Digital microsystems design

Lab 1

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Outline

- Measurement unit of information
  - Bit
  - Byte
  - Word
- Multiples of data storage units
- Conversions:
  - Binary to hexadecimal numbers conversions
  - Hexa to binary numbers conversions
- Time diagrams
- Registers, Buffers, Decoders, Multiplexers
- Endianness
- Addresses and memory locations

Review

- bit
  - A bit is the basic unit of information in computing and data transmission;
    - A bit can have only the value of either one or zero, which may be implemented in a variety of systems by means of a two-state device.
    - An example of such a device in electronics can be a flip-flop, a logic gate or a relay (in relay logic).
    - The two values can also be interpreted as logical values (true/false, yes/no), activation states (on/off), or any other two-valued attribute.

Source: http://www.translatorscafe.com/cafe/EN/units-converter/data-storage/d/

Review

- nibble
  - a nibble (also called nybble or nyble) is a four-bit aggregation, in other words, half of an octet.
    - There are sixteen (2^4=16) possible values of a nibble, therefore it corresponds to a single hexadecimal digit.
- byte
  - A byte is a unit of digital information in computing and data transmission that consists of eight bits.
    - The de facto standard of eight bits is a convenient power of two (2^8) permitting the values 0 through 255 for one byte.

Source: http://www.translatorscafe.com/cafe/EN/units-converter/data-storage/d/

Review

- byte – 8 bits
- word – 16 bits
- double-word – 32 bits
- quad-word – 64 bits

Review

- Multiples

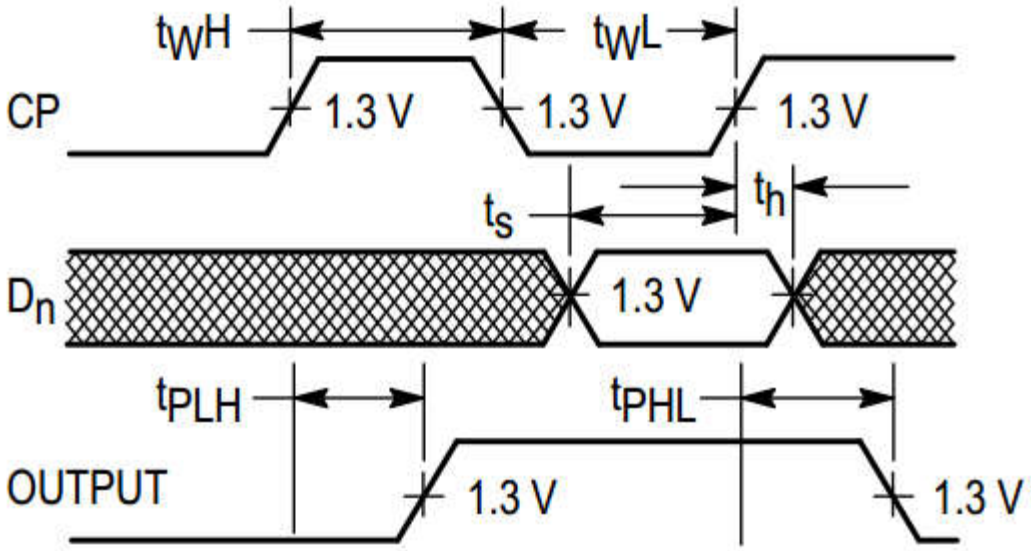
$$1\,KB = 2^{10}B = 1024\,B$$
$$1\,MB = 2^{10}KB = 2^{20}B$$
$$1\,GB = 2^{10}MB = 2^{30}B$$
$$1\,TB = 2^{10}GB = 2^{40}B$$
$$1\,PB = 2^{10}TB = 2^{50}B$$
$$1\,EB = 2^{10}PB = 2^{60}B$$

Review

- Conversions hexadecimal to binary
  - Each hexa digit -> 4 bits
  - ABCDh -> 1010 1011 1100 1101b
  - 423h -> 0100 0010 0011b
- Conversion binary to hexadecimal
  - Group bits in groups of 4 starting from right
  - Each group of bits -> 1 hexa digit
  - 1010 0101b -> A5h
  - 110011b -> 33h

