

# CSARCH2-MP2 User's Manual

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The application simulates a Full Associative Cache Mapping Function with MRU (Most Recently Used) as the Replacement Algorithm. It is able to support the following:

- Sequential that runs a single time
- Sequential with loop
- Sequential with varying loops
- Sequential with single-level nested loops
- Sequential with disjointed sequences (e.g. blocks 0-5, then blocks 10-15)

Furthermore, only the following inputs are supported:

- **Block Size:** Numbers only (words)
- **Cache Memory Size:** Numbers only (blocks or words)
- **Main Memory Size:** Numbers only (blocks or words)
- **Cache Access Time:** Numbers only (nanoseconds)
- **Main Memory Access Time:** Numbers only (nanoseconds)
- **Read Type:** Load Through / Non-load Through only
- **Sequence:** Comma-separated values (x,y,z), Range values (x-y), or a combination of both (x-y, z). Note that range values must not have space before and after the dash (blocks or addresses). Note that hex inputs are **NOT** supported.

# Pages

## A. Input Page

FA - MRU Simulator

Block Size **①** 16 words

Main Memory Size **②** 32 Blocks

MM Access Time **③** 10 ns

Cache Memory Size **④** 32 Blocks

Cache Access Time **⑤** 1 ns

Read Type **⑥** Load Through

**Next** **⑦**

The user is expected to input the following information to perform the cache simulation:

1. **Block Size:** Size of a block in words.
2. **Main Memory Size:** Size of the Main Memory. May be either in blocks or words.
3. **Main Memory Access Time:** Main Memory Access Time represented in nanoseconds.
4. **Cache Memory Size:** Size of the Cache Memory Size. May be either in blocks or words.
5. **Cache Access Time:** Cache Access Time represented in nanoseconds.
6. **Read Type:** Read type of the cache. May either be Load-Through or No Load-Through.
  - **Load-Through:** The desired information can optionally be sent to the processor prior to completion of the cache line fill.
  - **No Load-Through:** The information is read from the main memory and a block or cache line is copied from the main memory onto the cache (cache line fill). The data is then transferred from the cache to the CPU.

7. **Next Button:** Go to the Sequence Page (Enabled once all the fields are filled)

## B. Sequence Page

The screenshot shows the 'FA - MRU Simulator' window. At the top, there is a 'Number of Sequence Groups' input field with the value '3' (callout 1), a 'Create' button (callout 2), and a 'Blocks' dropdown menu (callout 3). Below this is a 'Sequences' section containing three groups. Each group has a '+' button (callout 4), a '-' button (callout 5), a 'Group' label, a 'Sequence' input field (callout 7), and a 'Repetitions' input field (callout 8). The first group has '1, 3, 5' in the sequence field and '1' in the repetitions field. The second group has '9-15' in the sequence field and '1' in the repetitions field. The third group has '1, 3-10, 5' in the first sequence field and '4' in the repetitions field, and '6' in the second sequence field and '2' in the repetitions field. At the bottom left is a 'Begin Simulate' button (callout 9).

1. **Number of Sequence Groups:** This determines the number of sequence groups in the simulation. Generally, this is useful for creating a group of sequences (where each can have varying number of loops) that will be looped  $n$  times; this allows support for nested loop.
2. **Create Button:** Creates/updates number of sequence groups in the sequence group input area of the page.
3. **Input Type:** Determines whether sequence input is in terms of Blocks or Addresses
4. **Add Sequence Button:** Adds a new sequence field in the sequence group.
5. **Remove Sequence Button:** Removes endmost sequence field in the sequence group.

- 6. **Number of Group Repetitions:** Determines the number of times a sequence group will loop.
- 7. **Sequence:** A data sequence is represented as a string of characters. One inner loop is also supported per data sequence. **Repetitions** refer to the number of times the line sequence will be looped/repeated.

