Learning Objectives

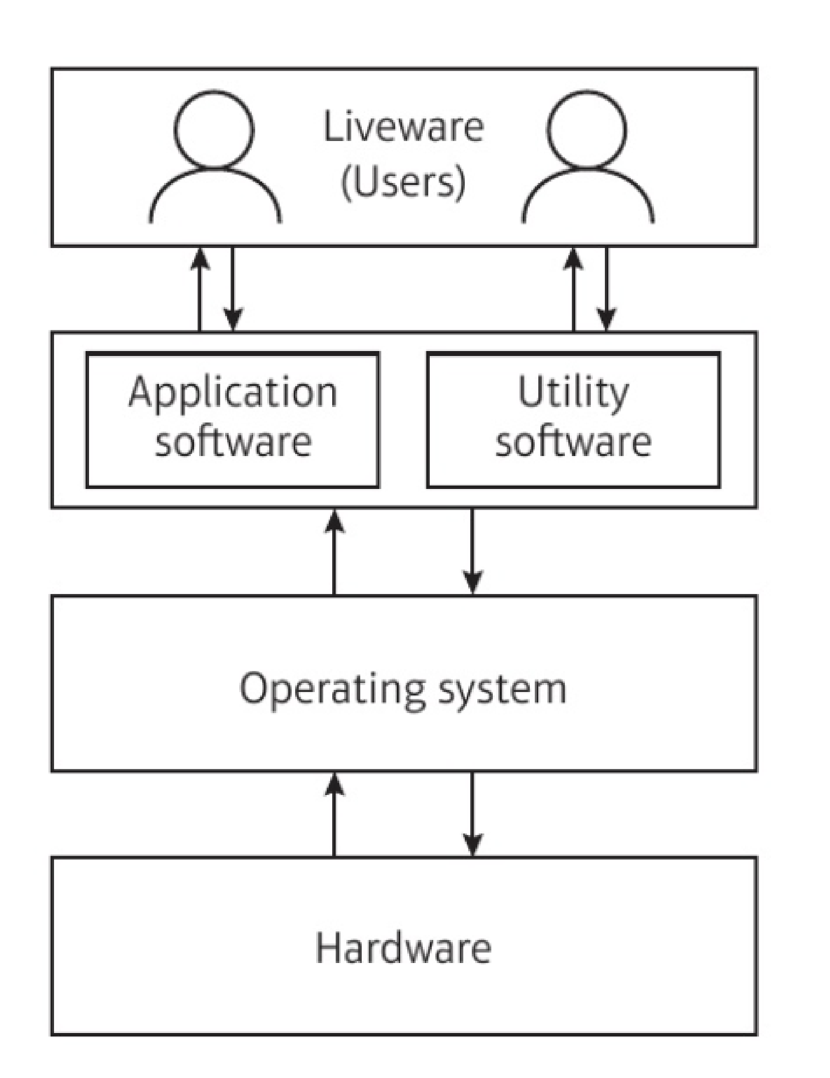
- Explain the purpose of an **operating system** and describe how it manages **files, process, peripheral devices and users**
- Describe how **utility software** tools are used for file repair, backup, data compression, disk defragmentation and protecting against malware
- Explain why it is important to develop **robust software** and describe how audit trails and code reviews help to identify code vulnerabilities.

Operating systems main functions

- User interface
- User management
- File management
- Process management
- Memory management
- Peripheral management

What is software?

