Chapter 2

Review questions:

1. *What happens during the fetch stage of the fetch-execute cycle?* The value stored in the PC is sent to memory, memory retrieves the instruction and sends it back to the CPU.
2. *What happens during the decode stage of the fetch-execute cycle?* The control unit examines the instruction in the IR to determine the operation (op code) and operand(s).
3. *What happens during the execute stage of the fetch-execute cycle?* The instruction is executed by moving the datum from one location to another or using the proper circuit in the ALU.
4. *What is a load?* Moving a datum from memory to the CPU.
5. *What is a store?* Moving a datum from the CPU to memory.
6. *What is an operand?* A datum to be used in an instruction, for instance in A + B, A and B are operands.
7. *What is the ALU? What are some of the circuits in the ALU?* The arithmetic-logic unit, the component in the CPU that performs all arithmetic and logic operations. Circuits include adder/subtracter, multiplier, divider, shifter, rotator, parity computation, AND, OR, XOR, NOT, comparator.
8. *What does the control unit do?* The component in the CPU that handles the fetch-execute cycle and sends out commands to all of the other components in the computer.
9. *What does the PC store?* The address of the next programming instruction in memory.
10. *What does the IR store?* The current instruction to be decoded and executed.
11. *What does the AC store?* The current computed result.
12. *Is the AC the only data register?* It depends on the architecture, it is in some (older) computers but not in modern computers.
13. *What is moved over the data bus?* Data being loaded or stored, between the CPU and memory, and program instructions being passed back from memory to the CPU.
14. *What is moved over the address bus?* The location in memory or I/O subsystem that the CPU wants to move data between.
15. *What is moved over the control bus?* Commands from the control unit, or status information from the devices in the computer.
16. *Why does a processor's GHz rating not necessarily tell you how fast it is?* 1 GHz is 1 billionth of a second, which is the rate at which the processor's clock pulses. This rate indicates how quickly one step from the fetch execute cycle lasts, but different processors have different length fetch execute cycles.
17. *What is MIPS and how does it differ from GHz?* Millions of instructions per second – the number of integer operations that can be executed in a second. This gives you a better indication of the processor's speed than GHz because it indicates the execution time of whole instructions.
18. *What is Megaflops and how does it differ from MIPS?* Millions of floating point operations per second – the same as MIPS, but only pertains to floating point operations.
19. *What is a benchmark?* A program that is run on a number of different processors to gage the processor's performance. Typically benchmarks are combined into a suite so that overall processor performance is determined by the speed that the processor executes all of the programs.

20. *What is the memory hierarchy?* All of the storage locations in the computer from the fastest (registers) to the slowing (removable storage devices). Each level in the hierarchy as you move down the hierarchy is slower but cheaper so there is more of it. Therefore, each level acts as "backstop"for the upper levels.
21. *Which form of memory is faster, DRAM or SRAM?* SRAM.
22. *Why are there both on-chip and off-chip caches?* The on-chip cache, because it is on the CPU with the rest of the circuitry, must be small, but it responds more rapidly than the off-chip cache which is some distance away. The off-chip cache is larger. So the two caches act as the first and second stop in looking for an item in memory.
23. *What happens if the CPU looks for something at one level of the memory hierarchy and does not find it?* The CPU looks the next level of the hierarchy for the item.
24. *Where is virtual memory stored?* Swap space which is stored on the hard disk.
25. *What were the forms of input and output found in early computers?* Punch card and magnetic tape. The printer was off-line, so the tape would be unmounted, moved to the printer, mounted on the printer and finally printed out.
26. *What is HCI? What does it study?* Human-computer interaction. It studies how humans should interact with computers by considering human psychology, human physiology and the state of the art in computer science such as speech recognition and gesture recognition.
27. *What is a repetitive stress injury?* An injury that occurs from heavy usage of a computer component such as the keyboard or mouse.
28. *What types of input and output devices could you use as wearable technology?* Virtual reality gloves and goggles, headset (microphone and headphone), possibly a joystick or a small touchscreen, also GPS tracking chip.
29. *What are some of the applications for virtual reality?* Exploration, education, remote control of devices, games.
30. *Why is it important to wear a grounding strap?* Your body may retain a static charge that, if discharged to chips on a motherboard, could fry those chips.
31. *What might happen if you discharge static while working with the motherboard?* Chips could be permanently damaged.
32. *Why should you install the CPU onto the motherboard before installing the motherboard into the system unit?* It is far easier to maneuver around the motherboard before it is connected to the system unit. Also, you have to push the CPU into its socket and pushing too hard once the motherboard is mounted on the standoffs could possibly crack the motherboard.
33. *What does the CPU cooling unit do? Why is it necessary?* The CPU generates heat because of its power utilization. Without the cooling unit, the chip may produce so much heat that it could damage itself or nearby components. The cooling unit combines a heat sink and a fan to dispel as much waste heat as possible.
34. *When installing a storage drive, how does the SATA data connector differ from the IDE data connector?* The IDE data connector contains a number of individual "holes" to plug into a multi-pronged port, the SATA connector is a strip that has a number of "pins" on it, so that instead of having a connector with holes, it is one long rectangular connector.