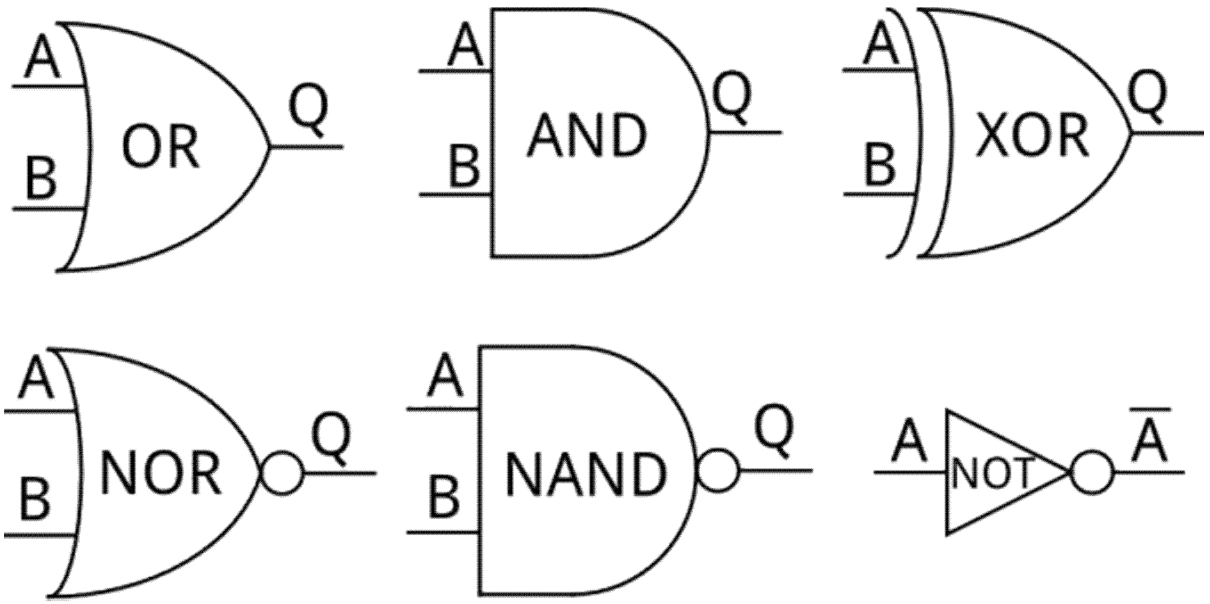
Review

- Time diagrams



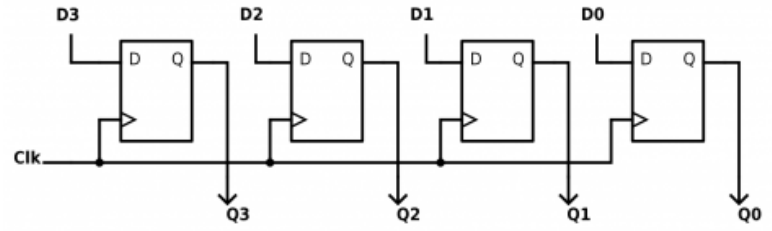
Review

- Logic gates



Review

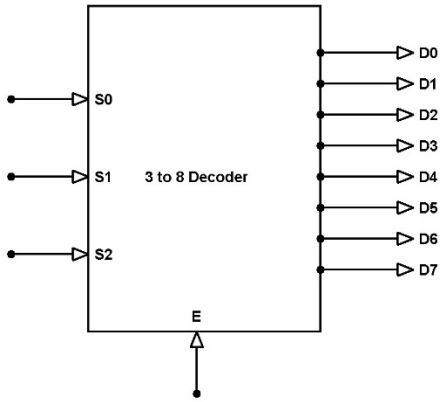
- Register
  - Clock signal Edge-Triggered D-Type Inputs
  - Data changes synchronously



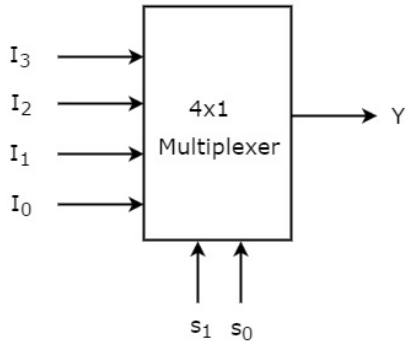
- Latch
  - The flip-flops appear transparent to the data when Latch Enable (LE) is HIGH
  - Data changes asynchronously