Examples of sequences with loops:

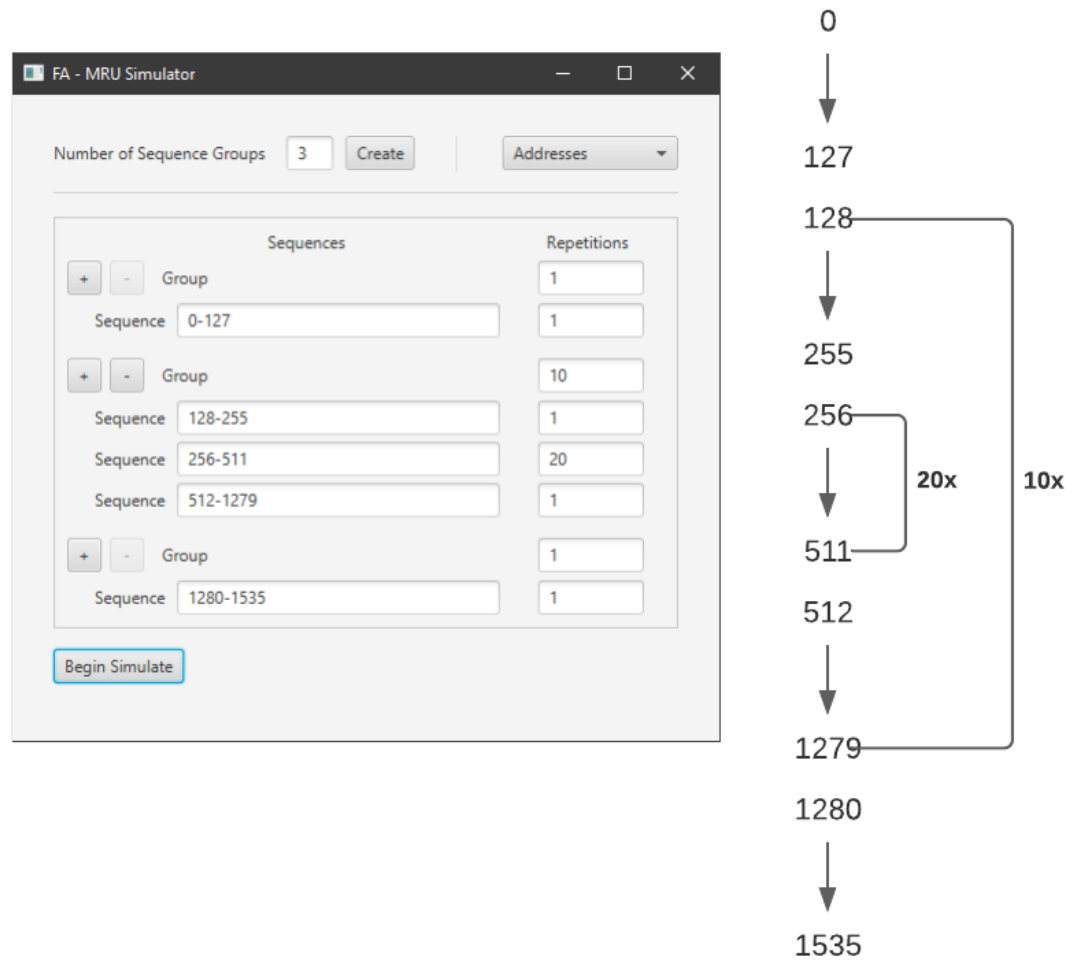


Figure 1: Sample sequence pattern with one loop

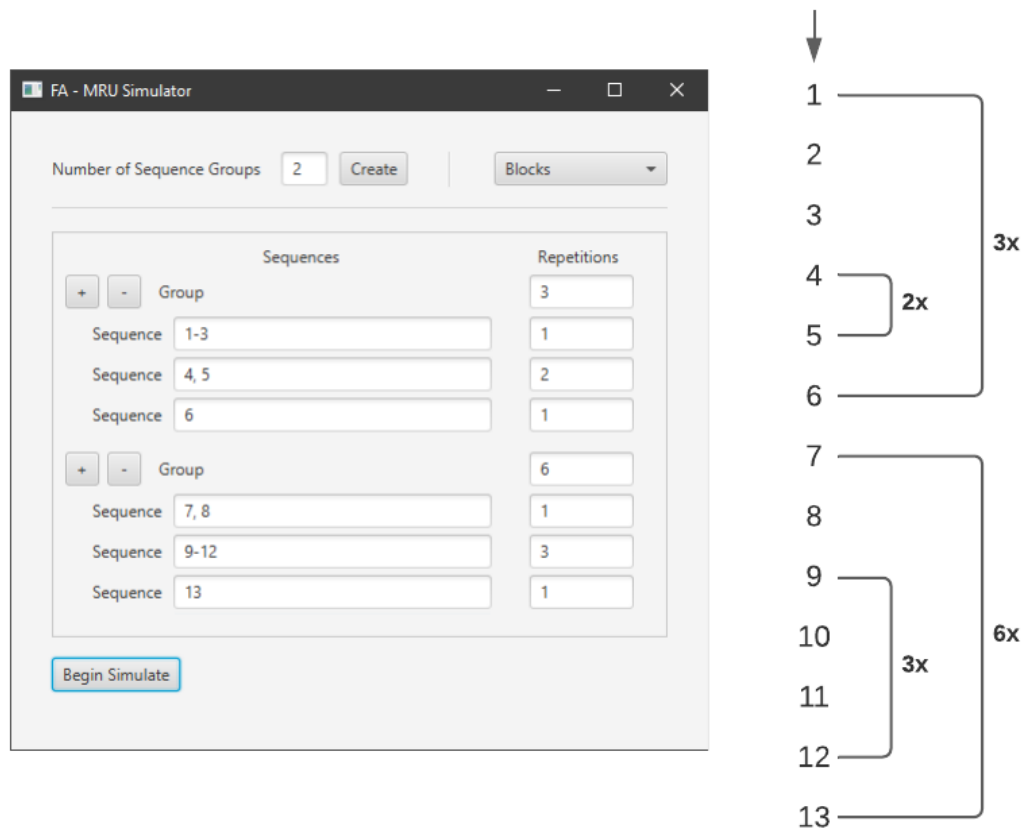


Figure 2: Sample sequence pattern with two loops

8. **Number of Sequence Repetitions:** Determines the number of times a sequence will loop.
9. **Begin Simulate:** Run simulation.

## C. Output Page

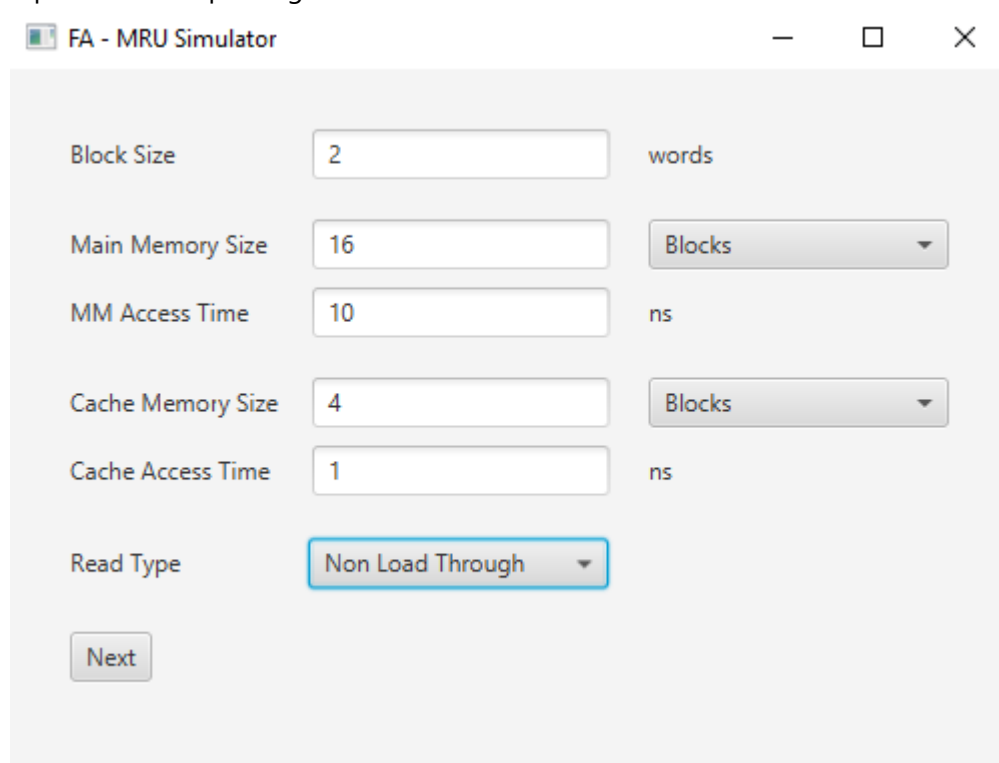
Once the necessary fields have been filled up, the application will display the following information:

1. **Hit Rate:** Percentage of memory accesses found in the cache memory.
2. **Miss Rate:** Percentage of memory accesses not found in the cache.
3. **Miss Penalty:** Extra time required to fetch a block from the Main Memory into the cache memory.
4. **Average Access Time:** Average memory access time retrieved by the processor.
5. **Total Access Time:** Total memory access time with cache of the program.
6. **Cache Contents:** The representation of the cache memory (and its contents) in table form.
7. **Export Results Button:** Exports the result to a text file.

