****

**MSPM’S**

**Deogiri Institute of Engineering and Management Studies, Aurangabad**

**Department of Basic Science and Humanities**

Report on

DELL G5 & DELL G7

Submitted By

**Name and Roll No. of the Student**

ABHISHEK SAPKAL (26041)

ATHARVA PANSARE (26042)

Under the Guidance of

**Name of the Teacher**

**PROF.PANKAJ DUROLE**

Department of Basic Sciences and Humanities

(Deogiri Institute of Engineering and Management Studies)

2018-2019



CERTIFICATE

This is to Certify that Mr. Abhishek Sapkal and Atharva Pansare has successfully Completed his Report on date 29/8/2019.

**Prof. Pankaj Durole Dr .S. Kalyankar Dr. Ulhas Shiurkar**

**Subject Teacher H.O.D. Director**

Central processing unit:

A **central processing unit** (**CPU**), also called a **central processor** or **main processor**, is the electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic [arithmetic](https://en.wikipedia.org/wiki/Arithmetic), logic, controlling, and [input/output](https://en.wikipedia.org/wiki/Input/output) (I/O) operations specified by the instructions. The computer industry has used the term "central processing unit" at least since the early 1960s. Traditionally, the term "CPU" refers to a [processor](https://en.wikipedia.org/wiki/Processor_(computing)), more specifically to its processing unit and [control unit](https://en.wikipedia.org/wiki/Control_unit) (CU), distinguishing these core elements of a computer from external components such as [main memory](https://en.wikipedia.org/wiki/Main_memory) and [I/O](https://en.wikipedia.org/wiki/I/O) circuitry.

The form, [design](https://en.wikipedia.org/wiki/CPU_design), and implementation of CPUs have changed over the course of their history, but their fundamental operation remains almost unchanged. Principal components of a CPU include the [arithmetic logic unit](https://en.wikipedia.org/wiki/Arithmetic_logic_unit) (ALU) that performs arithmetic and [logic operations](https://en.wikipedia.org/wiki/Logic_operation), [processor registers](https://en.wikipedia.org/wiki/Processor_register) that supply [operands](https://en.wikipedia.org/wiki/Operand) to the ALU and store the results of ALU operations, and a control unit that orchestrates the fetching (from memory) and execution of instructions by directing the coordinated operations of the ALU, registers and other components.

Most modern CPUs are [microprocessors](https://en.wikipedia.org/wiki/Microprocessor), where the CPU is contained on a single [metal-oxide-semiconductor](https://en.wikipedia.org/wiki/Metal-oxide-semiconductor) (MOS) [integrated circuit](https://en.wikipedia.org/wiki/Integrated_circuit) (IC) chip. An IC that contains a CPU may also contain [memory](https://en.wikipedia.org/wiki/Computer_memory), [peripheral](https://en.wikipedia.org/wiki/Peripheral) interfaces, and other components of a computer; such integrated devices are variously called [microcontrollers](https://en.wikipedia.org/wiki/Microcontroller) or [systems on a chip](https://en.wikipedia.org/wiki/System_on_a_chip) (SoC). Some computers employ a [multi-core processor](https://en.wikipedia.org/wiki/Multi-core_processor), which is a single chip containing two or more CPUs called "cores"; in that context, one can speak of such single chips as ["sockets"](https://en.wikipedia.org/wiki/CPU_socket).

Array processors or [vector processors](https://en.wikipedia.org/wiki/Vector_processor) have multiple processors that operate in parallel, with no unit considered central. There also exists the concept of [virtual CPUs](https://en.wikipedia.org/wiki/Central_processing_unit#Virtual_CPUs) which are an abstraction of dynamical aggregated computational resources.

**Control unit**

The **control unit** (CU) is a component of the CPU that directs the operation of the processor. It tells the computer's memory, arithmetic and logic unit and input and output devices how to respond to the instructions that have been sent to the processor.

It directs the operation of the other units by providing timing and control signals. Most computer resources are managed by the CU. It directs the flow of data between the CPU and the other devices. [John von Neumann](https://en.wikipedia.org/wiki/John_von_Neumann) included the control unit as part of the [von Neumann architecture](https://en.wikipedia.org/wiki/Von_Neumann_architecture). In modern computer designs, the control unit is typically an internal part of the CPU with its overall role and operation unchanged since its introduction

**Arithmetic logic unit**

The arithmetic logic unit (ALU) is a digital circuit within the processor that performs integer arithmetic and [bitwise logic](https://en.wikipedia.org/wiki/Bitwise_logic) operations. The inputs to the ALU are the data words to be operated on (called [operands](https://en.wikipedia.org/wiki/Operands)), status information from previous operations, and a code from the control unit indicating which operation to perform. Depending on the instruction being executed, the operands may come from [internal CPU registers](https://en.wikipedia.org/wiki/Processor_register) or external memory, or they may be constants generated by the ALU itself.

When all input signals have settled and propagated through the ALU circuitry, the result of the performed operation appears at the ALU's outputs. The result consists of both a data word, which may be stored in a register or memory, and status information that is typically stored in a special, internal CPU register reserved for this purpose.

