

Computer Architecture and Operating Systems

ACCB4001

Investigate Computer Systems

By

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A.

i) Convert the following decimal numbers to Binary

a) 42

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	128	64	32	16	8	4	2	1
42	0	0	1	0	1	0	1	0

Does 32 go into 42? Yes

So $\rightarrow 42 - 32 = 10$

Does 8 go into 10? Yes

So $\rightarrow 10 - 8 = 2$

Does 2 go into 2? Yes

So $\rightarrow 2 - 2 = 0$

Check answer $\rightarrow 32 + 8 + 2 = \mathbf{42}$

Decimal number 42 in Binary $\rightarrow$ **101010**

b) 135

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	128	64	32	16	8	4	2	1
135	1	0	0	0	0	1	1	1

Does 128 go into 135? Yes

So $\rightarrow 135 - 128 = 7$

Does 4 go into 7? Yes

So $\rightarrow 7 - 4 = 3$

Does 2 go into 3? Yes

$$\text{So} \rightarrow 3 - 2 = 1$$

Does 1 go into 1? Yes

$$\text{So} \rightarrow 1 - 1 = 0$$

$$\text{Check answer} \rightarrow 128 + 4 + 2 + 1 = \mathbf{135}$$

Decimal number in Binary $\rightarrow$ **1000111**

ii) Convert the following binary numbers to base 10

a) 11010111

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
1	1	0	1	0	1	1	1

$$128 + 64 + 16 + 4 + 2 + 1 = 215$$

Binary 11010111 in base 10 $\rightarrow$ **215**

b) 11011001

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
1	1	0	1	1	0	0	1

$$128 + 64 + 16 + 8 + 1 = 217$$

Binary 11011001 in base 10 $\rightarrow$ **217**

iii) Convert the following hex numbers to binary

a) CD

0 → 0	6 → 6	12 → <u>C</u>
1 → 1	7 → 7	13 → <u>D</u>
2 → 2	8 → 8	14 → E
3 → 3	9 → 9	15 → F
4 → 4	10 → A	
5 → 5	11 → B	

C → 12

D → 13

12			
<u>8</u>	<u>4</u>	2	1
1	1	0	0

13			
<u>8</u>	<u>4</u>	2	<u>1</u>
1	1	0	1

Hexadecimal CD to binary → **11001101**

b) 9A

0 → 0	6 → 6	12 → C
1 → 1	7 → 7	13 → D
2 → 2	8 → 8	14 → E
3 → 3	9 → 9	15 → F
4 → 4	10 → <u>A</u>	
5 → 5	11 → B	

9

A → 10

9			
<u>8</u>	4	2	<u>1</u>
1	0	0	1

10				
	<u>8</u>	4	<u>2</u>	1
1	0	1	0	

Hexadecimal 9A to binary → **10011010**

iv) Convert the following Hex numbers to decimal

a) 2F

$$2 \times 16^1 \xrightarrow{2} 2 \times 16 = 32$$

$$15 \times 16^0 \xrightarrow{F \rightarrow 15} 15 \times 1 = 15$$

$$32 + 15 = 47$$

Hexadecimal 2F to decimal $\rightarrow$ **47**

b) A2

$$10 \times 16^1 \xrightarrow{A \rightarrow 10} 10 \times 16 = 160$$

$$2 \times 16^0 \xrightarrow{2} 2 \times 1 = 2$$

$$160 + 2 = 162$$

Hexadecimal A2 to decimal $\rightarrow$ **162**

v) If a graphic image is stored as an uncompressed 8 bit per channel/RGB colour bitmap (.BMP file) of dimensions 800*600 pixels, calculate how much memory storage it would occupy.

$$800 \times 600 \text{ pixels} = 480,000$$

$$480,000 \times 24 \text{ (8 bits for each RGB channel)} = 11,520,000$$

$$11,520,000 \div 8 = 1,440,000 \text{ bytes}$$

$$\text{Bytes} \rightarrow \mathbf{1,440,000}$$

$$1,440,000 \div 1024 = 1,406.25 \text{ kB}$$

Kilobytes → **1.406 kB**

$$1,406.25 \div 1024 = 1.373290102$$

Megabytes → **1.37 mB of storage ***

* This does not include metadata such as geo location or EXIF data.

B.

You have been asked to build a high end computer system for gaming. You must include a detailed description of each component selected and the reason for your choices. Selection and costs must be justified. Included with the system you must include a monitor to complement the system and include a keyboard and mouse. Any other peripherals must be fully justified.