## Sample Inputs

### A. Memory Size in Blocks

## 1. Inputs for the Input Page:

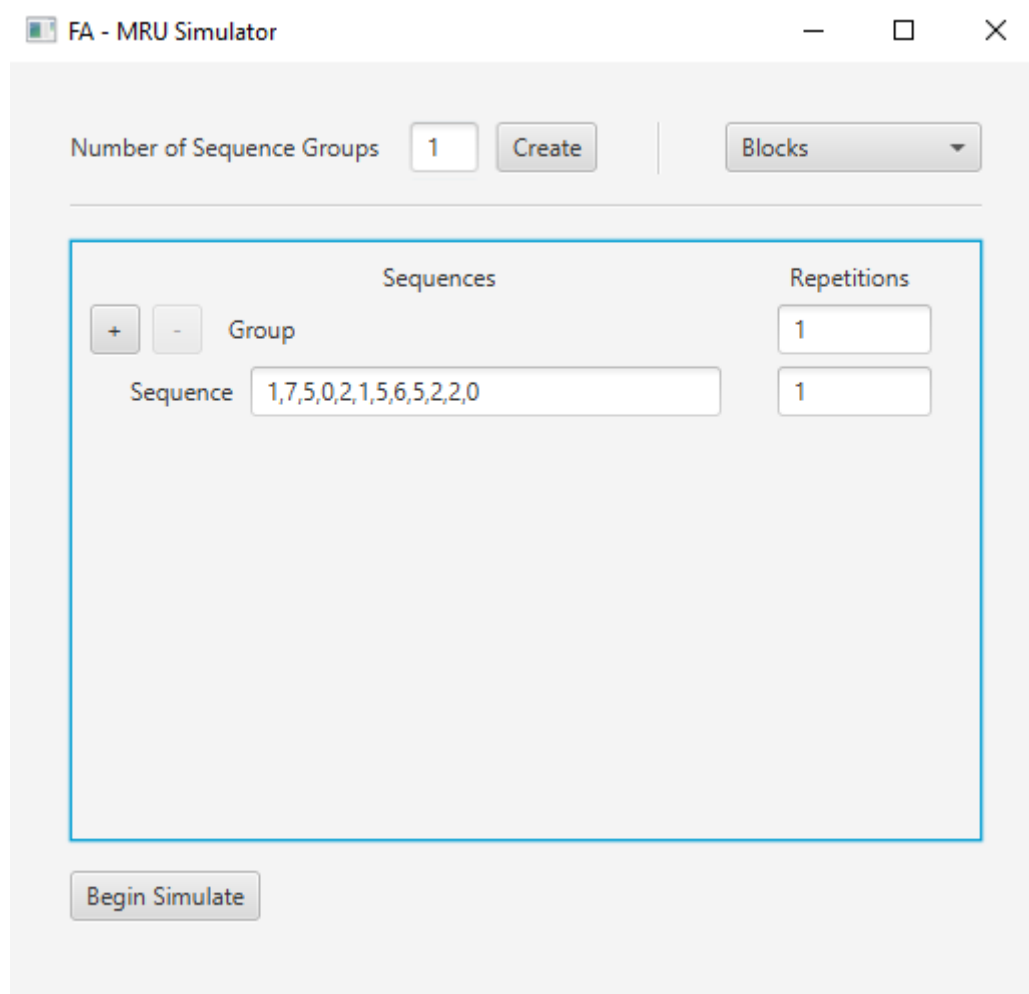


The screenshot shows the 'FA - MRU Simulator' window. It contains several input fields and dropdown menus for configuring the simulation parameters. The 'Block Size' is set to 2 words. The 'Main Memory Size' is 16 Blocks. The 'MM Access Time' is 10 ns. The 'Cache Memory Size' is 4 Blocks. The 'Cache Access Time' is 1 ns. The 'Read Type' is set to 'Non Load Through'. A 'Next' button is located at the bottom left.

