Report: CS422

Programming Assignment 1

Group 1

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Lots of data structures have been used to maintain the statistics. The choice has been done so that the space used by these lies within 1 GB and the number of instrutions executed by the analysis functions are minimum.

Each instruction is decoded within Instruction routine and all parameters are then passed to analysis routines.

The data structures have been listed in counters.h file

- PART A DecodeInsInfo Routine finds the instruction type, number of loads and stores (considering bus width to be limit for 1 memory operation). Analysis routine increments the corresponding counters

- Part B Using statistics from Part A, we calculate the total number of cycles used. The number of instruction is taken to be 1E+9 (and not the summation of counters)

- Part C Two boolean arrays, each of length 2^{27} are used. One records the memory footprint of instructions and the other records for data. Each boolean item corresponds to one block in the cache. Since, each block is 32 bytes long, there are total 2^{27} blocks in the virtual address space, all initialized as 0

  A function by the name FootprintRoutine is used to mark the blocks. For each data/instruction fetch, this routine is invoked once. The routine just sets the boolean value corresponding to accessed block.

  ExitRoutine function iterates over these arrays to count the number of touched blocks

- Part D Various arrays and counters maintain the required statistics. This is straight forward. Distribution for instruction length, number of operands, number of register read/write operands, number of memory operands, and number of memory read/write operands can be maintained using simple arrays. The other 3 pair of values need some counters

400.perlbench diffmail.pl

```
Instruction Type Results:
Loads: 356203304 (0.228005)
Stores: 206221408 (0.132002)
NOPs: 974707 (0.000623908)
Direct calls: 12843565 (0.00822115)
Indirect calls: 2813126 (0.00180068)
Returns: 15656695 (0.0100218)
Unconditional branches: 30501984 (0.0195243)
Conditional branches: 130065739 (0.0832549)
Logical operations: 100375207 (0.06425)
Rotate and Shift: 4272765 (0.00273499)
Flag operations: 868515 (0.000555935)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 954096 (0.000610715)
The rest: 700508425 (0.448394)
CPI: 29.1211
Instruction Size Results:
0: 0
1: 117568177
2: 256862334
3: 275033288
4: 52953505
5: 78550590
6: 185057308
7: 33974758
8: 28
9: 0
10: 12
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 453449920
1: 530898226
2: 15486678
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 191126546
1: 354389509
2: 868849
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 340640529
1: 205744375
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 974707
1: 1077837
2: 520433314
3: 355077497
4: 103530497
5: 15658390
6: 3247758
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 10216374
1: 259878278
2: 537904662
3: 179178891
4: 7007352
5: 2566685
6: 3247758
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 136065207
1: 684887585
2: 175795754
3: 2382582
4: 868872
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 2808
Data Blocks Accesses: 31195
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 3.73924
Maximum value of immediate: 2147483647
Minimum value of immediate: -2147483648
Maximum value of displacement used in memory addressing: 135918104
Minimum value of displacement used in memory addressing: -1408
```

401.bzip2 input.source

```
Instruction Type Results:
Loads: 452705858 (0.268847)
Stores: 231174314 (0.137287)
NOPs: 36514 (2.16845e-05)
Direct calls: 791576 (0.000470092)
Indirect calls: 13 (7.72028e-09)
Returns: 791585 (0.000470097)
Unconditional branches: 21299275 (0.012649)
Conditional branches: 129923016 (0.0771571)
Logical operations: 71000925 (0.0421652)
Rotate and Shift: 61832193 (0.0367202)
Flag operations: 6130 (3.64041e-06)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 0 (0)
The rest: 714314688 (0.424209)
CPI: 35.194
Instruction Size Results:
0: 0
1: 38611319
2: 219201535
3: 436966312
4: 75326853
5: 22047180
6: 141356893
7: 51341666
8: 15085632
9: 0
10: 62610
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 399852690
1: 516406278
2: 83736947
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 147437367
1: 452705858
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 368968911
1: 231174314
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 36514
1: 6147
2: 597647676
3: 382870297
4: 2693783
5: 14191375
6: 2554208
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 5189068
1: 183351886
2: 533608373
3: 215105767
4: 46790899
5: 13399799
6: 2554208
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 132331561
1: 712782102
2: 152332112
3: 2554225
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 753
Data Blocks Accesses: 2441019
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 3.48541
Maximum value of immediate: 1431655766
Minimum value of immediate: -858993459
Maximum value of displacement used in memory addressing: 135000192
Minimum value of displacement used in memory addressing: -4848
```