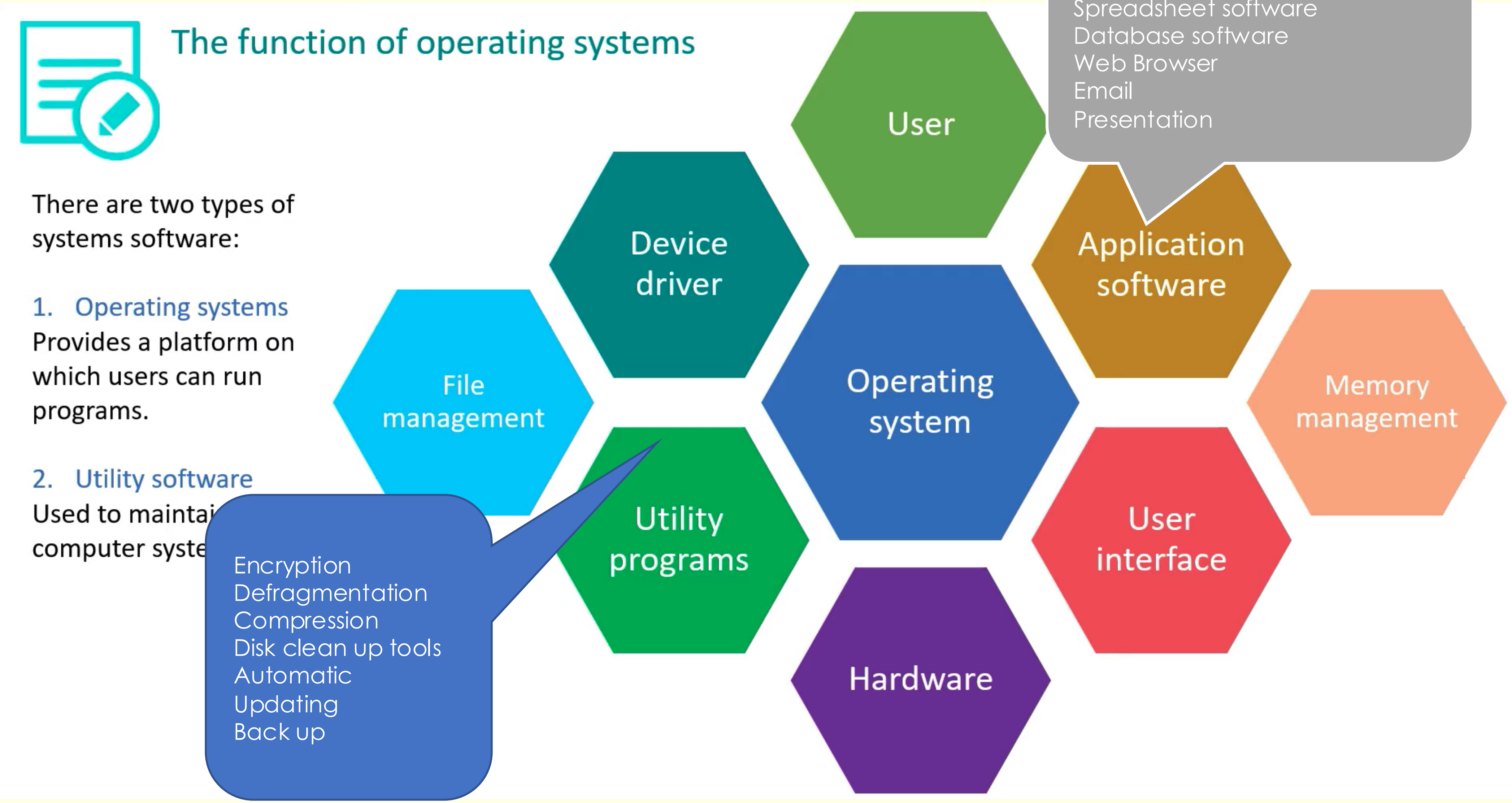
- Software is the set of programs that run on a computer system.
- Three types of software
- **Operating system** – a program that controls and manages the hardware and all other software on a computer and provides an interface for liveware(users).
- **Application software** - programs or apps designed for end users, such as a **web browser, spreadsheet, console game and email client.**
- **Utility software** – programs that add functionality to a computer system or improve its performance in some way, such **as disk repair, compression or anti-malware.**



Operating Systems

OS enables the hardware to communicate effectively with the software
Provides an interface for users to interface with the computer.

- ➢Microsoft Windows
- ➢Apple OS X
- ➢Linux
- ➢Android



The function of operating systems

There are two types of systems software:

1. Operating systems

Provides a platform on which users can run programs.

2. Utility software

Used to maintai

computer syste

User

Device driver

Application software

File management

Operating system

Memory management

Utility programs

User interface

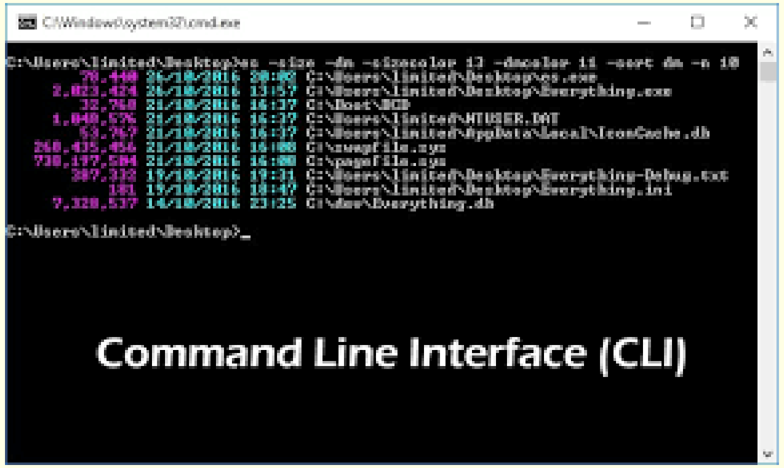
Hardware

Word processing software
Spreadsheet software
Database software
Web Browser
Email
Presentation

