

Question 8: (4 marks)

Given a direct-mapped cache memory with the following characteristics:

- Cache size = 256 Bytes,
- 8 cache lines,

Calculate the hit ratio for the matrix a in the following code:

```
int sum_array_cols(double a[16][16]) {  
    int i, j;  
    double sum = 0;  
    for (j = 0; j < 16; j++)  
        for (i = 0; i < 16; i++)  
            sum += a[i][j];  
    return sum;  
}
```

Assume the following:

- Cache is initially empty,
- The variables sum , i , and j are stored in registers, and thus do not require memory accesses.

Show your work!

Since the cache is direct-mapped, we expect lots of conflict misses.

Size of cache line = $256/8 = 32$ Bytes, which can fit 8 doubles.

Upon each reference to elements in the a matrix, the line fills up with 8 of those elements, but they don't get used. Rather, they get replaced immediately at the next reference, which is to an element in a different column.

Hence, the hit ratio = 0.