403.gcc cp-decl.i

```
Instruction Type Results:
Loads: 338884652 (0.224543)
Stores: 170335975 (0.112864)
NOPs: 3905948 (0.00258806)
Direct calls: 30221292 (0.0200244)
Indirect calls: 396109 (0.000262459)
Returns: 30617401 (0.0202869)
Unconditional branches: 31772428 (0.0210522)
Conditional branches: 145817192 (0.0966175)
Logical operations: 54600163 (0.0361777)
Rotate and Shift: 634872 (0.000420662)
Flag operations: 0 (0)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 0 (0)
The rest: 702034595 (0.465164)
CPI: 26.461
Instruction Size Results:
0: 0
1: 181978624
2: 305565912
3: 282662454
4: 87593160
5: 53448081
6: 76319512
7: 12432257
8: 0
9: 0
10: 0
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 495938403
1: 498902567
2: 5159030
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 165176945
1: 338884652
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 333725622
1: 170335975
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 3905948
1: 2491792
2: 426160253
3: 363402433
4: 173422173
5: 30617401
6: 0
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 7272318
1: 316989688
2: 482070931
3: 189701216
4: 3569738
5: 396109
6: 0
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 67562433
1: 724670150
2: 207767417
3: 0
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 242
Data Blocks Accesses: 66157
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 3.76978
Maximum value of immediate: 136599840
Minimum value of immediate: -2147483587
Maximum value of displacement used in memory addressing: 138633083
Minimum value of displacement used in memory addressing: -96
```

429.mcf

```
Instruction Type Results:
Loads: 415212495 (0.272225)
Stores: 110040171 (0.0721455)
NOPs: 1477638 (0.000968782)
Direct calls: 12556363 (0.00823232)
Indirect calls: 0 (0)
Returns: 12556363 (0.00823232)
Unconditional branches: 8314476 (0.00545121)
Conditional branches: 178242828 (0.116861)
Logical operations: 75119532 (0.0492505)
Rotate and Shift: 3516410 (0.00230546)
Flag operations: 0 (0)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 0 (0)
The rest: 708216390 (0.464327)
CPI: 27.2626
Instruction Size Results:
0: 0
1: 80626492
2: 485393557
3: 315526126
4: 50531353
5: 22076615
6: 5249757
7: 40596100
8: 0
9: 0
10: 0
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 487182373
1: 500382588
2: 12435039
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 97605132
1: 415212495
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 402777456
1: 110040171
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 1477638
1: 0
2: 484784937
3: 457346724
4: 43834338
5: 12556363
6: 0
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 3759861
1: 148510605
2: 677530846
3: 170198688
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 70906675
1: 770283346
2: 158771468
3: 38511
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 65
Data Blocks Accesses: 11672907
Maximum number of bytes touched by an instruction: 4
Average number of bytes touched by an instruction: 4
Maximum value of immediate: 1374389535
Minimum value of immediate: -100000000
Maximum value of displacement used in memory addressing: 134957120
Minimum value of displacement used in memory addressing: -76
```

450.soplex ref.mps

```
Instruction Type Results:
Loads: 546362980 (0.331629)
Stores: 101149822 (0.0613955)
NOPs: 11471 (6.96262e-06)
Direct calls: 3199444 (0.00194198)
Indirect calls: 135 (8.19417e-08)
Returns: 3199579 (0.00194207)
Unconditional branches: 13171022 (0.00799449)
Conditional branches: 103110479 (0.0625855)
Logical operations: 13848328 (0.0084056)
Rotate and Shift: 10323916 (0.00626636)
Flag operations: 23244937 (0.0141091)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 306667552 (0.18614)
The rest: 523223137 (0.317584)
CPI: 33.3756
Instruction Size Results:
0: 0
1: 77075441
2: 441684114
3: 398958236
4: 16506344
5: 3277725
6: 40943890
7: 17615588
8: 3938662
9: 0
10: 0
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 530021471
1: 439602075
2: 30376454
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 52879281
1: 417099248
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 386722794
1: 83255735
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 11471
1: 23
2: 415270404
3: 395014100
4: 186468205
5: 3235797
6: 0
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 23455330
1: 216024871
2: 577322366
3: 140222612
4: 42938489
5: 36332
6: 0
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 69539567
1: 764796405
2: 165664028
3: 0
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 1177
Data Blocks Accesses: 5682052
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 5.25245
Maximum value of immediate: 2147483647
Minimum value of immediate: -1074790400
Maximum value of displacement used in memory addressing: 135856732
Minimum value of displacement used in memory addressing: -344
```

