***SYSTEM SPICIFICATION***

***I am using HP Laptop 15-bs544tu, which specifications & modern development as follows:***

***MICRO-PROCESSOR:*** It has ***INTEL CORE I3 6006U MOBILE (6th generation)*** processor. It is clocked at 2.00GHz with 3MB L3 cache memory, it has 2 cores & 4 threads, it is enable to encode 4K video because of Intel HD 520 integrated GPU.

Descriptions of components of CPU are as follows:

* ***CORE: -*** A **multi-core processor** is a single [computing](https://en.wikipedia.org/wiki/Computing) component with two or more independent [processing units](https://en.wikipedia.org/wiki/Central_processing_unit) called cores, which read and execute [program instructions](https://en.wikipedia.org/wiki/Instruction_set). The instructions are ordinary [CPU instructions](https://en.wikipedia.org/wiki/Instruction_set) (such as add, move data, and branch) but the single processor can run multiple instructions on separate cores at the same time, increasing overall speed for programs amenable to [parallel computing](https://en.wikipedia.org/wiki/Parallel_computing). Multi-core processors are widely used across many application domains, including [general-purpose](https://en.wikipedia.org/wiki/Computer), [embedded](https://en.wikipedia.org/wiki/Embedded_system), [network](https://en.wikipedia.org/wiki/Network_processor), [digital signal processing](https://en.wikipedia.org/wiki/Digital_signal_processing)(DSP), and [graphics](https://en.wikipedia.org/wiki/Graphics_processing_unit) (GPU).In my laptop processor has 2 cores so processing speed is less than other processor which has more than 2 cores.
* ***THREAD:*** - **Hyper-threading** is [Intel's](https://en.wikipedia.org/wiki/Intel) [proprietary](https://en.wikipedia.org/wiki/Proprietary_hardware) [simultaneous multithreading](https://en.wikipedia.org/wiki/Simultaneous_multithreading) (SMT) implementation used to improve [parallelization](https://en.wikipedia.org/wiki/Parallel_computation) of computations (doing multiple tasks at once) performed on [x86](https://en.wikipedia.org/wiki/X86) microprocessors. For each [processor core](https://en.wikipedia.org/wiki/Multi-core) that is physically present, the [operating system](https://en.wikipedia.org/wiki/Operating_system) addresses two virtual (logical) cores and shares the workload between them when possible. The main function of hyper-threading is to increase the number of independent instructions in the pipeline; it takes advantage of [superscalar](https://en.wikipedia.org/wiki/Superscalar) architecture, in which multiple instructions operate on separate data in parallel. With HTT, one physical core appears as two processors to the operating system, allowing concurrent scheduling of two processes per core. In addition, two or more processes can use the same resources: if resources for one process are not available, then another process can continue if its resources are available. In my computer has 4 threads so depend on threading my processor is less than the other processor which has more than 4 threads for performing multiple parallelization.
* ***CLOCK RATE: -***  The **clock rate** typically refers to the [frequency](https://en.wikipedia.org/wiki/Frequency) at which a [chip](https://en.wikipedia.org/wiki/Integrated_circuit) like a  CPU, one core of a [multi-core processor](https://en.wikipedia.org/wiki/Multi-core_processor), is running and is used as an indicator of the [processor](https://en.wikipedia.org/wiki/Microprocessor)'s speed. It is measured in *clock cycles per second* or its equivalent, the [SI](https://en.wikipedia.org/wiki/International_System_of_Units) unit [hertz](https://en.wikipedia.org/wiki/Hertz) (Hz), the clock rate of the first generation of computers was measured in hertz or kilohertz (kHz), but in the 21st century the speed of modern CPUs is commonly advertised in gigahertz (GHz). This metric is most useful when comparing processors within the same family, holding constant other features that may affect performance. [Video card](https://en.wikipedia.org/wiki/Video_card) and CPU manufacturers commonly select their highest performing units from a manufacturing batch and set their maximum clock rate higher, fetching a higher price. My computer has 2.00 GHz clock speed so other processor which has more clock speed than my processor that perform the operation very fester than my processor.
* ***GPU:*** - A **graphics processing unit** (**GPU**) is a specialized [electronic circuit](https://en.wikipedia.org/wiki/Electronic_circuit) designed to rapidly manipulate and alter [memory](https://en.wikipedia.org/wiki/Memory_(computing)) to accelerate the creation of [images](https://en.wikipedia.org/wiki/Image) in a [frame buffer](https://en.wikipedia.org/wiki/Frame_buffer) intended for output to a [display device](https://en.wikipedia.org/wiki/Display_device). GPUs are used in [embedded systems](https://en.wikipedia.org/wiki/Embedded_system), [mobile phones](https://en.wikipedia.org/wiki/Mobile_phone), [personal computers](https://en.wikipedia.org/wiki/Personal_computer), [workstations](https://en.wikipedia.org/wiki/Workstation), and [game consoles](https://en.wikipedia.org/wiki/Game_console). Modern GPUs are very efficient at manipulating [computer graphics](https://en.wikipedia.org/wiki/Computer_graphics) and [image processing](https://en.wikipedia.org/wiki/Image_processing), and their highly parallel structure makes them more efficient than general-purpose [CPUs](https://en.wikipedia.org/wiki/Central_processing_unit) for [algorithms](https://en.wikipedia.org/wiki/Algorithm) where the processing of large blocks of data is done in parallel. In a personal computer, a GPU can be present on a [video card](https://en.wikipedia.org/wiki/Video_card), or it can be embedded on the [motherboard](https://en.wikipedia.org/wiki/Motherboard) or—in certain CPUs—on the CPU [die](https://en.wikipedia.org/wiki/Die_(integrated_circuit)). My computer has HD 520 integrated graphics so more than that graphics gives the more efficient HD quality display than my computer.
* ***CACHE: -*** A **CPU cache** is a [hardware cache](https://en.wikipedia.org/wiki/Hardware_cache) used by the CPU of a [computer](https://en.wikipedia.org/wiki/Computer) to reduce the average cost (time or energy) to access [data](https://en.wikipedia.org/wiki/Data_(computing)) from the [main memory](https://en.wikipedia.org/wiki/Main_memory). A cache is a smaller, faster memory, closer to a [processor core](https://en.wikipedia.org/wiki/Processor_core), which stores copies of the data from frequently used main [memory locations](https://en.wikipedia.org/wiki/Memory_location). Most CPUs have different independent caches, including [instruction](https://en.wikipedia.org/wiki/Instruction_cache) and [data caches](https://en.wikipedia.org/wiki/Data_cache), where the data cache is usually organized as a hierarchy of more cache levels (L1, L2, L3, etc.). All modern (fast) CPUs (with few specialized exceptions) have multiple levels of CPU caches. The first CPUs that used a cache had only one level of cache; unlike later level 1 caches, it was not split into L1d (for data) and L1i (for instructions). Almost all current CPUs with caches have a split L1 cache. They also have L2 caches and, for larger processors, L3 caches as well. The L2 cache is usually not split and acts as a common repository for the already split L1 cache. Every core of a [multi-core processor](https://en.wikipedia.org/wiki/Multi-core_processor) has a dedicated L2 cache and is usually not shared between the cores. The L3 cache, and higher-level caches, are shared between the cores and are not split. An L4 cache is currently uncommon, and is generally on DRAM, rather than on SRAM, on a separate die or chip. That was also the case historically with L1, while bigger chips have allowed integration of it and generally all cache levels, with the possible exception of the last level. Each extra level of cache tends to be bigger and be optimized differently. My computer has 3MB cache so modified cache has more size than my computer cache so it helps to map the memory efficiently than my computer cache.

