



Assignment 1

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1 Implementational Details

- The instruction count was maintained at the basic block level hence the total number instructions analyzed are a bit more than 10^9
- The output file should be specified by the `-o` flag, it is set to `result.out` by default.

2 PART A:

2.1 400.perlbench diffmail.pl

Instruction Name	Count	Percentage
Loads	356794555	22.8374
Stores	205699633	13.1662
Nops	955623	0.0611667
Direct Calls	12714763	0.813835
Indirect Calls	2845923	0.182159
Returns	15560689	0.995995
Unconditional Branches	30557755	1.95591
Conditional Branches	129964015	8.31862
Logical Operations	100029402	6.40259
Rotate and Shift	4285577	0.274307
Flag Operations	860346	0.0550683
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	927522	0.059368
Rest	701130501	44.8773

2.2 401.bzip2 input.source

Instruction Name	Count	Percentage
Loads	452706179	26.8848
Stores	231174034	13.7287
Nops	36514	0.00216845
Direct Calls	791608	0.0470111
Indirect Calls	13	7.72028e-07
Returns	791617	0.0470116
Unconditional Branches	21299200	1.26489
Conditional Branches	129923157	7.71572
Logical Operations	71000676	4.2165
Rotate and Shift	61831910	3.672
Flag Operations	6130	0.000364041
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	0	0
Rest	714315095	42.4209

2.3 403.gcc cp-decl.i

Instruction Name	Count	Percentage
Loads	182639819	12.1144
Stores	325067236	21.5615
Nops	699527	0.0463992
Direct Calls	8566918	0.568238
Indirect Calls	547756	0.0363323
Returns	9114673	0.60457
Unconditional Branches	9322746	0.618371
Conditional Branches	134469830	8.91929
Logical Operations	120416072	7.98712
Rotate and Shift	2265937	0.150298
Flag Operations	194360	0.0128918
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	5	3.31647e-07
Rest	714324199	47.3806

2.4 429.mcf

Instruction Name	Count	Percentage
Loads	415211922	27.2225
Stores	110040675	7.21459
Nops	1477639	0.0968783
Direct Calls	12555922	0.823203
Indirect Calls	0	0
Returns	12555923	0.823203
Unconditional Branches	8314820	0.545144
Conditional Branches	178243369	11.6862
Logical Operations	75119489	4.92505
Rotate and Shift	3516376	0.230544
Flag Operations	0	0
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	0	0
Rest	708216472	46.4327

2.5 450.soplex ref.mps

Instruction Name	Count	Percentage
Loads	547814804	33.2694
Stores	98788824	5.99955
Nops	3550	0.000215595
Direct Calls	3177232	0.192957
Indirect Calls	111	6.74115e-06
Returns	3177343	0.192963
Unconditional Branches	12756863	0.774738
Conditional Branches	103253465	6.27069
Logical Operations	13996308	0.850011
Rotate and Shift	10483160	0.636654
Flag Operations	22970370	1.39502
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	309500278	18.7963
Rest	520681318	31.6215

2.6 456.hmmmer np3.hmm

Instruction Name	Count	Percentage
Loads	547670707	33.7367
Stores	75698951	4.66308
Nops	34317	0.00211394
Direct Calls	144578	0.00890605
Indirect Calls	937	5.77195e-05
Returns	145515	0.00896377
Unconditional Branches	205820	0.0126786
Conditional Branches	144361300	8.8927
Logical Operations	1158481	0.0713628
Rotate and Shift	294092	0.0181162
Flag Operations	5648	0.000347919
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	40212	0.00247707
Rest	853608138	52.5825

2.7 471.omnetpp

Instruction Name	Count	Percentage
Loads	371234959	23.1873
Stores	229793818	14.3529
Nops	802441	0.0501203
Direct Calls	21327950	1.33214
Indirect Calls	3689213	0.230428
Returns	25017163	1.56257
Unconditional Branches	22189460	1.38595
Conditional Branches	117334365	7.32869
Logical Operations	60009497	3.74818
Rotate and Shift	7139640	0.445941
Flag Operations	20159545	1.25916
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	96963378	6.05632
Rest	625367354	39.0603

2.8 483.xalancbmk

Instruction Name	Count	Percentage
Loads	366814526	23.8745
Stores	170090653	11.0705
Nops	22128305	1.44024
Direct Calls	13254662	0.862693
Indirect Calls	9006997	0.58623
Returns	22257343	1.44864
Unconditional Branches	8598217	0.559624
Conditional Branches	177528859	11.5546
Logical Operations	37269244	2.42571
Rotate and Shift	5611195	0.36521
Flag Operations	1676750	0.109133
Vector Instructions	0	0
Conditional Moves	0	0
MMX and SSE Instructions	0	0
System Calls	0	0
Floating Points	7319005	0.476365
Rest	694872228	45.2265

3 PART B:

Benchmark	CPI
400.perlbench diffmail.pl	25.8425
401.bzip2 input.source	29.0233
403.gcc cp-decl.i	24.2363
429.mcf	24.7616
450.soplex ref.mps	28.0956
456.hmmer nph3.hmm	27.4958
471.omnetpp	26.9027
483.xalancbmk	25.1121