Block Size	2	words
Main Memory Size	16	Blocks
MM Access Time	10	ns
Cache Memory Size	4	Blocks
Cache Access Time	1	ns
Read Type	Non Load Through	

Next

## 2. Inputs for the Sequence Page:



The screenshot shows the 'FA - MRU Simulator' window for the sequence configuration. At the top, there is a 'Number of Sequence Groups' field set to 1, a 'Create' button, and a 'Blocks' dropdown menu. Below this is a table for defining sequences. The table has two columns: 'Sequences' and 'Repetitions'. The first row shows a sequence '1,7,5,0,2,1,5,6,5,2,2,0' with a repetition of 1. A 'Begin Simulate' button is at the bottom.

Sequences	Repetitions
1,7,5,0,2,1,5,6,5,2,2,0	1

Begin Simulate

3. Output:

FA - MRU Simulator

Block	Data
0	1
1	7
2	5
3	0

Cache Hits4

Cache Misses8

Miss Penalty22.0

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Average Memory Access Time

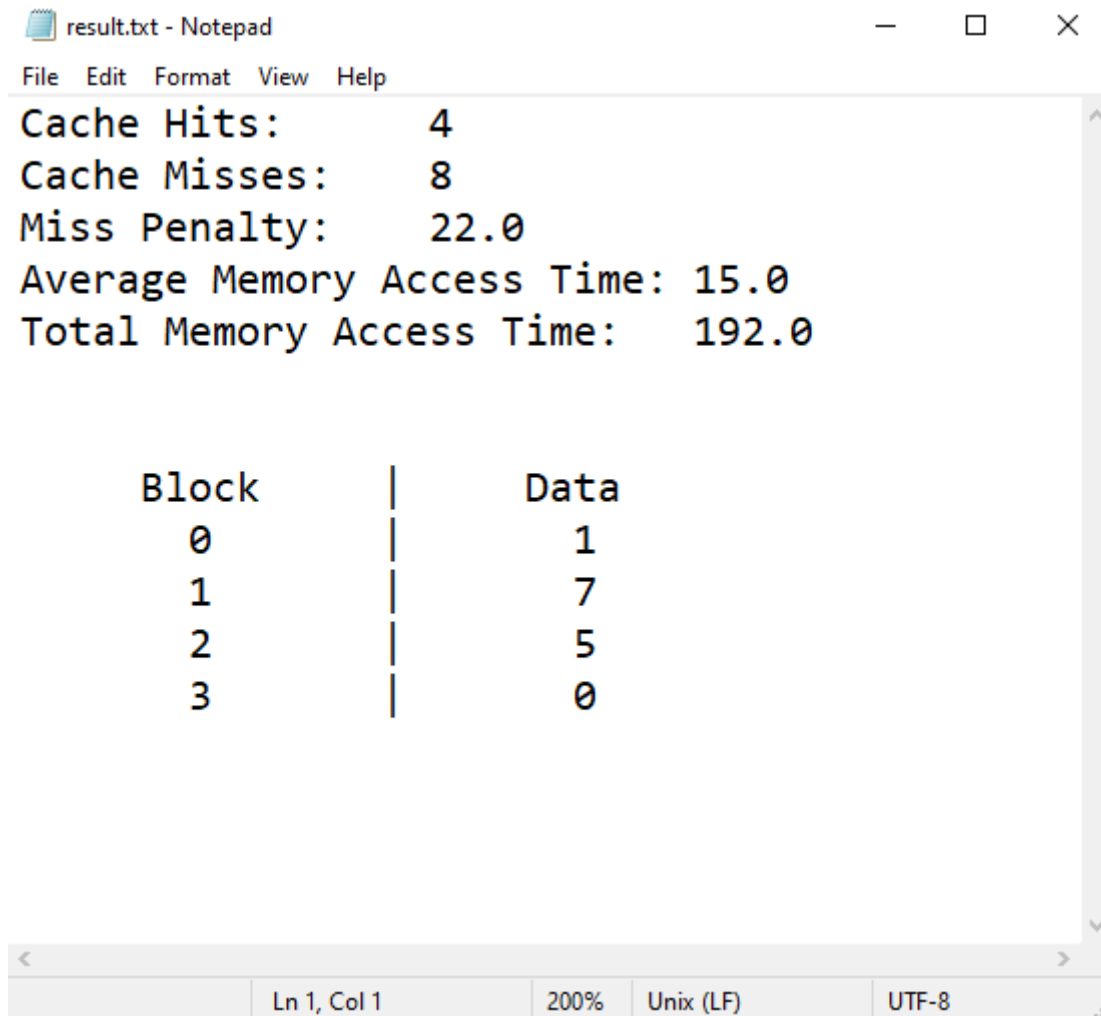
15.0

Total Memory Access Time

192.0

Export Results

4. By clicking the Export Results button, a text file containing the results will be exported.