**Address generation unit**

**Address generation unit** (**AGU**), sometimes also called **address computation unit** (**ACU**),[[1]](https://en.wikipedia.org/wiki/Address_generation_unit#cite_note-1) is an [execution unit](https://en.wikipedia.org/wiki/Execution_unit) inside the CPU that calculates [addresses](https://en.wikipedia.org/wiki/Memory_address) used by the CPU to access [main memory](https://en.wikipedia.org/wiki/Main_memory). By having address calculations handled by separate circuitry that operates in parallel with the rest of the CPU, the number of [CPU cycles](https://en.wikipedia.org/wiki/CPU_cycle) required for executing various [machine instructions](https://en.wikipedia.org/wiki/Machine_instruction) can be reduced, bringing performance improvements.

While performing various operations, CPUs need to calculate memory addresses required for fetching data from the memory; for example, in-memory positions of [array elements](https://en.wikipedia.org/wiki/Array_element) must be calculated before the CPU can fetch the data from actual memory locations. Those address-generation calculations involve different [integer arithmetic operations](https://en.wikipedia.org/wiki/Integer_arithmetic_operation), such as addition, subtraction, [modulo operations](https://en.wikipedia.org/wiki/Modulo_operation), or [bit shifts](https://en.wikipedia.org/wiki/Bit_shift). Often, calculating a memory address involves more than one general-purpose machine instruction, which do not necessarily [decode and execute](https://en.wikipedia.org/wiki/Instruction_cycle) quickly. By incorporating an AGU into a CPU design, together with introducing specialized instructions that use the AGU, various address-generation calculations can be offloaded from the rest of the CPU, and can often be executed quickly in a single CPU cycle.

Capabilities of an AGU depend on a particular CPU and its [architecture](https://en.wikipedia.org/wiki/Computer_architecture). Thus, some AGUs implement and expose more address-calculation operations, while some also include more advanced specialized instructions that can operate on multiple [operands](https://en.wikipedia.org/wiki/Operand) at a time. Furthermore, some CPU architectures include multiple AGUs so more than one address-calculation operation can be executed simultaneously, bringing further performance improvements by capitalizing on the [superscalar](https://en.wikipedia.org/wiki/Superscalar) nature of advanced CPU designs. For example, [Intel](https://en.wikipedia.org/wiki/Intel) incorporates multiple AGUs into its [Sandy Bridge](https://en.wikipedia.org/wiki/Sandy_Bridge_(microarchitecture)) and [Haswell](https://en.wikipedia.org/wiki/Haswell_(microarchitecture)" \o "Haswell (microarchitecture))[microarchitectures](https://en.wikipedia.org/wiki/Microarchitecture), which increase bandwidth of the CPU memory subsystem by allowing multiple memory-access instructions to be executed in parallel.

**Memory management unit (MMU)**

Most high-end microprocessors (in desktop, laptop, server computers) have a memory management unit, translating logical addresses into physical RAM addresses, providing [memory protection](https://en.wikipedia.org/wiki/Memory_protection) and [paging](https://en.wikipedia.org/wiki/Paging) abilities, useful for [virtual memory](https://en.wikipedia.org/wiki/Virtual_memory). Simpler processors, especially [microcontrollers](https://en.wikipedia.org/wiki/Microcontroller), usually don't include an MMU

**Random-access memory**

**Random-access memory**  is a form of [computer memory](https://en.wikipedia.org/wiki/Computer_memory) that can be read and changed in any order, typically used to store working [data](https://en.wikipedia.org/wiki/Data) and [machine code](https://en.wikipedia.org/wiki/Machine_code).[[1]](https://en.wikipedia.org/wiki/Random-access_memory#cite_note-1)[[2]](https://en.wikipedia.org/wiki/Random-access_memory#cite_note-2) A [random-access](https://en.wikipedia.org/wiki/Random_access) memory device allows [data](https://en.wikipedia.org/wiki/Data) items to be [read](https://en.wikipedia.org/wiki/Read_(computer)) or written in almost the same amount of time irrespective of the physical location of data inside the memory. In contrast, with other direct-access data storage media such as [hard disks](https://en.wikipedia.org/wiki/Hard_disk), [CD-RWs](https://en.wikipedia.org/wiki/CD-RW), [DVD-RWs](https://en.wikipedia.org/wiki/DVD-RW) and the older [magnetic tapes](https://en.wikipedia.org/wiki/Magnetic_tape_data_storage) and [drum memory](https://en.wikipedia.org/wiki/Drum_memory), the time required to read and write data items varies significantly depending on their physical locations on the recording medium, due to mechanical limitations such as media rotation speeds and arm movement.

RAM contains [multiplexing](https://en.wikipedia.org/wiki/Multiplexer) and [demultiplexing](https://en.wikipedia.org/wiki/Demultiplexing) circuitry, to connect the data lines to the addressed storage for reading or writing the entry. Usually more than one bit of storage is accessed by the same address, and RAM devices often have multiple data lines and are said to be "8-bit" or "16-bit", etc. devices.

In today's technology, random-access memory takes the form of [integrated circuit](https://en.wikipedia.org/wiki/Integrated_circuit) (IC) chips with [MOS](https://en.wikipedia.org/wiki/MOSFET) (metal-oxide-semiconductor) [memory cells](https://en.wikipedia.org/wiki/Memory_cell_(computing)). RAM is normally associated with [volatile](https://en.wikipedia.org/wiki/Volatile_memory) types of memory (such as [DRAM](https://en.wikipedia.org/wiki/DRAM) [modules](https://en.wikipedia.org/wiki/DIMM)), where stored information is lost if power is removed, although non-volatile RAM has also been developed.[[3]](https://en.wikipedia.org/wiki/Random-access_memory#cite_note-3) Other types of [non-volatile memories](https://en.wikipedia.org/wiki/Non-volatile_memory) exist that allow random access for read operations, but either do not allow write operations or have other kinds of limitations on them. These include most types of [ROM](https://en.wikipedia.org/wiki/Read_only_memory) and a type of [flash memory](https://en.wikipedia.org/wiki/Flash_memory) called [*NOR-Flash*](https://en.wikipedia.org/wiki/Flash_memory#NOR_flash).

