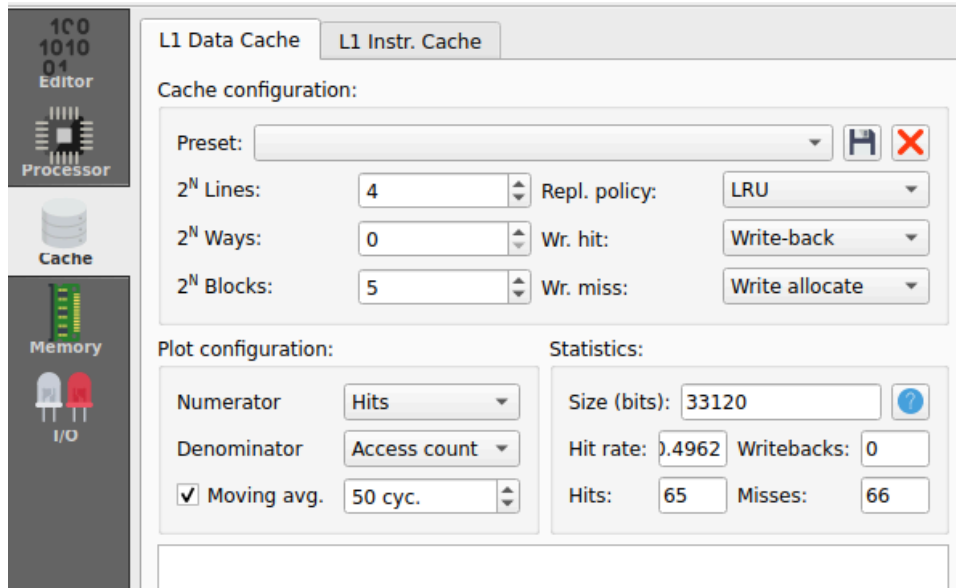# Computer Architecture - CS2323. Autumn 2025
Homework-5 (Cache experiments)

In this lab assignment, we will use Ripes simulator (or our in-house simulator) to execute different assembly codes with different cache configurations and understand the effect on the hit/miss rate of the data cache.

In Ripes, there is a button named "Cache" on the left which opens a cache analysis window. You may execute some portion of this step by step to understand the animation of how the cache is filled and evicted for different instructions.

1. Cache reads: Execute the assembly programs 1 and 2 and observe the hit rates for various data cache configurations.
   You should vary the configurations atleast as per the following (you are free to explore more combinations as well):
   Lines: 1, 2, 3 keeping Blocks as 2 and Ways as 0. In RIPES, Lines refers to the block size
   Blocks: 3, 4, 5 keeping Lines as 3 and Ways as 0. In RIPES, Blocks refers to the number of blocks
   Ways: 0, 1 keeping Blocks as 2 and Lines as 3. In RIPES, Ways refers to the associativity.

2. Write-policies: Modify programs 1 and 2 to replace "ld x20, 0(x12)" to "sd x20, 0(x12)". Use the preset cache configuration (32-entry 4-word direct mapped). Run program-1 and program-2 for various combinations of Write-through and Write-back policies (with allocate and without allocate).

3. Associativity: Execute program 3 and vary the following configurations:
   a. 32-entry 4-word direct mapped
   b. 32-entry 4-word 2-way set associative
   c. 32-entry 4-word fully associative

Repeat the above experiments for two different settings in each of the assembly code:
L1: (8, 8), (16,16)

Submission instructions:

Prepare a report where you tabulate the hit rate, number of hits, number of misses, and total accesses. Summarize the observations and explain the trend that you observe during this experiment.

An example observation could be "Increasing Lines does not improve the hit rate in program-1 because … However, it improves the hit rate in program-2 because…", or

Submit the report in pdf format with name CSYYBTECHZZZZZ.pdf. The report should be maximum 4-pages.

Note: Submissions are subject to similarity check and hence submit only your own work.

Program-1

```
.data
L1: .dword 8, 8
A:

.text
la x3, L1
ld x4, 0(x3)
ld x5, 8(x3)
addi x3, x3, 16

    addi x10, x0, 0
    add x12, x3, x0
If1: beq x4, x10, end1
     addi x11, x0, 0
If2:    beq x5, x11, end2
        ld x20, 0(x12)
        addi x12, x12, 8
        addi x11, x11, 1
        beq x0, x0, If2
end2:   addi x10, x10, 1
     beq x0, x0, If1
end1: nop
```

Program-2:

```
.data
L1: .dword 8, 8
A:

.text
la x3, L1
ld x4, 0(x3)
ld x5, 8(x3)
addi x3, x3, 16

    addi x10, x0, 0
    add x12, x3, x0
If1: beq x4, x10, end1
     addi x11, x0, 0
     slli x15, x10, 3
     add x12, x3, x15
If2:    beq x5, x11, end2
        ld x20, 0(x12)
        slli x15, x5, 3
        add x12, x12, x15
        addi x11, x11, 1
        beq x0, x0, If2
end2:   addi x10, x10, 1
        beq x0, x0, If1
end1: nop
```

Program-3:

```
.data
L1: .dword 8, 8
A:

.text
la x3, L1
ld x4, 0(x3)
ld x5, 8(x3)
addi x3, x3, 16

    addi x10, x0, 0
    add x12, x3, x0
If1: beq x4, x10, end1
     addi x11, x0, 0
If2:   beq x5, x11, end2
        ld x20, 0(x12)
        ld x20, 1024(x12)
        addi x12, x12, 8
        addi x11, x11, 1
        beq x0, x0, If2
end2:  addi x10, x10, 1
       beq x0, x0, If1
end1: nop
```