notes / recordings will give you relevant pointers, but you need to do more to succeed

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- Successful students will normally <https://powcoder.com>

- Do the suggested readings and attempt to solve the self-study questions every week
- Prepare for and attend lab classes regularly
- Brush up on their programming skills independently, if necessary
- Do the exercises BEFORE solutions are posted, and review their work afterwards
- Explore the additional material and readings independently
- Make an effort in their coursework assignments

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○ Core text

Tanenbaum & Bos:

Modern operating systems, 4th edition

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Physical copies in the library and online access

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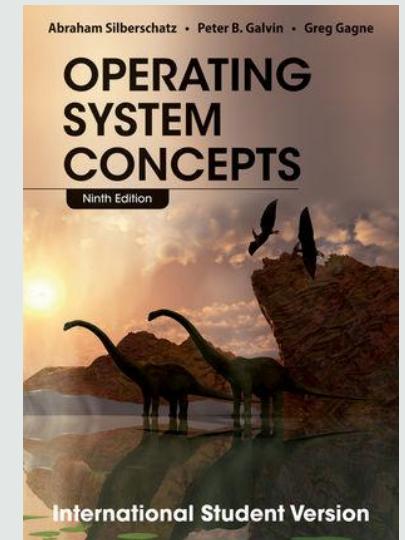


○ Recommended text

Silberschatz, Galvin & Gagne:

Operating system concepts, 9th edition

Physical copies in the library



- Optional / more in-depth reading

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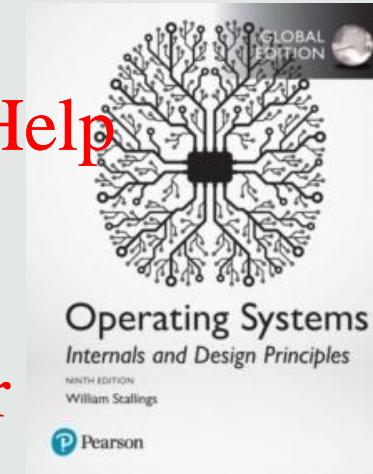
Stallings:

Operating Systems, Internals and Design Principles

<https://powcoder.com>

Physical copies of the third edition in the library
(latest: ninth ed.)

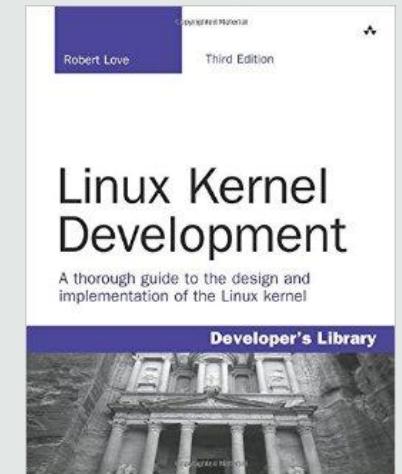
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Love:

Linux Kernel development

Physical copies of the third edition in the library
and online access to an older edition



- **QEMU**

Virtualisation platform for simulating different hardware devices and operating systems

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- **Netbeans / Java** (majority of programming tasks)

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For implementing different operating system parts, also for the first coursework assignment

- **Others** (incidental)

Notepad++ / NASM compiler: Assembly language

Notepad++ / gcc compiler: C

Today: A brief introduction to operating systems

- A bit of history
 - Ancient (20th century) systems
 - Batch monitors
 - Multi-programming and multi-tasking
 - PCs and GUIs
 - Mobile devices