The two main types of volatile random-access [semiconductor memory](https://en.wikipedia.org/wiki/Semiconductor_memory) are [static random-access memory](https://en.wikipedia.org/wiki/Static_random-access_memory) (SRAM) and [dynamic random-access memory](https://en.wikipedia.org/wiki/Dynamic_random-access_memory) (DRAM). Commercial uses of semiconductor RAM date back to 1965, when IBM introduced the SP95 SRAM chip for their [System/360 Model 95](https://en.wikipedia.org/wiki/IBM_System/360) computer, and [Toshiba](https://en.wikipedia.org/wiki/Toshiba" \o "Toshiba)used DRAM memory cells for its Toscal BC-1411 [electronic calculator](https://en.wikipedia.org/wiki/Electronic_calculator), both based on [bipolar transistors](https://en.wikipedia.org/wiki/Bipolar_transistor). Commercial MOS memory, based on [MOS transistors](https://en.wikipedia.org/wiki/MOS_transistor), was developed in the late 1960s, and has since been the basis for all commercial semiconductor memory. The first commercial DRAM IC chip, the [Intel 1103](https://en.wikipedia.org/wiki/Intel_1103), was introduced in October 1970. [Synchronous dynamic random-access memory](https://en.wikipedia.org/wiki/Synchronous_dynamic_random-access_memory) (SDRAM) later debuted with the [Samsung](https://en.wikipedia.org/wiki/Samsung_Electronics) KM48SL2000 chip in 1992.

Ty of RAM

The two widely used forms of modern RAM are [static RAM](https://en.wikipedia.org/wiki/Static_random_access_memory) (SRAM) and [dynamic RAM](https://en.wikipedia.org/wiki/Dynamic_random-access_memory) (DRAM). In SRAM, a [bit of data](https://en.wikipedia.org/wiki/Bit) is stored using the state of a six-transistor [memory cell](https://en.wikipedia.org/wiki/Memory_cell_(computing)). This form of RAM is more expensive to produce, but is generally faster and requires less dynamic power than DRAM. In modern computers, SRAM is often used as [cache memory for the CPU](https://en.wikipedia.org/wiki/CPU_cache). DRAM stores a bit of data using a transistor and capacitor pair, which together comprise a DRAM cell. The capacitor holds a high or low charge (1 or 0, respectively), and the transistor acts as a switch that lets the control circuitry on the chip read the capacitor's state of charge or change it. As this form of memory is less expensive to produce than static RAM, it is the predominant form of computer memory used in modern computers.

Both static and dynamic RAM are considered *volatile*, as their state is lost or reset when power is removed from the system. By contrast, [read-only memory](https://en.wikipedia.org/wiki/Read-only_memory) (ROM) stores data by permanently enabling or disabling selected transistors, such that the memory cannot be altered. Writeable variants of ROM (such as [EEPROM](https://en.wikipedia.org/wiki/EEPROM) and [flash memory](https://en.wikipedia.org/wiki/Flash_memory)) share properties of both ROM and RAM, enabling data to [persist](https://en.wikipedia.org/wiki/Persistence_(computer_science)) without power and to be updated without requiring special equipment. These persistent forms of semiconductor ROM include [USB](https://en.wikipedia.org/wiki/Universal_serial_bus) flash drives, memory cards for cameras and portable devices, and [solid-state drives](https://en.wikipedia.org/wiki/Solid-state_drives). [ECC memory](https://en.wikipedia.org/wiki/ECC_memory) (which can be either SRAM or DRAM) includes special circuitry to detect and/or correct random faults (memory errors) in the stored data, using [parity bits](https://en.wikipedia.org/wiki/Parity_bit) or [error correction codes](https://en.wikipedia.org/wiki/Error_detection_and_correction#Error-correcting_code).

Memory cell

The memory cell is the fundamental building block of [computer memory](https://en.wikipedia.org/wiki/Computer_memory). The memory cell is an [electronic circuit](https://en.wikipedia.org/wiki/Electronic_circuit) that stores one [bit](https://en.wikipedia.org/wiki/Bit) of binary information and it must be set to store a logic 1 (high voltage level) and reset to store a logic 0 (low voltage level). Its value is maintained/stored until it is changed by the set/reset process. The value in the memory cell can be accessed by reading it.

In SRAM, the memory cell is a type of [flip-flop](https://en.wikipedia.org/wiki/Flip-flop_(electronics)) circuit, usually implemented using [FETs](https://en.wikipedia.org/wiki/Field_effect_transistor). This means that SRAM requires very low power when not being accessed, but it is expensive and has low storage density.

A second type, DRAM, is based around a capacitor. Charging and discharging this capacitor can store a "1" or a "0" in the cell. However, the charge in this capacitor slowly leaks away, and must be refreshed periodically. Because of this refresh process, DRAM uses more power, but it can achieve greater storage densities and lower unit costs compared to SRAM.

