**Lab 6- Lab Report**

**Part A (Matrix Size n = 100)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Block size (words)** | **2** | **4** | **8** | **16** | **32** |
| **Cache Size (bytes)** |  |  |  |  |  |
| **128** | Miss Rate: 48%  Number of misses: 10149 | Miss Rate: 24%  Number of misses: 2529 | Miss Rate: 12%  Number of misses: 1267 | Miss Rate: 6%  Number of misses: 636 | Miss Rate: 3%  Number of misses: 321 |
| **256** | Miss Rate: 48%  Number of misses: 10149 | Miss Rate: 24%  Number of misses: 2529 | Miss Rate: 12%  Number of misses: 1267 | Miss Rate: 6%  Number of misses: 636 | Miss Rate: 3%  Number of misses: 321 |
| **512** | Miss Rate: 49%  Number of misses: 5050 | Miss Rate: 24%  Number of misses: 2527 | Miss Rate: 12%  Number of misses: 1265 | Miss Rate: 6%  Number of misses: 634 | Miss Rate: 3%  Number of misses: 319 |
| **1024** | Miss Rate: 49%  Number of misses: 5050 | Miss Rate: 24%  Number of misses: 2527 | Miss Rate: 12%  Number of misses: 1265 | Miss Rate: 6%  Number of misses: 634 | Miss Rate: 3%  Number of misses: 319 |
| **2048** | Miss Rate: 49%  Number of misses: 5050 | Miss Rate: 24%  Number of misses: 2527 | Miss Rate: 12%  Number of misses: 1265 | Miss Rate: 6%  Number of misses: 634 | Miss Rate: 3%  Number of misses: 319 |

Table 1.1 Miss Rates of Column-wise Summation for Direct Mapped Cache (n=100)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Block size (words)** | **2** | **4** | **8** | **16** | **32** |
| **Cache Size (bytes)** |  |  |  |  |  |
| **128** | Miss Rate: 97%  Number of misses: 10056 | Miss Rate: 97%  Number of misses: 10031 | Miss Rate: 97%  Number of misses: 10019 | Miss Rate: 97%  Number of misses: 10011 | Miss Rate: 98%  Number of misses: 10104 |
| **256** | Miss Rate: 97%  Number of misses: 10056 | Miss Rate: 97%  Number of misses: 10011 | Miss Rate: 97%  Number of misses: 10019 | Miss Rate: 97%  Number of misses: 10031 | Miss Rate: 97%  Number of misses: 10008 |
| **512** | Miss Rate: 97%  Number of misses: 10054 | Miss Rate: 97%  Number of misses: 10029 | Miss Rate: 97%  Number of misses: 10017 | Miss Rate: 97%  Number of misses: 10017 | Miss Rate: 97%  Number of misses: 10008 |
| **1024** | Miss Rate: 84%  Number of misses: 8654 | Miss Rate: 77%  Number of misses: 7929 | Miss Rate: 97%  Number of misses: 10017 | Miss Rate: 97%  Number of misses: 10009 | Miss Rate: 97%  Number of misses: 10017 |
| **2048** | Miss Rate: 84%  Number of misses: 8654 | Miss Rate: 24%  Number of misses: 2529 | Miss Rate: 76%  Number of misses: 7917 | Miss Rate: 97%  Number of misses: 10006 | Miss Rate: 97%  Number of misses: 10009 |

Table 1.2 Miss Rates of Row-wise Summation for Direct Mapped Cache (n=100)

miss rate decreases with larger block sizes (spatial locality)

number of sets in a fixed size cache decreases -> conflicts

larger caches not changed

full associative mapping less collisions

main memory blocks can go to different cache blocks

**Part B (Matrix Size n = 100)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Good hit rate  Cache size: 2048  Block size: 4 | Medium hit rate  Cache size: 1024  Block size: 4 | Poor hit rate  Cache size: 128  Block size: 2 |
| **Fully associative (LRU)** | Miss Rate: 24%  Number of misses: 2529 | Miss Rate: 85%  Number of misses: 17627 | Miss Rate: 97%  Number of misses: 10008 |
| **Fully associative (Random)** | Miss Rate: 34%  Number of misses: 7015 | Miss Rate: 73%  Number of misses: 7600 | Miss Rate: 97%  Number of misses: 20016 |
| **Direct Mapped** | Miss Rate: 24%  Number of misses: 5073 | Miss Rate: 77%  Number of misses: 7929 | Miss Rate: 98%  Number of misses: 10104 |

**Part C (Matrix Size n = 100)**

|  |  |  |  |
| --- | --- | --- | --- |
| N-way Set Associative Cache Set Size | Good hit rate  Cache size: 2048  Block size: 4 | Medium hit rate  Cache size: 1024  Block size: 4 | Poor hit rate  Cache size: 128  Block size: 2 |
| **2** | Miss Rate: 40%  Number of misses: 17359 | Miss Rate: 97%  Number of misses: 10029 | Miss Rate: 97%  Number of misses: 10008 |
| **4** | Miss Rate: 24%  Number of misses: 2529 | Miss Rate: 97%  Number of misses: 10029 | Miss Rate: 97%  Number of misses: 10056 |
| **8** | Miss Rate: 24%  Number of misses: 2529 | Miss Rate: 97%  Number of misses: 10029 | Miss Rate: 97%  Number of misses: 10056 |
| **16** | Miss Rate: 24%  Number of misses: 2529 | Miss Rate: 97%  Number of misses: 10029 | Miss Rate: 97%  Number of misses: 10056 |