456.hmmer nph3.hmm

```
Instruction Type Results:
Loads: 547670127 (0.337367)
Stores: 75698537 (0.0466306)
NOPs: 34317 (2.11394e-05)
Direct calls: 144622 (8.90876e-05)
Indirect calls: 959 (5.90747e-07)
Returns: 145581 (8.96784e-05)
Unconditional branches: 205862 (0.000126812)
Conditional branches: 144361633 (0.0889273)
Logical operations: 1158704 (0.000713766)
Rotate and Shift: 294108 (0.000181172)
Flag operations: 5669 (3.49212e-06)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 40212 (2.47707e-05)
The rest: 853607370 (0.525825)
CPI: 32.1684
Instruction Size Results:
0: 0
1: 25078705
2: 302861295
3: 296150036
4: 270388635
5: 24861165
6: 68360363
7: 416483
8: 11883318
9: 0
10: 0
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 376809003
1: 623023923
2: 166111
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 75527790
1: 547662244
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 547496133
1: 75693901
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 34887
1: 3512
2: 566126453
3: 432938674
4: 713115
5: 159551
6: 23808
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 610949
1: 75620324
2: 562399107
3: 281425562
4: 79905321
5: 14929
6: 23808
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 75148967
1: 755280071
2: 169547154
3: 23808
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 485
Data Blocks Accesses: 84054
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 3.99751
Maximum value of immediate: 2147483647
Minimum value of immediate: -987654321
Maximum value of displacement used in memory addressing: 135294312
Minimum value of displacement used in memory addressing: -580
```

471.omnetpp

```
Instruction Type Results:
Loads: 371223581 (0.231871)
Stores: 229770941 (0.143518)
NOPs: 802040 (0.000500964)
Direct calls: 21323705 (0.013319)
Indirect calls: 3688453 (0.00230385)
Returns: 25012161 (0.0156229)
Unconditional branches: 22184188 (0.0138565)
Conditional branches: 117348321 (0.0732971)
Logical operations: 60016070 (0.0374867)
Rotate and Shift: 7152318 (0.00446742)
Flag operations: 20156512 (0.01259)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 96936050 (0.0605474)
The rest: 625380182 (0.39062)
CPI: 31.0497
Instruction Size Results:
0: 0
1: 154557939
2: 308538146
3: 382106005
4: 34343013
5: 45112931
6: 48828682
7: 26512863
8: 0
9: 0
10: 421
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 449263790
1: 542971602
2: 7764608
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 212438169
1: 337159001
2: 1139040
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 331672473
1: 219063737
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 802040
1: 226022
2: 518298255
3: 281785376
4: 172723520
5: 25025747
6: 1139040
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 29000572
1: 197508958
2: 540436796
3: 219768642
4: 8460182
5: 3685810
6: 1139040
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 165345656
1: 665549602
2: 167589760
3: 375942
4: 1139040
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 890
Data Blocks Accesses: 529669
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 4.22163
Maximum value of immediate: 2147483647
Minimum value of immediate: -2092037281
Maximum value of displacement used in memory addressing: 136090116
Minimum value of displacement used in memory addressing: -104
```

483.xalancbmk

```
Instruction Type Results:
Loads: 366276310 (0.238773)
Stores: 168185768 (0.109639)
NOPs: 22311795 (0.0145449)
Direct calls: 13127535 (0.00855777)
Indirect calls: 8954195 (0.00583719)
Returns: 22081559 (0.0143948)
Unconditional branches: 8550442 (0.00557398)
Conditional branches: 178524111 (0.116379)
Logical operations: 37558738 (0.0244843)
Rotate and Shift: 5572155 (0.00363246)
Flag operations: 1655504 (0.00107921)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 7226897 (0.00471117)
The rest: 693966010 (0.452392)
CPI: 27.7226
Instruction Size Results:
0: 0
1: 145284870
2: 321194773
3: 446408872
4: 31653413
5: 23918510
6: 23516137
7: 7636612
8: 260208
9: 60248
10: 66357
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 495505133
1: 477027185
2: 26996623
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 140060631
1: 363963177
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 336966554
1: 167057254
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 22311795
1: 740535
2: 422728203
3: 413473895
4: 101243782
5: 24020500
6: 15481290
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 29712554
1: 237241769
2: 457558052
3: 249969717
4: 1201193
5: 8835425
6: 15481290
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 113280934
1: 686082477
2: 185153490
3: 15483099
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 2295
Data Blocks Accesses: 657333
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 4.15894
Maximum value of immediate: 2147483647
Minimum value of immediate: -1431655765
Maximum value of displacement used in memory addressing: 139657912
Minimum value of displacement used in memory addressing: -1392
```

