COMP2120 Tutorial Exercise

March 19, 2025

Consider a hypothetical machine with 64K words of cache memory, with size of 128 words. (1K = 1024)

1. How many blocks are there in the cache memory?

   Solution: $64K/128 = 512$ blocks.

2. How many sets are there in the cache memory if
   (a) Direct-map cache organization is used?

   Solution: $512/1 = 512$ sets.

   (b) Four-way set associative cache organization is used?

   Solution: $512/4 = 128$ sets.

3. Write down the number of bits in each field for a 32-bit address. (The memory is byte address, i.e. each word is 4 bytes) for both direct-map and four-way set associate cache.

Cache Tag	Cache Set Number	Offset in the block

   Solution:
   Direct-map cache organization: Offset: 9 bits, Set Number: 9 bits, Tag: 14 bits.
   Four-way set associative cache organization: Offset: 9 bits, Set Number: 7 bits, Tag: 16 bits.

4. Calculate the average memory access time if the cache hit time is 8ns, cache miss penalty is 105ns and the cache hit rate is 95.0%.

   Solution: Average Memory Access Time $= 8 + (1 - 95\%) \times 105 = 13.25$ns.