

CA ASSIGNMENT 3 – DIRECT MAPPED CACHE

IMPLEMENTATION

NOTE- Please keep the trace files and the .cpp files in the same folder to run the Cache implementation programs effectively. There are 6 .cpp files, one for each type of Cache.

OUTPUTS OF THE EXPERIMENTS:

a) **64 KB Cache size, 4 Bytes cache line**

Tag = 16 bits Index = 14 bits Byte offset = 2 bits

```
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ g++ A_64_4.cpp
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ ./a.out
GCC:      Hits: 482513      Misses: 33170      Hit Ratio: 0.935678      Miss Ratio: 0.0643225      Hit/Miss Rate: 14.5467
GZIP:     Hits: 320883      Misses: 160161      Hit Ratio: 0.667055      Miss Ratio: 0.332945      Hit/Miss Rate: 2.0035
SWIM:     Hits: 280442      Misses: 22751      Hit Ratio: 0.924962      Miss Ratio: 0.075038      Hit/Miss Rate: 12.3266
MCF:      Hits: 7502        Misses: 719728      Hit Ratio: 0.0103159      Miss Ratio: 0.989684      Hit/Miss Rate: 0.0104234
TWOLF:    Hits: 476625      Misses: 6199        Hit Ratio: 0.987161      Miss Ratio: 0.012839      Hit/Miss Rate: 76.8874
```

b) **512 KB Cache size, 4 Bytes cache line**

Tag = 13 bits Index = 17 bits Byte offset = 2 bits

```
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ g++ B_512_4.cpp
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ ./a.out
GCC:      Hits: 483844      Misses: 31839      Hit Ratio: 0.938259      Miss Ratio: 0.0617414      Hit/Miss Rate: 15.1966
GZIP:     Hits: 320883      Misses: 160161      Hit Ratio: 0.667055      Miss Ratio: 0.332945      Hit/Miss Rate: 2.0035
SWIM:     Hits: 280738      Misses: 22455      Hit Ratio: 0.925938      Miss Ratio: 0.0740617      Hit/Miss Rate: 12.5022
MCF:      Hits: 7505        Misses: 719725      Hit Ratio: 0.01032      Miss Ratio: 0.98968      Hit/Miss Rate: 0.0104276
TWOLF:    Hits: 476771      Misses: 6053        Hit Ratio: 0.987463      Miss Ratio: 0.0125367      Hit/Miss Rate: 78.7661
```

c) **1. 64 KB Cache size, 1 Bytes cache line**

Tag = 16 bits Index = 16 bits Byte offset = 0 bits

```
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ g++ C_64_1.cpp
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ ./a.out
GCC:      Hits: 479257      Misses: 36426      Hit Ratio: 0.929364      Miss Ratio: 0.0706364      Hit/Miss Rate: 13.157
GZIP:     Hits: 320875      Misses: 160169      Hit Ratio: 0.667039      Miss Ratio: 0.332961      Hit/Miss Rate: 2.00335
SWIM:     Hits: 280209      Misses: 22984      Hit Ratio: 0.924194      Miss Ratio: 0.0758065      Hit/Miss Rate: 12.1915
MCF:      Hits: 7445        Misses: 719785      Hit Ratio: 0.0102375      Miss Ratio: 0.989763      Hit/Miss Rate: 0.0103434
TWOLF:    Hits: 475323      Misses: 7501        Hit Ratio: 0.984464      Miss Ratio: 0.0155357      Hit/Miss Rate: 63.368
```

c) **2. 64 KB Cache size, 8 Bytes cache line**

Tag = 16 bits Index = 13 bits Byte offset = 3 bits

```
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ g++ C_64_8.cpp
asmita@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ ./a.out
GCC:      Hits: 493164      Misses: 22519      Hit Ratio: 0.956332      Miss Ratio: 0.0436683      Hit/Miss Rate: 21.8999
GZIP:     Hits: 320891      Misses: 160153      Hit Ratio: 0.667072      Miss Ratio: 0.332928      Hit/Miss Rate: 2.00365
SWIM:     Hits: 282967      Misses: 20226      Hit Ratio: 0.93329      Miss Ratio: 0.06671      Hit/Miss Rate: 13.9903
MCF:      Hits: 7545        Misses: 719685      Hit Ratio: 0.010375      Miss Ratio: 0.989625      Hit/Miss Rate: 0.0104838
TWOLF:    Hits: 477081      Misses: 5743        Hit Ratio: 0.988105      Miss Ratio: 0.0118946      Hit/Miss Rate: 83.0717
```

1. 3. 64 KB Cache size, 16 Bytes cache line

Tag = 16 bits Index = 12 bits Byte offset = 4 bits

```
asmitha@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ g++ C_64_16.cpp
asmitha@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ ./a.out
```

