***3η Σειρά Ασκήσεων*** ***Αρχιτεκτονική Υπολογιστών***

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**Άσκηση 1**

Ορίζουμε αρχικά ως:

* *MRLi: miss rate (%)*
* *hitLi: cycles needed to resolve a hit (cycles)*
* *MPLi: miss penalty time (cycles)*
* *AMATLi: average memory access time (cycles)*

Επομένως, σύμφωνα με την εκφώνηση:

* *MRL1 = 100% - 97.5% = 2.5% = 0.025*
* *hitL1 = 1 cycle*
* *MPL1 = 90 cycles*
* *MRL2 = 100% - 88% = 12% = 0.12*
* *hitL2 = ???*
* *MPL2 = MPL1 = 90 cycles*

Άρα για την 1η περίπτωση:

Ενώ, στην 2η περίπτωση θα ισχύει:

Θέλουμε:

Δοκιμάζοντας τις τιμές 3 και 4, προκύπτει πως:

Άρα **hitL2(max) = 3.**

**Άσκηση 2**

* *Ερώτημα (α)*

H **cache έχει** 256/32/2 = **4 sets**, ενώ **κάθε block χωρά** 32/8 = **4 στοιχεία** ενός πίνακα. Επομένως, στην ανάλυση μας, θα έχουμε έναν πίνακα 4x2, όπου κάθε κελί θα χωρά 4 στοιχεία ενός πίνακα και μάλιστα με την παρακάτω διάταξη. Θα τονίζουμε με **bold** το block που δείχνει η LRU.

***i=0, j=0: m m m h***

B[0][0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | B[0][0-3] | **-** |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | A[0][0-3] |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

C[0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

***i=0, j=2: m h m h***

B[0][2]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | B[0][0-3] | **A[0][0-3]** |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | A[0][0-3] |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

C[2]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** |  |  |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

***i=0, j=4: m m m h***

B[0][4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | B[0][4-7] | **-** |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **B[0][4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

C[4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

***i=0, j=6: m h m h***

B[0][6]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | B[0][4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **B[0][4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

C[6]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

A[0][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** |  |  |
| ***j = 4-7*** |  |  |

Άρα για i=0 έχουμε **6 hits** (και 10 misses).

***i=1, j=0: m m h h***

B[1][0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **-** |
| ***j = 4-7*** |  |  |

A[1][0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** |  |  |

C[0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** |  |  |

A[1][0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** |  |  |

***i=1, j=2: h h h h***

B[1][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** |  |  |

A[1][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** |  |  |

C[2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** |  |  |

A[1][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** |  |  |

***i=1, j=4: m m h h***

B[1][4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[1][4-7] | **-** |

A[1][4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[1][4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

***i=1, j=6: h h h h***

B[1][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

A[1][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[1][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

Άρα για i=1 έχουμε **12 hits** (και 4 misses).

***i=2, j=0: m m m h***

B[2][0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | B[2][0-3] |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **B[2][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[0]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **A[2][0-3]** | C[0-3] |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

***i=2, j=2: m h m h***

B[2][2]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **A[2][0-3]** | B[2][0-3] |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **B[2][0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[2]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **A[2][0-3]** | C[0-3] |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

***i=2, j=4: m m m h***

B[2][4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **C[4-7]** | B[2][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **B[2][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[4]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **A[2][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

***i=2, j=6: m h m h***

B[2][6]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **A[2][4-7]** | B[2][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **B[2][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[6]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **A[2][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[2][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[1][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

Άρα για i=2 έχουμε **6 hits** (και 10 misses).

***i=3, j=0: m m m h***

B[3][0]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[0][0]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **A[2][0-3]** | A[0][0-3] |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[0]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[0][0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

***i=3, j=2: h h h h***

B[3][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[0][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

C[2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | C[0-3] | **A[0][0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

A[0][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[1][4-7]** | A[1][4-7] |

***i=3, j=4: m m m h***

B[3][4]: compulsory miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[0][4]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **A[2][4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

C[4]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[0][4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

***i=3, j=6: h h h h***

B[3][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[0][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

C[6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | C[4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[0][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **C[0-3]** | A[0][0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

Άρα για i=3 έχουμε **10 hits** (και 6 misses).