Encryption
Defragmentation
Compression
Disk clean up tools
Automatic
Updating
Back up

What is a user interface?

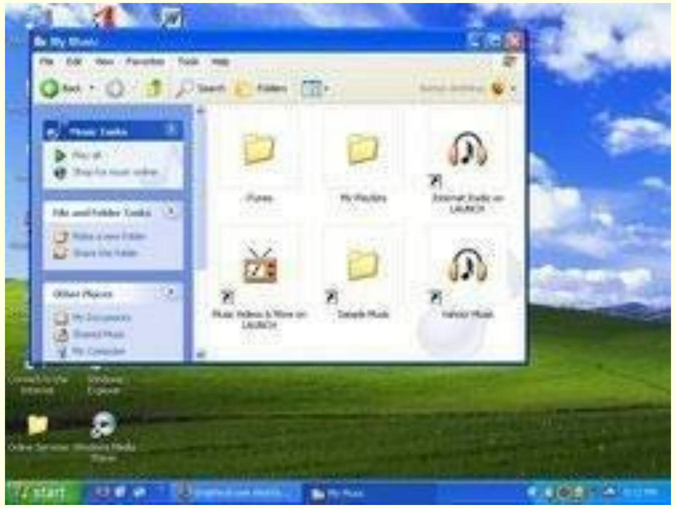
- A user interface is **how the user interacts with the operating system**
- Examples of user interfaces include:
  - **Command Line Interface (CLI)**
  - **Graphical User Interface (GUI)**
  - **Natural language (NLI)**



```
C:\Users\limited\Desktop>es -size -dm -sizecolor 13 -dmcolor 11 -sort dm -n 10
       78,440 26/10/2016 20:02 C:\Users\limited\Desktop\es.exe
    2,023,424 26/10/2016 13:57 C:\Users\limited\Desktop\Everything.exe
       32,768 21/10/2016 16:37 C:\Boot\BCD
    1,048,576 21/10/2016 16:37 C:\Users\limited\NTUSER.DAT
       53,767 21/10/2016 16:37 C:\Users\limited\AppData\Local\IconCache.db
  268,435,456 21/10/2016 16:00 C:\swapfile.sys
  738,197,504 21/10/2016 16:00 C:\pagefile.sys
      207,332 19/10/2016 19:31 C:\Users\limited\Desktop\Everything-Debug.txt
          181 19/10/2016 18:47 C:\Users\limited\Desktop\Everything.ini
    7,328,537 14/10/2016 23:25 C:\dev\Everything.db

C:\Users\limited\Desktop>_
```

Command Line Interface (CLI)



Interface	Advantages	Disadvantages
Command line (**CLI**) **Text based commands** **Advanced users**	•Uses less system resources •Useful for automation of tasks •Commands are often faster to type than navigating menus	•Requires users to remember commands •Typing errors are common •Less intuitive than GUI
Graphical (**GUI**) **Visual elements** such as windows, icons, menus & pointers (**WIMP**) GUIs are **optimised for mouse and touch gesture input**	•Intuitive and user-friendly •Requires no previous knowledge to use •Information is visual, making it easier to understand	•Uses more system resources •Can be slower to find and execute commands •Can be frustrating when doing repetitive tasks
Natural language (**NLI**) Spoken word to respond to spoken or textual inputs from a user Examples include: **Virtual assistants** - Amazon Alexa, Google Assistant, Siri **Search engines** **Smart home devices**	•Can be used by people with disabilities •Intuitive	•Not always reliable •Privacy concerns

What is user management?