GCC:	Hits: 503073	Misses: 12610	Hit Ratio: 0.975547	Miss Ratio: 0.024453	Hit/Miss Rate: 39.8948
GZIP:	Hits: 321266	Misses: 159778	Hit Ratio: 0.667852	Miss Ratio: 0.332148	Hit/Miss Rate: 2.0107
SWIM:	Hits: 291407	Misses: 11786	Hit Ratio: 0.961127	Miss Ratio: 0.0388729	Hit/Miss Rate: 24.7248
MCF:	Hits: 367264	Misses: 359966	Hit Ratio: 0.505018	Miss Ratio: 0.494982	Hit/Miss Rate: 1.02027
TWOLF:	Hits: 479633	Misses: 3191	Hit Ratio: 0.993391	Miss Ratio: 0.00660903	Hit/Miss Rate: 150.308

c) 4. 64 KB Cache size, 32 Bytes cache line

Tag = 16 bits Index = 11 bits Byte offset = 5 bits

```
asmitha@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ g++ C_64_32.cpp
asmitha@LAPTOP-CQ3CKJ96:/mnt/c/Users/hp/Documents/new/CA-ASSIGNMENT_3$ ./a.out
```

GCC:	Hits: 508156	Misses: 7527	Hit Ratio: 0.985404	Miss Ratio: 0.0145962	Hit/Miss Rate: 67.5111
GZIP:	Hits: 321454	Misses: 159590	Hit Ratio: 0.668242	Miss Ratio: 0.331758	Hit/Miss Rate: 2.01425
SWIM:	Hits: 296434	Misses: 6759	Hit Ratio: 0.977707	Miss Ratio: 0.0222927	Hit/Miss Rate: 43.8577
MCF:	Hits: 547142	Misses: 180088	Hit Ratio: 0.752364	Miss Ratio: 0.247636	Hit/Miss Rate: 3.03819
TWOLF:	Hits: 480922	Misses: 1902	Hit Ratio: 0.996061	Miss Ratio: 0.00393932	Hit/Miss Rate: 252.851

TABLES AND GRAPHS:

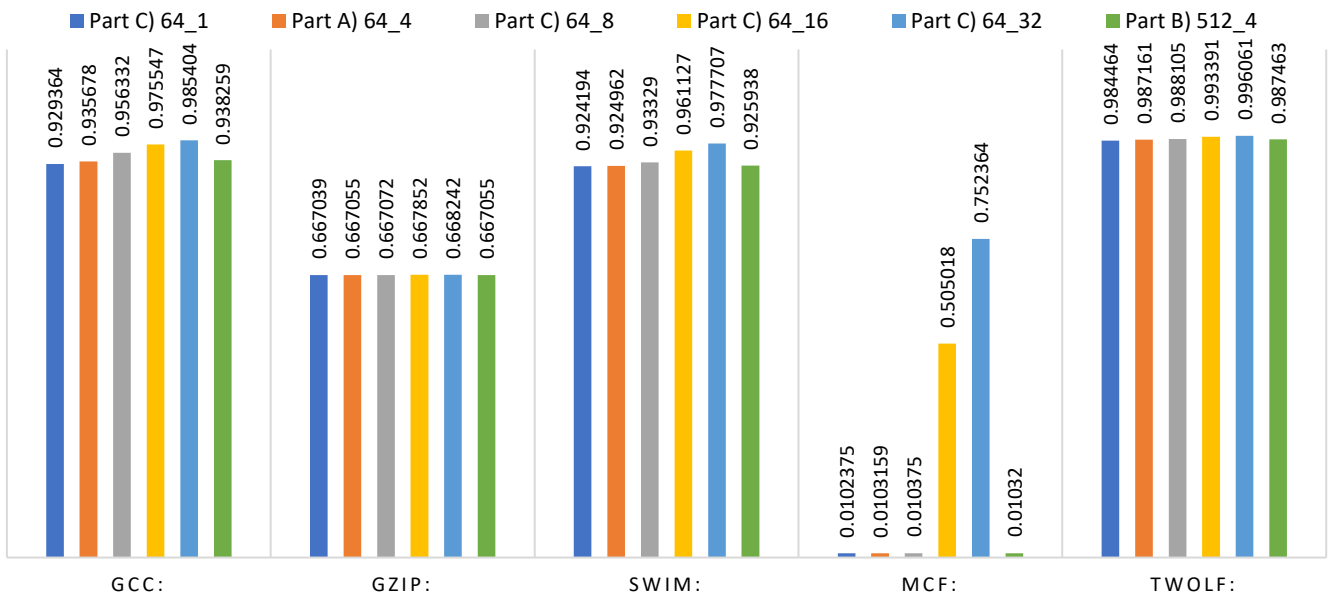
a) Hit Ratios

HIT RATIO	Part C) 64_1	Part A) 64_4	Part C) 64_8	Part C) 64_16	Part C) 64_32	Part B) 512_4
GCC:	0.929364	0.935678	0.956332	0.975547	0.985404	0.938259
GZIP:	0.667039	0.667055	0.667072	0.667852	0.668242	0.667055
SWIM:	0.924194	0.924962	0.93329	0.961127	0.977707	0.925938
MCF:	0.0102375	0.0103159	0.010375	0.505018	0.752364	0.01032
TWOLF:	0.984464	0.987161	0.988105	0.993391	0.996061	0.987463