The screenshot shows a Notepad window titled "result.txt - Notepad". The text inside the window is as follows:

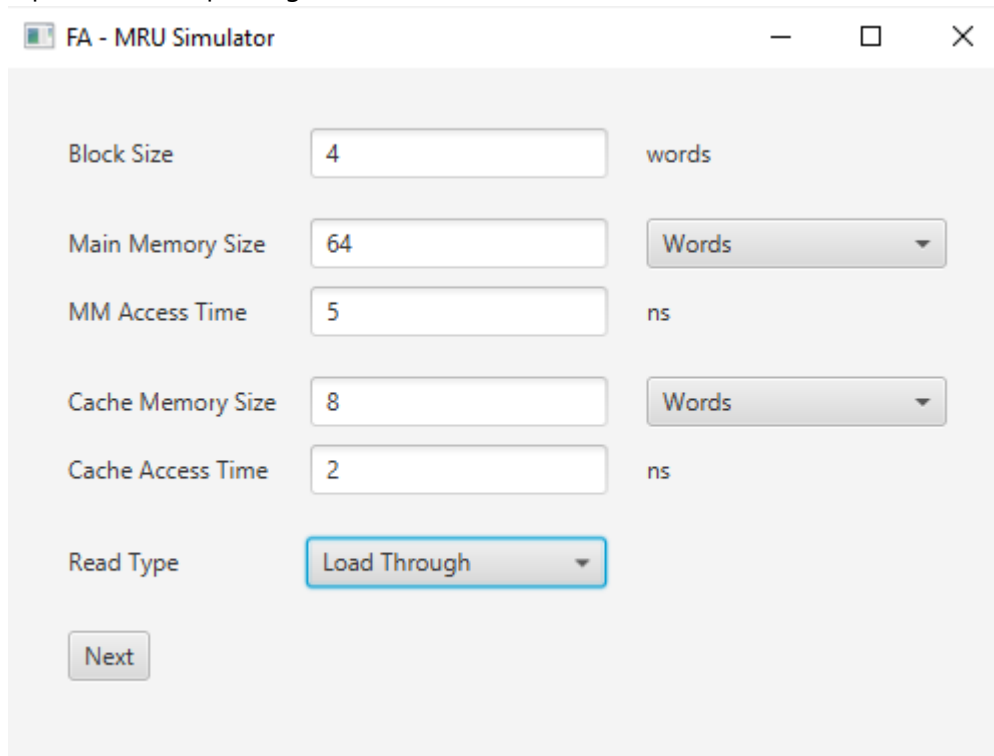
```
Cache Hits:      4
Cache Misses:    8
Miss Penalty:    22.0
Average Memory Access Time: 15.0
Total Memory Access Time:  192.0
```

Block	Data
0	1
1	7
2	5
3	0

At the bottom of the Notepad window, the status bar shows: "Ln 1, Col 1", "200%", "Unix (LF)", and "UTF-8".

## B. Memory Size in Words

1. Inputs for the Input Page:



The screenshot shows the "FA - MRU Simulator" window. It contains the following input fields and controls:

- Block Size: 4 words
- Main Memory Size: 64 Words (dropdown menu)
- MM Access Time: 5 ns
- Cache Memory Size: 8 Words (dropdown menu)
- Cache Access Time: 2 ns
- Read Type: Load Through (dropdown menu)
- Next button



2. Inputs for the Sequence Page:

FA - MRU Simulator

Number of Sequence Groups

2

Create

Blocks

Sequences		Repetitions
<div><div>+</div><div>-</div></div> Group		3
Sequence	3-5	1
Sequence	6,7	2
<div><div>+</div><div>-</div></div> Group		1
Sequence	9-11,15	3

