CS422A: Computer Architecture

Homework 4

Submitted By
Harshit Raj | 200433
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About the Analysis

Each instruction is instrumented, and read-write operands' effective address and size are passed to analysis. Three different cache classes are implemented to simulate cache block hits and misses.

L1 misses remain same in all of the policies across all the program. Cachlines which are dead on arrival are around 60-85% of all the cahcelines.

This implies that eviction policy like SRRIP would yeild in better L2 hits. However application like perlbench doesn't observe improvement from LRU to SRRIP as the DOA lines are 8% in this. This pattern is not determisitic even in presence of large DOA lines as seen in mcf. But mostly SRRIP seem to perform better than LRU eviction policy, even if marginally so. This improvement isn't huge in nature.

Since NRU policy is used when we have storage constraints. NRU policy misses more tha SRRIP policy. SRRIP and NRU policy roughly behaves the same in principle just srrv becomes a ref bit losing some layer of robustnes while decreasing comparator load. We mostly observe SRRIP performs better than NRU. But no clear conclusion or pattern can be observed between NRU and LRU.

Machine used: `image1.cse.iitk.ac.in`

Table of contents

Usage

```
# Build the tool

make TARGET=ia32 obj-ia32/HW4.so

# Run the tool on a benchmark

cd /path/to/spec_2006/400.perlbench/

pin -t /path/to/obj-ia32/HW4.so -f <FAST_FORWARD_VAL> -o executable..out --
./executable exec_args
```

- `-f` flag is used to specify the fast-forward instruction count in billions.
- `-o` flag is used to specify the output file.
- `-t` flag is used to specify the pin tool to be used.
- `--` is used to separate the pin tool arguments from the application arguments.

Analysis of 400.perlbench diffmail.pl

```
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HW4 analysis results from perlbench.diffmail.out

Number of instructions: 208000000000

Fast forward at:        207000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:              561911617

L1 Misses:                   904040 0.00160887

L2 Accesses:                 904040

L2 Misses:                    17179 0.0190025

L2 Block Fills:               17179

L2 Evicts at 0 Hit:            1531 0.0891204

L2 Evicts atleast 2 Hits:        11 0.458333

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SRRIP Cache Statistics

L1 Accesses:              561911617

L1 Misses:                   904040 0.00160887

L2 Accesses:                 904040

L2 Misses:                    17179 0.0190025

L2 Block Fills:               17179

L2 Evicts at 0 Hit:            1555 0.0905175

L2 Evicts atleast 2 Hits:         0 0

========================================================
```

```
NRU Cache Statistics

L1 Accesses:                  561911617

L1 Misses:                       904040 0.00160887

L2 Accesses:                     904040

L2 Misses:                        17306 0.019143

L2 Block Fills:                   17306

L2 Evicts at 0 Hit:                1478 0.0854039

L2 Evicts atleast 2 Hits:           172 0.843137

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Time elapsed: 30.6749 minutes
```

Analysis of 401.bzip2 input.source

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HW4 analysis results from bzip2.source.out

Number of instructions: 302000000000

Fast forward at:        301000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:                683880211

