# CPT160-
# Intro to Computer Systems

Assignment 2

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# Contents

# Part A System Architecture

## 1a) Part Names

A. Memory Chip

B. SODIMM RAM card

C. Memory Chip

D. Memory Chip and QR code for spec sheet

E. DDR4 SO DIMM-2 Socket

F. SATA HDD connector/cable

G. DMIC Connector

H. Wireless Charging Lid Header

## 1b) Component description

a, c, d, and b) This is the Ram for the built NUC with the components listed being the memory chips. Typically known as a laptop memory chips SODIMMs have seen their place now in very small form factors for what intel has branded a NUC others call just a mini pc. Ram does what its name says it is Random Access memory; this stores short-term data for quicker computing allowing files that are currently in use to be stored.

e) An extra expansion slot if another SODIMM was to be installed allowing the user to increase the Ram running it in dual channel. For a system as small as this small form factor I see no relevant reason it would be needed 8gb is usually a stock standard starting point on the initial SODIMM and if more processing was needed you wouldn't be using a NUC.

f) Expansion slot allowing the user to connect a SATA drive to the board for more storage. Unlike normal SATA cables this ribbon cable that connects to the pin socket includes the power loop.

g) It allows for header front to be connected to the board with the additional jacks that are also present including power, etc. It is a good way to connect devices that will be removed for easy access.

h) The new way to charge with the included header in the NUC you can now use it to charge your devices. I am not going to explain how wireless charging works; but that's what this component does.

## 2a) Part Names

I. M.2 SSD/M.2 expansion slot

J. Front Panel Header

K. SATA Interface

L. Intel® Wi-Fi 6 AX201 Wi-Fi adapter in AX201 WIFI Connector

## 2b-c) Examples of use and Specifications

i) Generally speaking, you would find an SSD in this slot that would be used for booting. This NUC has one M.2 connector supporting M.2 2280 (key type M) modules; with the type being SATA 6.0Gb/s.

j) The front panel connector is used to connect power, reset and HDD lights sometimes even case speakers. Since this has a DCIM for control it is unused in this regard.

k) Typically connected would be an SSD in this particular setup the expansion bay allows for 2.5" drives up to 7mm in height. This connector is also SATA 6.0gb/s.

L) As the name states you would install a Wi-Fi card in this slot; this NUC has as stated an Intel® Wi-Fi 6 AX201, 802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth 5 chip installed. Technical specs include Maximum Transfer speed up to 2.4 Gbps, Next Generation Form Factor (NGFF) 12x16 soldered-down package, Supports OFDMA, 1024QAM, Target Wake Time (TWT) and spatial reuse.

## 3a) Connector Names

A. Thunderbolt™ Port

B. USB 3.2 Gen 2 Port

C. Audio Jack

D. Front Panel Power Button

E. SDXC slot

## 3b) Connector Functions

A) Allows attachment of any device that uses Thunderbolt cable for connectivity the list is endless as to what uses thunderbolt.

b) Allows attachment of any devise that uses USB cable for connectivity again endless list of devices.

c) Allows connection of headset using a 3.5mm jack.

d) Turns the NUC on, also allows the user to reset or hard power off the device.

e) Allows insertion of SD cards to read/write data the xc is just Extended capacity.

## 4a) Connector names

A. 19V DC Input Jack

B. mDP Port

C. LAN Connector

D. USB 3.2 Gen 2 Ports

E. HDMI 2.0b

F. Thunderbolt™ Port

## 4b) Connector Functions

a) Input from a power brick to allow the system to power on; gives the device power.

b) Allows connection of displays that have a mini display port cable; typically, adapter is used to convert to the more common DisplayPort or HDMI this will give the user capabilities of running dual monitor.

c) Allows connection to a router using LAN cable; more stable and secure than the built in wi-fi.

d) Allows attachment of any devise that uses USB cable for connectivity again endless list of devices.

e) Allows connection of a display using HDMI would be common in most workspaces.

f) Allows attachment of any device that uses Thunderbolt cable for connectivity the list is endless as to what uses thunderbolt.