- User management is a process carried out by the operating system **enabling different users to log onto a computer**
- User management includes:
  - **Adding** and **deleting** users
  - **Allocating** different **access rights** for different users on a network
  - **Authenticating** users
- The OS is able to **maintain settings for individual users**, such as desktop backgrounds, icons and colour schemes

File management

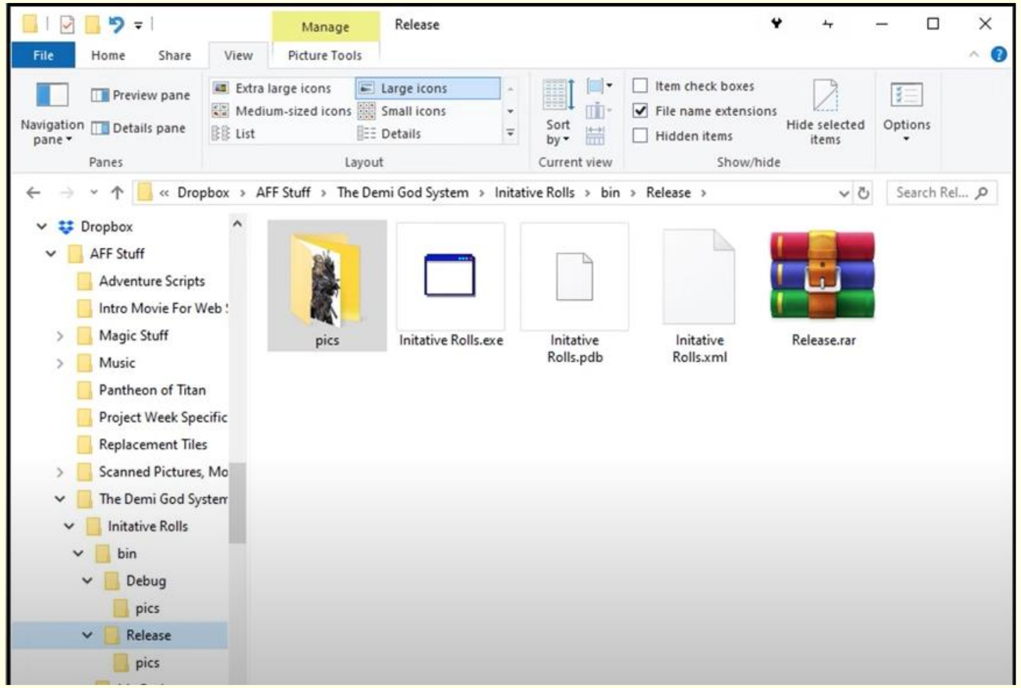
Organising and keeping track of files stored on a computer’s secondary storage.

OS provides a number of functions to manage their files and directories, such as, save, open, copy, duplicate, rename and delete.

File permissions

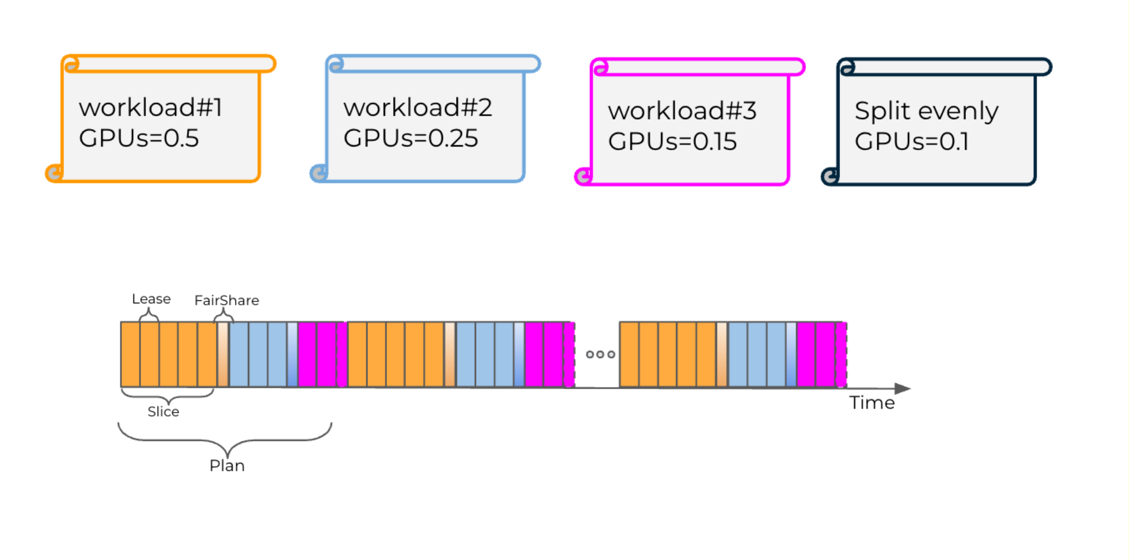
Used to control who can access a file and what they are allowed to do with it.