Introduction

I have been asked to build a high end computer system for gaming. In this assignment I will be researching and analysing each component. As I have not been given a budget I will be making decisions based on a reasonable price : performance basis.

Central Processing Unit (CPU)

The first component I began to research was the central processing unit or CPU. The 3 CPU's that seemed to be the favourite for high end gaming are the 'Intel Core i7 10700k' (£342), 'Intel Core i9 10900k' (£440) and the 'AMD Ryzen 9 3900x' (£440.00). After researching all three CPU's thoroughly I came to the conclusion that the Intel i7 processor would be the best fit for a high end computer system for gaming. "That is a no brainer, but the Core i7 is certainly a processor geared towards high-end gaming" - WePC. The i7 is an 8 core, 16 thread CPU, that can operate up to a clock speed of 5.1 GHz.



1.1

The reasons for not choosing the Intel i9 were because it is better suited for workstations and servers. "Unless you plan on cramming multiple high-end

GPUs into the PC or you also need to use some very CPU-intensive professional software, then an i9 would simply be overkill.” - gamingscan.

CPU cost = £342

Processor	Intel Core i7-10700K	Ryzen 9 3900x
Base Clock:	3.8 GHz	3.8 GHz
Max Boost Clock:	5.1 GHz	4.6 GHz
L3 Cache:	16MB	64MB
PCI Express Version:	PCIe 3.0	PCIe 4.0
PCIe Lanes:	16	24
TDP:	125W	105W
Price:	\$374	\$413
Availability	Amazon	Amazon

The reason I didn't feel the AMD Ryzen 9 3900x wasn't right for my gaming system was because it is slower, only operating up to a max clock speed of 4.6GHz. "This makes the Intel CPU far better when it comes to raw processing speed" - Premium Builds.

CPU cost = £342.00

1.2

Motherboard

I then began researching for the best motherboards available for PC gaming. I first came across the 'Asus ROG Maximus XII Extreme' (£839.99). Which is an extremely powerful and luxurious component, but I feel it would be too powerful, and with a price tag like that, too much. "it only really makes sense if you're buying a K-series Core i9 and genuinely intend to overclock the nuts off it" - PC Gamer.

I then came across the 'MSI MPG Z490 Gaming Carbon WiFi' (£199.99) and the 'MSI MAG B460M Mortar Wifi' (£131.94). I decided to go with the B460 Mortar as it has an impressive I/O and good VRM, WiFi 6 and 2.5Gb LAN. As well as being recommended over other motherboards, and being the PC Gamer Editor's pick, at £131.94 the B460 is also great value for money.



1.3

Motherboard cost = £131.94

Memory (RAM)

I then moved on to searching for the best RAM available for a high end gaming system. I first came across the 'Team Xtream ARGB 16GB DDR4 3600MHz C14' (£157.78), but I felt this wasn't the best suited for my gaming system as it was only 16GB, and also better suited to work with AMD Ryzen CPUs, and I chose an Intel i7. I then looked at the 'Corsair Dominator platinum RGB 32GB DDR4 3200MHz' (£114.99) which according to PC Gamer is "The best high-end RAM for gaming" - PC Gamer. It is also at a great price point but I wanted more MHz in order to get more speed.

I then found the '32GB G.skill DDR4 Trident Royal Gold 4000MHz PC4 3200 (L17 Dual Kit)' (£365.83). I decided to choose this RAM, and buy 2 of them. They are high capacity, fast and a good price point for the quality and importance of the component. The Trident is also great for Intel CPU's. "The best high-frequency RAM for gaming" - PC Gamer. The other RAM options I found would simply fill the RAM slots much quicker.



1.4

RAM cost (for 2) = £731.66

Graphics Processing Unit (GPU)

I decided that as the GPU is one of the most important components for my gaming system that I would choose the best one on the market. As the games need to run efficiently, and look of a higher definition graphics with enhanced framerates. "Higher framerates mean smoother, faster games with less stutter or freezing due to load on the CPU." - Androidguys.



1.5

My first option for the GPU was the 'AMD Radeon RX 5600' (£274.98), which is a great base price but unfortunately is only designed for 1080p gaming, and only runs to 8.07 TFLOPS. I then decided to go with the 'Nvidia GeForce RTX 3080' (£526.12 / \$699) which is the best of the best for GPU's and definitely worth the money, it runs to a whopping 29.76 TFLOPS which will greatly improve the gaming experience and will make the whole gaming system better and quicker. "The best graphics card for PC gaming right now." - PC Gamer.

