

CS422 Assignment 1

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Implementation details

We have done Basic Block level instrumentation for counting number of instructions to speedup the fast forward phase. Terminate check is also placed at basic block level. In a basic block, for each instruction, we check the fast forward condition and insert the analysis call accordingly. We have made global variables to count the different types of instructions in part A. For part B, the CPI can be directly calculated using the values of part A. For part C, we have maintained two sets *instrAddr* and *dataAddr* to count the different instruction and data addresses touched during the entire program. For part D, we have maintained maps and some global variables to store the observed counts. The time taken for the entire run starting from when the main function of the instrumentation tool is called till when all the results get printed is also measured and displayed.

Usage

The following commands are used to build and run the tool on a benchmark application:

Build

```
make TARGET=ia32 obj-ia32/HW1.so
```

Run Tool on a Benchmark Application

```
cd /path/to/spec_2006/<benchmark>/  
  
/path/to/pin -t /path/to/obj-ia32/HW1.so -f <fast_forward_count> -o  
<output_filename> -- ./<benchmark_executable> <command_line_args>
```

Contents

1	400.perlbench	3
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1 400.perlbench

Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	355871479	22.778228
Stores	206623580	13.225334
NOPs	988291	0.063257
Direct calls	12938625	0.828161
Indirect calls	2791000	0.178643
Returns	15729627	1.006805
Unconditional branches	30473782	1.950532
Conditional branches	130107072	8.327750
Logical operations	100532319	6.434762
Rotate and shift	4247535	0.271872
Flag operations	874518	0.055975
Vector instructions	0	0.000000
Conditional moves	0	0.000000
MMX and SSE instructions	0	0.000000
System calls	0	0.000000
Floating point instructions	972962	0.062276
Others	700180903	44.816405

Part B: CPI Results

CPI : 25.842458

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 2833

Instruction Footprint (Bytes) : 90656

Data Footprint (32 byte Blocks) : 31474

Data Footprint (Bytes) : 1007168

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
0	0
1	117754131
2	257038568
3	275150032
4	53029342
5	78579243
6	184490184
7	33958473
8	28
9	0
10	12

Memory Instruction Operand Results

Number of Memory Operands	Count
0	453331763
1	531076178
2	15428693

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	191561197
1	354090898
2	852776

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	340367757
1	206137114

Instruction Operand Results

Number of Instruction Operands	Count
0	988291
1	1076967
2	520125843
3	354988314
4	103866236
5	15731348
6	3223014

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	10329261
1	259466088
2	538311904
3	179210729
4	6919868
5	2539149
6	3223014

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	136290401
1	684727799
2	175754962
3	2374052
4	852799

Maximum Number of Bytes Touched : 8

Average Number of Bytes Touched : 3.740064

Maximum Value of Immediate : 2147483647

Minimum Value of Immediate : -2147483648

Maximum Value of Displacement : 135918104

Minimum Value of Displacement : -1408

Total Instructions executed : 208,000,000,002

Total Instructions executed after Fast Forward : 1,000,000,002

Time Taken (minutes) : 67.021492

2 401.bzip2

Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	452705836	26.884748 %
Stores	231174338	13.728702 %
NOPs	36514	0.002168 %
Direct Calls	791574	0.047009 %
Indirect Calls	13	0.000001 %
Returns	791583	0.047010 %
Unconditional Branches	21299280	1.264896 %
Conditional Branches	129923001	7.715710 %
Logical Operations	71000941	4.216518 %
Rotate and Shift	61832212	3.672017 %
Flag Operations	6130	0.000364 %
Vector Instructions	0	0.000000 %
Conditional Moves	0	0.000000 %
MMX and SSE Instructions	0	0.000000 %
System Calls	0	0.000000 %
Floating Point Instructions	0	0.000000 %
Others	714314668	42.420857 %

Part B: CPI Results

CPI : 29.023281

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 759

Instruction Footprint (Bytes) : 24288

Data Footprint (32 byte Blocks) : 2537194

Data Footprint (Bytes) : 81190208

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
0	0
1	38611324
2	219201533
3	436966378
4	75326838
5	22047149
6	141356864
7	51341673
8	15085632
9	0
10	62610

