**CS224**

**Section No.: 3**

**Spring 2021**

**Lab No.: 6**

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**1.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Cache Size KB** | **N way cache** | **Word Size in bits** | **Block size (no. of words)** | **No. of Sets** | **Tag Size in bits** | **Index Size (Set No.) in bits** | **Word Block Offset Size in bits** | **Byte Offset Size in bits** | **Block Replacement Policy Needed (Yes/No)** |
| 1 | 8 | 1 | 8 | 8 |  | 19 | 10 | 3 | 0 | No |
| 2 | 8 | 2 | 16 | 8 |  | 20 | 8 | 3 | 1 | Yes |
| 3 | 8 | 4 | 16 | 4 |  | 21 | 8 | 2 | 1 | Yes |
| 4 | 8 | Full | 16 | 4 |  | 29 | 0 | 2 | 1 | Yes |
| 9 | 32 | 1 | 16 | 2 |  | 17 | 13 | 1 | 1 | No |
| 10 | 32 | 2 | 16 | 2 |  | 18 | 12 | 1 | 1 | Yes |
| 11 | 32 | 4 | 8 | 8 |  | 19 | 10 | 3 | 0 | Yes |
| 12 | 32 | Full | 8 | 8 |  | 29 | 0 | 3 | 0 | Yes |

**2.a)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Instruction** | **Iteration No.** | | | | |
| **1.** | **2.** | **3.** | **4.** | **5.** |
| lw $t1, 0xA4($0) | Compulsory | Conflict | Conflict | Conflict | Conflict |
| lw $t2, 0xA8($0) | Compulsory | Hit | Hit | Hit | Hit |
| lw $t3, 0xAC($0) | Conflict | Conflict | Conflict | Conflict | Conflict |

**2.b)**

**For 1 set:** 1 bit (from set) + 2 bits (from block offset) +2 bits (from byte offset) = 5 bits

32 – 5 = 27 bits (for Tag), so 27 + (32 x 4) + 1 = 156 bits

**Total cache memory:** [1 bit (from V) + 27 bits (from Tag) + 32 x 4 bits] x 2 = 312 bits

**2.c)**

* 1 EQUALITY COMPARATOR (to check Tag)
* 1 AND gate (to check Hit)
* 1 4x1 MULTIPLEXER (to select word in the block)

**3.a)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Instruction** | **Iteration No.** | | | | |
| **1.** | **2.** | **3.** | **4.** | **5.** |
| lw $t1, 0xA4($0) | Compulsory | Capacity | Capacity | Capacity | Capacity |
| lw $t2, 0xA8($0) | Compulsory | Capacity | Capacity | Capacity | Capacity |
| lw $t3, 0xAC($0) | Capacity | Capacity | Capacity | Capacity | Capacity |

**3.b)**

**For 1 set:** 2 bits (from byte offset) = 2 bits (No bits from set nor block offset is coming)

32 – 2 = 30 bits (for Tag). Therefore,

[1 bit (from v) + 30 bits (from Tag) + 32 bits] x 2 (for N = 2) = 126 bits (for a set & entire memory)

**Total cache memory size in number of bits:** 126 bits

**3.c)**

* 2 EQUALITY COMPARATORS (to check Tag)
* 2 AND gates (to check Hit)
* 1 OR gate (to check Hit)
* 1 2x1 MULTIPLEXER (to select way in the block)