***i=4, j=0: m h m h***

B[0][0]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | B[0][0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[3][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[1][0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | B[0][0-3] | **A[0][0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

C[0]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[1][0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

***i=4, j=2: h h h h***

B[0][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | B[0][0-3] | **C[0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[1][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | B[0][0-3] | **C[0-3]** |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

C[2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[1][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **C[4-7]** | A[0][4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

***i=4, j=4: m h m h***

B[0][4]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | B[0][4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | B[3][4-7] | **A[1][4-7]** |

A[1][4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | B[0][4-7] | **A[0][4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

C[4]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

A[1][4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

***i=4, j=6: h h h h***

B[0][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | B[0][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

A[1][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | B[0][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

C[6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

A[1][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | **B[3][0-3]** | A[1][0-3] |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

Άρα για i=4 έχουμε **12 hits** (και 4 misses).

***i=5, j=0: m m h h***

B[1][0]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **B[0][0-3]** | C[0-3] |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

A[2][0]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

C[0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **A[2][0-3]** | C[0-3] |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

A[2][0]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

***i=5, j=2: h h h h***

B[1][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

A[2][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

C[2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | **A[2][0-3]** | C[0-3] |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

A[2][2]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | **B[3][4-7]** | A[1][4-7] |

***i=5, j=4: m m h h***

B[1][4]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **B[0][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

A[2][4]: conflict miss:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

C[4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **A[2][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

A[2][4]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

***i=5, j=6: h h h h***

B[1][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

A[2][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

C[6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | **A[2][4-7]** | C[4-7] |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

A[2][6]: hit:

|  |  |  |  |
| --- | --- | --- | --- |
| ***i = 0,2,4*** | ***j = 0-3*** | A[2][0-3] | **C[0-3]** |
| ***j = 4-7*** | A[2][4-7] | **C[4-7]** |
| ***i = 1,3,5*** | ***j = 0-3*** | B[1][0-3] | **A[1][0-3]** |
| ***j = 4-7*** | B[1][4-7] | **A[1][4-7]** |

Άρα για i=5 έχουμε **12 hits** (και 4 misses).

Συνολικά, λοιπόν:

***i=0***

Β[0][0] Α[0][0] C[0] A[0][0]: m m m h

Β[0][2] Α[0][2] C[2] A[0][2]: m h m h

Β[0][4] Α[0][4] C[4] A[0][4]: m m m h

Β[0][6] Α[0][6] C[6] A[0][6]: m h m h

***i=1***

Β[1][0] Α[1][0] C[0] A[1][0]: m m h h

Β[1][2] Α[1][2] C[2] A[1][2]: h h h h

Β[1][4] Α[1][4] C[4] A[1][4]: m m h h

Β[1][6] Α[1][6] C[6] A[1][6]: h h h h

***i=2***

Β[2][0] Α[2][0] C[0] A[2][0]: m m m h

Β[2][2] Α[2][2] C[2] A[2][2]: m h m h

Β[2][4] Α[2][4] C[4] A[2][4]: m m m h

Β[2][6] Α[2][6] C[6] A[2][6]: m h m h

***i=3***

Β[3][0] Α[0][0] C[0] A[0][0]: m m m h

Β[3][2] Α[0][2] C[2] A[0][2]: h h h h

Β[3][4] Α[0][4] C[4] A[0][4]: m m m h

Β[3][6] Α[0][6] C[6] A[0][6]: h h h h

***i=4***

Β[0][0] Α[1][0] C[0] A[1][0]: m h m h

Β[0][2] Α[1][2] C[2] A[1][2]: h h h h

Β[0][4] Α[1][4] C[4] A[1][4]: m h m h

Β[0][6] Α[1][6] C[6] A[1][6]: h h h h

***i=5***

Β[1][0] Α[2][0] C[0] A[2][0]: m m h h

Β[1][2] Α[2][2] C[2] A[2][2]: h h h h

Β[1][4] Α[2][4] C[4] A[2][4]: m m h h

Β[1][6] Α[2][6] C[6] A[2][6]: h h h h

Άρα συνολικά, έχουμε **58 hits**, **38 misses**.

* *Ερώτημα (β)*

H **cache έχει** 256/32/4 = **2 sets**, ενώ **κάθε block χωρά** 32/8 = **4 στοιχεία** ενός πίνακα. Επομένως, στην ανάλυση μας, θα έχουμε έναν πίνακα 2x4, όπου κάθε κελί θα χωρά 4 στοιχεία ενός πίνακα. Θα τονίζουμε με **bold** το block που δείχνει η LRU.