Discussion question points:

1. *How important is it for an IT person to understand the functions of individual computer components such as the role of the CPU and memory? How important is it for an IT person to understand concepts like cache memory, pipelining processors, the use of the bus, the fetch-execute cycle, and the use of registers? How important is it for an IT person to understand the differences between SRAM, DRAM and ROM?* This topic will be on most students' minds as they struggle through the material in this chapter (this will be among the most challenging of the material from the book). Without an understanding of the role of CPU and memory, the student will have difficulty troubleshooting performance related problems and making informed decisions on computer purchases. For instance, if a computer is responding slowly, will the student understand that the problem is not the processor but with too limited amount of main memory? Alternatively, when purchasing a computer, the IT person should not be fooled into just selecting the processor with the highest clock speed. Although some of the concepts involved in the fetch-execute cycle may not be relevant to the IT person, the more the IT person understand regarding the foundations provided in this chapter, the better off they will be. In fact, it is not out of the ordinary for some IT programs to include a full course on computer organization. Of the items listed above, I would rank the importance in understanding them as follows: what the CPU does, what memory does and the memory hierarchy, what cache memory is, the differences between SRAM, DRAM and ROM, what the fetch-execute cycle is,, pipelining processors and finally the use of the bus.
2. *As an IT person, do you ever expect to program in assembly language? If so, provide some examples and if not, explain why not.* I would normally say "no, the IT person would never program in assembly language". However, I was surprised to get some very positive feedback from an IT student who took my computer organization course. He told me that learning assembly language was going to greatly enhance his ability to be a system administrator and that all students should take the course.
3. *Which is more significant in IT education, understanding the function of the hardware of the computer or understanding how to assemble (build) a computer? Explain.* I would say that the typical IT person will not be involved in IT assembly or repair and so, while it is important to know everything about the computer, the IT person will be far better served by understanding the function of the hardware. Most students will probably not agree with this, at least not initially.
4. *Most people believe that the processor's clock speed is the most important factor in a processor's performance. Discuss all of the factors that can impact the performance of a processor. Rank your factors in the order that you feel will have the most significant impact on performance. Where did the clock speed rank?* The biggest factor is whether the processor is pipelined or not. We did not cover the pipeline in any detail, but in essence a pipeline is a form of parallelism that lets the CPU handle multiple instructions at one time. The next factor is the number of steps in the fetch-execute cycle. This is followed by clock rate. After this, we also have the impact that the memory hierarchy causes (small caches for instance will reduce processor performance) and the size of the word. Larger word sizes permit great amounts of data to be moved and processed at one time.
5. [skipped]

6. *For the input and output devices listed in table 2.1, which ones could cause repetitive stress injuries? Which ones might you identify as replacements to prevent repetitive stress injuries?* Certainly the keyboard and the mouse are among the worst. The joystick can also lead to problems. Replacements for the mouse are the other pointing devices, touch pad/point, trackball. The trackball can also cause problems. The touch screen can also be used as a replacement for a pointing device. The replacement for the keyboard is the microphone. Speaking to your computer is far easier on the body than typing. In small devices, the touch screen can serve as a keyboard, so while it can reduce stress from using a mouse, it can cause similar stress as to the keyboard. Finally, the pen tablet can also cause stress on the wrist depending on how much writing is required.
7. [skipped]
8. *You work for a large organization. Your employer asks you to put together the specifications for new desktop computers for the employees. As these are work computers, there will not be a high demand on multimedia performance, but instead there is a desire for ease of use, efficient communications and large storage. Put together a specification in terms of what you would look for, including platform (e.g., Windows, Mac, Linux), processor type and speed, amount of cache, memory, word size and secondary storage. What other factors will impact your decision?* I would start with a Windows-based computer if the work environment was based on traditional forms of processing but would select a Mac if instead the work revolved around more artistic pursuits. I would use Linux only because 1. much of the software is free or 2. I was using the computer(s) to host servers. Next, since we want efficient communication and large storage, I would make sure that every computer had a network card which will typically offer a higher bandwidth than a MODEM, a large hard disk drives (1TB at least, preferably more). I would also make sure that we had at least one network file server. Since multimedia performance is not a concern, main memory and processing power is less required, so I would obtain mid-scale processors with 4-8GB of main memory. I would make sure that all of the computers had an on-chip cache of at least 32KB and an off-chip cache of at least 1MB, preferably more like 2MB.
9. [skipped]