Addressing

To be useful, memory cells must be readable and writeable. Within the RAM device, multiplexing and demultiplexing circuitry is used to select memory cells. Typically, a RAM device has a set of address lines A0... An, and for each combination of bits that may be applied to these lines, a set of memory cells are activated. Due to this addressing, RAM devices virtually always have a memory capacity that is a power of two.

Usually several memory cells share the same address. For example, a 4 bit 'wide' RAM chip has 4 memory cells for each address. Often the width of the memory and that of the microprocessor are different, for a 32 bit microprocessor, eight 4 bit RAM chips would be needed.

Often more addresses are needed than can be provided by a device. In that case, external multiplexors to the device are used to activate the correct device that is being accessed

Memory addressing

One can read and over-write data in RAM. Many computer systems have a memory hierarchy consisting of [processor registers](https://en.wikipedia.org/wiki/Processor_register), on-die [SRAM](https://en.wikipedia.org/wiki/Static_random-access_memory) caches, external [caches](https://en.wikipedia.org/wiki/CPU_cache), [DRAM](https://en.wikipedia.org/wiki/DRAM), [paging](https://en.wikipedia.org/wiki/Paging) systems and [virtual memory](https://en.wikipedia.org/wiki/Virtual_memory) or [swap space](https://en.wikipedia.org/wiki/Swap_space) on a hard drive. This entire pool of memory may be referred to as "RAM" by many developers, even though the various subsystems can have very different [access times](https://en.wikipedia.org/wiki/Access_time), violating the original concept behind the *random access* term in RAM. Even within a hierarchy level such as DRAM, the specific row, column, bank, [rank](https://en.wikipedia.org/wiki/Memory_rank), channel, or [interleave](https://en.wikipedia.org/wiki/Interleaved_memory) organization of the components make the access time variable, although not to the extent that access time to rotating [storage media](https://en.wikipedia.org/wiki/Storage_media) or a tape is variable. The overall goal of using a memory hierarchy is to obtain the highest possible average access performance while minimizing the total cost of the entire memory system (generally, the memory hierarchy follows the access time with the fast CPU registers at the top and the slow hard drive at the bottom).

In many modern personal computers, the RAM comes in an easily upgraded form of modules called [memory modules](https://en.wikipedia.org/wiki/DIMM) or DRAM modules about the size of a few sticks of chewing gum. These can quickly be replaced should they become damaged or when changing needs demand more storage capacity. As suggested above, smaller amounts of RAM (mostly SRAM) are also integrated in the [CPU](https://en.wikipedia.org/wiki/CPU) and other [ICs](https://en.wikipedia.org/wiki/Integrated_circuit) on the [motherboard](https://en.wikipedia.org/wiki/Motherboard), as well as in hard-drives, [CD-ROMs](https://en.wikipedia.org/wiki/CD-ROM), and several other parts of the computer system.

Operating systems

An **operating system** (**OS**) is [system software](https://en.wikipedia.org/wiki/System_software) that manages [computer hardware](https://en.wikipedia.org/wiki/Computer_hardware)  and  [software](https://en.wikipedia.org/wiki/Computer_software)  resources and provides common [services](https://en.wikipedia.org/wiki/Daemon_(computing)) for [computer programs](https://en.wikipedia.org/wiki/Computer_program). [Time-sharing](https://en.wikipedia.org/wiki/Time-sharing) operating systems [schedule tasks](https://en.wikipedia.org/wiki/Scheduler_(computing))  for efficient use of the system and may also include accounting software for cost allocation of [processor time](https://en.wikipedia.org/wiki/Scheduling_(computing)),  [mass storage](https://en.wikipedia.org/wiki/Mass_storage), [printing](https://en.wikipedia.org/wiki/Printer_(computing)), and other resources.

For hardware functions such as [input and output](https://en.wikipedia.org/wiki/Input_and_output) and [memory allocation](https://en.wikipedia.org/wiki/Memory_allocation), the operating system acts as an intermediary between programs and the computer hardware,[[1]](https://en.wikipedia.org/wiki/Operating_system#cite_note-1)[[2]](https://en.wikipedia.org/wiki/Operating_system#cite_note-2) although the application code is usually executed directly by the hardware and frequently makes [system calls](https://en.wikipedia.org/wiki/System_call) to an OS function or is interrupted by it. Operating systems are found on many devices that contain a computer – from [cellular phones](https://en.wikipedia.org/wiki/Cellular_phone) and [video game consoles](https://en.wikipedia.org/wiki/Video_game_console) to [web servers](https://en.wikipedia.org/wiki/Web_server) and [supercomputers](https://en.wikipedia.org/wiki/Supercomputer).

