Final Exam

COMP 262 Computer Organization & Architecture

### 100 points total. One hour.

### *Your answers should be written in blue (the “Normal” style from the formatting menu).*

### *A typical length of your response is suggested by the title of the section. However, adjust your own response length as needed to answer any given question. As you write, you may push other questions forward along the page. That is expected. However, if it pushes the questions or answers onto a new page, you wrote too much!*

### *Good luck, and don’t forget to* ***submit*** *your Final when you are ready! When you are ready to submit, see instructions on the CI Learn page for this assignment.*

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# One-to-Few Word Answer

## General Quick Questions (9 pts)

### How many CPUs wgere found in a typical PC from 1980? (1 pt)

The PC had one CPU. With one core.

### How many CPUs were found in a typical PC from 1990? (1 pt)

Typically found in CPUs in the 1990 were one CPU with two cores.

### How many CPUs were found in a typical PC from 2000? (1 pt)

This is where they developed one CPU, with multi core processors. Could be up to 4 cores on expensive hardware. Possibly a multi CPU unit if had the money.

### How many CPUs, GPUs, and neural processors (all combined) are found in a typical iPhone X? (Ballpark it.) (2 pts)

They all combine would add up to around 10-12.

### Choose one computing device in this room. Name the device and name its architecture. (2 pts)

My laptop, it’s a asus laptop with a i7 core processor. There is up to 8 cores inside the laptop. It runs on x86-x64 architecture.

### What would you expect for a typical bus width (the number of data lines) inside a 64-bit CPU vs. a 32-bit CPU? (2 pts)

The number of data lines in a comparing 64-bit CPU vs a 32-bit CPU would be up to 4 times the number of data lines or bus width.

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# One-to-Few Word Answer (cont.)

## Units of the CPU (7 pts)

### Name the unit that manages the rest of them. (1 pt)

Control unit.

### Besides setting pins, what else does this unit do? (2 pts)

This unit controls the architectures and code. It can manipulate instructions to make functions add or subtract or send it to the ALU. It can help control the ALU or send information to it to be processed.

### Name the unit that handles mathematical operations. (2 pt)

The ALU would be the unit that handles mathematical operations.

### Besides mathematical operations, what else does this unit do? (2 pts)

It can control the data movement through operations known as AND, OR, XOR, XAND

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# Two-to-Few-Sentence Answer

## Class Basics (21 pts)

### What is computer organization? (7 pts)

Computer organization is chips and placement of things inside the computer. The architecture is the language that helps run the program, like machine code. I like to think of the organization as the hardware part of computers.

### What’s the difference between transistors, logic gates, and logic circuits? (7 pts)

Transistors help move data to different parts of the computer. IE the ALU to do mathematical operations. They help pass logical statements. Logic gates are composed of transistors. Logic gates manipulate 1 and 0, whereas 1 is true and 0 is false. Logic circuits help pass this information.

### How does (or doesn’t) the control unit of a CPU directly interpret assembly language? Also, how does (or doesn’t) it directly interpret C code? Explain. (7 pts)

Every language has a presidency. High level languages are here to help the users understand their code more efficiently to write programs. When someone writes in java or c code, the computer then has to break that code down into lower level languages for the computer to understand it. This is why lower languages run “more efficiently” because you are missing steps that have to actually convert your code into legible code for your computer. Your computer then can take the binary code and represent it by using the things quoted in the above statement to output a statement or do operations.

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# Two-to-Few-Sentence Answer (cont.)

## Parallel Computing (21 pts)

### Why is parallel computing the hot way these days of gaining additional processing power? In your answer, explain why it’s a mixed bag. (7 pts)

Parallel computing is the “hot way” of gaining additional processing power because it is a fast way to process code. GPU’s are a great example of how parallel computing is advanced because of how fast they are able to process parallel code. In a great article about the future of computing, the CPU’s have almost “hit a wall” in the advancement, because of limitation of size and power. The GPU’s have been getting more and more powerful with less of a limitation. They will continue to get more powerful, and they run solely on parallel computing. This is a mixed bag because we require a CPU to run certain programs like our processing system that can’t yet be run by a GPU. The greatest thing I learned about this class is to keep an open mind about the futures of computing, don’t put limitations on new idea’s, where I believe that parallel computing will evolve into something even more powerful.

### Explain the difference between multiprocessing and multithreading. Tie in ideas of shared memory and message passing. (7 pts)

There are differences and similarities between multiprocessing and multithreading is that it is all. They are all ran by the CPU. Multiprocessing uses cores to output data and split up the work load, whereas multithreading uses threads to split up workloads. Cores and threads are one that seems to be interlocked, but that is where the ideas of shared memory and message passing comes along. A CPU shares memory through the cashes, mainly the L3 cashe that can allocate different memory into different cashes. Message passing is different in the sense that not everything could be shared or passed through. This is important for hiding information to users that should not have access to that information.

