1. Classification of interrupts
    a. Examples of possible interrupts
        i. Power failure
        ii. Arithmetic overflow
        iii. I/O device request
        iv. OS call (system call or syscall)
        v. Page fault (in virtual memory, will discuss this later)
    b. How to classify interrupts
        i. By timing (with the clock)
            1. Synchronous (deterministic) – function of program and memory state
                a. Overflows, page faults
            2. Asynchronous (nondeterministic) – external device, or hardware malfunction
                a. Printer ready, bus error
        ii. Source of interrupt
            1. User request – from a user program (OS / system call)
            2. Coerced – from the OS or hardware (page fault, protection violation)
        iii. Masking
            1. User maskable – can be temporarily ignored (overflow, user-set breakpoint)
            2. Non-maskable – must be handled (power failure, page fault, reset button)
        iv. Location (or time) in instruction
            1. Within an instruction – must be dealt with to finish instruction (page fault)
            2. Between instructions – not part of an instruction (I/O device request, OS call)
        v. Result
            1. Resume - transparently return to user process (page fault, I/O request)
            2. Terminate – give up and die (protection violation, power failure)

2. Memory overview
    a. Terminology
        i. Word – usually the size of an int, 32 bits
            1. Bytes are a fixed size, words are not!
        ii. Addressable units – usually bytes, but can be words
            1. 2^A = number of addressable units, where A is the number of bits in an address
        iii. Unit of transfer – number of bits written out or read into memory at a time
            1. Same idea as bus width

3. Characteristics of memory systems (incomplete list)
    a. Physical type
        i. Need two well-defined states in the medium to differentiate 0 and 1
        ii. Semiconductor – flip-flops, capacitors, so on
        iii. Magnetic surface – stored using magnetism (like hard drives)
        iv. Optical – CDs, Blu-ray, etc. read via shining a laser at the medium
            1. Reflection or lack thereof (due to tiny pits) represents different values
        v. Paper – punched-out hole represents 0/1 versus no hole
            1. Used to program machines via punch cards
    b. Volatility
        i. Non-volatile – retains information when power is off (hard drives)
        ii. Volatile – loses information when power is cut (registers, flip flops, RAM)
    c. Location – internal (RAM) or external (USB hard drive)
    d. Capacity – number of bytes, number of words
    e. Units of transfer – larger memory devices tend to have larger units of transfer
    f. Access methods
        i. Sequential – linear search to pass through intermediate records
            1. O(n) to find a piece of data
            2. Tape drives are sequential
        ii. Direct access – reach general vicinity (via tracks), then sequentially to exact sector
            1. O(n/tracks + sectors)
            2. Hard drives do this
        iii. Random access – each addressable location has a unique, physically wired-in addressing mechanism
            1. O(1) to access that piece
            2. RAM (hence the name)
        iv. Associative – ask for a piece of data, rather than the address
            1. O(1) to ask if memory contains value 1234
            2. Memory looks at everything in parallel to determine address
            3. Content Addressable Memory (CAM)
    g. Performance
        i. Access time – time it takes to do a read or write
        ii. Cycle time – in RAM, access time + extra time to reset circuit/memory
            1. Must get ready again to access another value
        iii. Transfer rate – rate at which data can be transferred in and out of memory
    h. Erasability
        i. Some memories are non-erasable, hence the term read-only memory (ROM)
        ii. Otherwise, most memories we encounter are erasable
        iii. Do CDs and punch cards count as erasable?
            1. Can turn one value into another by forming a pit or punching a hole
            2. But usually can't reverse the process, once pit/hole is made that's it
            3. Wouldn't really consider these erasable in the same context as the others