The dominant [desktop](https://en.wikipedia.org/wiki/Personal_computer) operating system is [Microsoft Windows](https://en.wikipedia.org/wiki/Microsoft_Windows) with a market share of around 82.74%. [macOS](https://en.wikipedia.org/wiki/MacOS) by [Apple Inc.](https://en.wikipedia.org/wiki/Apple_Inc.) is in second place (13.23%), and the varieties of [Linux](https://en.wikipedia.org/wiki/Linux) are collectively in third place (1.57%).[[3]](https://en.wikipedia.org/wiki/Operating_system#cite_note-3) In the [mobile](https://en.wikipedia.org/wiki/Mobile_operating_system) ([smartphone](https://en.wikipedia.org/wiki/Smartphone) and [tablet](https://en.wikipedia.org/wiki/Tablet_computer) combined) sector, use in 2017 is up to 70% of [Google](https://en.wikipedia.org/wiki/Google)'s [Android](https://en.wikipedia.org/wiki/Android_(operating_system))[[4]](https://en.wikipedia.org/wiki/Operating_system#cite_note-4)and according to third quarter 2016 data, Android on smartphones is dominant with 87.5 percent and a growth rate 10.3 percent per year, followed by [Apple](https://en.wikipedia.org/wiki/Apple_Inc.)'s [iOS](https://en.wikipedia.org/wiki/IOS" \o "IOS)with 12.1 percent and a per year decrease in market share of 5.2 percent, while other operating systems amount to just 0.3 percent.[[5]](https://en.wikipedia.org/wiki/Operating_system#cite_note-5) [Linux distributions](https://en.wikipedia.org/wiki/Linux_distribution) are dominant in the server and supercomputing sectors. Other specialized classes of operating systems, such as embedded and real-time systems, exist for many applications.

Types of operating systems

### Single- and multi-tasking

### A single-tasking system can only run one program at a time, while a [multi-tasking](https://en.wikipedia.org/wiki/Multi-tasking) operating system allows more than one program to be running in concurrency. This is achieved by [time-sharing](https://en.wikipedia.org/wiki/Time-sharing), where the available processor time is divided between multiple processes. These processes are each interrupted repeatedly in [time slices](https://en.wikipedia.org/wiki/Time_slice) by a task-scheduling subsystem of the operating system. Multi-tasking may be characterized in preemptive and co-operative types. In preemptive multitasking, the operating system slices the [CPU](https://en.wikipedia.org/wiki/Central_processing_unit) time and dedicates a slot to each of the programs. Unix-like operating systems, such as [Solaris](https://en.wikipedia.org/wiki/Solaris_(operating_system)) and [Linux](https://en.wikipedia.org/wiki/Linux)—as well as non-Unix-like, such as [AmigaOS](https://en.wikipedia.org/wiki/AmigaOS" \o "AmigaOS)—support preemptive multitasking. Cooperative multitasking is achieved by relying on each process to provide time to the other processes in a defined manner. [16-bit](https://en.wikipedia.org/wiki/16-bit) versions of Microsoft Windows used cooperative multi-tasking. [32-bit](https://en.wikipedia.org/wiki/32-bit) versions of both Windows NT and Win9x, used preemptive multi-tasking.

### Single- and multi-user

### Single-user operating systems have no facilities to distinguish users, but may allow multiple programs to run in tandem.[[6]](https://en.wikipedia.org/wiki/Operating_system#cite_note-6) A [multi-user](https://en.wikipedia.org/wiki/Multi-user) operating system extends the basic concept of multi-tasking with facilities that identify processes and resources, such as disk space, belonging to multiple users, and the system permits multiple users to interact with the system at the same time. Time-sharing operating systems schedule tasks for efficient use of the system and may also include accounting software for cost allocation of processor time, mass storage, printing, and other resources to multiple users.

### Distributed

A [distributed operating system](https://en.wikipedia.org/wiki/Distributed_operating_system) manages a group of distinct computers and makes them appear to be a single computer. The development of networked computers that could be linked and communicate with each other gave rise to distributed computing. Distributed computations are carried out on more than one machine. When computers in a group work in cooperation, they form a distributed system.

### Templated

### In an OS, distributed and [cloud computing](https://en.wikipedia.org/wiki/Cloud_computing) context, [templating](https://en.wikipedia.org/wiki/Glossary_of_operating_systems_terms) refers to creating a single [virtual machine image](https://en.wikipedia.org/wiki/Virtual_machine_image) as a guest operating system, then saving it as a tool for multiple running virtual machines. The technique is used both in [virtualization](https://en.wikipedia.org/wiki/Virtualization) and cloud computing management, and is common in large server warehouses.

### Embedded

### [Embedded operating systems](https://en.wikipedia.org/wiki/Embedded_operating_system) are designed to be used in [embedded computer systems](https://en.wikipedia.org/wiki/Embedded_system). They are designed to operate on small machines like PDAs with less autonomy. They are able to operate with a limited number of resources. They are very compact and extremely efficient by design. [Windows CE](https://en.wikipedia.org/wiki/Windows_CE) and [Minix 3](https://en.wikipedia.org/wiki/Minix_3" \o "Minix 3) are some examples of embedded operating systems.

### Real-time

### A [real-time operating system](https://en.wikipedia.org/wiki/Real-time_operating_system) is an operating system that guarantees to process events or data by a specific moment in time. A real-time operating system may be single- or multi-tasking, but when multitasking, it uses specialized scheduling algorithms so that a deterministic nature of behavior is achieved. An event-driven system switches between tasks based on their priorities or external events while time-sharing operating systems switch tasks based on clock interrupts.

