Tutorial using the on-line Animations for

Computer Organization and Architecture, Eighth Edition

by William Stallings

This is available at http://www.williamstallings.com/COA/Animation/Links.html

In this first exercise we will be using the Cache Simulator: which has four topics.

Section A Cache Address Structure

(1) On the demo set the following entries:
      Memory Size 1 Megabyte
      Cache Size   64 kByte
      Block Size   32 bytes

Choose initially Direct Mapping
Press SHOW.
Note the address field structure as explained below the diagram. In particular:

Total bits = 20; Block Size = $\log_2 (32) = 5$; 11 bits for the cache as explained; and 4 bits for the Tag as explained.

The **exercise** is now the following:

 For a Memory Size 2 Megabytes and given the address fields are
 Tag Field   3 bits
(Cache Block) Index Field   12 bits
(Block Size) Offset   Field   5 bits

(a) What is the size of the Cache ?
(b) What is the Block Size?
(c) How many Main Memory Blocks?
(d) How many Cache Blocks?

(e) What changes will happen in the fields of the address if
      (i)   Main Memory is changed to 1 Megabyte?
      (ii)   Main Memory is still 2 Megabytes, but the Block Size is 64 bits?

(2) On the demo now set the following entries
      Memory Size 1Megabyte
      Cache Size   64 KByte
      Block Size 32 bytes
Choose Set Associative with 4 blocks and press Show.

Note the address field and compare to (1). Number of bits is still 20; Block Size = $\log_2(32) = 5$ again; but number of bits in the index (set) field is now 9 bits, (2 bits less) since the number of cache sets = (number of cache blocks)/4. The 2 bits move to the TAG field, which now has 6 bits and not 4 bits.

Exercise:
For a Main Memory Size 2 Megabytes, and a Cache Size of 128 KBytes, and an address divided into the following fields

Tag Field	7 bits
(Cache Set) Index Field	9 bits
(Block Size)Offset Field	5 bits

(a) What is the block size in bytes?
(b) What is the number of sets in the cache?
(c) What is the number of blocks in the cache?
(d) What is the number of blocks/set?
(e) How many Main memory Blocks map to the same set?

(f) What changes in the fields occur:
      (i)   if the Main memory is changed to 8 Megabytes?
      (ii)   If the Main memory remains 2 Megabytes, but the cache size is changed to
             64 Kbytes?