L1 Misses:                    8429627 0.0123262

L2 Accesses:                  8429627

L2 Misses:                    4456862 0.528714

L2 Block Fills:               4456862

L2 Evicts at 0 Hit:           3020358 0.677687

L2 Evicts atleast 2 Hits:      732428 0.515751

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SRRIP Cache Statistics

L1 Accesses:                683880211

L1 Misses:                    8429627 0.0123262

L2 Accesses:                  8429627

L2 Misses:                    4511853 0.535238

L2 Block Fills:               4511853

L2 Evicts at 0 Hit:           3388094 0.750932

L2 Evicts atleast 2 Hits:      681330 0.615266

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```

```
NRU Cache Statistics

L1 Accesses:              683880211

L1 Misses:                  8429627 0.0123262

L2 Accesses:                8429627

L2 Misses:                  4476881 0.531089

L2 Block Fills:             4476881

L2 Evicts at 0 Hit:         3023671 0.675397

L2 Evicts atleast 2 Hits:    729305 0.507581

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Time elapsed: 35.2186 minutes
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Analysis of 403.gcc cp-decl.i

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HW4 analysis results from gcc.cp-decl.out

Number of instructions: 108000000000

Fast forward at:        107000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:              497493426

L1 Misses:                 23086059 0.0464048

L2 Accesses:               23086059

L2 Misses:                  5004216 0.216764

L2 Block Fills:             5004216

L2 Evicts at 0 Hit:         4743790 0.947959

L2 Evicts atleast 2 Hits:    116188 0.476098

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SRRIP Cache Statistics

L1 Accesses:              497493426

L1 Misses:                 23086059 0.0464048

L2 Accesses:               23086059

L2 Misses:                  4994283 0.216333

L2 Block Fills:             4994283

L2 Evicts at 0 Hit:         4751024 0.951293

L2 Evicts atleast 2 Hits:    118773 0.523517

========================================================
```

```
NRU Cache Statistics

L1 Accesses:                497493426

L1 Misses:                   23086059 0.0464048

L2 Accesses:                 23086059

L2 Misses:                    5009856 0.217008

L2 Block Fills:               5009856

L2 Evicts at 0 Hit:          4744744 0.947082

L2 Evicts atleast 2 Hits:     119660 0.481088

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Time elapsed: 14.5258 minutes
```

Analysis of 429.mcf

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HW4 analysis results from mcf.out

Number of instructions: 378000000000

Fast forward at:          377000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:                525252592

L1 Misses:                   68233880 0.129907

L2 Accesses:                 68233880

L2 Misses:                   33528245 0.491372

L2 Block Fills:              33528245

L2 Evicts at 0 Hit:          20454557 0.610069

L2 Evicts atleast 2 Hits:    2357225 0.180529

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SRRIP Cache Statistics

L1 Accesses:                525252592

L1 Misses:                   68233880 0.129907

L2 Accesses:                 68233880

L2 Misses:                   34429944 0.504587

L2 Block Fills:              34429944

L2 Evicts at 0 Hit:          22882323 0.664605

L2 Evicts atleast 2 Hits:    2106989 0.18272

===========================================================
```

```
NRU Cache Statistics

L1 Accesses:                    525252592

L1 Misses:                       68233880 0.129907

L2 Accesses:                     68233880

L2 Misses:                       33760314 0.494773

L2 Block Fills:                  33760314

L2 Evicts at 0 Hit:             20504228 0.607347

L2 Evicts atleast 2 Hits:        2449971 0.185047

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Time elapsed: 46.2605 minutes
```

Analysis of 450.soplex ref.mps

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HW4 analysis results from soplex.ref.out

Number of instructions: 365000000000

Fast forward at:        364000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:              501370443

L1 Misses:                 19141842 0.038179

L2 Accesses:               19141842

L2 Misses:                 18372923 0.95983

L2 Block Fills:            18372923

L2 Evicts at 0 Hit:        18006923 0.980079

L2 Evicts atleast 2 Hits:     75174 0.215019

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SRRIP Cache Statistics

L1 Accesses:              501370443

L1 Misses:                 19141842 0.038179

L2 Accesses:               19141842

L2 Misses:                 18330181 0.957598

L2 Block Fills:            18330181

L2 Evicts at 0 Hit:        18012033 0.982643

L2 Evicts atleast 2 Hits:     97217 0.322162

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```