## 4c) HDMI Resolution

This NUC using the HDMI 2.0b has a maximum resolution of 4k this being 3840 x 2160 pixels.

## 4d) USB Thunderbolt difference

The ports in question are Thunderbolt 3 and USB 3.2 gen 2; theoretical transfer rates on these ports are 40000Mbps and 10000Mbps respectively. In terms of standards USB connections have not changed over time and therefore backwards compatibility with previous peripherals is not hindered, likewise with thunderbolt they have adopted the USB-C connector type so even though thunderbolt is not yet royalty free as the case with USB, they have allowed their design to be utilised with other systems connections as to not ruin themselves in the market.

## 5) Design Information

5i) The core architecture of this product is what I would describe as basic with some sparkle. The NUC or next unit of computing uses built in CPU and GPUs with a very bare kit to allow it to be very small in size; relatively speaking it is a laptop without a screen or keyboard/trackpad. This model has the following–

- a soldered-down 11th generation Intel® Core™ i7-1165G7 quad-core processor with up to a maximum 28 W TDP
- 2.80 GHz base frequency, 4.70 GHz turbo frequency, 8 threads
- 12 MB Intel® Smart Cache
- Intel® UHD Graphics
- Integrated memory controller
- Integrated PCH

5ii) Information that was able to be found

Intel® UHD Graphics for 11th Gen Intel Processors

- Intel UHD (G4)
- Integrated graphics (uses laptop's RAM as video memory)
- 48 cores
- up to 1250 MHz clock speed

5iii) From personal experience I find the following projects/businesses which have used this system to be the following:

Schools- this one is a no brainer but with more teaching being done through online services without the area needed to expand classrooms allowing for a full computer setup NUCs have been used to save on space while giving students the processing power they need.

Offices(anywhere) – The medical centre my wife works in has adopted the use of NUCs not only for space saving design but also for the processing needed to upgrade their systems saving on money with a yearly plan as to get the next upgrade as needed.

Hotels – lately I have found some hotel rooms are providing rooms with NUCs/small form factor pcs not only can they have a system with integrated ordering and check outs through the tv in the room they also have no need to upgrade the TV's allowing for money savings and upgradability.

## 6) Pricing

a) $532.81 from intel Australia
https://www.intel.com.au/content/www/au/en/products/sku/205601/intel-nuc-11-pro-board-nuc11tnbi7/specifications.html

b) Guessing it doesn't really matter I would probably buy a scandisk extreme pro 128gb. This 'module' I would expect to pay around $75. It has the following specifications read speed of 170MB/s and read/write speed class 10. Storage capacity as stated is 128GB. The NUC that has been described has no compatibility issues with this card.

# Part B Workstation Build

Requirements - It needs multiple CPUs, GPUs and as much RAM as possible, and massive storage.

## Prologue

I read the previous requirement as go all out and make the best workstation possible, then it asks for the basic and fit for purpose which would not have these requirements. For the build set up the following assumptions were made:

- Single takes for video capture to edit
- Camtasia recording takes 11mb per 1 minute
- If more than listed storage space is required a NAS server would be used alongside.
- Stated **minimum** ram for running programs is 8gb Camtasia and 256mb POV-ray
- Storage space will be explained in future section.
- System will be beyond recommended specs to allow for smoother editing/rendering.
- Videos will be of 1080p quality/ H.264 encoded.
- Parts are picked subject to availability pointless building a system you can't get parts for.
- With previous point available parts may be well beyond what's needed the decisions were made with monetary value for what you get in mind.