- Basic concepts
 - Abstraction
 - Resources
 - Protection

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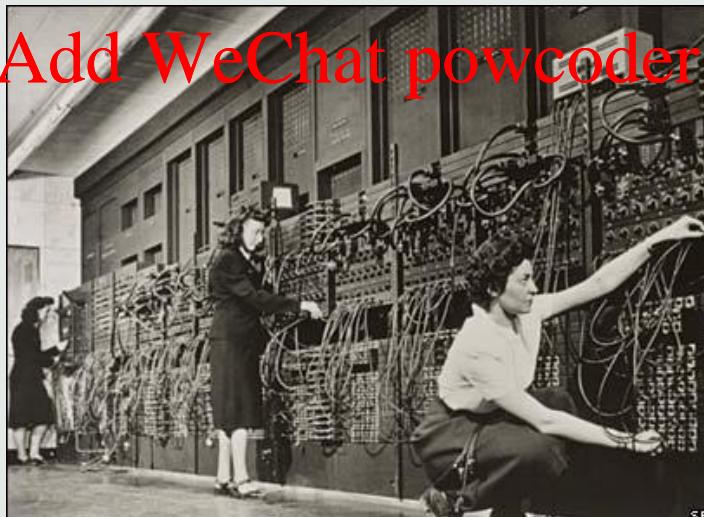
A bit of history

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Humble beginnings: Relays and vacuum tubes

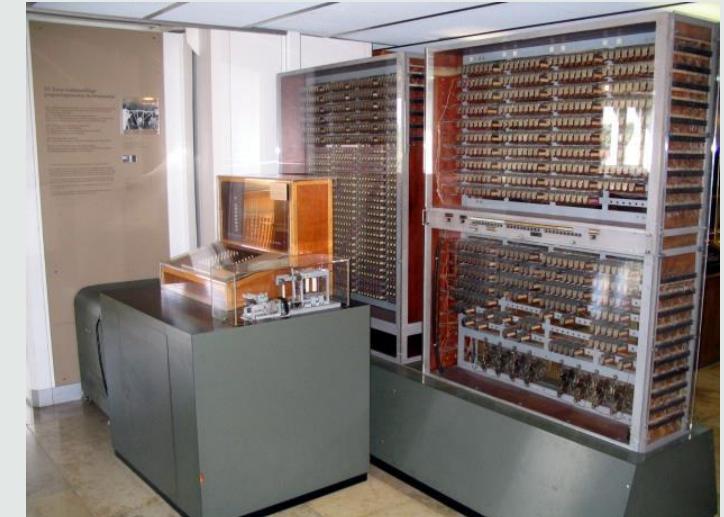
- 1930s – 1960s digital computers
- Directly programmed with punched cards or by placing wires to connect to the machine's internal functions
- No operating systems

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ENIAC

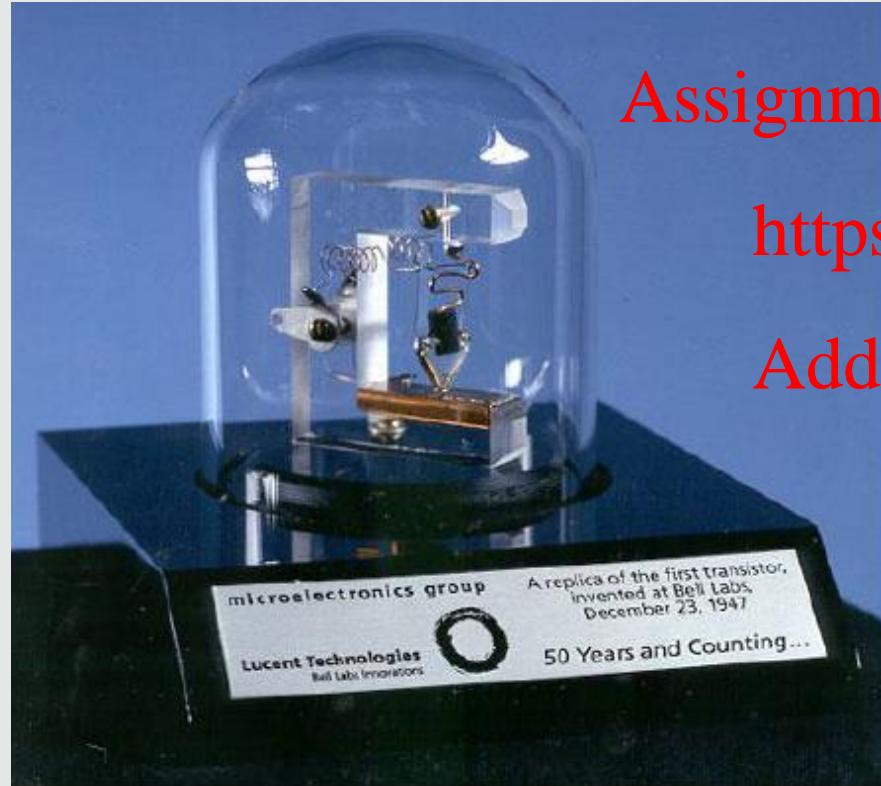


ZUSE Z3

A bit of history

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Then, this happened:



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A bit of history

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Batch systems

- Invention of the transistor allowed miniaturisation, and eventually, integrated circuits
- 1950s&60s mainframe systems could cost millions of \$\$\$
- Simple operating systems for batch processing
- First programming languages (e.g., FORTRAN)



An IBM 360 mainframe

A bit of history

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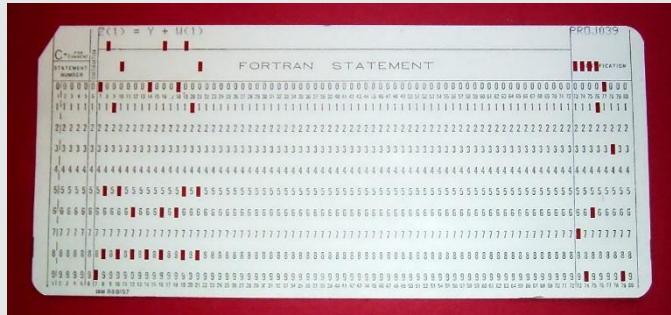
Batch systems

- Instructions on punched cards are copied onto tape and then processed by the computer in a “batch”
- Results are then printed out

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A punched card



An IBM 360 rig in action

A bit of history

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Commercial successes

- Integrated circuits become more widespread
- Minicomputers become more affordable for businesses to use
- Still, we're pushing buttons to enter machine code directly

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PDP “Mini” computer console



Not really “Mini” by today’s standards

A bit of history

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The problem with batch monitors

- System resources are not efficiently used

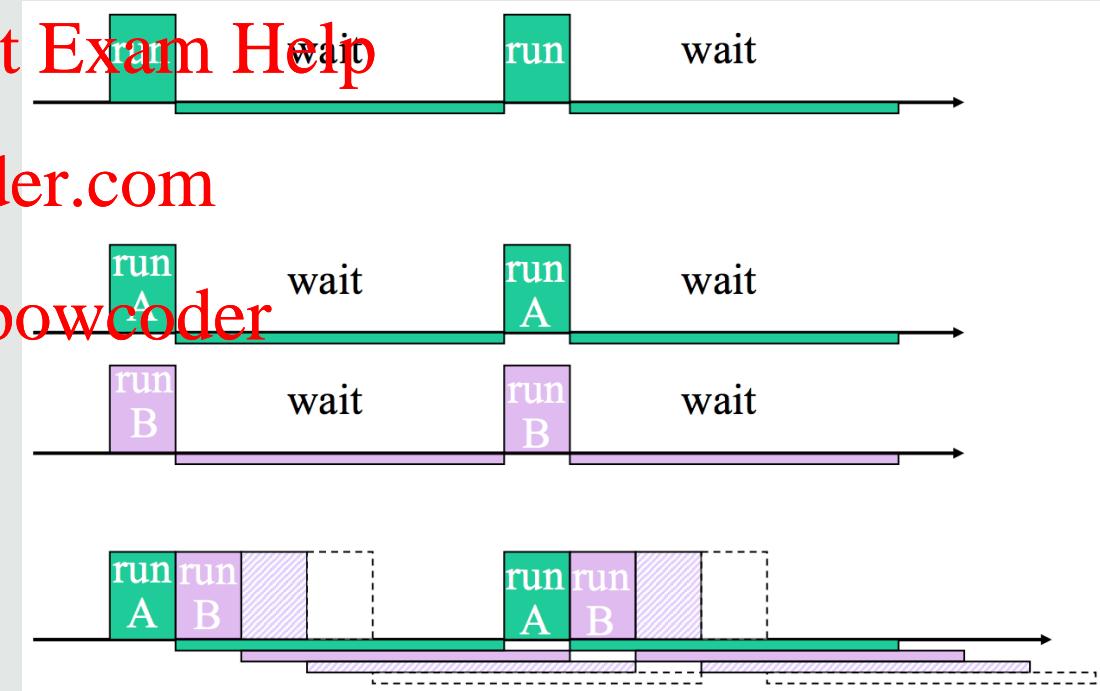
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e.g., idle CPU during I/O operations

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- What can we do?

