Computer Architecture

Tutorial 2 – Main Memory Organisation

1   How many address bits are required for a 4G x 32-bit main memory if
- (a)   main memory is word-addressable?
- (b)   main memory is byte-addressable?

2   Suppose that a 1G x 32-bit main memory is built using 256M x 4-bit RAM chips and that this memory is **word-addressable**.

For this memory organisation evaluate:
- a)   the number of RAM chips per memory module?
- b)   the number of memory modules?
- c)   the number of RAM chips for the full memory?
- d)   the number of address bits needed for a memory module?
- e)   the number of address bits needed for the full memory?

In which memory module would memory word 14 (i.e. word address 14) be found when the memory system uses:
- f)   high-order interleave?
- g)   low-order interleave?

Assume memory modules are numbered from 0.

3   Suppose that the main memory given in question 2 is **byte-addressable**.

For this byte-addressable memory organisation evaluate:
- a)   the number of address bits needed for the full memory?

In which memory module would byte 14 (i.e. byte address 14) be found when the memory system uses:
- b)   high-order interleave?
- c)   low-order interleave?

Assume memory modules are numbered from 0.

4   Comment on the implications if we wished to transfer data between a little-endian memory (e.g. on an Intel computer) and a big-endian memory (e.g. on a PowerPC computer)?

Remember to show your working and carry out all the conversions without a calculator ☺