**Recent Developments of Mobile Mainstream Processors segment are as follows:**

**6th generation (Sky Lake):**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Processor branding** | **model** | **Cores(threads)** | **Clock rate** | **GPU** | **L3 cache** |
| Core i7 | [6500U](http://ark.intel.com/products/88194) | 2 (4) | 2.5 GHz | HD 520 | 4MB |
| Core i5 | [6200U](http://ark.intel.com/products/88193) | 2 (4) | 2.3 GHz | HD 520 | 3MB |

**7th generation (kaby lake):**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Processor branding** | **model** | **Cores(threads)** | **Clock rate** | **GPU** | **L3 cache** |
| Core i7 | [7500U](http://ark.intel.com/products/95451/Intel-Core-i7-7500U-Processor-4M-Cache-up-to-3_50-GHz-) | 2 (4) | 2.7 GHz | HD 620 | 4MB |
| Core i5 | [7200U](http://ark.intel.com/products/95443/Intel-Core-i5-7200U-Processor-3M-Cache-up-to-3_10-GHz) | 2 (4) | 2.5 GHz | HD 620 | 3MB |
| Core i3 | [7100U](http://ark.intel.com/products/95442/Intel-Core-i3-7100U-Processor-3M-Cache-2_40-GHz-) | 2 (4) | 2.4 GHz | HD 620 | 3 MB |
|  |  |  |  |  |  |

**8th generation (coffee lake):**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Processor branding** | **model** | **Cores(threads)** | **Clock rate** | **GPU** | **L3 cache** |
| Core i9 | [8950HK](https://ark.intel.com/products/134903/Intel-Core-i9-8950HK-Processor-12M-Cache-up-to-4_60-GHz) | 6 (12) | 2.9 GHz | UHD 630 | 12 MB |
| Core i7 | [8750H](https://ark.intel.com/products/134906/Intel-Core-i7-8750H-Processor-9M-Cache-up-to-4_10-GHz) | 6 (12) | 2.2 GHz | UHD 630 | 9 MB |
|  |  |  |  |  |  |
| Core i5 | [8300H](https://ark.intel.com/products/134876/Intel-Core-i5-8300H-Processor-8M-Cache-up-to-4_00-GHz) | 4(8) | 2.3 GHz | UHD 630 | 8 MB |
| Core i3 | [8100H](https://ark.intel.com/products/149160/Intel-Core-i3-8100H-Processor-6M-Cache-3_00-GHz) | 4 (4) | 3.0 GHz | UHD 630 | 6 MB |

***Advantages of 6th generation:***

* In this generation the major improvement noticed in the performance of GPU was improved, which enable us to play 4K video.