Multi-programming is a solution
but brings additional problems
(e.g., scheduling, data integrity)



A bit of history

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Time-sharing and multi-tasking

- 1970s terminals – interactive computing systems
- Multiple users share centralised resources, using relatively cheap terminals <https://powcoder.com>
- Operating systems needed to handle a lot of I/O data and coordinate processing
- Responsiveness is assured by time-sharing
- Today, the general concept has been revived in cloud- and remote-computing, and more generally, Software-as-a-Service (SaaS) scenarios.



Tip: Read about the story of MULTICS (Further resources on Study Direct)

A bit of history

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From Mini to Micro: meet the personal computer

- We're in the 1980s – Assignment Project Exam Help affordable for small businesses and home users
- IBM asks the newly founded Microsoft company to outfit their new IBM PC with MS-DOS (Microsoft Disk Operating System) Add WeChat powcoder
- MS-DOS: hardware drivers & simple console shell
- Users enter commands with a keyboard
- Later, graphical user interfaces (GUI) became more common with Apple's Macintosh products and later also Microsoft's Windows 3 operating system, and others (e.g., IBM OS/2, Linux).



A bit of history

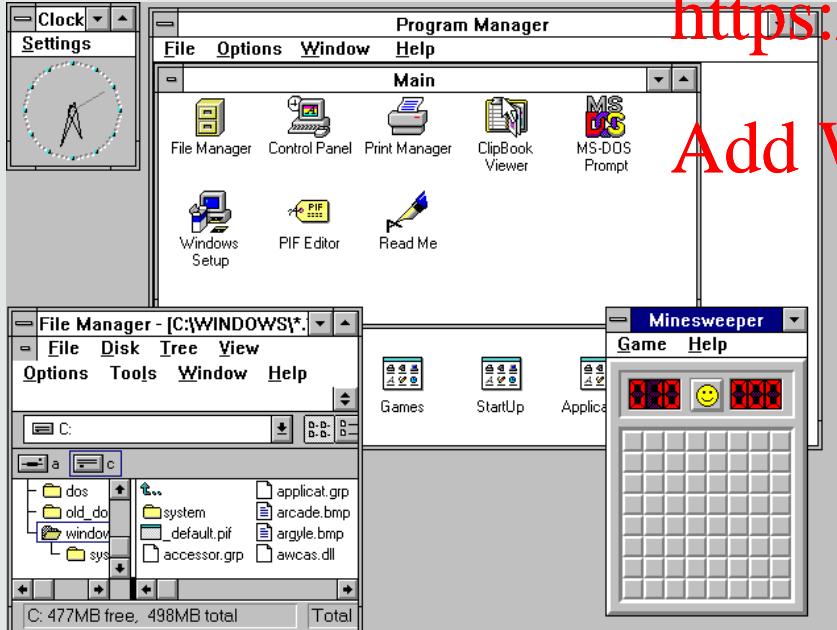
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Graphical shells

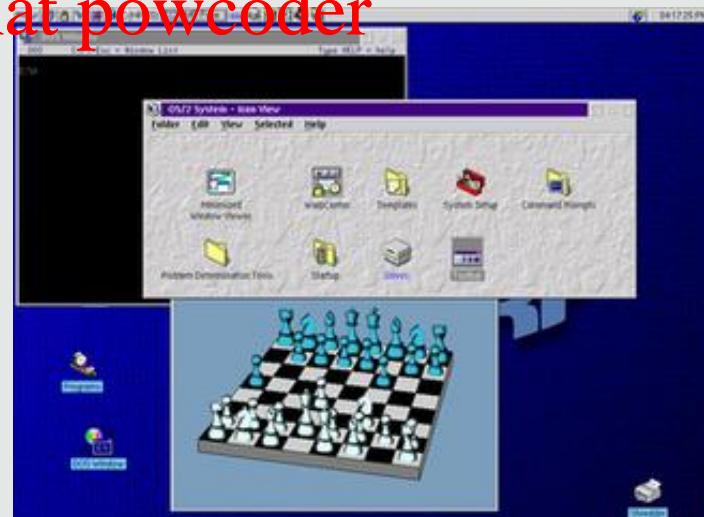
- The concept of a GUI with windows, icons, etc was originally developed by Xerox PARC

