

# Template Week 3 – Hardware

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## Assignment 3.1: Examine your phone

What processor is in your phone? Qualcomm Snapdragon 8 Gen 2

To which architecture family does this processor belong? In other words, which Instruction Set Architecture (ISA) is used? It belongs to ARM architect family and its uses RISC instruction set

How much RAM is in it? 12 GB

How much storage does your phone have? 1 TB

What operating system is running on your phone? Android

Approximately how many applications do you have installed? 250

Which application do you use the most? Samsung notes

Can your phone be charged with what type of plug? Type C

Which I/O ports can you visually see on your phone? Only type C

## Assignment 3.2: Examine your laptop

What processor is in your laptop? Intel Core i9 12<sup>th</sup> Gen 12900H

To which architecture family does this processor belong? In other words, which Instruction Set Architecture (ISA) is used? It belongs to x86 architect, and it uses x86-64 (Intel 64) ISA

How much RAM is in it? 32 GB

How much storage does your laptop have? 2 TB

Which operating system is running on your laptop? Windows (build 25H2 to be more specific)

Approximately how many applications do you have installed? 200 - 300

Which application do you use the most? Microsoft Edge

Can your laptop be charged with what type of plug? Barrel-pin, smart-tip

Which I/O ports can you visually see on your laptop? AUX (input and output) / thunderbolt 4 shared with USB-C / 2 x USB-A Gen3.2 / 1 x USB-A gen 2 / SD card input (using a convertor) / HDMI / LAN / mini display port

### Assignment 3.3: Power to the laptop

What is the input voltage? 100-240 V

What is the output voltage? 19.5 V

How many watts can your power adapter deliver? 330 W

Is the input voltage AC or DC? AC

Is the output voltage AC or DC? DC

AC/DC what is that?

AC stands for alternative current which is the kind of electricity current running through the construction cables and into the power sockets. In this format, the voltage alternates between the positive and negative values of its amplitude in a wavy manner. However, almost all of the day-to-day electronics and appliances like laptops, fridges and televisions require DC which is the short term for direct current. Unlike alternating current, direct current doesn't flip the polarity of its voltage which is crucial for such devices; because those devices are built on the basis of sensitive components such as transistors which are extremely reliant on the tiniest changes in the voltage, hence that's the backbone of their behaviour and even if they survive an alternating current their features will no longer be accurate.

If you reverse the polarity of the output voltage, is that bad for your laptop?

Yes, because although the absolute value of the voltage remains the same, its direction changes since current flows from the place with more voltage to less voltage (positive to negative). That means that if the output voltage is reversed, the electric field will be going outwards from the laptop. However, in most cases the circuit components are not built on a complete symmetric basis, meaning that when the current leaves a spot, it's expected to flow in an expected order; that means it's not supposed to enter the components from certain sides but when that happens it has to force its way through which results in the burnout of various boards such as motherboard. However, that doesn't necessarily happen because before that point, the other protective barriers like the adapter have already burnt to prevent this from happening.

You forgot your power adapter; your laptop normally needs 15 watts. You will be loaned a power adapter that can deliver 50 watts. Voltage, polarity, etc. are all the same compared to the original power adapter. You can connect the borrowed power adapter to your laptop. What will happen? Also explain why you think that.

For laptops, most probably nothing harmful. The number of watts that's mentioned on adapters doesn't mean that the adapter will always output that amount no matter what; but rather it indicates the maximum power it's capable to deliver. Whether or not that amount is drawn depends on the connected device. In most cases what actually causes the draw of more current (I), is mismatches of voltage, not the value of the nominal watts; and that interplay between current and voltage is apparent from OHM's law

$$V = I \times R$$

For a given device Resistance is determined by its internal circuitry therefore it will usually stay stable in such scenario. Thus, if voltage stays the same, the connected device is not going to receive more

current than needed, even though the adapter is theoretically capable of providing so. On the other hand, according to the formulas for watt such as:

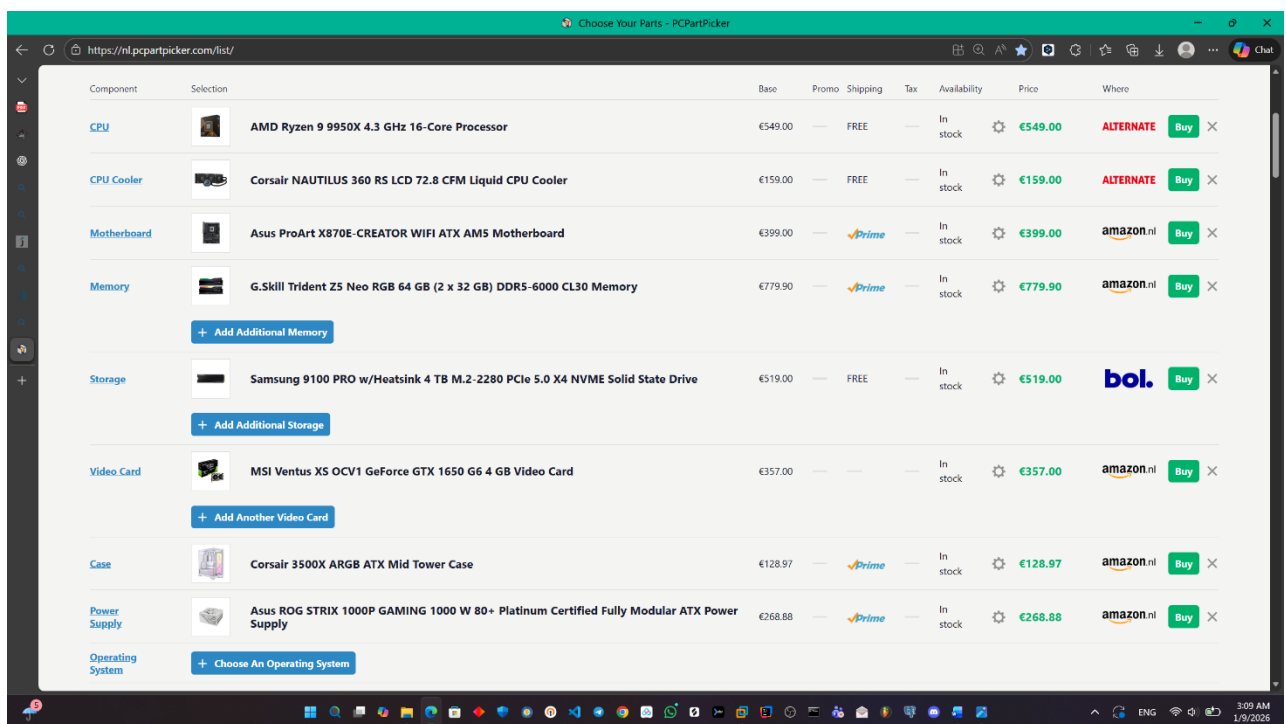
$$P = I \times V, P = I^2 R, P = V^2 / R$$

If voltage changes then the real current is going to change as well and since that change will be in the same direction for both voltage and current (both incremental), then our input device will in fact receive more power (watts) than it's supposed to; and that increment is even going to be exponential

Lastly, Laptops usually have a power regulation system which prevents the device from getting more current than supposed

### Assignment 3.4: Build your dream PC

Screenshots PC configuration + motivation:



The screenshot shows the PCPartPicker website with a configured PC build. The components listed are:

Component	Selection	Base	Promo	Shipping	Tax	Availability	Price	Where
CPU	AMD Ryzen 9 9950X 4.3 GHz 16-Core Processor	€549.00	—	FREE	—	In stock	€549.00	ALTERNATE Buy
CPU Cooler	Corsair NAUTILUS 360 RS LCD 72.8 CFM Liquid CPU Cooler	€159.00	—	FREE	—	In stock	€159.00	ALTERNATE Buy
Motherboard	Asus ProArt X870E-CREATOR WIFI ATX AM5 Motherboard	€399.00	—	Prime	—	In stock	€399.00	amazon.nl Buy
Memory	G.Skill Trident Z5 Neo RGB 64 GB (2 x 32 GB) DDR5-6000 CL30 Memory	€779.90	—	Prime	—	In stock	€779.90	amazon.nl Buy
+ Add Additional Memory								
Storage	Samsung 9100 PRO w/Heatsink 4 TB M.2-2280 PCIe 5.0 X4 NVME Solid State Drive	€519.00	—	FREE	—	In stock	€519.00	bol. Buy
+ Add Additional Storage								
Video Card	MSI Ventus XS OCV1 GeForce GTX 1650 G6 4 GB Video Card	€357.00	—	—	—	In stock	€357.00	amazon.nl Buy
+ Add Another Video Card								
Case	Corsair 3500X ARGB ATX Mid Tower Case	€128.97	—	Prime	—	In stock	€128.97	amazon.nl Buy
Power Supply	Asus ROG STRIX 1000P GAMING 1000 W 80+ Platinum Certified Fully Modular ATX Power Supply	€268.88	—	Prime	—	In stock	€268.88	amazon.nl Buy
Operating System	+ Choose An Operating System							

## COMPARING MY CURRENT SPECS vs MY DREAM BUILD

- CPU

My dream CPU has 16 cores 32 threads compared to 12 core 24 thread I have. It uses Zen 5 micro-architect with AM5 socket compared to my current AM4, so it supports sustained workloads and multitasking better and also has better thermal benchmarks

- **RAM**

Both are ddr5 but my choice has twice the capacity despite the same stick count. It also has a higher clock speed of 6000 compared to the current frequency of 4000, also having lower latency. Effective bandwidth is +90 compared to only 60-65 for the old one which contributes to the faster data transfer

- **MOTHERBOARD**

Both support PCIe5 generation, but the new build has better power delivery. It also has updated generation and types of I/o ports, for example having native support for usb-4 compared to usb3.2 at max. the old board doesn't have a Wi-Fi/Bluetooth controller

- **Storage Device**

Dream hard drive has 14800 MB/s and 13400 MB/s sequential read and write respectively compared to the current 7000 and 5000 but they both use a PCIe4 connection.

- **Cooling**

My water cooling still has one of the most silent enclosures with a min noise of only 10 db compare to +10-15 db for most other pump+fan units. But its major drawback is being 240mm, meaning to have only 2 fans compared to 3 on a radiator of the size 280mm and above

- **PSU**

Because of higher wattage the new build has more headroom for the transient spikes but that comes at the cost of larger size

- **GPU**

Slightly more VRAM memory (6 GB compared to 4). And also a whole generation leap

## THIS LONG SECTION IS ABOUT JUSTIFYING WHY I CHOSE THE PARTS I CHOSE

You can skip to the next part if you decide

### CPU

I initially wanted to go for threadripper 7960 but then I came across an article talking about thread overhead; Saying that not only the speed of the processor doesn't follow a linear pattern with the number of its cores but also may fall back since there are now too many cores which result in a prolonged time for the data flow between them. All that while its usually double the price of simpler yet mainstream products. Therefore, I chose ryzen 9 9950X; with the reason being that over time I've learnt ryzen cpus are generally faster than their intel competitors with regards to multitasking because they usually have more threads which makes them number one pick for this purpose. My use case being music production, exactly falls into this realm. Generally, I want to avoid cpus that are more specialized for graphic environments, such as most intel products, as well as X3D version of the same ryzen product. That way I can put more money on multitasking

### Hard Drive

After cpu, my top priority is storage drive because my workflow not only requires a lot of storage size, but also a decent speed. I've been happy with Samsung NVME 980 m2 drive, therefore, I will this time go for the updated version 9100 pro. That is an expensive unit but since I prefer my OS drive being the fastest, I'll have to store all data volumes on that single physical drive. Therefore, my design will only have one storage device for everything (which of course risks data integrity and portability). The chosen device is preferred to be bundled with a heatsink

### Motherboard

For compatibility I got to choose a motherboard that has AM5 chipset to support ryzen series 9000 cpus. therefore, it of course should be ddr5 which maximizes the performance integrity with regards to ram and cpu; (if it works with zen4 it might be ok with bios updates, but I don't want to deal with that hassle).