Review

- Decoder

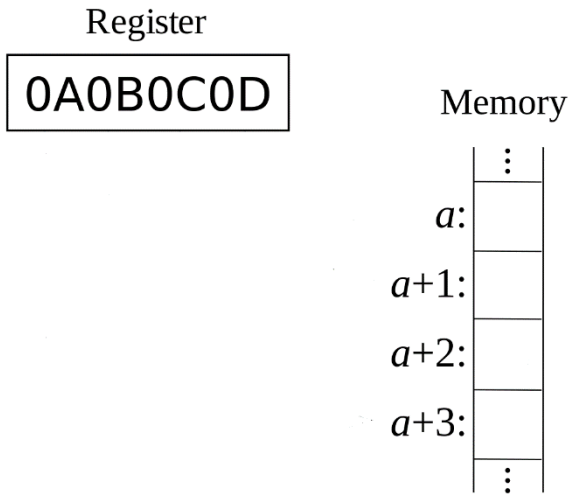


- Multiplexer



Review

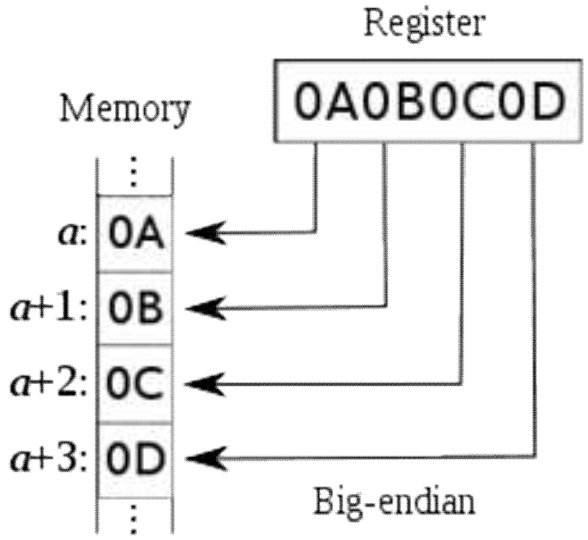
- Endianness
  - The terms endian and endianness refer to the convention used to interpret the bytes making up a data word when those bytes are stored in computer memory.



Source: http://en.wikipedia.org/wiki/Endianness

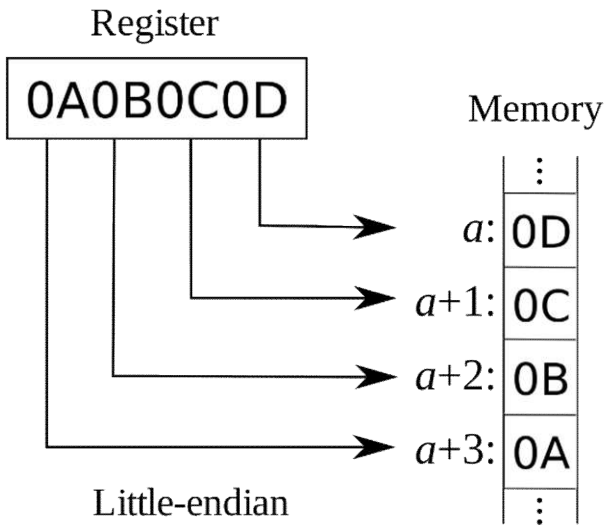
Review

- Endianness
  - Big-endian
    - Most significant bytes are stored at the lower addresses



Review

- Endianness
  - Little-endian
    - Least significant bytes are stored at the lower addresses