### Give one example of a problem that can be tackled with a supercomputer that couldn't be tackled with a distributed network of computers, and very briefly tell what features of the problem make it challenging for distributed computing. (7 pts)

There are many examples of problems that can be tackled with a supercomputer that couldn’t be tackled with a distributed network of computers. Mainly supernatural events like to use supercomputers to tackle the information. Weather data patterns that are rapidly changing, that need VAST amounts of data could be a good example where a supercomputer would excel. Distributed network of computers has the processing power, but the data inside is hard to distribute evenly throughout the computers. The cable that is required may be longer which means the further the distance the longer the time it takes for data to interlocked between all. Supercomputers are a very interesting topic and having that guest speaker was really interesting as she explained supercomputers and the effect it has on computing in general.

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# Two-to-Few-Sentence Answer (cont.)

## Tiered Memory (21 pts)

### What's the primary advantage of having memory caches located so physically close to the processing units? (7 pts)

The advantage of having memory caches located physically close to the processing unit is because they have one of the highest processing rates. As stated, you want the Cashes as close to the processing unit because they store quick and very important data that can be accessed very quickly. If you were to put the cashes farther away from the processing unit the time traveled would be greater, making it take more time to access this very important information. The hierarchy of memory is very interesting, its why you would never put a hard drive closer to the processor over cashes or say RAM. Hard drive is slow accessible memory that has storage properties, and compared to the cashes can hold a huge amount of memory. There are advantages to all memory, and the placement is key inside your computer.

### Discuss at least *one* non-trivial *similarity* between a "shared" cache (e.g. the L3 cache) and RAM. (7 pts)

Cache and RAM are similar in the sense that they hold information that has to be accessed quickly for your computer. When shopping for a computer, before taking this class, I always asked for how much RAM was on the computer, because that in a sense would tell you how fast the computer ran or processed information quickly. Cashes is even quicker memory then RAM, and hold the most important of information, stuff that is going to be accessed often and readily at hand. One similarity between the two is they all need constant power to run. Once you shut off your computer, you will lose the information that was stored inside the Cashes and RAM. This is why it is important to save your information onto your hard drive.

### Even in the most high-end computers, RAM doesn't use the highest-speed memory technology available. Why not? (7 pts)

Because RAM, even though it is super-fast to the human eye, needs to have more open memory. It needs space to allocate processing information. If we made the RAM the highest-speed memory, then we would lose out on important memory space, IE storage. We have the cashes as the highest-speed memory and they can only store a small amount of information into them. They are referred as most expensive. The more expensive you get, the less data that it can hold or store inside of it. RAM is fast data, but we still need to store the lots of programs that you have running. Let say you have 10 windows up, a video game, and YouTube playing in your background. You have a lot of information flooding into the RAM. If you didn’t have enough storage room inside you wouldn’t run all those programs efficiently. Long story short, cost efficiency plays a huge part.

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# Two-to-Few-Sentence Answer (cont.)

## Control Unit (21 pts)

### In the John Scott control unit, steps 1 - 3 fetch a single instruction code, and step 7 resets the stepper back to step 1. What happens in step 4 - 6? (You don’t need the diagram to answer this. Note that I’ll be looking for a key word here.) (7 pts)

In step 4-6 it will be placed into the ALU to convert a designated application for what you are trying to do. These actions have either a 1 or a 0 to show a certain function that needs to be processed. It would then store the information back to where you wanted to place it.

### Writing simple programs from scratch in machine code takes a while and is nearly impossible to read. What's *another* big reason that programmers don’t choose to write in machine code (or assembly) for general-purpose programs? (7 pts)

This is a great question. After taking 162 last semester and working with assembly, I know first-hand how tough it is to learn and understand assembly code. The amount of comments needed on my programs to actually understand what was going on was incredible. I think a big reason why programmers don’t choose to write in machine code for general-purpose programs is that computers have got so strong over the past that there is less of a need for super-fast efficient code. I hate to say that, but writing in C or Java has taken steps above anything else. These programs convert your code into machine code that is legible for your computer, which obviously takes more time. I talk to my dad who is a retired software engineer, about the sheer advancement in computers it would blow your mind. He has written programs in Java or C that used to take hours to run, and now can be ran in less than 1 minutes with the current processing power. I would say this is a big reason why we would not need to write in machine code or assembly for general-purpose programs.

### What's the difference between a program and a microprogram? (7 pts)

The difference between a program and microprogram is mainly the architype that it is written in. Microprogram would use logic gates and flip flop circuits. A program would be essentially converted into microprogram to help the computer export the commands.

# Bonus

## Circuitverse (5 bonus pts)

### After you have completed and submitted your final exam, but before leaving the classroom, complete this problem (found in our group on Circuitverse) for up to five bonus points:

**Make an LED light up for just one clock cycle out of every eight. You can use any CircuitVerse elements you find useful.**