## Workstation Table

| Parts | Model | Cost | Link |
|---|---|---|---|
| CPU | AMD Ryzen 5 5600X 3.7 GHz 6-Core Processor | $288.95 | https://www.amazon.com/dp/B08166SLDF?tag=pcpapi-20&linkCode=ogi&th=1&psc=1 |
| Motherboard | Gigabyte X570 AORUS PRO WIFI ATX AM4 Motherboard | $244.99 | https://www.amazon.com/dp/B07STNZF9L?tag=pcpapi-20&linkCode=ogi&th=1&psc=1 |
| Memory | Corsair Vengeance LPX 32 GB (2 x 16 GB) DDR4-3600 CL18 Memory | $149.99 | https://www.amazon.com/dp/B07ZPLM1R1?tag=pcpapi-20&linkCode=ogi&th=1&psc=1 |
| Storage | Samsung 970 Evo Plus 1 TB M.2-2280 NVME Solid State Drive x 1<br><br>Seagate IronWolf NAS 8 TB 3.5" 7200RPM Internal Hard Drive x2 | $144.99<br><br>$209.99 x 2 | https://www.amazon.com/dp/B07MFZY2F2?tag=pcpapi-20&linkCode=ogi&th=1&psc=1<br><br>https://pcpartpicker.com/mr/lenovo/sD848d |
| Graphics | EVGA GeForce RTX 3060 12 GB XC GAMING Video Card | $789.49 | https://www.amazon.com/dp/B08WM28PVH?tag=pcpapi-20&linkCode=ogi&th=1&psc=1 |
| Display | MSI Optix MAG27CQ 27.0" 2560x1440 144 Hz Monitor | $317.36 | https://www.amazon.com/dp/B079NGSWRL?tag=pcpapi-20&linkCode=ogi&th=1&psc=1 |
| Cooling | ARCTIC Liquid Freezer II 240 56.3 CFM Liquid CPU Cooler | $86.99 | https://pcpartpicker.com/mr/newegg/c4MTwP |
| Case | Corsair 4000D Airflow ATX Mid Tower Case | $94.99 | https://pcpartpicker.com/mr/bestbuy/bCYQzy |

| | | | |
|---|---|---|---|
| Power supply | Corsair RM (2019) 650 W 80+ Gold Certified Fully Modular ATX Power Supply | $99.99 | https://pcpartpicker.com/mr/newegg/WxL48d |
| Total Cost | | $2639.76 | |

## 2) Compatibility and item breakdown

All listed items were placed into part picker with no compatibility issues, the following is an explanation of why each item was chosen, excluding storage and cooling for next part.

CPU – Although only a 6 core 12 thread processor the ability of this CPU to not only run the programs but to scrub through and edit the videos surpasses the requirement field. Another option would be the Ryzen 9 with 12 cores however for the graphic designer in question with the programs used this would only give a slight edge over in rendering of videos and for the extra cost was not deemed necessary. Benchmarking shows this to be a great choice outperforming many 8 core CPUs.

Motherboard – This choice was made mainly for the compatibility for the chipset, and although many other boards can produce the same results for the price tag this board comes with a lot extra. For the extra cost there is a valid upgrade path with the additional SATA 6 ports storage could also be increased easily if needed.

Memory – Although relatively speaking 16GB should be enough I opted for dual channel 32GB 3600 RAM, this decision was made for future requirements programs are always changing including OS that require more and more effective memory so the system will now have that covered.

Graphics – This selection was fun the GPU I wanted was not available and all the in between were also not available. The 3060 is overkill for what is needed for video editing and capture and could theoretically be done on a lesser card however I did not want to list an eBay 2nd hand card as sometimes that's throwing your money away. This system could use a 1650 but for the price deference the 3060 was chosen. I do believe a 1050ti could handle this video editing however the 3060 has better everything and price to performance is a better investment.

Display – This could be a lesser display but from experience if you are sitting down video editing you want a high refresh rate for all the video scrubbing 27" is also very comfortable to work at and I got a 4k monitor because wasn't that much more expensive than a 1080p.