***i=0, j=0: m m m h***

B[0][0]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | B[0][0-3] |  |  |  |
| ***j=4-7*** |  |  |  |  |

A[0][0]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | **-** |  |
| ***j=4-7*** |  |  |  |  |

C[0]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** |  |  |  |  |

A[0][0]: hit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** |  |  |  |  |

***i=0, j=2: h h h h***

B[0][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | B[0][0-3] | A[0][0-3] | **C[0-3]** |  |
| ***j=4-7*** |  |  |  |  |

A[0][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | B[0][0-3] | A[0][0-3] | **C[0-3]** |  |
| ***j=4-7*** |  |  |  |  |

C[0]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** |  |  |  |  |

A[0][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** |  |  |  |  |

***i=0, j=4: m m m h***

B[0][4]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | B[0][4-7] |  |  |  |

A[0][4]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] |  |  |

C[4]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

A[0][4]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

***i=0, j=6: h h h h***

B[0][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | B[0][4-7] | A[0][4-7] | **C[4-7]** |  |

A[0][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | B[0][4-7] | A[0][4-7] | **C[4-7]** |  |

C[6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

A[0][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] |  |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

Άρα για i=0 έχουμε **10 hits** (και 6 misses).

***i=1, j=0: m m h h***

B[1][0]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **B[0][0-3]** | A[0][0-3] | C[0-3] | B[1][0-3] |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

A[1][0]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | A[0][0-3] | **C[0-3]** | B[1][0-3] |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

C[0]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | A[0][0-3] | C[0-3] | **B[1][0-3]** |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

A[1][0]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | A[0][0-3] | C[0-3] | **B[1][0-3]** |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

***i=1, j=2: h h h h***

B[1][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

A[1][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

C[2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

A[1][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] |  |

***i=1, j=4: m m h h***

B[1][4]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | **B[0][4-7]** | A[0][4-7] | C[4-7] | B[1][4-7] |

A[1][4]: compulsory miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | A[1][4-7] | A[0][4-7] | **C[4-7]** | B[1][4-7] |

C[4]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | A[1][4-7] | A[0][4-7] | C[4-7] | **B[1][4-7]** |

A[1][4]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

***i=1, j=6: h h h h***

B[1][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

A[1][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

C[6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

A[1][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | **A[0][0-3]** | C[0-3] | B[1][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

Άρα για i=1 έχουμε **12 hits** (και 4 misses).

***i=2, j=0: m m h h***

B[2][0]: miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | B[2][0-3] | C[0-3] | **B[1][0-3]** |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

A[2][0]: miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | A[1][0-3] | B[2][0-3] | **C[0-3]** | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

C[0]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

A[2][0]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

***i=2, j=2: h h h h***

B[2][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

A[2][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

C[2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

A[2][2]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | **A[0][4-7]** | C[4-7] | B[1][4-7] |

***i=2, j=4: m m h h***

B[2][4]: miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | B[2][4-7] | C[4-7] | **B[1][4-7]** |

A[2][4]: miss:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | A[1][4-7] | B[2][4-7] | **C[4-7]** | A[2][4-7] |

C[4]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | **A[1][4-7]** | B[2][4-7] | C[4-7] | A[2][4-7] |

A[2][4]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | **A[1][4-7]** | B[2][4-7] | C[4-7] | A[2][4-7] |

***i=2, j=6: h h h h***

B[2][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | **A[1][4-7]** | B[2][4-7] | C[4-7] | A[2][4-7] |

A[2][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | **A[1][4-7]** | B[2][4-7] | C[4-7] | A[2][4-7] |

C[6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | **A[1][4-7]** | B[2][4-7] | C[4-7] | A[2][4-7] |

A[2][6]: hit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***j=0-3*** | **A[1][0-3]** | B[2][0-3] | C[0-3] | A[2][0-3] |
| ***j=4-7*** | **A[1][4-7]** | B[2][4-7] | C[4-7] | A[2][4-7] |

Άρα για i=2 έχουμε **12 hits** (και 4 misses).

Για τα υπόλοιπα i προκύπτει παρόμοιο μοτίβο (**12 hits** και 4 misses).

Άρα, **συνολικά** έχουμε **70 hits** και **26 misses**.

Είναι προφανές πως η **2η περίπτωση είναι προτιμότερη**.