Review

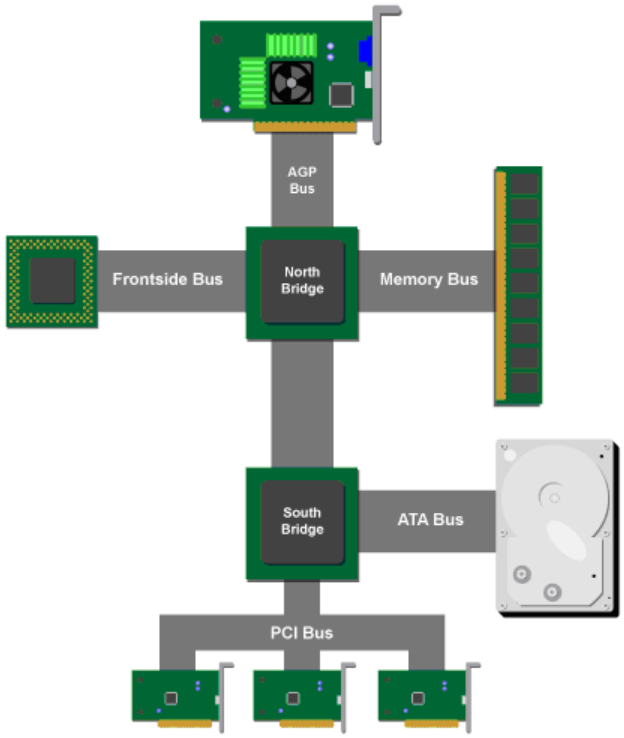
- Addresses and memory locations
  - How many address lines are needed to address a specific memory?