Begin Simulate

3. Output:

FA - MRU Simulator

Block	Data
0	15
1	5

Cache Hits 5

Cache Misses 28

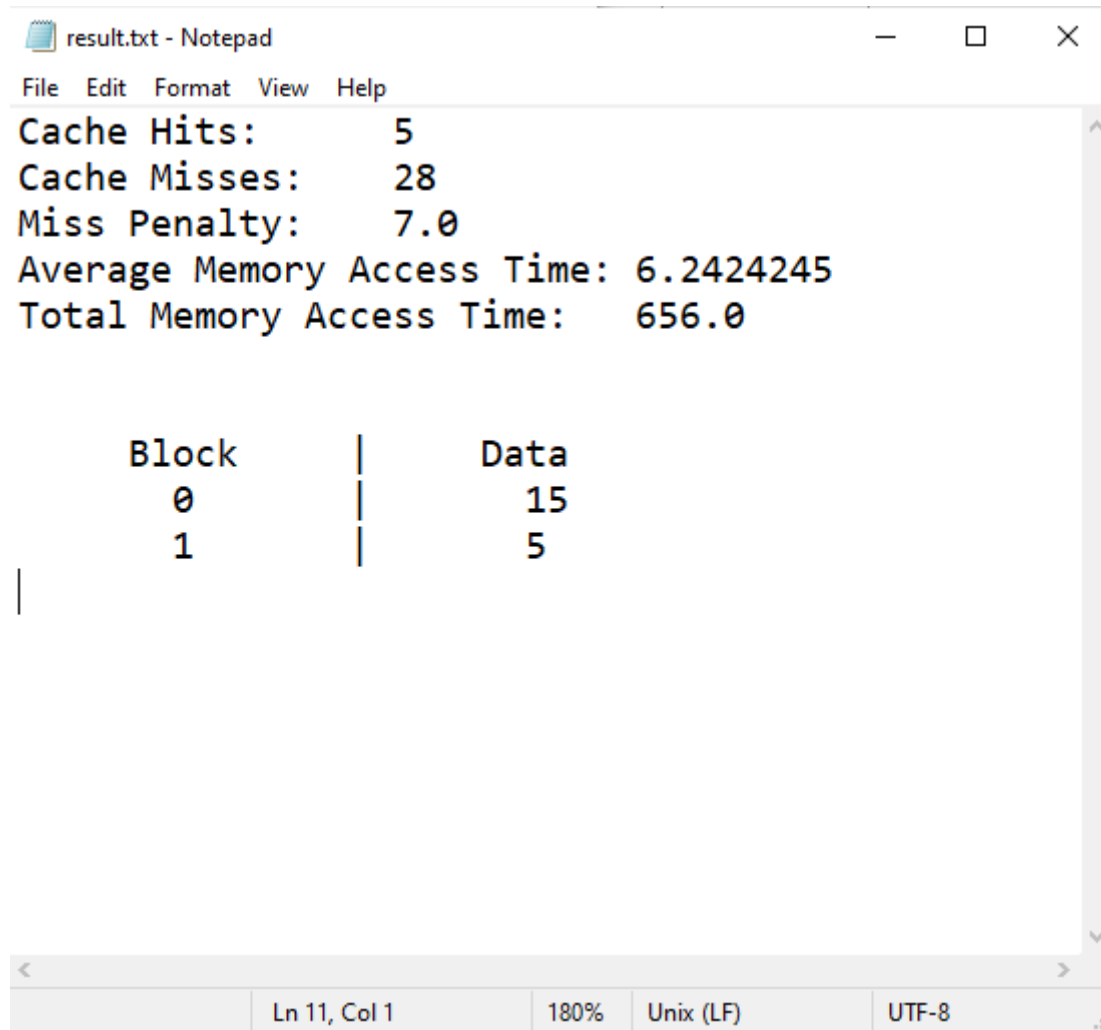
Miss Penalty 7.0

Average Memory Access Time 6.2424245

Total Memory Access Time 656.0

Export Results

## 4. Contents of text file:



```
result.txt - Notepad
File Edit Format View Help
Cache Hits:      5
Cache Misses:    28
Miss Penalty:    7.0
Average Memory Access Time: 6.2424245
Total Memory Access Time:  656.0

      Block      |      Data
      0          |      15
      1          |      5
```

Ln 11, Col 1    180%    Unix (LF)    UTF-8

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