Memory Instruction Operand Results

Number of Memory Operands	Count
0	399852701
1	516406256
2	83736959

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	147437379
1	452705836

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	368968877
1	231174338

Instruction Operand Results

Number of Instruction Operands	Count
0	36514
1	6147
2	597647701
3	382870281
4	2693777
5	14191373
6	2554208

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	5189068
1	183351907
2	533608395
3	215105758
4	46790866
5	13399799
6	2554208

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	132331577
1	712782066
2	152332133
3	2554225

Maximum Number of Bytes Touched : 8

Average Number of Bytes Touched : 3.485408

Maximum Value of Immediate : 1431655766

Minimum Value of Immediate : -858993459

Maximum Value of Displacement : 135000192

Minimum Value of Displacement : -4848

Total Instructions executed : 302,000,000,001

Total Instructions executed after Fast Forward : 1,000,000,001

Time Taken (minutes) : 85.555630

3 403.gcc

Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	338874870	22.453792 %
Stores	170335115	11.286376 %
NOPs	3906208	0.258825 %
Direct calls	30224753	2.002687 %
Indirect calls	396037	0.026241 %
Returns	30620791	2.028928 %
Unconditional branches	31772040	2.105210 %
Conditional branches	145812205	9.661492 %
Logical operations	54593174	3.617335 %
Rotate and shift	634876	0.042067 %
Flag operations	0	0.000000 %
Vector instructions	0	0.000000 %
Conditional moves	0	0.000000 %
MMX and SSE instructions	0	0.000000 %
System calls	0	0.000000 %
Floating point instructions	0	0.000000 %
Others	702039916	46.517047 %

Part B: CPI Results

CPI : 24.280716

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 244

Instruction Footprint (Bytes) : 7808

Data Footprint (32 byte Blocks) : 69153

Data Footprint (Bytes) : 2212896

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
0	0
1	181999152
2	305571952
3	282642850
4	87585597
5	53447300
6	76319376
7	12433773

Memory Instruction Operand Results

Number of Memory Operands	Count
0	495947712
1	498894591
2	5157697

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	165177418
1	338874870

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	333717173
1	170335115

Instruction Operand Results

Number of Instruction Operands	Count
0	3906208
1	2490506
2	426139822
3	363397192
4	173445482
5	30620790

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	7270540
1	317014363
2	482049477
3	189701039
4	3568544
5	396037

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	67549745
1	724662970
2	207787285

Maximum Number of Bytes Touched : 8

Average Number of Bytes Touched : 3.769787

Maximum Value of Immediate : 136599840

Minimum Value of Immediate : -2147483587

Maximum Value of Displacement : 138633083

Minimum Value of Displacement : -96

Total Instructions executed : 108,000,000,006

Total Instructions executed after Fast Forward : 1,000,000,006

Time Taken (minutes) : 38.634900

4 429.mcf

Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	415212498	27.222538
Stores	110040206	7.214556
NOPs	1477638	0.096878
Direct calls	12556368	0.823232
Indirect calls	0	0.000000
Returns	12556368	0.823232
Unconditional branches	8314469	0.545121
Conditional branches	178242791	11.686115
Logical operations	75119524	4.925054
Rotate and shift	3516410	0.230546
Flag operations	0	0.000000
Vector instructions	0	0.000000
Conditional moves	0	0.000000
MMX and SSE instructions	0	0.000000
System calls	0	0.000000
Floating point instructions	0	0.000000
Others	708216435	46.432728

Part B: CPI Results

CPI : 24.761595

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 65

Instruction Footprint (Bytes) : 2080

Data Footprint (32 byte Blocks) : 11672916

Data Footprint (Bytes) : 373533312

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
1	80626511
2	485393545
3	315526128
4	50531369
5	22076610
6	5249737
7	40596103

Memory Instruction Operand Results

Number of Memory Operands	Count
0	487182340
1	500382622
2	12435041

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	97605165
1	415212498

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	402777457
1	110040206

Instruction Operand Results

Number of Instruction Operands	Count
0	1477638
1	0
2	484784970
3	457346674
4	43834353
5	12556368

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	3759854
1	148510614
2	677530843
3	170198692

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	70906698
1	770283289
2	158771505
3	38511