GPU cost = £526.12

Storage (SSD)

I then started to look at different storage options for my gaming system, the first option I found was the 'Crucial MX500 1TB' (£89.47) which is a great price point for 1 terabyte of space but unfortunately the motherboard I have chosen ('MSI MAG B460M Mortar Wifi') only supports M.2 interface.

I then found another 2 options for storage, the 'Addlink S70' (£45.80) and the 'WD Black SN750 1TB' (£139.04). I decided to go with the WD in the end as the sequential read and write speeds of the Addlink were "Seq. read: 3,400MB/s (512GB version) | Seq. write: 2,000MB/s (512GB version)" - PC Gamer. And the sequential speeds of the WD were "Seq. read: 3,470MB/s | Seq. write: 3,000MB/s" - PC Gamer. So the speeds of the WD were much better, and it has 1 terabyte of storage.



1.6

SSD cost = £134.09

Power Supply Unit

I researched into the best power supply units available for gaming, being a vital component in the gaming system. I came across the 'Cooler Master Masterwatt 750w' (£98) and the 'Gamdias Astrape P1-750G' (£119.99). And they are both standard choices for gaming systems, but as my system will be high end I feel that the more wattage this component can supply, the better.

1.7



I then found the 'Corsair RM850x' (£241.87), and decided to choose this as it has 850w which is the highest capacity for wattage. This will also give plenty of overhead for powering the GPU and CPU. "Reliability and a great balance of performance and features make the RM850x our all-around top choice for power supplies." - PC Gamer.

Power supply unit cost = £241.87

System Cooling

I had two clear options when it came to this component of my gaming system, the first was the 'Noctua NH-D15' (£74.09). This liquid cooler is one of the quietest available, only producing 24.6 dbA at the maximum. "Even working at 100 percent the cooler ran quieter than just about all of its competitors." - PC Gamer. The only problem with this cooler is that it is quite bulky, which could potentially cause problems.

I then found, and chose the 'EVGA CLC 240' (£98.07), which produces a much lower sound of 16.4 dbA and is a much slimmer and less bulky cooler than the Noctua. The EVGA also produces an excellent performance per watt, and at a great price for the standard of the product. "Matching cooling of the latest chip-chillers from Corsair and NZXT, the 240mm CLC costs a fraction of the price" - PC Gamer.



1.8

System Cooling cost = £98.07

Case

After researching and choosing the right components for my gaming system, I then needed to choose the right case. I chose the 'Phanteks Evolv X'



(£199.99) as it supports Micro ATX which would fit with my chosen motherboard, the B460. It also has the best combination of size and expansion abilities, it has more space for drive bays if wanted in future. This case also has cooling built in. "the Evolv X stands out

as an excellent chassis for anyone looking for a mid-tower instance with a little something extra.” - PC Gamer.

1.9

Case cost = £199.99

Operating System

When choosing the operating system I only had 3 real options, Windows 8, Linux and Windows 10, so I went through the pros and cons of each. Linux has been known to run some games at a slower rate than its competitors, compatibility is also an issue, in terms of hardware and software. This also affects the games you are able to play, as not every game is made with the Linux operating system in mind. “In terms of choice of games, Linux is lagging behind drastically. There are just over 3000 games available on Steam for Linux, in comparison to Windows this is severely lagging behind.” - GLS.

Windows 8 also has some compatibility issues as more games are being targeted for Windows 10. “The overall performance of games on Windows 8 is as good as you will need for all current games, but as time goes forward this may no longer be the case.” - GLS. It has also been known to be slow, and have some security issues.



Windows 10 was my definite choice when it came to the operating system, being the most popular and having the most compatibility with hardware, software and games. It also has the highest gaming performance. “Windows 10 has the widest choice of games available of any OS.” - GLS.

2.1

Operating System cost = £119.99

Monitor

I was torn between two excellent monitors which I felt would have both complemented the gaming system. The ‘BenQ EL2870U’ (£209.99) and the ‘ASUS ROG Swift PG279Q’ (£599.99). Unfortunately the ASUS does not run in 4K and is currently being phased out for a newer model.

Therefore I chose the BenQ, it is an affordable 4K option and has a great response time. The monitor is 28 inches and has 3840x2160 resolution,



2.2

as well as having a great pair of integrated speakers. It is also a great price and won't break the bank. "The best budget 4K HDR monitor" - PC Gamer.