The following choices are not vital to component compatibility, but they provide me with extra power:

- Having wifi and Bluetooth chip: so, I don't have to deal with expansion cards and Bluetooth dongles
- PCIe5 port: although most high-speed drives are gen4 anyways and even a gen 5 drive like Samsung nvme 9100 is fallback compatible anyways, but it's good to know that it will be futureproof
- Native support for usb4 / TB4: although there are i/o extension cards for usb4 that also work with PCIe4 but if the bios itself doesn't have that feature defined in it, I don't think it will give me the full speeds
- Number of ports/sockets: generally, the more i/o or PCIe ports the more versatile the product is

## RAM

With regards to my use case (being music production), I need a lot of ram (in size). That's because unlike typical workflows, I like to load my most used assets (such as sound and preset libraries) directly on ram upon system boot. The reason for that is I can then benefit from its significantly faster speeds compared to normal storage devices. For the speed I've already been happy with speeds of 4-5 MHz but the higher the better. In order of compatibility with my cpu, RAM has to be ddr5. I'll usually go with 2 channels to not only save the costs but also to keep space for potential future upgrades

## Cooling

Ryzen cpu's are known for getting hotter than their competitors and if I have freedom of choice I will go with neither air cooling nor AIO (all-in-one) water cooling, but rather I'll make a custom loop from scratch because cpu is the part that I care about the most; therefore, I need to be extra sure that it doesn't throttle. Since that wasn't in the list my next choice will be water cooling since I found it to be still more efficient than air solutions

A couple of years ago I tried a lot of water coolings for my cpu (being ryzen 9 5900). An infamous entity back then was nzxt kraken coolers and the public backlash was about its software issues, its weak capability compared to the cheaper counterparts and some failure reports. I generally didn't like deep cool products either because of their high fan noise. Since my work case is audio production, I need quiet fans and a robust software through which I can meticulously control the fans; something that I found viable with corsair products.

Since this time my cpu is much heavier, I'm going to pick a 360 mm radiator

## Case

Since I'm going with a 360mm 3xfan water cooler I need to pick a case that can fit the components. As an aesthetic choice I want it to be attached to the ceiling. I don't care much about the aesthetics of the case and the kind of rgbs embedded in it as long as it has a glass side panel (again as an aesthetic choice). The case should also not only be able to fit my psu (since its relatively large) but should also have a separate section for it, covering the unit preventing it from collecting dust (which is a common problem I'd faced)

## Power Supply Unit

I calculated the rough total power consumption my system will have and that became less than a thousand watts; but to be safe, I'll go with a 1000W unit that has the 80plus gold standard. Without those kinds of warranties, I'll be risking the entire build on burnouts resulted by current instability. It's also important for such device to have active cooling with fans but that also brings attention to the fan noise.

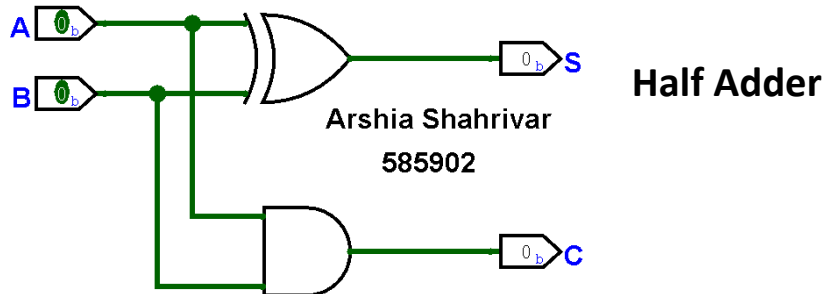
## GPU

I don't have anything to say about this part since it's the least important in my build (with regards to my use case). I would even buy it second handed with the least power that just meets the "sufficient" criteria