***Advantages of 6th generation over 7th generation:***

* In this generation the clock rate of micro-processor was increased which improved the response time.
* It also improved the performance of GPU, which increase the frame rate and smooth buffering of the video.

***Advantages of 7th generation over 8th generation:***

* In this generation the major improvement in the core and thread part. In this part increase the core and thread so we can perform more number of parallel operation.
* In this generation also improve the clock rate of the micro-processor for increase the response time of the micro-processor.
* The performance of the GPU was increased so we can watch the UHD video.
* The cache is also improved so it helps to map the memory efficiently.

***RAM:*** It has 8GB DDR4 (2133MHz) manufacture by A-data technology.

* In [computing](https://en.wikipedia.org/wiki/Computing), **DDR4 SDRAM**, an [abbreviation](https://en.wikipedia.org/wiki/Abbreviation) for **double data rate fourth-generation synchronous dynamic random-access memory**, is a type of [synchronous dynamic random-access memory](https://en.wikipedia.org/wiki/Synchronous_dynamic_random-access_memory) (SDRAM) with a high [bandwidth](https://en.wikipedia.org/wiki/Bandwidth_(computing)) ("[double data rate](https://en.wikipedia.org/wiki/Double_data_rate)") interface. DDR4 is not compatible with any earlier type of random-access memory (RAM) due to different signaling voltages, physical interface and other factors. The primary advantages of DDR4 over its predecessor, DDR3, include higher module density and lower voltage requirements, coupled with higher [data rate transfer](https://en.wikipedia.org/wiki/Bit_rate#Goodput_(data_transfer_rate)) speeds. The DDR4 standard allows for [DIMMs](https://en.wikipedia.org/wiki/DIMM) of up to 64 [GB](https://en.wikipedia.org/wiki/Gibibyte) in capacity, compared to DDR3's maximum of 16 GB per DIMM
* DDR4 RAM is available in 3 space categories that are 4GB, 8GB, and 16GB, so if want to increase the efficiency of RAM work increase the space of RAM.
* Efficiency of DDR4 RAM depend on speed range very form 2133MHz to 4000MHz, so the rate of data transfer is increased that shown as follow:

|  |  |
| --- | --- |
| **Types** | **Transfer speed(GB/s)** |
| 2100MHz | 20.4 |
| 2400MHz | 22.9 |
| 3000MHz | 27.4 |
| 3600MHz | 33.0 |
| 4000MHz | 35.5 |

***HDD:*** It has 1TB hard disk drive manufacture by Western Digital.

Descriptions of comparative parameters are as follows:

* ***Capacity (formatted)*** is denote the size of the HDD. So if we increase the capacity i.e. we increase the size of data storage.
* ***Form factor***
* ***Data transfer rate*** is thetransfer speed of data from secondary memory to primary memory and processor. So if increase the data transfer rate i.e. increases the transfer speed of data from secondary memory to primary memory and processor.
* ***Cache Memory*** is the high speed memory where we store boot files of operating system to speed up the start up process. Higher cache memory help to store larger boot files of modern operating system like windows 10.
* ***Rotational speed*** is the rotated speed of the disk. Higher rotational speed helps to access the files faster.
* ***Data density*** is a measure of the quantity of information [bits](https://en.wikipedia.org/wiki/Bit) that can be stored on a given length of [track](https://en.wikipedia.org/wiki/Hard_disk), area of [surface](https://en.wikipedia.org/wiki/Surface_area), or in a given [volume](https://en.wikipedia.org/wiki/Volume) of a [computer storage medium](https://en.wikipedia.org/wiki/Computer_storage). Generally, higher density is more desirable, for it allows greater volumes of data to be stored in the same physical space. Density therefore has a direct relationship to storage capacity of a given medium. Density also generally has a fairly direct effect on the performance within a particular medium, as well as price.

**Compression between this model (WD10EZRZ) and recent developments are as follows:**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **WD10EZRZ** | **Developed to (2018)** |
| **Capacity (formatted)** | 1 terabytes | 14 terabytes |
| **Form factor** | 3.5-inch | 3.5-inch |
| **Data transfer rate (max)**  **Buffer to host**  **Host to/from drive** | 6 Gb/s  150 MB/s | 6 Gb/s  175 MB/s |
| **Cache (MB)** | 16Mb | 64MB |
| **Rotational speed (RPM)** | 5400rpm | 7200rpm |
| **Data density** | 6 giga[bits](https://en.wikipedia.org/wiki/Bit) per [square inch](https://en.wikipedia.org/wiki/Square_inch) | 1.3 terabits per square inch in 2015 |