## 3) Storage breakdown

Storage as the list shows I have chosen to have a 1TB SSD as boot drive with 2 HDD for storage. These 2 drives will be set up in raid 1 with windows mirroring. Effectively giving 8TB of capacity for videos giving approximately 12000 hours of video capture (given the equation listed in prologue). Now there are many viable options for setting up a raid but in the workstation itself I believe this to be the best system. As previously stated, if I was going to set up a larger storage bank, I would set a raid 10 NAS server system for storage but the cost in doing so would have to be viable. In the case here the raid 1 will give a singular backup and you should have at least 2 and this is where the NAS server would come into play. Even if you were to set up more HDDS in workstation making a raid 10 this doesn't cover you for malware or other disasters on that 1 station therefore destroying all your data. Since the user will be working at the workstation a drive failure should be easily detectable therefore reducing the risks of total drive failure. There are also many other ways to back up data I would

suggest an external HDD if not the NAS for having the 2nd backup also so in the event of total failure 1 drive would still be available for backup to raid 1.

## 4) Cooling System

The case and the liquid cooler could be many different things the main reason for initially the case was the complete airflow and fan headers it had however the defining factor was how the PSU mounted and the cable management design all cases will have good cooling. The other choice was the CPU cooler which I opted for liquid cooling for 2 main reasons. The first reason being since I am using a mid-case, I did not wish to have a typical block cooler taking up effective airspace and room inside from experience these can get in the way of connection slots be it RAM or SATA cables. The second reason was for the CPU overclock capability; although not needed it could be done with this setup.

## Conclusion

The build I have put forth not only will get the job done but will be viable for years to come which when building a PC is a defining factor. I could put forth a budget system that could also complete these tasks but at a much slower pace which can be infuriating at times. I believe some parts could be changed out if parts are made available; for the price tag at the end, it will surpass any prebuilt and will have a greater upgrade route in the future.

## Part C Junk Yard Special

1 a) IBM 486
b) the ST-412 has a 5.25 inch form factor whereas the 1TB ATA is of a 3.5 inch form factor.

2
a) You would find MFM on Floppy disk drives be it the 5 ¼ inch or the 3 ½ inch.
b) The change in the signal level is achieved by reversing the polarity of the magnetic field running through the disk a transmission of an electrical current is read depicting either a 0 or 1.
c)i) RLL encoding compresses the information into smaller segments by the use of a no pulse variance allowing segments of pulses to be combined to make the data bit you require.
ii) As complicated as it may seem it improves the density by reducing the number of consecutive 0 written and limiting the number of 1s in a row reducing how much the polarity will change therefore increasing data storage. This is limited to the way the encoding worked as such there are limitations on maximum number of 0 bits and 1 bits hardware can detect therefore exceeding this limit with encoding cannot be done.

3.
a. From my knowledge these old controllers were slow as the data transfer rates from the read write capabilities from the system to the disk with the main cause being the controller was separate from the disk drive. So, the drive would have to send data to controller than onwards and then if not correct back and by this time the drive would be further ahead so to speak the processing of data wasn't fast enough for the spin cycle. The penalty for this was laggy seek times.
b. To fix this they buffered the system reducing seek time, allowing the heads to read the data or write them in available positioning. Sending step pulses as fast as it gets them therefore could get the requested information a lot faster as the head movement would know where to go.

## Part D Advanced Question - memory

a. Since page 3 is occupied already by process B a minor page fault will occur. The processes from Page 5 from process A could not be transferred until the time that process B page 5 is made clear.

b. Since the information is not loaded major page fault, page 7 needs to be brought in a free slot is found to bring in page 7 once this is done the data can then be read into memory and indicate it is there.

c. The information of speed will increase yes, since the process will be optimized and reading through of the page's frames would take less time. Less processing means improved performance since RAM can access in nanoseconds having the lessor disk drive that is hosting the virtual memory or the pages sorted helps.

d. No it does not necessarily replace page 3 since there are multiple empty frames/blocks. Completely different processes and page 7 slot is available to be brought in as stated in part of the answer to b.

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# References

I have no quotes or direct passages and as such no references.