Hard Disk Drive (HDD)

A **hard disk drive** (**HDD**), **hard disk**, **hard drive**, or **fixed disk**[[b]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-3) is an electro-mechanical [data storage device](https://en.wikipedia.org/wiki/Data_storage_device) that uses [magnetic storage](https://en.wikipedia.org/wiki/Magnetic_media) to store and retrieve [digital](https://en.wikipedia.org/wiki/Digital_data) information using one or more rigid rapidly rotating disks ([platters](https://en.wikipedia.org/wiki/Hard_disk_platter)) coated with magnetic material. The platters are paired with [magnetic heads](https://en.wikipedia.org/wiki/Disk_read-and-write_head), usually arranged on a moving [actuator](https://en.wikipedia.org/wiki/Actuator) arm, which read and write data to the platter surfaces.[[2]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-ostep-4) Data is accessed in a [random-access](https://en.wikipedia.org/wiki/Random-access) manner, meaning that individual [blocks](https://en.wikipedia.org/wiki/Block_(data_storage)) of data can be stored or retrieved in any order and not only [sequentially](https://en.wikipedia.org/wiki/Sequential_access). HDDs are a type of [non-volatile storage](https://en.wikipedia.org/wiki/Non-volatile_storage), retaining stored data even when powered off.[[3]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-5)[[4]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-6)[[5]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-7)

Introduced by [IBM](https://en.wikipedia.org/wiki/IBM) in 1956,[[6]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-IBM350-8) HDDs became the dominant [secondary storage](https://en.wikipedia.org/wiki/Secondary_storage) device for [general-purpose computers](https://en.wikipedia.org/wiki/History_of_general-purpose_CPUs) by the early 1960s. Continuously improved, HDDs have maintained this position into the modern era of [servers](https://en.wikipedia.org/wiki/Server_(computing)) and [personal computers](https://en.wikipedia.org/wiki/Personal_computer). More than 224 companies have [produced HDDs historically](https://en.wikipedia.org/wiki/List_of_defunct_hard_disk_manufacturers), though after extensive industry consolidation most units are manufactured by [Seagate](https://en.wikipedia.org/wiki/Seagate_Technology), [Toshiba](https://en.wikipedia.org/wiki/Toshiba), and [Western Digital](https://en.wikipedia.org/wiki/Western_Digital). HDDs dominate the volume of storage produced ([exabytes](https://en.wikipedia.org/wiki/Exabyte) per year) for [servers](https://en.wikipedia.org/wiki/Server_(computing)). Though production is growing slowly, sales revenues and unit shipments are declining because [solid-state drives](https://en.wikipedia.org/wiki/Solid-state_drive) (SSDs) have higher data-transfer rates, higher areal storage density, better reliability,[[7]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-9) and much lower latency and access times.[[8]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-10)[[9]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-11)[[10]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-arstechnica.com-12)[[11]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-Santo_Domingo-13)

The revenues for SSDs, most of which use NAND, slightly exceed those for HDDs.[[12]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-Barrons-14) Though SSDs have nearly 10 times higher cost per bit, they are replacing HDDs in applications where speed, power consumption, small size, high capacity and durability are important.[[10]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-arstechnica.com-12)[[11]](https://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-Santo_Domingo-13)

The primary characteristics of an HDD are its capacity and [performance](https://en.wikipedia.org/wiki/Hard_disk_drive_performance_characteristics). Capacity is specified in [unit prefixes](https://en.wikipedia.org/wiki/Unit_prefix) corresponding to powers of 1000: a 1-[terabyte](https://en.wikipedia.org/wiki/Terabyte) (TB) drive has a capacity of 1,000 [gigabytes](https://en.wikipedia.org/wiki/Gigabyte) (GB; where 1 gigabyte = 1 billion [bytes](https://en.wikipedia.org/wiki/Byte)). Typically, some of an HDD's capacity is unavailable to the user because it is used by the [file system](https://en.wikipedia.org/wiki/File_system) and the computer [operating system](https://en.wikipedia.org/wiki/Operating_system), and possibly inbuilt redundancy for [error correction](https://en.wikipedia.org/wiki/Error_correction) and recovery. Also there is confusion regarding storage capacity, since capacities are stated in decimal Gigabytes (powers of 10) by HDD manufacturers, whereas some operating systems report capacities in binary Gibibytes, which results in a smaller number than advertised. Performance is specified by the time required to move the heads to a track or cylinder (average access time) adding the time it takes for the desired sector to move under the head (average [latency](https://en.wikipedia.org/wiki/Latency_(engineering)), which is a function of the physical [rotational speed](https://en.wikipedia.org/wiki/Rotational_speed) in [revolutions per minute](https://en.wikipedia.org/wiki/Revolutions_per_minute)), and finally the speed at which the data is transmitted (data rate).

The two most common [form factors](https://en.wikipedia.org/wiki/Form_factor_(design)) for modern HDDs are 3.5-[inch](https://en.wikipedia.org/wiki/Inch), for desktop computers, and 2.5-inch, primarily for laptops. HDDs are connected to systems by standard [interface](https://en.wikipedia.org/wiki/Computer_interface) cables such as [PATA](https://en.wikipedia.org/wiki/Parallel_ATA) (Parallel ATA), [SATA](https://en.wikipedia.org/wiki/SATA) (Serial ATA), [USB](https://en.wikipedia.org/wiki/USB) or SAS ([Serial Attached SCSI](https://en.wikipedia.org/wiki/Serial_Attached_SCSI)) cables.