Optional Binaries

436.cactusADM

```
Instruction Type Results:
Loads: 1040897113 (0.43879249)
Stores: 331288195 (0.13965528)
NOPs: 2265 (9.54816e-07)
Direct calls: 531583 (0.00022408)
Indirect calls: 193 (8.13596e-08)
Returns: 531776 (0.00022417)
Unconditional branches: 535270 (0.00022564)
Conditional branches: 4305613 (0.00181504)
Logical operations: 1626452 (0.00068563)
Rotate and Shift: 1059308 (0.00044655)
Flag operations: 5 (2.10776e-09)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 851723620 (0.35904599)
The rest: 139683915 (0.05888407)
CPI: 29.3439
Instruction Size Results:
0: 0
1: 1658075
2: 263441857
3: 78112025
4: 15678300
5: 1609525
6: 603728526
7: 35771692
8: 0
9: 0
10: 0
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 273540873
1: 690600456
2: 35858671
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 150924616
1: 575534481
2: 30
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 539675870
1: 186783257
2: 0
```

```
3: 0
4: 0
Instruction Operand Results:
0: 2265
1: 23
2: 83585116
3: 461382400
4: 454498390
5: 531776
6: 30
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 18274777
1: 42914482
2: 532137779
3: 397790920
4: 8881877
5: 135
6: 30
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 149849567
1: 791740358
2: 58409919
3: 126
4: 30
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 1224
Data Blocks Accesses: 4413133
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 7.35779
Maximum value of immediate: 1431655766
Minimum value of immediate: -2147483648
Maximum value of displacement used in memory addressing: 135701372
Minimum value of displacement used in memory addressing: -2620
```

437.leslie3d

```
Instruction Type Results:
Loads: 736426958 (0.380104)
Stores: 201007862 (0.103749)
NOPs: 83321 (4.30058e-05)
Direct calls: 913 (4.71242e-07)
Indirect calls: 17 (8.77449e-09)
Returns: 930 (4.80016e-07)
Unconditional branches: 169181 (8.73222e-05)
Conditional branches: 41549368 (0.0214456)
Logical operations: 435798 (0.000224936)
Rotate and Shift: 5168287 (0.00266759)
Flag operations: 32 (1.65167e-08)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 394808389 (0.203779)
The rest: 557783762 (0.287898)
CPI: 47.8717
Instruction Size Results:
0: 0
1: 34716305
2: 503707635
3: 58912511
4: 82555
5: 412265
6: 400346933
7: 1821778
8: 0
9: 0
10: 18
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 378021297
1: 548828785
2: 73149916
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 68829514
1: 553149187
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 479999271
1: 141979430
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 83321
1: 33
2: 317860462
3: 492868494
4: 189186654
5: 992
6: 44
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 357049
1: 58705672
2: 653894677
3: 270600734
4: 16441752
5: 72
6: 44
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 68909555
1: 735960299
2: 195129988
3: 158
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 2631
Data Blocks Accesses: 2476189
Maximum number of bytes touched by an instruction: 10
Average number of bytes touched by an instruction: 5.55829
Maximum value of immediate: 2147483647
Minimum value of immediate: -2147483648
Maximum value of displacement used in memory addressing: 135182404
Minimum value of displacement used in memory addressing: -1760
```

462.libquantum

```
Instruction Type Results:
Loads: 272551617 (0.195188)
Stores: 123805702 (0.0886633)
NOPs: 0 (0)
Direct calls: 135 (9.66801e-08)
Indirect calls: 0 (0)
Returns: 135 (9.66801e-08)
Unconditional branches: 11 (7.87764e-09)
Conditional branches: 167152228 (0.119706)
Logical operations: 140432489 (0.100571)
Rotate and Shift: 110868034 (0.079398)
Flag operations: 0 (0)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 0 (0)
The rest: 581546968 (0.416474)
CPI: 20.8179
Instruction Size Results:
0: 0
1: 56284908
2: 454564058
3: 430780438
4: 55434168
5: 222
6: 82
7: 2936124
8: 0
9: 0
10: 0
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 621970244
1: 359702193
2: 18327563
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 105478139
1: 272551617
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 254224054
1: 123805702
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 0
1: 0
2: 468977926
3: 475587080
4: 55434859
5: 135
6: 0
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 0
1: 323549375
2: 450090763
3: 226359862
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 105477633
1: 659848676
2: 234673691
3: 0
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 50
Data Blocks Accesses: 1048592
Maximum number of bytes touched by an instruction: 4
Average number of bytes touched by an instruction: 3.56008
Maximum value of immediate: 124
Minimum value of immediate: -1
Maximum value of displacement used in memory addressing: 134982404
Minimum value of displacement used in memory addressing: -56
```