Monitor cost = £209.99

Keyboard

For the gaming systems keyboard I chose the 'Corsair k100 RGB Optical' (£287.54). The keyboard features responsive optical switches as well as constant RGB. Although this keyboard is expensive it is of premium build quality. "feature-wise, the K100 RGB's got it all. Dedicated media controls and a USB pass-through, a metal volume wheel, RGB lighting." "the K100 RGB nails the basics, as well as including the fancy extras, and that's why it's top of the list." - PC Gamer



2.3

Keyboard cost = £287.54

Mouse



cloth pads,

The mouse I chose for my gaming system was the 'Razer Deathadder V2' (£34.69). I chose this mouse as it has one of the best sensors available, and supports a large variety of grips and hand sizes. "It also has an excellent optical mouse sensor that will work on both hard and

and it has the ultimate body shape for a claw or hybrid claw/palm grip.” - PC Gamer. It has a simple and aesthetically pleasing design, and perfectly places buttons. I feel it will complement my gamins system well.

Mouse cost = £34.69

Cost

The overall cost of the high end gaming system I will build made out of the components I have chosen is, £3,399.95.

Bibliography

- 1) <https://www.wepec.com/>
- 1) <https://www.gamingscan.com/intel-core-i7-vs-i9-for-gaming/>
- 2) <https://premiumbuilds.com/cpus/intel-core-i7-10700k-vs-ryzen-9-3900x/>
- 3) <https://www.pcgamer.com/uk/best-gaming-motherboards/>
- 4) <https://www.pcgamer.com/best-ddr4-ram/#:~:text=Best%20RAM%20for%20gaming.%201%201.%20TEAM%20XTREEM,5.%20G.Skill%20Ripjaws%20V%2016GB%20DDR4-2400MHz.%20More%20items>
- 5) <https://www.androidguys.com/tips-tools/what-is-the-gpu-and-why-is-it-important/>
- 6) <https://www.pcgamer.com/the-best-graphics-cards/>
- 7) <https://www.pcgamer.com/best-ssd-for-gaming/#:~:text=Best%20SSD%20for%20gaming.%201%201.%20Addlink%20S70..5%205.%20Crucial%20P1%201TB%20NVMe.%20More%20items>
- 8) <https://www.pcgamer.com/uk/best-power-supply-unit-for-pc-gaming-our-top-psu-for-pc/>
- 10) <https://www.pcgamer.com/uk/best-cpu-coolers/>
- 11) <https://gameslearningsociety.org/best-os-for-gaming/>
- 12) <https://www.pcgamer.com/uk/best-pc-case/>
- 13) <https://www.pcgamer.com/uk/best-gaming-monitor/>
- 14) <https://www.pcgamer.com/uk/best-gaming-keyboard/>
- 15) <https://www.pcgamer.com/uk/the-best-gaming-mouse/>

Figure list

1.1) Image of Intel Core i7 10700k

<https://www.intel.co.uk/content/www/uk/en/products/processors/core/core-vpro/i7-6700.html>

1.2) i7-10700K vs 3900X: Spec Comparison

<https://premiumbuilds.com/cpus/intel-core-i7-10700k-vs-ryzen-9-3900x/>

1.3) MSI MAG B460M Mortar - image © MSI

<https://www.pcgamer.com/msi-mag-b460m-mortar-review-benchmarks/>

1.4) 32GB G.skill DDR4 Trident Royal Gold 4000MHz PC4 3200 (L17 Dual Kit) - ebay

<https://www.ebay.co.uk/itm/183812363487?var=0>

1.5) Nvidia GeForce RTX 3080 - image credit: Future

<https://www.pcgamer.com/the-best-graphics-cards/>

1.6) WD Black SN70 1TB - image credit: WD

<https://www.pcgamer.com/best-ssd-for-gaming/#:~:text=Best%20SSD%20for%20gaming.%201%201.%20Addlink%20S70..5%205.%20Crucial%20P1%201TB%20NVMe.%20More%20items>

1.7) Corsair RM850x - image credit: Corsair

<https://www.pcgamer.com/uk/best-power-supply-unit-for-pc-gaming-our-top-psu-for-pc/>

1.8) EVGA CLC 240 - image credit: EVGA

<https://www.pcgamer.com/uk/best-cpu-coolers/>

1.9) Windows 10

<https://gameslearningsociety.org/best-os-for-gaming/>

2.1) Phanteks Evolv X - image credit: Phanteks

<https://www.pcgamer.com/uk/best-pc-case/>

2.2) BenQ EL2870U - image credit: BenQ

<https://www.pcgamer.com/uk/best-gaming-monitor/>

2.3) Corsair k100 RGB Optical - image credit: Corsair

<https://www.pcgamer.com/uk/best-gaming-keyboard/>

2.4) Razer Deathadder V2 - image credit: Razer

<https://www.pcgamer.com/uk/the-best-gaming-mouse/>