Read: uses can view
Write: uses can read and amend
Execute: can execute a file
Delete: users can delete a file



What is process management?

- Process management is a process carried out by the operating system **dividing time** (**time slicing**) in to small chunks and **allocating them to different processes**

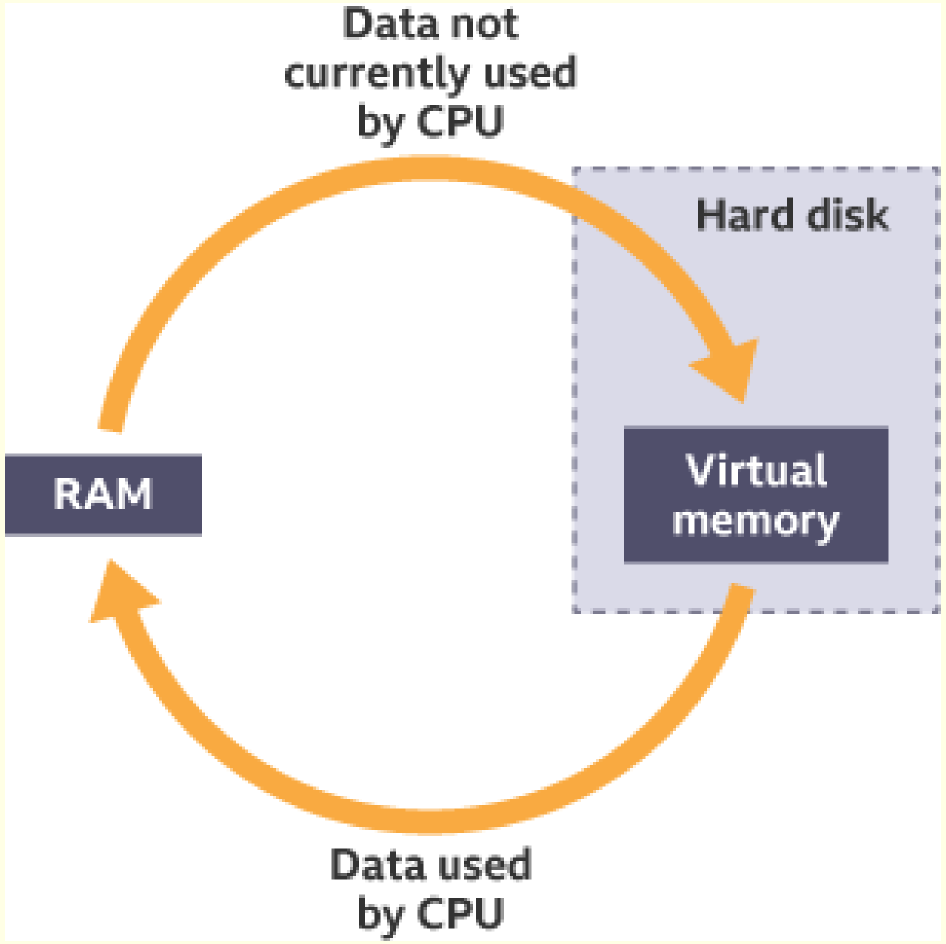


Multitasking

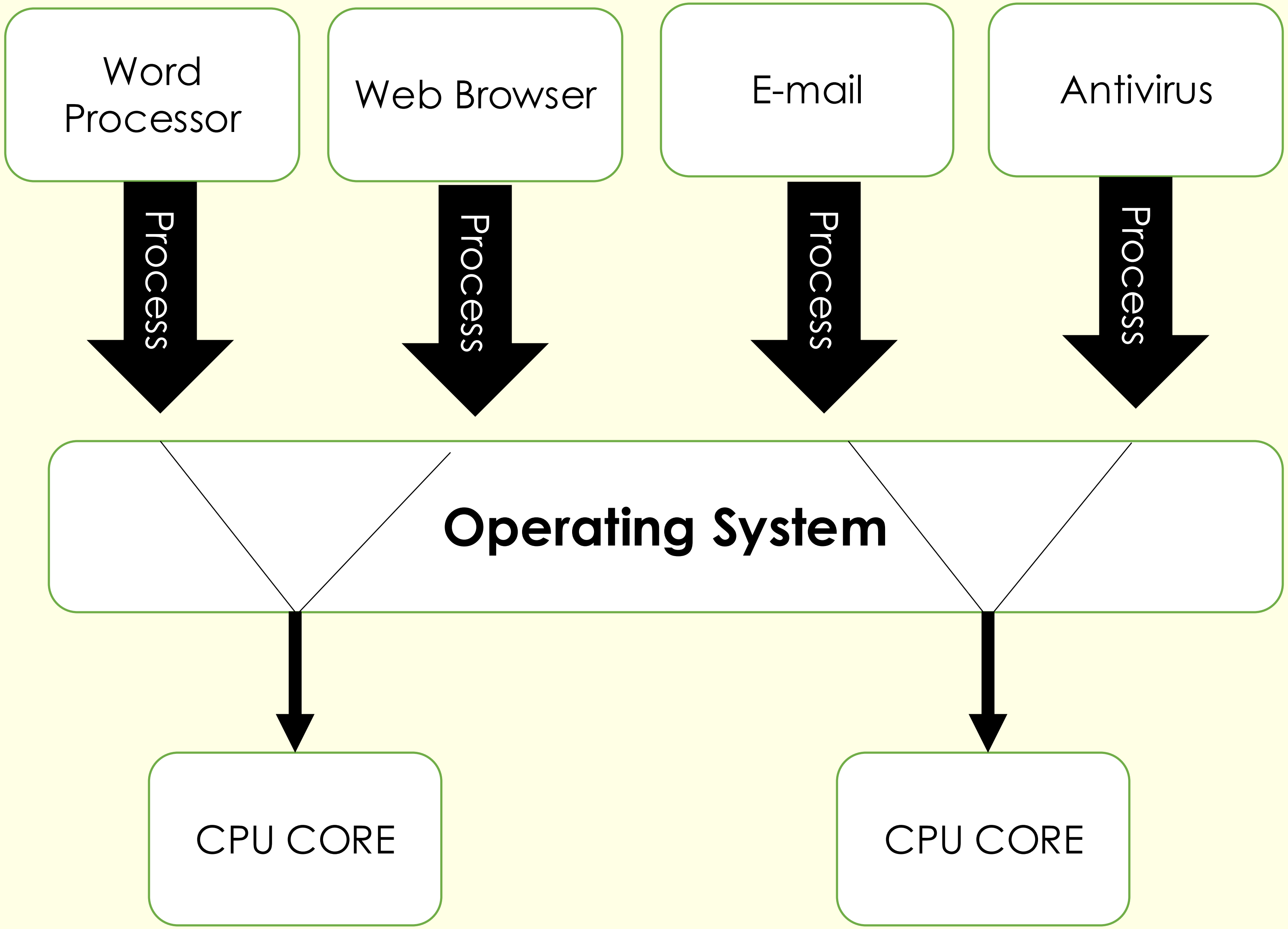
- The CPU can only execute **one process at a time**, it can can execute **billions of them in one second.**
- The OS uses a **scheduling algorithm** to **prioritise** processes
- Processes are **placed in queue** whist waiting to be carried out, they return to the back of the queue when their time is up
- The goal of process management is to **share resources** (CPU & main memory)

What is memory management?

- Memory management makes **multitasking** possible.