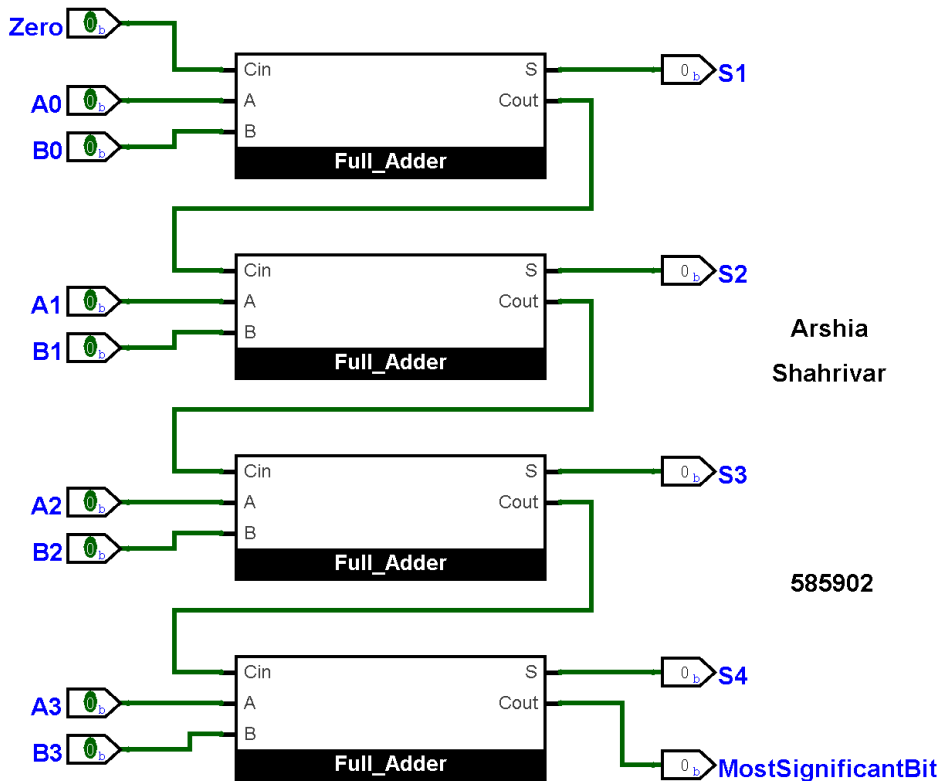
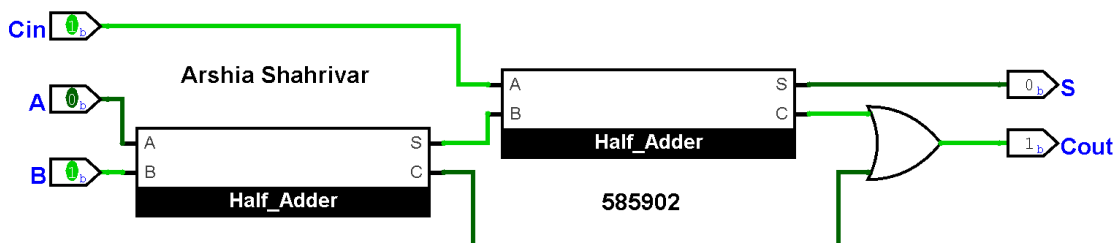
### Assignment 3.5: Adders

Complete the **half adder**, **full adder** and **4-bit adder** assignment as described in the PowerPoint slides of week 3 in Logisim. Save the chip design and also export three PNG pictures of the separate finished designs. See the PowerPoint slides of week 3.

Paste the three exported PNG pictures in here.



#### Full Adder:



Ready? Save this file and export it as a pdf file with the name: [week3.pdf](#)