Chapter 2 What's a Micro?

1.1)   Compile a list of at least 25 everyday objects that incorporate microcontrollers, microprocessors or digital signal processors.

> Cell phone
> Mp3 player
> Microwave oven
> PDA
> Automobiles (many!)
> Desktop computer
> Disk drives
> Digital cameras
> Dishwashers
> Washing machines
> Ovens
> DVD players
> CD players
> Stereo receivers
> Electronic musical keyboards
> Computer keyboards
> Computer mice
> Network routers / wireless access points
> Laser Printers
> Ink Jet printer
> Navigation systems
> Bicycle computers
> Noise cancelling headphones
> Video cameras
> TVs

1.2)   Using the internet, locate the data sheet for the Atmel ATmega128A microcontroller, and answer the following:

   a)   Does the ATmega128A have a von Neumann or a Harvard architecture?
   b)   How much non-volatile Flash program memory is incorporated?
   c)   How much volatile RAM data memory is incorporated?
   d)   List at least 5 other important peripheral systems that are included (there are many more than 5!)

> a)   Harvard, but the data sheet doesn't explicitly call this out. You need to study the block diagram to see that the program flash is connected directly to the instruction register.
> b)   128K Bytes
> c)   4K Bytes
> d)   UART
>   16 bit Timer
>   A/D Converter
>   Analog comparator
>   Brown out detector
>   Pulse Width Modulation
>   Real Time Clock
>   Two Wire Interface
>   Watchdog

1.3)   How is a microprocessor different from a microcontroller?

> A microprocessor does not contain program memory and data memory and I/O.

1.4)   How big is the address space for a microcontroller whose address bus is 24 bits wide?

> 2^{24}-1 = 16,777,215 locations

1.5)   What is the biggest number that can be represented with 28 bits?

> 2^{28}-1 = 268,435,455

1.6)   List three different types of non-volatile memory.

> Flash EEPROM
> ROM
> EEPROM

1.7)   Using the internet, locate the data sheet for the Microchip PIC16LF727, and answer the following:

   a)   What is the fastest clock source that can be used with this chip? What is the slowest?
   b)   Is there an analog-to-digital converter peripheral included on this chip?
   c)   How wide is the program memory bus? That is, how many bits are the program instructions?
   d)   How many input/output (I/O) pins does the PIC16LF727 have?

> a)   20MHz, DC (0Hz)
> b)   YES: 8 bits
> c)   14 bits
> d)   36

1.8)   What kind of microcontroller peripheral is present on the PIC12F609 that is not present on the MC9S12C32?

> An analog comparator

1.9)   What prevents a microcontroller with a von Neumann architecture from attempting to execute data? What about a microcontroller with a Harvard architecture?

> Nothing prevents the processor from executing data in a von Neumann architecture.
>
> In a Harvard architecture, the instructions are not fetched from the data space so it is impossible to execute data.

1.10)   How many I/O pins are available in the largest HC9S12C32? How many are input only?

> 60 total I/O pins: 58 are inputs or outputs (I/O) and 2 are input only