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<https://powcoder.com>

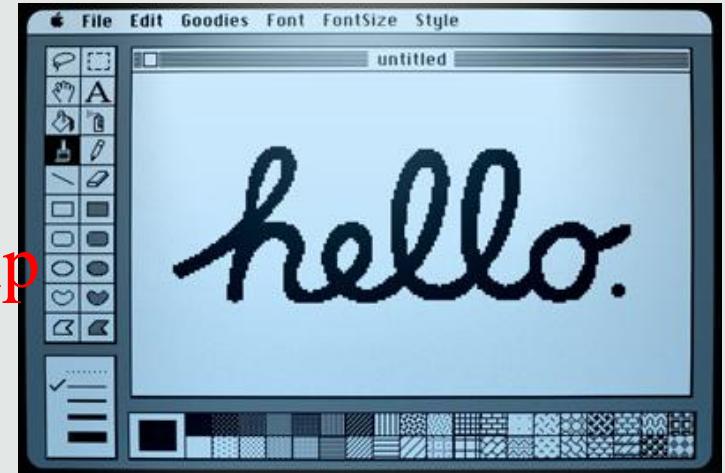
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Windows 3.1



OS/2



Macintosh

A bit of history

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Mobile devices

- Focus on networking and internet access
- “Smart” phones – different application focus and requirements
- Operating systems must adapt!

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Palm OS (1996)



Symbian OS (2000)



Blackberry (2002)



iOS (2007)



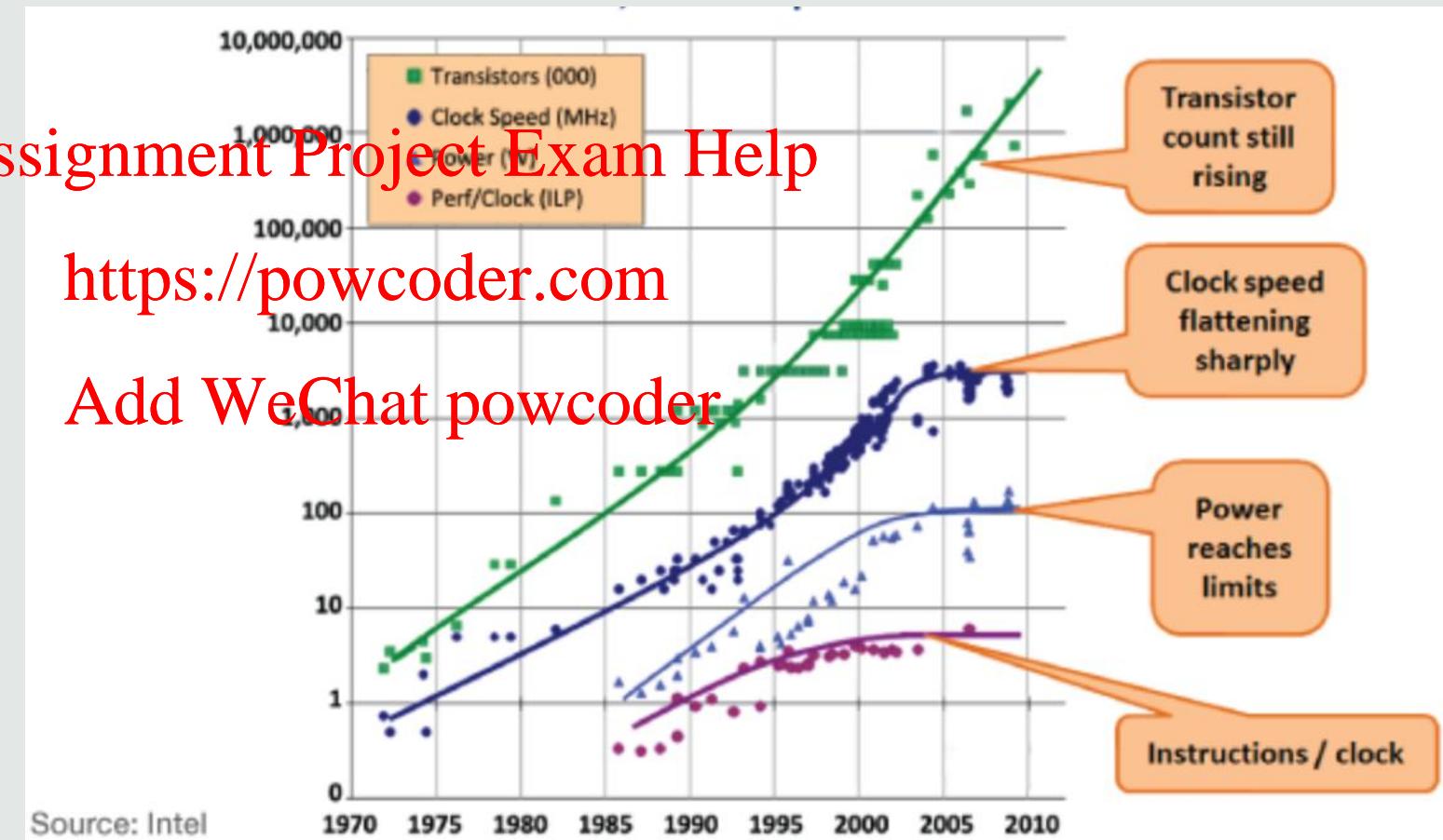
Android (2008)

