

**Problem 50. (14 points):**

Consider a direct mapped cache of size 64K with block size of 16 bytes. Furthermore, the cache is write-back and write-allocate. You will calculate the miss rate for the following code using this cache. Remember that `sizeof(int) == 4`. Assume that the cache starts empty and that local variables and computations take place completely within the registers and do not spill onto the stack.

A. Now consider the following code to copy one matrix to another. Assume that the `src` matrix starts at address 0 and that the `dest` matrix follows immediately follows it.

```
void copy_matrix(int dest[ROWS][COLS], int src[ROWS][COLS])
{
    int i, j;

    for (i=0; i<ROWS; i++) {
        for (j=0; j<COLS; j++) {
            dest[i][j] = src[i][j];
        }
    }
}
```

1. What is the cache miss rate if `ROWS = 128` and `COLS = 128`?  
Miss rate = \_\_\_\_\_%
2. What is the cache miss rate if `ROWS = 128` and `COLS = 192`?  
Miss rate = \_\_\_\_\_%
3. What is the cache miss rate if `ROWS = 128` and `COLS = 256`?  
Miss rate = \_\_\_\_\_%

B. Now consider the following two implementations of a horizontal flip and copy of the matrix. Again assume that the `src` matrix starts at address 0 and that the `dest` matrix follows immediately follows it.

```
void copy_n_flip_matrix1(int dest[ROWS][COLS], int src[ROWS][COLS])
{
    int i, j;

    for (i=0; i<ROWS; i++) {
        for (j=0; j<COLS; j++) {
            dest[i][COLS - 1 - j] = src[i][j];
        }
    }
}
```

1. What is the cache miss rate if `ROWS` = 128 and `COLS` = 128?

Miss rate = \_\_\_\_\_%

2. What is the cache miss rate if `ROWS` = 128 and `COLS` = 192?

Miss rate = \_\_\_\_\_%

```
void copy_n_flip_matrix2(int dest[ROWS][COLS], int src[ROWS][COLS])
{
    int i, j;

    for (j=0; j<COLS; j++) {
        for (i=0; i<ROWS; i++) {
            dest[i][COLS - 1 - j] = src[i][j];
        }
    }
}
```

1. What is the cache miss rate if `ROWS` = 128 and `COLS` = 128?

Miss rate = \_\_\_\_\_%

2. What is the cache miss rate if `ROWS` = 192 and `COLS` = 128?

Miss rate = \_\_\_\_\_%