- Memory management is a process carried out by the operating system **allocating main memory (RAM) between different programs** that are **open at the same time**
- The OS is responsible for **copying programs and data from secondary to main memory** as it is needed
- **Programs and data require different amounts of RAM** to operate efficiently and the OS manages this process
- **RAM is allocated** based on **priority and fairness**, for example, system applications (essential) may have a higher priority than user applications
- The OS uses a **paging algorithm** to **dynamically manage** the memory
- The paging algorithm can **adjust memory allocation** as needed and **swap processes** between **RAM** and **virtual** memory if needed



Multi-tasking

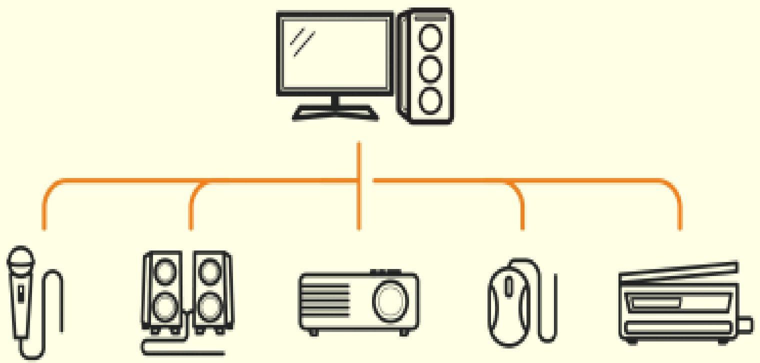


What is peripheral management?

