EE204 - Computer Architecture

Project Report

**General Cache Simulator**

**Group Members:**

* Areeka Aijaz (k17-3913)
* Tooba Shahid (k17-3731)

**Date:**

23/December/2019

**Introduction:**

Cache is a component used to store data so that for next request, data can be served faster. Cache memory is used to achieve higher performance. In our project cache simulator is used to simulate data in cache using three different block mapping techniques. Idea is to keep track of hits, compulsory misses, capacity misses and conflict misses.

**Specification:**

1. User will be asked to select Block mapping technique.

* Direct Mapped Addresses
* Set Associative
* Fully Associative

1. Then user will be asked for size of block.
2. Next, used will be asked for cache size.
3. If Mapping technique is set associative, then user will be asked to enter number of blocks per cache.

**Output will be:**

1. Number of hits.
2. Number of compulsory misses.
3. Number of conflict misses.
4. Number of capacity misses.

**Working:**

There are two functions and a main.

1. Generate Addresses:

This function is used to generate random memory addresses to be placed in cache.

1. Cache Simulator:

This function will handle all the working for placing addresses in cache. It will return whether there is a hit or a miss and it will also calculate compulsory misses, capacity misses and conflict misses.

1. Main:

Main function will take required inputs from users and then it will call Cache simulator to place memory addresses in cache as per the given inputs.

**Results:**

The output is based on generating one hundred thousand addresses per simulation.

1. **Direct Mapped Cache:**

Constant Cache Size of 32KB and Variable Block Size:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Block Size** | **4 bytes** | **8 bytes** | **16 bytes** | **32 bytes** | **64 bytes** | **128 bytes** |
| **Hits** | 50000 | 50000 | 75000 | 75000 | 75000 | 75000 |
| **Compulsory Miss** | 16384 | 10922 | 8192 | 6553 | 5461 | 4681 |
| **Capacity Miss** | 33616 | 39078 | 16808 | 18447 | 19539 | 20319 |
| **Conflict Miss** | 0 | 0 | 0 | 0 | 0 | 0 |

1. **Set Associative Cache:**
2. Constant Block Size of 4 bytes, Constant Cache Size of 16KB:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Set Associative** | **2-way** | **4-way** | **8-way** | **16-way** |
| **Hits** | 50000 | 50512 | 50384 | 50224 |
| **Compulsory Miss** | 4096 | 2048 | 1024 | 512 |
| **Capacity Miss** | 45904 | 47440 | 48592 | 49264 |
| **Conflict Miss** | 0 | 0 | 0 | 0 |

1. Constant Cache Size of 64KB with 2-way set associative:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Block Size** | **4 bytes** | **8 bytes** | **16 bytes** | **32 bytes** | **64 bytes** | **128 bytes** |
| **Hits** | 50000 | 50000 | 75000 | 75000 | 75000 | 75000 |
| **Compulsory Miss** | 16384 | 10922 | 8192 | 6553 | 5461 | 4681 |
| **Capacity Miss** | 33616 | 39078 | 16808 | 18447 | 19539 | 20319 |
| **Conflict Miss** | 0 | 0 | 0 | 0 | 0 | 0 |

1. **Fully Associative Cache:**
2. Constant Cache Size of 32KB and Variable Block Size:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Block Size** | **4 bytes** | **8 bytes** | **16 bytes** | **32 bytes** | **64 bytes** | **128 bytes** |
| **Hits** | 50000 | 50000 | 75000 | 75000 | 75000 | 75000 |
| **Compulsory Miss** | 16384 | 10922 | 8192 | 6553 | 5461 | 4681 |
| **Capacity Miss** | 33616 | 39078 | 16808 | 18447 | 19539 | 20319 |
| **Conflict Miss** | 0 | 0 | 0 | 0 | 0 | 0 |

1. Constant Block Size of 8 bytes and Variable Cache Size:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cache Size** | **1 KB** | **2 KB** | **4 KB** | **8 KB** | **16 KB** | **32 KB** |
| **Hits** | 50000 | 50000 | 50000 | 50000 | 50000 | 50000 |
| **Compulsory Miss** | 341 | 682 | 1365 | 2730 | 5461 | 10922 |
| **Capacity Miss** | 49659 | 49318 | 48635 | 47270 | 44539 | 39078 |
| **Conflict Miss** | 0 | 0 | 0 | 0 | 0 | 0 |

**Conclusion:**

Cache Simulator will place memory addresses in cache and then it will keep track of number of hits and number of misses by generating one hundred thousand addresses per simulation. Hence, the project will conclude that we can use any of the mapping technique. Although, fully associative is less used because it is difficult to search data in it. On the other hand, miss rate is high in direct mapped addresses, while set associative works better.