

## **ECE 6100 Homework 2 Report**

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Parameters for the below results, apart from those mentioned varying are kept at the given default configuration.

### **1. Results for Varying Cache Sizes:**

Cache Size/ Intensive	Non Memory Intensive		Memory Intensive	
KBs	IPC	HIT Ratio	IPC	HIT Ratio
128	0.250187	0.999157	0.280176	0.9956776
512	0.250204	0.999169	0.280184	0.9956902
1024	0.250204	0.999169	0.280211	0.9957289
2048	0.250204	0.999169	0.280211	0.9957292

### **2. Results for Varying Cache Associativity**

Associativity/ Intensive	Non Memory Intensive		Memory Intensive	
No. of Ways	IPC	HIT Ratio	IPC	HIT Ratio
1	0.250094	0.999068	0.280102	0.9640888
2	0.250196	0.999163	0.28016	0.9630181
4	0.250204	0.999169	0.280184	0.9956902
8	0.250204	0.999169	0.280184	0.9956842
16	0.250204	0.999169	0.280184	0.9956852

### **Discussion and Conclusions:**

1. As the hit ratio increases, the memory accesses are reduced, and thus improving the IPC.
2. As, the cache size increases the IPC and the hit ratio is seen to increase up to a certain value.
3. If the cache size, is kept lower than that required by the trace, it results in higher number of capacity misses.
4. It is observed that for the non-memory trace the IPC and the hit ratio stop increases at 512 Kb, whereas it is seen to increase for the memory-intensive case till 1024 KB and a marginal increase for 2048. This is because the memory requirements for the non-intensive memory trace is much lesser as compared to the memory intensive trace and is thus saturated at a lower cache size value. So, the working set can be determined from the above results for the two traces.

Based on the given choices of 128, 512, 1024 and 2048 (in KBs)

A size of **512 KB** is sufficient for Non-memory intensive cache and a size of **1024 KB** is sufficient for the memory intensive trace. ( ignoring the marginal increase in cache hit ratio of 0.0000003)

**Performance Increase:**

Memory Intensive: 128 KB to 1MB -> 0.01249%

Non Memory Intensive : 128 KB to 512 KB -> 0.00679%

4. Thus, the performance increase obtained due increase in cache size is much lesser for the non-memory intensive trace as compared to the memory intensive trace.

5. We observe a similar phenomenon when we try to increase the associativity of the cache. The optimal results are obtained when the associativity is set at 4. Further increase only marginally impacts the IPC. The reason is as follows: The set(line) provides additional slots for blocks having a particular set of address bits. In case of direct mapped a cache block is mapped to a single specific position. If additional blocks have the same index address bits, it would have to evict the previous block compulsorily. Thus, increasing the associativity helps reduce the number of conflict misses. But, after a certain increase in associativity and because of the way the traces uses data with a particular set of address bits, further increase does not impact the performance much.

**Associativity of 4** provides the best in terms of performance for **both the traces**.

Performance Increase: ( Increase from 1 to 4)

Memory Intensive: 0.029%

Non-Memory intensive : 0.0439%

A 512 KB 4-way associative cache is favourable good choice for the traces, especially the non-memory intensive trace.