- Peripheral management is a process carried out by the operating system **managing the way peripherals (hardware) interact with software**
- The OS **allocates system resources** to peripherals to ensure **efficient operation**
- Peripheral management makes **plug-and-play** (PnP) functionality possible, **automatically detecting and configuring new peripherals** without the need for manually installing **device drivers** or power cycling the system

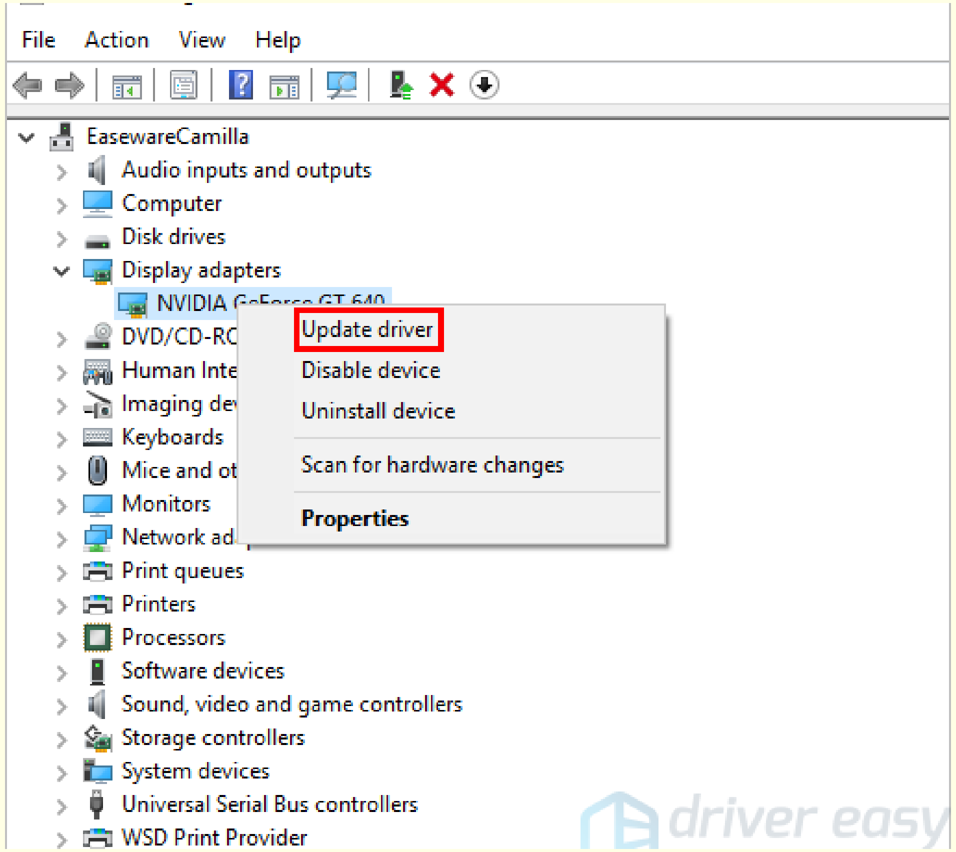
Peripheral Devices

A Peripheral Device connects to a computer system to add functionalities.



What is a device driver?

- A device driver is **a piece of software used to control a piece of hardware**
- Peripherals **require device drivers** in order to be used by the operating system
- The OS has **generic device drivers built in** which makes **basic compatibilit**y possible and enables **plug-and-play** (PnP)
- In order for hardware to be used to its **maximum capacity**, often **a separate device driver must be downloaded** from the manufacturer
- Device drivers are **OS specific** and are **regularly updated**



Worked Example

The operating system controls the scheduling of processes. Describe how the operating system uses scheduling to allocate processor time **[4]**

Answer

A description that makes reference to any **four** of the following points:

- All processes are held in a queue
- Processes are prioritised
- Processes are allocated time slices
- Length of time slice depends on priority
- (and) processes are switched (at the end of their time slice)
- Unfinished processes are put to the back of the queue
- During the time slice the process has exclusive use of the processor

