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CS376 – Problem Set #1

For the following questions, answer in this document completely, then submit the document back to Canvas. All answers must be in your own words – you can discuss answers with others, but any work you turn in must be your own. These questions are based on Ch1 and Ch2 of your text. Most questions have multiple parts –be sure to answer all parts of the question.

1. ***(20 points)*** **What is an operating system? Give a short description of its purpose. Then, define and describe four of its duties specifying which part of the computer the duty serves: hardware or application.**
   An operating system is special type of program that controls a computer's hardware and also acts as a layer between the use and the hardware. The main purpose of the operating system is to facilitate the sharing of resources on a computer. One duty of the operating system is program execution which is running programs and determining which programs need to be running when. This serves the application. Another duty is I/O which is taking input from the user and giving output to the user. This serves the application. A third duty of the OS is user interface, this can come in the form of a GUI like windows or a command line interface such as MS-DOS. This serves the application. A fourth duty of the operating system is communications which involves sharing information between processes or even other computers. This serves the application.
2. ***(10 points)*** **When the CPU makes a request for data that is not in RAM, a request will be made to retrieve the data from the hard disk. Describe the process including how the request goes from CPU to the disk drive, what components are used, what parts of the operating system are invoked.**
   The request goes from the CPU to the disk controller via the system bus as an I/O call. The request is to transfer some part of the hard disk into RAM, so the disk controller then processes this request and starts to transfer the data from the disk drive into RAM. During this, the operating system is responsible for keeping track of which parts of memory are being used and who is using them, deciding which data to move in and out of memory, and allocating and deallocating memory as needed.
3. ***(20 points)*** **Interrupts serve an important purpose. What is the purpose of an interrupt? Why is the CPU allowed to be interrupted in the first place? What are the different types of interrupt? When an interrupt occurs, by what mechanism does the OS determine what code to execute in order to carry out the task the interrupt requests?**
   An interrupt is a signal to the CPU that indicates an event needs immediate attention and request that the CPU interrupt the currently executing program to attend to the request. The purpose of interrupts is that it allows for better control over the computer. Instead of having to wait for an application to finish running and hope that what they want done has the highest priority, the CPU will deal with the process immediately. The different types of interrupts are hardware interrupts and software interrupts. Hardware interrupts come from the hardware and signal that they need some attention. This can come in the form of typing on a keyboard for instance. Software interrupts are generated by programs when they want to make a system call

to be performed. Interrupts are signals describing the location where the code that performs a given interrupt's request is located.

4. ***(5 points)*** **Find the definition of a trap. How does a trap differ from an interrupt?**
   A trap is an interrupt that is caused by either an error or a specific request from a user program that indicates an OS service can be performed. Traps are usually software-based interrupts where as interrupts are normally hardware interrupts.

5. **(*12 points)* What is the difference between a CPU, a processor, and a core?**
   A processor is a generic name used to describe a CPU. A CPU is a central processing unit that is a component of a computer. A computer can have multiple processors. It carries out operations such as arithmetic, logical, control, and input and output. A core is a unit inside the CPU that receives and executes instructions. A CPU can have multiple cores.

6. ***(8 points)*** **Define the "kernel". How does the kernel differ from system programs? Give an example.**
   The kernel is the core of the operating system and is the first program that is loaded into main memory and remains there until the computer is turned off. The kernel acts as a translator that makes the computer understand commands from the user. The kernel differs from system programs because the kernel is always running but system programs are not.

7. ***(13 points)*** **Describe how a user program makes a request to the operating system. Be sure to include something a program does that invokes a service from the operating system and give the mechanism by which a program you've written has requested a service from the OS.**
   The user program makes requests to the OS using system calls. A system call is how the operating system provides a service. When a system call is invoked an interrupt is generated and then the CPU must handle it. An example of a system call is printing. An example of a program I have written that has used a system call would be CS274 projects where we were printing to the screen via system calls in assembly. To do so you have to load the information to be printed into specific registers and then indicate the operation to be done and then call syscall.

8. ***(12 points)*** **What storage devices are closest to the CPU? What storage device is the next closest? What qualities of these storage devices make them better for CPU operation than say, a hard disk or magnetic tape?**
   The storage devices closest to the CPU are registers and cache which are located inside the CPU. The next closest storage device would be main memory/RAM. These storages devices are all quick in comparison to the other types of memory. They have short access times, but these types of memory are much more costly than the other types of memory, so they are used in relatively small amounts. They are also volatile storage devices which means that they do not store data permanently. This is where hard disk and magnetic tape come in. They can hold data permanently and they are much cheaper so you can have much larger hard disk than ram.