Week 8 Topics:
Operating System Details: Device and File System Management

As you saw from the Midterm Exam, these questions actually DID form the basis of the questions I used for the exam. Didn't believe me, did you? Now that you know this, why not study these now and review them weekly with me on Mondays! I may actually ask you to do something with these in class!

1. What does the Device Manager provide to the[/an] application programmer? **A hardware independent software interface to the system peripherals and devices.**

2. What is the purpose of the bus? **To link the CPU, peripheral, and memory hardware components together electrically.**

3. Devices have registers. What are the registers for? **Storing small amounts of data about the state of the device, instructions to preform, or other data that is ready to be moved from one location to another.**

4. What do the device IN and OUT instructions accomplish? **OUT instructions tell an output-capable device that data from a specified address is ready to be exported or displayed.**
   IN instructions tell an input-capable device that the data is contains is ready to be read into memory.

5. What is memory mapped I/O. **This is where a I/O device is presented to the computer as if it were a range of physical memory. When the system writes to this address the physical device performs an action such as printing a character on a screen. For input devices, the device can be read as if the system were accessing a physical block of information, whether it is there or not.**

6. Describe how DMA works. **By engaging a sophisticated controller on the device, the Kernel can give the device a memory address and a function to perform (or in the case of a disk drive a location on the drive) where the device can automatically move data to and from the memory location without the need for the CPU to get involved. Once the transfer is complete, the controller can then signal the Kernel and CPU that it is done by way of an interrupt and pass control of the process back to the for finalization.**

7. What is the difference between sequential devices and block devices? **Block devices can be accessed by means of addresses or coordinates and a single "block" of data is written or read from this location during any given transaction. Sequential devices read or write a word or byte of data at a time and always in a linear (sequential) fashion.**

8. What is a device driver? Where does it fit? **This is a highly specialized kernel module, purpose built for liaising between the kernel and the specific hardware system (or virtual compomnents) of the device. It also provides the appropriate call mechanisms and/or interfaces for the operating systems' API (Application Programming Interface)**

9. Describe the flow of execution from when an interrupt happens until it is finished. **When the CPU receives an interrupt signal from a device it immediately stops what it is working on, saves the program counter (bookmarks where it is at) and stores the context of what it was working on in a safe place where it won't get overwritten. The scheduler then switches to the device driver to deal with why the interrupt happened in the first place. Once the device has been dealt with the scheduler can elect to either re-start the pre-interrupt process or begin an new one that may have i higher priority.**

10. What is the difference between polling vs interrupts? The amount of hardware involved - Interrupts require controller hardware - and the amount of time the CPU and kernel have to spend directly dealing with the particular device.

Which is more efficient? Interrupts Why? interrupts free the CPU from having to constantly check to see if a device has done its assigned task. Each time this happens it requires the CPU to make a context switch and that takes up CUP cycles and resources.

11. What and why are disk scheduling algorithms? These are "seek" methods/strategies by which the device manager can optimize the efficiency of the process of locating, reading from, writing to, and verifying the various data blocks on a hard disk or other mechanical-motion storage medium.

12. What sometimes presents a problem for disk scheduling algorithms with current disk drives?
When disk disk drive controllers use virtual geometry (EG Native 4K blocks but only present as 512 block size to the kernel.)

13. What is a file system? An organized structure for storing and/or retrieving data to and from a long-term storage device such as a disk, network location, or read-only media, such as a CD-ROM, DVD, or Blu-ray disk.

14. List 5 things a file system must support.
File naming / identification convention
Directory structure / Organizational scheme
Object types, such as directories, files, pipes, streams, redirects, links (short-cuts), and devices
Data access, manipulation, and maintenance utilities
Access control / security scheme

15. What are the 3 tables a file system ODS must contain?
Free / available space
File locations
File metadata such as size, state, security, name, etc.

16. What is the purpose of the superblock? To tell the computer about the filesystem on the device - such as size, metadata about the file system objects, and where to find additional information.

How many of them are there? One primary, but multiple backup copies depending on the size of the disk.

17. What is the purpose of the inode table indirect and double indirect block? The indirect block contains pointers to additional blocks should the file size exceed the initial 13 blocks pointed to by the inode's pointers. The double indirect block contains additional pointers to additional blocks, similar to the indirect block, should the file still exceed the capacity of the indirect block and inode's pointers.

18. The inode table contains direct pointers to 13 disk blocks so small files can be accessed quickly. How does NTFS handle this same quick access for small files? By storing the actual data of those files directly in the MFT if they're under 512 bytes, and indexes to where the file is written if they happen to be greater.

19. How does NTFS handle larger files? Indexes stored in the MFT along with the metadata about the file

20. What is blocking? This is where a file system groups several individual disk sectors together in a cluster so as to keep file tables small.

21. What is the block size in Linux on deepblue? (4096 on hal)

22. What is the typical block size? 4096 bytes (4K)

23. What are several utilities that are provided for looking at a file system in the O/Ss we have studied? (Windows / DOS CL) dir, cd, del, ren, attrib, {redirection} <, >, {pipes} l
(Linux CL) ls, cd, rm, mv, chmod, {redirection} <, >, {pipe} l
(Windows GUI) Windows Explorer
(Linux GUI) Nautilus, Dolphin, Thunar, Konqueror

24. What is direct and sequential access? Direct access (AKA "Random Access") is where data locations can be stored and accessed at any point in/on the medium by means of an address or set of coordinates. Sequential access is where a the data can only be stored or retrieved by starting at a pre-defined point (usually the beginning) on the medium, and iterating over that medium in a step-by-step ("sequential") fashion until the data is located and stored or retrieved.