Solid state Drive

A **solid-state drive** (**SSD**) is a solid-state storage device that uses [integrated circuit](https://en.wikipedia.org/wiki/Integrated_circuit) assemblies as [memory](https://en.wikipedia.org/wiki/Computer_storage) to store data [persistently](https://en.wikipedia.org/wiki/Persistence_(computer_science)), typically using [flash memory](https://en.wikipedia.org/wiki/Flash_memory). It is also sometimes called a **solid-state device** or a **solid-state disk**, although SSDs lack the physical spinning [disks](https://en.wikipedia.org/wiki/Hard_disk_drive_platter) and movable [read-write heads](https://en.wikipedia.org/wiki/Disk_read-and-write_head) used by the conventional [electromechanical](https://en.wikipedia.org/wiki/Electromechanical) storage such as [hard drives](https://en.wikipedia.org/wiki/Hard_drive) ("HDD") or [floppy disks](https://en.wikipedia.org/wiki/Floppy_disk).

Compared with the electromechanical drives, SSDs are typically more resistant to physical shock, run silently, and have quicker [access time](https://en.wikipedia.org/wiki/Access_time) and lower [latency](https://en.wikipedia.org/wiki/Latency_(engineering)). SSDs store data in [semiconductor](https://en.wikipedia.org/wiki/Semiconductor) cells. As of 2019, cells can contain between 1 and 4 [bits](https://en.wikipedia.org/wiki/Bit_(computing)) of data. SSD storage devices vary in their properties according to the number of bits stored in each cell, with single bit cells ("SLC") being generally the most reliable, durable, fast, and expensive type, compared with 2 and 3 bit cells ("MLC" and "TLC"), and finally quad bit cells ("QLC") being used for consumer devices that do not require such extreme properties and are the cheapest of the four. In addition, [3D XPoint](https://en.wikipedia.org/wiki/3D_XPoint) memory (sold by [Intel](https://en.wikipedia.org/wiki/Intel) under the Optane brand), stores data by changing the electrical resistance of cells instead of storing electrical charges in cells, and SSDs made from [RAM](https://en.wikipedia.org/wiki/Random-access_memory) can be used for high speed, when data persistence after power loss is not required, or may use battery power to retain data when its usual power source is unavailable.[[4]](https://en.wikipedia.org/wiki/Solid-state_drive#cite_note-SNIA-101-4) [Hybrid drives](https://en.wikipedia.org/wiki/Hybrid_drive) or [solid-state hybrid drives](https://en.wikipedia.org/wiki/Solid-state_hybrid_drive) (SSHDs), such as [Apple's](https://en.wikipedia.org/wiki/Apple_Inc.) [Fusion Drive](https://en.wikipedia.org/wiki/Fusion_Drive), combine features of SSDs and HDDs in the same unit using both [flash memory](https://en.wikipedia.org/wiki/Flash_memory) and a HDD in order to improve the performance of frequently-accessed data.

While the price of SSDs has continued to decline over time, SSDs are (as of 2018) still more expensive per unit of storage than HDDs and are expected to remain so into the next decade.

SSDs based on [NAND Flash](https://en.wikipedia.org/wiki/NAND_Flash) will slowly leak charge over time if left for long periods without power. This causes worn-out drives (that have exceeded their endurance rating) to start losing data typically after one year (if stored at 30 °C) to two years (at 25 °C) in storage; for new drives it takes longer. Therefore, SSDs are not suitable for [archival storage](https://en.wikipedia.org/wiki/Data_preservation). [3D XPoint](https://en.wikipedia.org/wiki/3D_XPoint) is a possible exception to this rule, however it is a relatively new technology with unknown data-retention characteristics.

SSDs can use traditional [hard disk drive (HDD)](https://en.wikipedia.org/wiki/Hard_disk_drive) interfaces and form factors, or newer interfaces and form factors that exploit specific advantages of the [flash memory](https://en.wikipedia.org/wiki/Flash_memory) in SSDs. Traditional interfaces (e.g., [SATA](https://en.wikipedia.org/wiki/SATA) and [SAS](https://en.wikipedia.org/wiki/Serial_Attached_SCSI)) and [standard HDD form factors](https://en.wikipedia.org/wiki/List_of_disk_drive_form_factors) allow such SSDs to be used as drop-in replacements for HDDs in computers and other devices. Newer form factors such as [mSATA](https://en.wikipedia.org/wiki/MSATA), [M.2](https://en.wikipedia.org/wiki/M.2), [U.2](https://en.wikipedia.org/wiki/U.2), and [EDSFF](https://en.wikipedia.org/wiki/Enterprise_%26_Data_Center_SSD_Form_Factor) (formerly known as Ruler SSD) and higher speed interfaces such as [NVMe](https://en.wikipedia.org/wiki/NVMe" \o "NVMe) over [PCI Express](https://en.wikipedia.org/wiki/PCI_Express) can increase performance over HDD performance.

Graphics card

A Graphics Card is a piece of computer hardware that produces the image you see on a monitor. The Graphics Card is responsible for rendering an image to your monitor, it does this by converting data into a signal your monitor can understand. The better your graphics card the better, and smoother an image can be produced. This is naturally very important for gamers and video editors.

GPU

GPU stands for Graphics Processing Unit. It’s the brain of the graphics card and is what creates the visuals you see on the screen.  How powerful those GPU’s are will vary on the model you select. The GPU works as a translator, it takes data coming from the CPU and transforms it into imagery. More complex visuals, like you find in high-definition games require more complex and quicker GPUs to accommodate the stream of data.

FPS

Modern games provide 3D action and Photoshop realism, but for the user to get the best experience, their graphics card need to be up to scratch . To get the crisp image, your PC must be able to deliver these details at an acceptable frame rate (this is the number of times a game can update/refresh the image you see). You’ll see this figure expressed as frames per second or FPS. If your graphics card frame rate is too low, the nice fluid motion you’d expect from your £50 game turns into a slow jerky crawl, no better than your PC from 1998.