Maximum Number of Bytes Touched : 4

Average Number of Bytes Touched : 4.000000

Maximum Value of Immediate : 1374389535

Minimum Value of Immediate : -100000000

Maximum Value of Displacement : 134957120

Minimum Value of Displacement : -76

Total Instructions executed : 378,000,000,001

Total Instructions executed after Fast Forward : 1,000,000,001

Time Taken (minutes) : 107.098727

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Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	546361143	33.162668
Stores	101157534	6.139993
NOPs	11471	0.000696
Direct calls	3199444	0.194198
Indirect calls	135	0.000008
Returns	3199579	0.194206
Unconditional branches	13174539	0.799659
Conditional branches	103109446	6.258469
Logical operations	13846201	0.840428
Rotate and shift	10322498	0.626548
Flag operations	23247785	1.411079
Vector instructions	0	0.000000
Conditional moves	0	0.000000
MMX and SSE instructions	0	0.000000
System calls	0	0.000000
Floating point instructions	306663980	18.613688
Others	523224914	31.758360

Part B: CPI Results

CPI : 28.118836

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 1180

Instruction Footprint (Bytes) : 37760

Data Footprint (32 byte Blocks) : 5694977

Data Footprint (Bytes) : 182239264

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
0	0
1	77073018
2	441691435
3	398955445
4	16506344
5	3277725
6	40943193
7	17614170
8	3938662

Memory Instruction Operand Results

Number of Memory Operands	Count
0	530019910
1	439594498
2	30385584

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	52878572
1	417101510

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	386715926
1	83264156

Instruction Operand Results

Number of Instruction Operands	Count
0	11471
1	23
2	415273675
3	395012808
4	186466218
5	3235797

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	23458178
1	216024943
2	577314820
3	140233210
4	42932509
5	36332

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	69541706
1	764799883
2	165658403

Maximum Number of Bytes Touched : 8

Average Number of Bytes Touched : 5.252406

Maximum Value of Immediate : 2147483647

Minimum Value of Immediate : -1074790400

Maximum Value of Displacement : 135856732

Minimum Value of Displacement : -344

Total Instructions executed : 365,000,000,003

Total Instructions executed after Fast Forward : 1,000,000,003

Time Taken (minutes) : 188.264452

6 456.hmmmer

Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	547670658	33.736683
Stores	75698724	4.663065
NOPs	34317	0.002114
Direct calls	144622	0.008909
Indirect calls	959	0.000059
Returns	145581	0.008968
Unconditional branches	205862	0.012681
Conditional branches	144361450	8.892710
Logical operations	1158704	0.071377
Rotate and shift	294108	0.018117
Flag operations	5669	0.000349
Vector instructions	0	0.000000
Conditional moves	0	0.000000
MMX and SSE instructions	0	0.000000
System calls	0	0.000000
Floating point instructions	40212	0.002477
Others	853607545	52.582491

Part B: CPI Results

CPI : 27.495826

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 488

Instruction Footprint (Bytes) : 15616

Data Footprint (32 byte Blocks) : 84066

Data Footprint (Bytes) : 2690112

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
0	0
1	25078496
2	302860659
3	296150770
4	270388758
5	24861224
6	68360254
7	416483
8	11883348

Memory Instruction Operand Results

Number of Memory Operands	Count
0	376808277
1	623024641
2	166111

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	75527977
1	547662775

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	547496664
1	75694088

Instruction Operand Results

Number of Instruction Operands	Count
0	34887
1	3512
2	566126726
3	432938393
4	713115
5	159551
6	23808

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	610949
1	75620205
2	562398860
3	281425731
4	79905510
5	14929
6	23808

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	75149154
1	755280000
2	169547030
3	23808

Maximum Number of Bytes Touched : 8

Average Number of Bytes Touched : 3.997511

Maximum Value of Immediate : 2147483647

Minimum Value of Immediate : -987654321

Maximum Value of Displacement : 135294312

Minimum Value of Displacement : -580

Total Instructions executed : 265,000,000,003

Total Instructions executed after Fast Forward : 1,000,000,003

Time Taken (minutes) : 74.947272

7 471.omnetpp

Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	371235154	23.187329
Stores	229790831	14.352723
NOPs	802400	0.050118
Direct calls	21327693	1.332127
Indirect calls	3689260	0.230431
Returns	25016952	1.562558
Unconditional branches	22189690	1.385967
Conditional branches	117335308	7.328757
Logical operations	60009397	3.748184
Rotate and shift	7139700	0.445945
Flag operations	20159930	1.259188
Vector instructions	0	0.000000
Conditional moves	0	0.000000
MMX and SSE instructions	0	0.000000
System calls	0	0.000000
Floating point instructions	96963715	6.056349
Others	625365952	39.060325