A bit of history

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Moore's "Law"

- Current technologies & materials are hitting limits
- Other technologies emerge:
Parallel processing
GPUs
Computing clusters



What do operating systems do?

- Virtual machine abstraction

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- The pitfalls and dangers of multi-process scheduling and synchronisation are hidden from applications and these programs don't need to care about how they get access to resources – they are free to "think" that they have the computer for themselves (CPU, I/O, memory)

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- Portability: Programs can run on different hardware devices
- Different devices can support the same physical interfaces
- Multiple levels of abstraction (e.g., file systems) for better performance or security

What do operating systems do?

- **Resource allocation** Assignment Project Exam Help

- Request handling
- Conflict management

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- **Protection**

- From errors in programs
- From malicious software

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As a result, operating systems are pretty complex pieces of software.

Tip: Compare the code bases of different kinds of software (Further resources on Study Direct)

Today: A brief introduction to operating systems

- A bit of history:
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○ How operating systems came about and developed over time
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- A few basics about operating systems
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 - 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

- Tanenbaum & Bos., Modern Operating Systems

- Chapter 1
 - Chapter 12

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- Silberschatz et al., Operating System Concepts

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- Chapter 1
 - Chapter 2

Watch

- Lecture on Computers and Heuristics by Richard Feynman (1985)

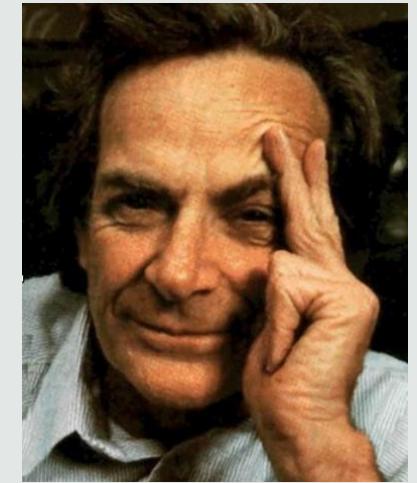
<https://www.youtube.com/watch?v=EKWGGDXe5MA>

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- “Dumber but faster” – on how computers work on the inside from the start, ca. 38 mins

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- Review the basic content on

Microarchitectures, Assignment Project Exam Help

Instruction set architectures,

Machine code and

Assembly language

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

- Introduction
 - **Operating System Architectures**
 - Processes
 - Threads
 - Process Scheduling
 - Process Synchronisation
 - Deadlocks
 - Memory Management
 - File Systems
 - Input / Output
 - Security and Virtualisation
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