Utility Software

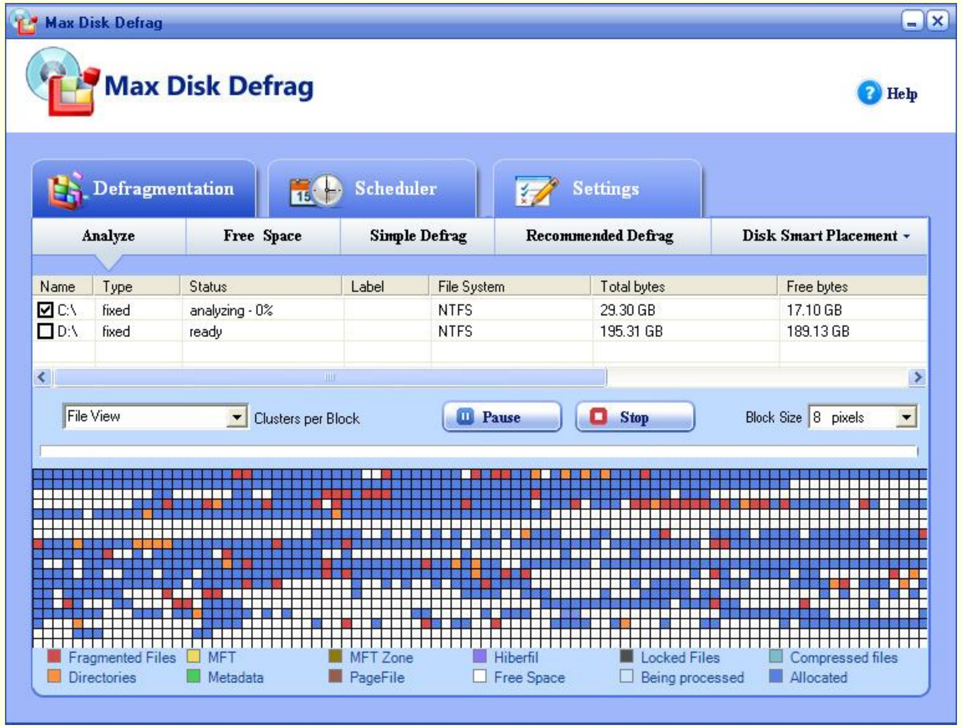
- **File Repair tool** – can fix a corrupt file
- **Backup** – automatically backup data to another location (cloud or network drive)
- **Compression software**– reduce file size and freeing up storage and speeding up transfer across a network
- **Disk Fragmentation** – fix a fragmented hard drive.
- **Anti-malware software**
- **Firewall**

Defragmenter

Defragmentation Utility

Over time the files on your hard drive get dispersed as things are deleted and re-written many times leaving gaps in the drive – it fragments.

Defragmenters reorganize files so that the files are put together, which frees up memory space.



Name	Type	Status	Label	File System	Total bytes	Free bytes
☑ C:\	fixed	analyzing - 0%		NTFS	29.30 GB	17.10 GB
□ D:\	fixed	ready		NTFS	195.31 GB	189.13 GB

File View Clusters per Block

Block Size 8 pixels

Compression Software

Zip it!

Software which can compress data into smaller file sizes

It removes redundant or duplicated data

Cheap storage and faster broadband speeds have pretty much made it redundant itself.

Still used though to compress onto a smaller medium like CD or for slower bandwidth connections

Backup

- This is a **COPY** of a file which is saved in a different location, in case something happens to the original, it can be restored.
- Backup HAS to be on an external device or into a cloud which has a different location to the original.

INCREMENTAL BACKUP	**FULL BACKUP**
Backup is focussed on files which are new or have been changed. No point in backing up stuff again when you have already backed it up! Copy it once then only copy files which are new or have been changed.	This is called is where every file and folder is copied (small systems only)

Robust Software

- Making sure the software can handle the unexpected without crashing, generating incorrect output or revealing sensitive data.

Code vulnerability – is a flaw in a program that compromises security

- Bad programming practices and insufficient testing
- Ready-made library subprogram can have security flaws
- Certain programming languages have specific vulnerabilities
- Sensitive data not encrypted
- Inadequate authentication

Code reviews are designed to spot instances of poor programming practice, find any vulnerabilities in the code and check its efficiency.

- Two types of code review:
  - Review by another programmer (time consuming)
  - An automated review – specialist software is used to examine the code.

Audit Trail

When a software application is being developed, it is important to be able to track who made what changes and when.

Identifies the point at which an error /security issue was introduced.

Enables the program to be rolled back to a previous state

Audit trail reduces errors and improves accountability.