CS 1541

Project 2

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Experiment 1:

To examine the effect of the block size, consider 3 cache sizes (1KB, 16KB and 128KB) with 4- way set associativity and LRU replacement. Compare the miss rate for block sizes of 4B, 16B, 32B, 64B, 128B and 256B. Produce two plots similar to the one on page 391 of the text book, one for each of the long traces. Produce two corresponding graphs to express the number of bytes written back (the y axis being the number of bytes written back instead of the miss rate).

The result of running our simulation with trace\_view\_on = 0 for each long trace file and the parameters specified in each experiment.

\*\* opening file sample\_large1.tr

+ Cache Size : 1KB

+ Block Size : 16B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 12389835

+ number of misses : 18049030

+ number of misses with write back : 18048966

+ rate of misses : 0.592960

\*\* opening file sample\_large1.tr

+ Cache Size : 1KB

+ Block Size : 128B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 6368927

+ number of misses : 24069938

+ number of misses with write back : 24069930

+ rate of misses : 0.790763

\*\* opening file sample\_large1.tr

+ Cache Size : 16KB

+ Block Size : 16B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 19941072

+ number of misses : 10497793

+ number of misses with write back : 10496769

+ rate of misses : 0.344881

\*\* opening file sample\_large1.tr

+ Cache Size : 16KB

+ Block Size : 128B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 20208523

+ number of misses : 10230342

+ number of misses with write back : 10230214

+ rate of misses : 0.336095

\*\* opening file sample\_large2.tr

+ Cache Size : 1KB

+ Block Size : 16B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 6464556

+ number of misses : 29620429

+ number of misses with write back : 29620365

+ rate of misses : 0.820852

\*\* opening file sample\_large2.tr

+ Cache Size : 1KB

+ Block Size : 128B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 6135180

+ number of misses : 29949805

+ number of misses with write back : 29949797

+ rate of misses : 0.829980

\*\* opening file sample\_large2.tr

+ Cache Size : 16KB

+ Block Size : 16B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 8840807

+ number of misses : 27244178

+ number of misses with write back : 27243154

+ rate of misses : 0.755000

\*\* opening file sample\_large2.tr

+ Cache Size : 16KB

+ Block Size : 128B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 12393957

+ number of misses : 23691028

+ number of misses with write back : 23690900

+ rate of misses : 0.656534

The data we gathered from running all of the simulations with sample\_large1.tr:





The data we gathered from running all of the simulations with sample\_long2.tr:





From the data gathered in Experiment 1, we can conclude that it is not always better to have a larger Block size. In the case of sample\_large1.tr we can clearly see that for a smaller cache size, it is more optimal to have a smaller block size. Additionally we can see a significant decrease in the amount of write backs and miss rate for 16KB cache but only a miner decrease for the largest cache size. It is also apparent from these graphs that for a 16KB cache, a block size of 64B is optimal while for the 128KB cache, a block size of 128B to 256B is optimal.

In the case of sample\_long2.tr, we can see that for a larger amount of instructions the miss rate will be more of the same for block sizes smaller then 64B. However for a small cache size of 1KB we can see that performance decreases when the block size increases, but for larger cache sizes the larger block sizes have better performance.

Experiment 2:

To examine the effect of the replacement policy, consider a 4KB cache with 32B blocks and 4- way associativity. Use a bar graph to plot the miss rate for each of the two long traces and 2 replacement policies (FIFO and LRU). Your plot should have 4 bars.

The result of running our simulation with trace\_view\_on = 0 for each long trace file and the parameters specified in each experiment.

\*\* opening file sample\_large1.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 4-way set associative

+ Replacement Policy : FIFO

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 15648066

+ number of misses : 14790799

+ number of misses with write back : 14790671

+ rate of misses : 0.485918

\*\* opening file sample\_large1.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 17564071

+ number of misses : 12874794

+ number of misses with write back : 12874666

+ rate of misses : 0.422972

\*\* opening file sample\_large2.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 4-way set associative

+ Replacement Policy : FIFO

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 7984444

+ number of misses : 28100541

+ number of misses with write back : 28100413

+ rate of misses : 0.778732

\*\* opening file sample\_large2.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 8255277

+ number of misses : 27829708

+ number of misses with write back : 27829580

+ rate of misses : 0.771227

The data we gathered from running all of the simulations:



From this experiment we can see that for the smaller of the files, sample\_large1.tr, we have a better miss rate for LRU then for FIFO. For the sample\_large2.tr we can see that it is almost equal, with FIFO having slightly less miss rate. We can conclude from this that for smaller amounts of instructions, LRU performs better, while FIFO is better for larger data sets.

Experiment 3:

To examine the effect of associativity, consider a 4KB cache with 32B blocks and LRU replacement. Use a bar graph to plot the miss rate for associativity = 1, 4 and 8. This plot will have 6 bars, three for each long trace

The result of running our simulation with trace\_view\_on = 0 for each long trace file and the parameters specified in each experiment.

\*\* opening file sample\_large1.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 1-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 20771557

+ number of misses : 9667308

+ number of misses with write back : 9667180

+ rate of misses : 0.317598

\*\* opening file sample\_large1.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 17564071

+ number of misses : 12874794

+ number of misses with write back : 12874666

+ rate of misses : 0.422972

\*\* opening file sample\_large1.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 8-way set associative

+ Replacement Policy : LRU

+ number of accesses : 30438865

+ number of reads : 20813032

+ number of writes : 9625833

+ number of hits : 14685055

+ number of misses : 15753810

+ number of misses with write back : 15753682

+ rate of misses : 0.517556

\*\* opening file sample\_large2.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 1-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 15952062

+ number of misses : 20132923

+ number of misses with write back : 20132795

+ rate of misses : 0.557931

\*\* opening file sample\_large2.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 4-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 8255277

+ number of misses : 27829708

+ number of misses with write back : 27829580

+ rate of misses : 0.771227

\*\* opening file sample\_large2.tr

+ Cache Size : 4KB

+ Block Size : 32B

+ 8-way set associative

+ Replacement Policy : LRU

+ number of accesses : 36084985

+ number of reads : 29411338

+ number of writes : 6673647

+ number of hits : 6200529

+ number of misses : 29884456

+ number of misses with write back : 29884328

+ rate of misses : 0.828169

The data we gathered from running all of the simulations:

From this experiment we can clear see that the miss rate increases with the amount of associativity. 1-way associative had the lowest miss rate while 8-way associative had the largest.