```
NRU Cache Statistics

L1 Accesses:              501370443

L1 Misses:                 19141842 0.038179

L2 Accesses:               19141842

L2 Misses:                 18379004 0.960148

L2 Block Fills:            18379004

L2 Evicts at 0 Hit:        18009467 0.979894

L2 Evicts atleast 2 Hits:     78663 0.222745

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Time elapsed: 86.2816 minutes
```

Analysis of 456.hmmer nph3.hmm

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HW4 analysis results from hmmer.nph3.out

Number of instructions: 265000000000

Fast forward at:          264000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:              623357688

L1 Misses:                  3262170 0.00523322

L2 Accesses:                3262170

L2 Misses:                  1604124 0.491735

L2 Block Fills:             1604124

L2 Evicts at 0 Hit:         1533491 0.955968

L2 Evicts atleast 2 Hits:     16541 0.304909

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SRRIP Cache Statistics

L1 Accesses:              623357688

L1 Misses:                  3262170 0.00523322

L2 Accesses:                3262170

L2 Misses:                  1549385 0.474955

L2 Block Fills:             1549385

L2 Evicts at 0 Hit:         1494190 0.964376

L2 Evicts atleast 2 Hits:     17495 0.450774

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```
NRU Cache Statistics

L1 Accesses:                623357688

L1 Misses:                  3262170 0.00523322

L2 Accesses:                3262170

L2 Misses:                  1593535 0.488489

L2 Block Fills:             1593535

L2 Evicts at 0 Hit:         1512860 0.949374

L2 Evicts atleast 2 Hits:    19902 0.309561

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Time elapsed: 30.276 minutes
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Analysis of 471.omnetpp

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HW4 analysis results from omnetpp.out

Number of instructions: 44000000000

Fast forward at:         43000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:                562158854

L1 Misses:                   13625467 0.0242378

L2 Accesses:                 13625467

L2 Misses:                   10170292 0.746418

L2 Block Fills:              10170292

L2 Evicts at 0 Hit:           8258928 0.812064

L2 Evicts atleast 2 Hits:      687583 0.362844

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SRRIP Cache Statistics

L1 Accesses:                562158854

L1 Misses:                   13625467 0.0242378

L2 Accesses:                 13625467

L2 Misses:                   10158661 0.745564

L2 Block Fills:              10158661

L2 Evicts at 0 Hit:           8669448 0.853405

L2 Evicts atleast 2 Hits:      724202 0.491708

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```

```
NRU Cache Statistics

L1 Accesses:                    562158854

L1 Misses:                       13625467 0.0242378

L2 Accesses:                     13625467

L2 Misses:                       10183176 0.747363

L2 Block Fills:                  10183176

L2 Evicts at 0 Hit:              8236107 0.808796

L2 Evicts atleast 2 Hits:        681429 0.352947

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Time elapsed: 6.28211 minutes
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Analysis of 483.xalancbmk

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HW4 analysis results from xalancbmk.out

Number of instructions: 1332000000000

Fast forward at:        1331000000000

Number of instructions after fast forward: 1000000000

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LRU Cache Statistics

L1 Accesses:              515883242

L1 Misses:                 13763275 0.0266791

L2 Accesses:               13763275

L2 Misses:                  2334683 0.169631

L2 Block Fills:             2334683

L2 Evicts at 0 Hit:        1359210 0.582182

L2 Evicts atleast 2 Hits:   540912 0.563985

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SRRIP Cache Statistics

L1 Accesses:              515883242

L1 Misses:                 13763275 0.0266791

L2 Accesses:               13763275

L2 Misses:                  2266251 0.164659

L2 Block Fills:             2266251

L2 Evicts at 0 Hit:        1427797 0.630026

L2 Evicts atleast 2 Hits:   479012 0.58269

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```
NRU Cache Statistics

L1 Accesses:                  515883242

L1 Misses:                     13763275 0.0266791

L2 Accesses:                   13763275

L2 Misses:                      2342443 0.170195

L2 Block Fills:                 2342443

L2 Evicts at 0 Hit:             1363965 0.582283

L2 Evicts atleast 2 Hits:        538147 0.55935

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Time elapsed: 170.407 minutes
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