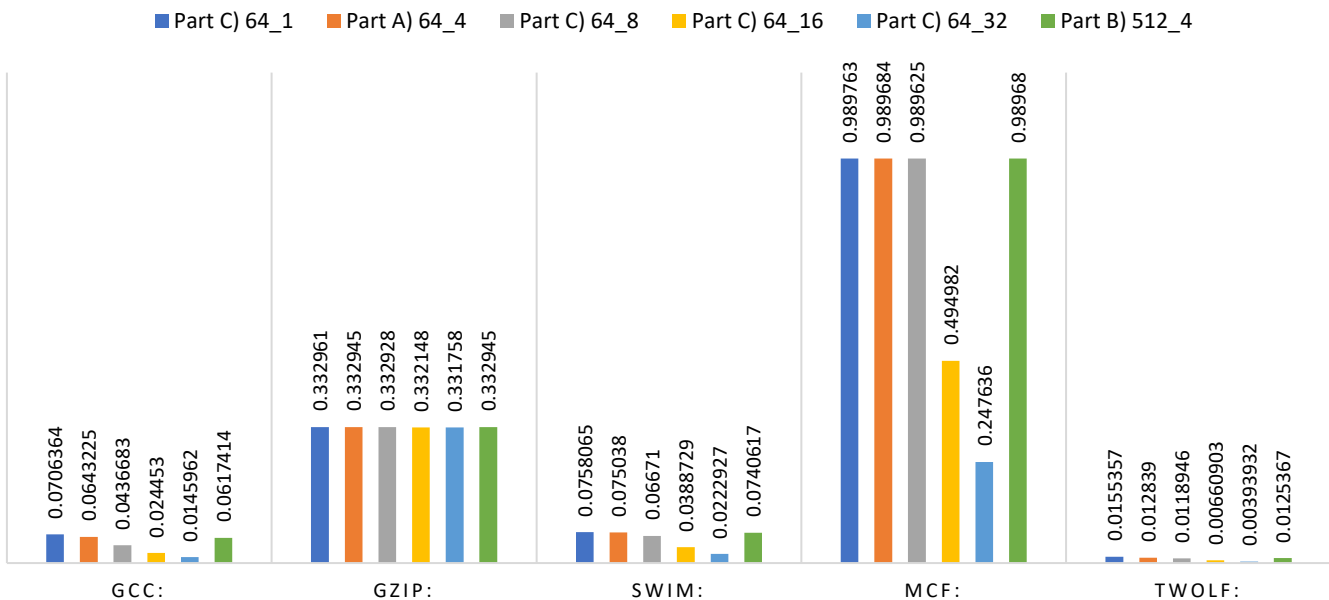
b) Miss Ratios

MISS RATIO	Part C) 64_1	Part A) 64_4	Part C) 64_8	Part C) 64_16	Part C) 64_32	Part B) 512_4
GCC:	0.0706364	0.0643225	0.0436683	0.024453	0.0145962	0.0617414
GZIP:	0.332961	0.332945	0.332928	0.332148	0.331758	0.332945
SWIM:	0.0758065	0.075038	0.06671	0.0388729	0.0222927	0.0740617
MCF:	0.989763	0.989684	0.989625	0.494982	0.247636	0.98968
TWOLF:	0.0155357	0.012839	0.0118946	0.00660903	0.00393932	0.0125367

HIT RATIOS



MISS RATIOS



OBSERVATIONS:

1. We can see that the hit rates of 64 KB, 1 byte cache is lower than the hit rate of 64 KB, 4 bytes cache, which is in turn lower than the hit rate of 64 KB, 8 bytes cache and so on. So, the hit rates are increasing as we increase the cache line/block size of the caches. This could be due to the spatial locality in the memory accesses made in the trace files.
2. We can also see that the hit rates for the 64 KB, 4 bytes cache is lower than the 512 KB, 4 bytes cache. So, the hit rates are increasing (even though minimally) as we increase the overall cache size.
3. Another peculiar observation is that the hit rates of the MCF trace file shoot up as soon as we use a 64 KB, 16 bytes cache or a 64 KB, 32 bytes cache for it. The hit rates in these two caches are exponentially larger than the 64 KB, 1 byte cache, 64 KB, 4 bytes cache and the 64 KB, 8 bytes cache hit rates. So, there is much more spatial locality in the memory accesses in the MCF trace file as compared to the other trace files.

TEAM MEMBERS –

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