Review

- 10 address lines - ? Memory size
- 1 GB - ? Address lines

System architecture

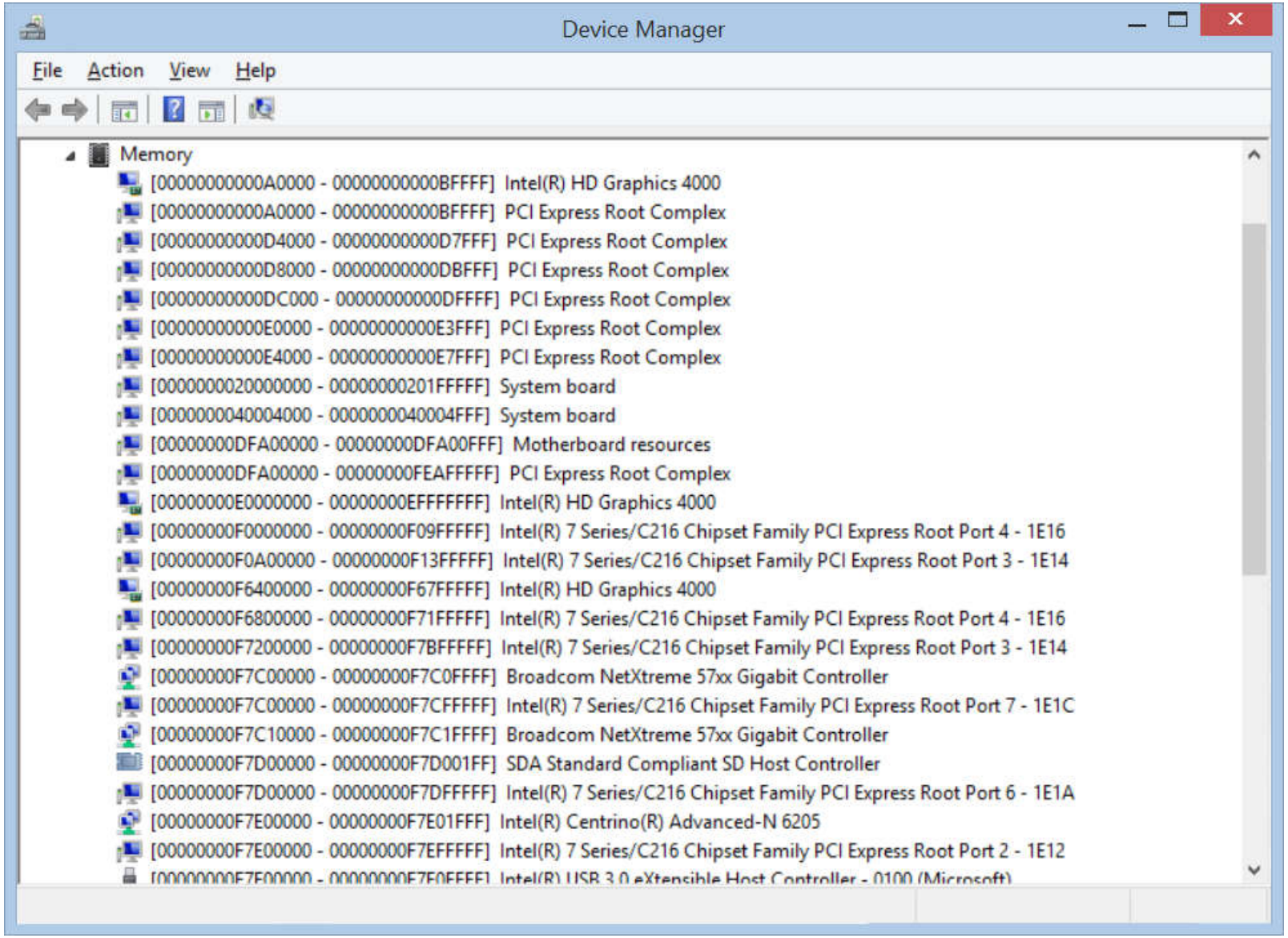
- FSB
- Memory bus
- Chipset
- I/O bus



Goal

- The discipline aims at providing students with knowledge needed to design a microprocessor based system (both HW and low-level SW) and to understand how different systems' components are interconnected and application software are implemented and executed

Memory map


Device Manager
File Action View Help
Memory
[00000000000A0000 - 00000000000BFFFF] Intel(R) HD Graphics 4000
[00000000000A0000 - 00000000000BFFFF] PCI Express Root Complex
[00000000000D4000 - 00000000000D7FFF] PCI Express Root Complex
[00000000000D8000 - 00000000000DBFFF] PCI Express Root Complex
[00000000000DC000 - 00000000000DFFFF] PCI Express Root Complex
[00000000000E0000 - 00000000000E3FFF] PCI Express Root Complex
[00000000000E4000 - 00000000000E7FFF] PCI Express Root Complex
[0000000020000000 - 00000000201FFFFF] System board
[0000000040004000 - 0000000040004FFF] System board
[00000000DFA00000 - 00000000DFA00FFF] Motherboard resources
[00000000DFA00000 - 00000000FEAFFFFF] PCI Express Root Complex
[00000000E0000000 - 00000000EFFFFFFF] Intel(R) HD Graphics 4000
[00000000F0000000 - 00000000F09FFFFF] Intel(R) 7 Series/C216 Chipset Family PCI Express Root Port 4 - 1E16
[00000000F0A00000 - 00000000F13FFFFF] Intel(R) 7 Series/C216 Chipset Family PCI Express Root Port 3 - 1E14
[00000000F6400000 - 00000000F67FFFFF] Intel(R) HD Graphics 4000
[00000000F6800000 - 00000000F71FFFFF] Intel(R) 7 Series/C216 Chipset Family PCI Express Root Port 4 - 1E16
[00000000F7200000 - 00000000F7BFFFFF] Intel(R) 7 Series/C216 Chipset Family PCI Express Root Port 3 - 1E14
[00000000F7C00000 - 00000000F7C0FFFF] Broadcom NetXtreme 57xx Gigabit Controller
[00000000F7C00000 - 00000000F7CFFFFF] Intel(R) 7 Series/C216 Chipset Family PCI Express Root Port 7 - 1E1C
[00000000F7C10000 - 00000000F7C1FFFF] Broadcom NetXtreme 57xx Gigabit Controller
[00000000F7D00000 - 00000000F7D001FF] SDA Standard Compliant SD Host Controller
[00000000F7D00000 - 00000000F7DFFFFF] Intel(R) 7 Series/C216 Chipset Family PCI Express Root Port 6 - 1E1A
[00000000F7E00000 - 00000000F7E01FFF] Intel(R) Centrino(R) Advanced-N 6205
[00000000F7E00000 - 00000000F7EFFFFF] Intel(R) 7 Series/C216 Chipset Family PCI Express Root Port 2 - 1E12

Memory overview

- Direct link between size, address lines (pins), address space (range)
  - 1 GB memory
  - 30 address lines
  - Address range: 0000 0000h – 3FFF FFFFh
- Addresses are assigned to bytes (not to bits or words)

Examples

- What is the address range of a 128 MB

Examples

- How big is a memory that has the following address range: 000000h - 1FFFFFh