RAM configurations[](http://www.ebuyer.com/666705-asus-gtx-970-strix-directcu-ii-oc-4gb-gddr5-dual-dvi-hdmi-strix-gtx970-dc2oc-4gd5)

Current graphics cards also contain RAM memory, this is dedicated graphics memory, so it’s separate from your PC’s RAM. The capacity for most modern graphics cards will range from 512MB to 8GB with the most popular formats being DDR3 and GDDR5 SDRAM .Memory is important on a graphics card as it allows users to play games at higher resolutions- Ideal for those using games like Skyrim, which contains very large texture packs. A minimum of 1GB memory is recommended for gamers, but this needs to be balanced out with other aspects of the card and the resolution you play a game at.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Display** | 15.6" (39.62 cm) display, 1920 x 1080 px | 15.6" (39.62 cm) display, 1920 x 1080 px |  |  | | **Storage** | 1 TB HDD | 1 TB HDD |  |  | | **Processor** | Intel Core i7 (8th Gen) Processor | Intel Core i7 (8th Gen) Processor |  |  | | **Ram** | 8 GB DDR4 RAM | 16 GB DDR4 RAM |  |  | |
| **MULTIMEDIA** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Secondary Camrearfacing** |  |  |  |  | | **Microphone Type** | Integrated Dual Array Digital Microphone | Dual Array Digital Microphone |  |  | | **Inbuilt Microphone** |  |  |  |  | | **Sound Technologies** | Waves MaxxAudio Pro | Waves MaxxAudio Pro |  |  | | **Webcam** |  |  |  |  | | **Speakers** | Stereo Speakers | Front Firing Speakers |  |  | | **Video Recording** | 720p HD | HD 720p |  |  | |
| **PERFORMANCE** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Graphics Memory** | 4 GB | 6 GB |  |  | | **Clockspeed** | 2.2 Ghz | 2.2 Ghz |  |  | | **Graphic Processor** | NVIDIA GeForce GTX 1050Ti | NVIDIA GeForce GTX 1060 |  |  | | **Processor** | Intel Core i7-8750H (8th Gen) | Intel Core i7-8750H (8th Gen) |  |  | |
| **MEMORY** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Memory Layout** | 1x8 Gigabyte | 2 x 8 Gigabyte |  |  | | **Expandable Memory** | 32 GB | - |  |  | | **Ram Type** | DDR4 | DDR4 |  |  | | **Memory Slots** | 1 | 2 SO-DIMM |  |  | | **Ram Speed** | 2400 Mhz | 2666 Mhz |  |  | | **Capacity** | 8 GB | 16 GB |  |  | |
| **DISPLAY DETAILS** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Display Type** | LED | LED |  |  | | **Display Resolution** | 1920 x 1080 Pixels | 1920 x 1080 Pixels |  |  | | **Display Touchscreen** |  |  |  |  | | **Display Features** | Full HD LED Backlit IPS Display | FHD IPS Anti-Glare LED-Backlit Display |  |  | | **Display Size** | 15.6 Inches (39.62 cm) | 15.6 Inches (39.62 cm) |  |  | |
| **PERIPHERALS** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Backlit Keyboard** |  | - |  |  | | **Pointing Device** | Touchpad with Multi-Touch Gestures Enabled | Touchpad with Multi-touch Gesture Support |  |  | | **Optical Drive** |  |  |  |  | | **Fingerprint Scanner** |  |  |  |  | |
| **GENERAL INFORMATION** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Dimensionswxhxd** | 382.01 x 264.16 x 25.5  mm | 389 x 274.7 x 24.9  mm |  |  | | **Operating System Type** | 64-bit | 64-bit |  |  | | **Weight** | 2.4 Kg | - |  |  | | **Operating System** | Windows 10 Home Basic | Windows 10 Home Basic |  |  | | **Model** | 15 5587 (G5587-7037RED-PUS) | 15 7588 (B568105WIN9) |  |  | | **Brand** | Dell | Dell |  |  | | **Colors** | Red | Black |  |  | |
| **NETWORKING** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Wireless Lan** | 802.11 a/b/g/n/ac | 802.11 a/b/g/n/ac |  |  | | **Bluetooth** |  |  |  |  | | **Bluetooth Version** | 5.0 | 5.0 |  |  | |
| **STORAGE** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Hdd Speedrpm** | 5400 RPM | 5400 RPM |  |  | | **Ssd Capacity** | 128 GB | 128 GB |  |  | | **Hdd Capacity** | 1 TB | 1 TB |  |  | | **Hdd Type** | SATA | SATA |  |  | |
| **BATTERY** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Power Supply** | 65 W AC Adapter W | 56 W AC Adapter W |  |  | | **Battery Cell** | 4 Cell | 4 Cell |  |  | | **Battery Type** | Li-Ion | Li-Ion |  |  | | **Battery Life** | 6 Hrs | - |  |  | |
| **PORTS** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Sd Card Reader** |  |  |  |  | | **Headphone Jack** |  |  |  |  | | **Microphone Jack** |  |  |  |  | |
| **OTHERS** |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Sales Package** | Laptop, Battery, AC Adapter, User Guide | Laptop, Battery, AC Adapter, User Guide |  |  | | **Lockport** |  |  |  |  | | **Warranty** | 1 Year | 1 Year |  |  | |