**Part A (Matrix Size n = 150)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Block size (words)** | **2** | **4** | **8** | **16** | **32** |
| **Cache Size (bytes)** |  |  |  |  |  |
| **128** | Miss Rate: 49%  Number of misses: 11302 | Miss Rate: 25%  Number of misses: 5654 | Miss Rate: 12%  Number of misses: 2830 | Miss Rate: 6%  Number of misses: 1418 | Miss Rate: 3%  Number of misses: 712 |
| **256** | Miss Rate: 49%  Number of misses: 11302 | Miss Rate: 25%  Number of misses: 5654 | Miss Rate: 12%  Number of misses: 2830 | Miss Rate: 6%  Number of misses: 1418 | Miss Rate: 3%  Number of misses: 712 |
| **512** | Miss Rate: 49%  Number of misses: 11300 | Miss Rate: 25%  Number of misses: 5652 | Miss Rate: 12%  Number of misses: 2828 | Miss Rate: 6%  Number of misses: 1416 | Miss Rate: 3%  Number of misses: 710 |
| **1024** | Miss Rate: 49%  Number of misses: 11300 | Miss Rate: 25%  Number of misses: 5652 | Miss Rate: 12%  Number of misses: 2828 | Miss Rate: 6%  Number of misses: 1416 | Miss Rate: 3%  Number of misses: 710 |
| **2048** | Miss Rate: 49%  Number of misses: 11300 | Miss Rate: 25%  Number of misses: 5652 | Miss Rate: 12%  Number of misses: 2828 | Miss Rate: 6%  Number of misses: 1416 | Miss Rate: 3%  Number of misses: 710 |

Table 2.1 Miss Rates of Column-wise Summation for Direct Mapped Cache (n=150)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Block size (words)** | **2** | **4** | **8** | **16** | **32** |
| **Cache Size (bytes)** |  |  |  |  |  |
| **128** | Miss Rate: 74%  Number of misses: 33903 | Miss Rate: 99%  Number of misses: 22519 | Miss Rate: 99%  Number of misses: 22531 | Miss Rate: 98%  Number of misses: 22511 | Miss Rate: 98%  Number of misses: 22508 |
| **256** | Miss Rate: 99%  Number of misses: 22556 | Miss Rate: 98%  Number of misses: 22511 | Miss Rate: 99%  Number of misses: 22519 | Miss Rate: 98%  Number of misses: 22511 | Miss Rate: 98%  Number of misses: 22508 |
| **512** | Miss Rate: 99%  Number of misses: 22556 | Miss Rate: 98%  Number of misses: 22506 | Miss Rate: 98%  Number of misses: 22527 | Miss Rate: 98%  Number of misses: 22511 | Miss Rate: 98%  Number of misses: 22508 |
| **1024** | Miss Rate: 64%  Number of misses: 14604 | Miss Rate: 91%  Number of misses: 20753 | Miss Rate: 98%  Number of misses: 22506 | Miss Rate: 98%  Number of misses: 22509 | Miss Rate: 98%  Number of misses: 22508 |
| **2048** | Miss Rate: 64%  Number of misses: 14604 | Miss Rate: 58%  Number of misses: 13329 | Miss Rate: 93%  Number of misses: 21366 | Miss Rate: 98%  Number of misses: 22506 | Miss Rate: 98%  Number of misses: 22508 |

Table 2.2 Miss Rates of Row-wise Summation for Direct Mapped Cache (n=150)

Increasing cache capacity can reduce conflict and capacity misses. Increasing block size can reduce compulsory misses ◊ spatial locality (might increase conflict misses)

**Part B (Matrix Size n = 150)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Good hit rate  Cache size: 2048  Block size: 4 | Medium hit rate  Cache size: 1024  Block size: 2 | Poor hit rate  Cache size: 256  Block size: 2 |
| **Fully associative (LRU)** | Miss Rate: 59%  Number of misses: 47103 | Miss Rate: 99%  Number of misses: 22554 | Miss Rate: 98%  Number of misses: 45012 |
| **Fully associative (Random)** | Miss Rate: 46%  Number of misses: 24585 | Miss Rate: 89%  Number of misses: 40768 | Miss Rate: 98%  Number of misses: 22457 |
| **Direct Mapped** | Miss Rate: 58%  Number of misses: 13329 | Miss Rate: 64%  Number of misses: 14604 | Miss Rate: 99%  Number of misses: 22556 |

**Part C (Matrix Size n = 150)**

|  |  |  |  |
| --- | --- | --- | --- |
| N-way Set Associative Cache Set Size | Good hit rate  Cache size: 2048  Block size: 4 | Medium hit rate  Cache size: 1024  Block size: 2 | Poor hit rate  Cache size: 256  Block size: 2 |
| **2** | Miss Rate: 54%  Number of misses: 12307 | Miss Rate: 71%  Number of misses: 16254 | Miss Rate: 99%  Number of misses: 22556 |
| **4** | Miss Rate: 77%  Number of misses: 17605 | Miss Rate: 86%  Number of misses: 19554 | Miss Rate: 99%  Number of misses: 22556 |
| **8** | Miss Rate: 89%  Number of misses: 20425 | Miss Rate: 99%  Number of misses: 22554 | Miss Rate: 99%  Number of misses: 22556 |
| **16** | Miss Rate: 99%  Number of misses: 22529 | Miss Rate: 99%  Number of misses: 22554 | Miss Rate: 99%  Number of misses: 22556 |