Part B: CPI Results

CPI : 26.902636

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 901

Instruction Footprint (Bytes) : 28832

Data Footprint (32 byte Blocks) : 554206

Data Footprint (Bytes) : 17734592

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
1	154578718
2	308551439
3	382074534
4	34347852
5	45117244
6	48822821
7	26506968
10	421

Memory Instruction Operand Results

Number of Memory Operands	Count
0	449250366
1	542984505
2	7765126

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	212450563
1	337160148
2	1138920

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	331672862
1	219076769

Instruction Operand Results

Number of Instruction Operands	Count
0	802400
1	225880
2	518294434
3	281743973
4	172763846
5	25030544
6	1138920

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	29000249
1	197518882
2	540431979
3	219765841
4	8457513
5	3686613
6	1138920

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	165349873
1	665542654
2	167592536
3	376014
4	1138920

Maximum Number of Bytes Touched : 8

Average Number of Bytes Touched : 4.221750

Maximum Value of Immediate : 2147483647

Minimum Value of Immediate : -2092037281

Maximum Value of Displacement : 136090116

Minimum Value of Displacement : -104

Total Instructions executed : 44,000,000,000

Total Instructions executed after Fast Forward : 1,000,000,000

Time Taken (minutes) : 13.955604

8 483.xalancbmk

Part A: Instruction Type Results

Instruction Type	Count	Percentage (%)
Loads	366595649	23.905020 %
Stores	167420597	10.917186 %
NOPs	22724397	1.481816 %
Direct Calls	12962886	0.845286 %
Indirect Calls	8921855	0.581778 %
Returns	21881692	1.426864 %
Unconditional Branches	8433084	0.549906 %
Conditional Branches	179994372	11.737098 %
Logical Operations	37396245	2.438540 %
Rotate and Shift	5499894	0.358638 %
Flag Operations	1637214	0.106760 %
Vector Instructions	0	0.000000 %
Conditional Moves	0	0.000000 %
MMX and SSE Instructions	0	0.000000 %
System Calls	0	0.000000 %
Floating Point Instructions	7148064	0.466112 %
Others	692934954	45.184999 %

Part B: CPI Results

CPI : 25.027322

Part C: Memory Footprint Results

Instruction Footprint (32 byte Blocks) : 2305

Instruction Footprint (Bytes) : 73760

Data Footprint (32 byte Blocks) : 819740

Data Footprint (Bytes) : 26231680

Part D: Instruction Analysis Results

Instruction Size Results

Instruction Size (Bytes)	Count
1	145030494
2	322777287
3	446022440
4	31268433
5	23677520
6	23298101
7	7546910
8	255902
9	58750
10	64166

Memory Instruction Operand Results

Number of Memory Operands	Count
0	496742157
1	474972735
2	27819765

Memory Instruction Read Operand Results

Number of Memory Read Operands	Count
0	138484715
1	364307785

Memory Instruction Write Operand Results

Number of Memory Write Operands	Count
0	336488020
1	166304480

Instruction Operand Results

Number of Instruction Operands	Count
0	22724397
1	731487
2	420287472
3	415937612
4	100161796
5	23797724
6	16359515

Instruction Register Read Operand Results

Number of Register Read Operands	Count
0	30096152
1	238179670
2	455245811
3	250135230
4	1177588
5	8806037
6	16359515

Instruction Register Write Operand Results

Number of Register Write Operands	Count
0	112679208
1	686392508
2	184567082
3	16361205

Maximum Number of Bytes Touched : 8

Average Number of Bytes Touched : 4.166650

Maximum Value of Immediate : 2147483647

Minimum Value of Immediate : -1431655765

Maximum Value of Displacement : 139657912

Minimum Value of Displacement : -1392

Total Instructions executed : 1,332,000,000,002

Total Instructions executed after Fast Forward : 1,000,000,002

Time Taken (minutes) : 396.553773