470.lbm

```
Instruction Type Results:
Loads: 709947499 (0.359871)
Stores: 262836221 (0.133231)
NOPs: 14 (7.09657e-09)
Direct calls: 163 (8.26244e-08)
Indirect calls: 16 (8.11037e-09)
Returns: 179 (9.07347e-08)
Unconditional branches: 4767450 (0.00241661)
Conditional branches: 7791834 (0.00394966)
Logical operations: 5059517 (0.00256466)
Rotate and Shift: 196 (9.9352e-08)
Flag operations: 79469 (4.02827e-05)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 965338519 (0.489328)
The rest: 16962643 (0.00859833)
CPI: 49.6392
Instruction Size Results:
0: 0
1: 106777
2: 487544570
3: 179628543
4: 891
5: 7579148
6: 324469411
7: 645484
8: 0
9: 0
10: 25176
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 510666201
1: 489308430
2: 25369
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 131821411
1: 357512388
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 357487019
1: 131846780
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 14
1: 19
2: 13365395
3: 457059475
4: 529574890
5: 179
6: 28
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 44824675
1: 133972883
2: 604379313
3: 216822946
4: 139
5: 16
6: 28
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 131900128
1: 822007045
2: 46092672
3: 155
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 380
Data Blocks Accesses: 13121299
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 7.95169
Maximum value of immediate: 2147483647
Minimum value of immediate: -1672357186
Maximum value of displacement used in memory addressing: 3216104
Minimum value of displacement used in memory addressing: -16080
```

482.sphinx3

```
Instruction Type Results:
Loads: 441157027 (0.29208)
Stores: 69241780 (0.0458434)
NOPs: 179616 (0.00011892)
Direct calls: 3277973 (0.00217027)
Indirect calls: 511 (3.38321e-07)
Returns: 3278484 (0.00217061)
Unconditional branches: 5487421 (0.00363309)
Conditional branches: 112770287 (0.0746626)
Logical operations: 35272617 (0.0233532)
Rotate and Shift: 264878 (0.00017537)
Flag operations: 4318933 (0.00285947)
Vector instructions: 0 (0)
Conditional moves: 0 (0)
MMX and SSE instructions: 0 (0)
System calls: 0 (0)
Floating point instructions: 412505536 (0.27311)
The rest: 422643594 (0.279823)
CPI: 26.5199
Instruction Size Results:
0: 0
1: 81214365
2: 430546464
3: 432112795
4: 26289993
5: 7126483
6: 17912551
7: 4753380
8: 43956
9: 0
10: 13
11: 0
12: 0
13: 0
14: 0
15: 0
16: 0
17: 0
18: 0
19: 0
Memory Instruction Operand Results:
0: 508706266
1: 480371874
2: 10921710
3: 0
4: 0
Memory Instruction Read Operand Results:
0: 55473679
1: 435819905
2: 0
3: 0
4: 0
Memory Instruction Write Operand Results:
0: 424898195
1: 66395389
2: 0
3: 0
4: 0
```

```
Instruction Operand Results:
0: 179616
1: 7759
2: 301659358
3: 502105573
4: 179681116
5: 16290754
6: 75824
7: 0
8: 0
9: 0
Instruction Register Read Operand Results:
0: 5016125
1: 112975973
2: 585932636
3: 151631790
4: 131354871
5: 13012781
6: 75824
7: 0
8: 0
9: 0
Instruction Register Write Operand Results:
0: 45850953
1: 833896299
2: 120175515
3: 77233
4: 0
5: 0
6: 0
7: 0
8: 0
9: 0
Instruction Blocks Accesses: 1172
Data Blocks Accesses: 153928
Maximum number of bytes touched by an instruction: 8
Average number of bytes touched by an instruction: 3.99254
Maximum value of immediate: 2147483647
Minimum value of immediate: -2147483648
Maximum value of displacement used in memory addressing: 135127364
Minimum value of displacement used in memory addressing: -121088
```