

Lab 9

Submit your program before the deadline.

1. In this lab assignment, you will write a program in MIPS assembly language that first defines an array of bytes of size 1024, where by default each byte is initially set to 0, then somehow ‘updates’ this array such that every element in the array becomes a 1. That is, every 0 of 1024 zeros becomes a 1.

Other than that, you need to try to optimize the *metric score* which is equal to

$$\text{metric score} = \text{AMAT} * \text{number of memory accesses}$$

, where AMAT is the Average Memory Access Time, used to measure the memory performance (refer to page 478 of textbook for more information), and is equal to

$$\text{AMAT} = \text{Hit time} + \text{Miss rate} * \text{Miss penalty}$$

Assume that the *hit time* is 1 ns. Further assume that the *miss penalty* is equal to

$$\text{miss penalty} = 1 \text{ ns} + 15 * \text{block size} + \text{block size} * 1 \text{ ns}$$

, where block size is given in words. For example, if the block size is 1 word, then the miss penalty is $1 + 15*1 + 1 = 17$ ns (refer to page 471 of textbook).

You can find the *number of memory accesses*, and the *miss rate* for calculating AMAT, using the Data Cache Simulator tool of MARS.

To activate the Data Cache Simulator tool click on Tools → Data Cache Simulator. Enable the Runtime Log and then click the ‘Connect to MIPS’ button.

The default value of cache size is 128 bytes. Do not change it. But you can change other parameters like ‘Cache block size’, ‘Placement policy’, etc.

Write your optimized parameters next to .text as comments like below (if there are no parameters, it will be graded with the default values):

```
.data
array: .space 1024
...
.text
#Number of blocks:
#Cache block size:
#YOUR METRIC SCORE:
#The reasons for my optimization
#In Assembly code:
#In the configurations of cache parameters:
...
your code goes here
```

Note: Bonus points of 0.2 may be given to 3 students, who will have the lowest *metric score*.