4 PART C:

Benchmark	Data Footprint	Instruction Footprint
400.perlbench diffmail.pl	31141	2808
401.bzip2 input.source	2528518	753
403.gcc cp-decl.i	1270192	2986
429.mcf	11672477	65
450.soplex ref.mps	5658602	645
456.hmmmer np3.hmm	85332	459
471.omnetpp	528736	890
483.xalancbmk	945417	2291

5 PART D:

5.1 400.perlbench diffmail.pl

- Distribution of instruction length

Instruction Length	No. of Instructions
1	117316650
2	256523747
3	274777160
4	52884002
5	78560978
6	185949935
7	33987490
8	28
10	12

- Distribution of the number of operands in an instruction

Number of Operands	No. of Instructions
0	955623
1	1070070
2	520939337
3	355067674
4	103118425
5	15562338
6	3286535

- Distribution of the number of register read operands in an instruction

Number of Register Read Operands	No. of Instructions
0	10051133
1	260456853
2	537300986
3	179175220
4	7122171
5	2607104
6	3286535

- Distribution of the number of register write operands in an instruction

Number of Register Write Operands	No. of Instructions
0	135748019
1	685243019
2	175718921
3	2397001
4	893042

- Distribution of the number of memory operands in an instruction

Number of Memory Operands	No. of Instructions
0	453462136
1	530787193
2	15582787

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	644008255
1	354930842
2	893019

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	794596229
1	205235887

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 8

Average number of memory bytes touched: 3.73783

- Analysis of Immediate field

Maximum value of immediate field: 2147483647

Minimum value of immediate field: -2147483648

- Analysis of Displacement field

Maximum value of displacement: 135918104

Minimum value of displacement: -1408

5.2 401.bzip2 input.source

- Distribution of instruction length

Instruction Length	No. of Instructions
1	38611253
2	219201447
3	436965445
4	75327033
5	22047561
6	141357434
7	51341590
8	15085632
10	62610

- Distribution of the number of operands in an instruction

Number of Operands	No. of Instructions
0	36514
1	6147
2	597647427
3	382870423
4	2693879
5	14191407
6	2554208

- Distribution of the number of register read operands in an instruction

Number of Register Read Operands	No. of Instructions
0	5189068
1	183351622
2	533608097
3	215105858
4	46791353
5	13399799
6	2554208

- Distribution of the number of register write operands in an instruction

Number of Register Write Operands	No. of Instructions
0	132331385
1	712782526
2	152331869
3	2554225

- Distribution of the number of memory operands in an instruction

Number of Memory Operands	No. of Instructions
0	399852486
1	516406655
2	83736779

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	547289741
1	452706179

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	768821886
1	231174034

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 8

Average number of memory bytes touched: 3.48541

- Analysis of Immediate field

Maximum value of immediate field: 1431655766

Minimum value of immediate field: -858993459

- **Analysis of Displacement field**

Maximum value of displacement: 135000192

Minimum value of displacement: -4848

5.3 403.gcc cp-decl.i

- **Distribution of instruction length**

Instruction Length	No. of Instructions
1	134729556
2	539241224
3	161189010
4	108118317
5	18510152
6	25882811
7	12276378
8	52553

- **Distribution of the number of operands in an instruction**

Number of Operands	No. of Instructions
0	699527
1	4904296
2	367130829
3	395857172
4	56156348
5	170996546
6	4255283

- **Distribution of the number of register read operands in an instruction**

Number of Register Read Operands	No. of Instructions
0	3020196
1	191723854
2	479430378
3	87096905
4	72051276
5	162422109
6	4255283

- **Distribution of the number of register write operands in an instruction**

Number of Register Write Operands	No. of Instructions
0	115161991
1	477023721
2	403434686
3	4379603

- **Distribution of the number of memory operands in an instruction**

Number of Memory Operands	No. of Instructions
0	509181855
1	473773284
2	16966884

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	817282207
1	182639816

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	674854787
1	325067236

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 8

Average number of memory bytes touched: 3.92885

- Analysis of Immediate field

Maximum value of immediate field: 1073741823

Minimum value of immediate field: -2147483587

- Analysis of Displacement field

Maximum value of displacement: 138634432

Minimum value of displacement: -1744

5.4 429.mcf

- Distribution of instruction length

Instruction Length	No. of Instructions
1	80626871
2	485391918
3	315525572
4	50530492
5	22077254
6	5249646
7	40598257

- Distribution of the number of operands in an instruction

Number of Operands	No. of Instructions
0	1477639
2	484786168
3	457347318
4	43832963
5	12555922

- Distribution of the number of register read operands in an instruction

Number of Register Read Operands	No. of Instructions
0	3760020
1	148512817
2	677526599
3	170200574

- Distribution of the number of register write operands in an instruction

Number of Register Write Operands	No. of Instructions
0	70907279
1	770284485
2	158769735
3	38511

- Distribution of the number of memory operands in an instruction

Number of Memory Operands	No. of Instructions
0	487183262
1	500380899
2	12435849

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	584788088
1	415211922

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	889959335
1	110040675

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 4

Average number of memory bytes touched: 4

- Analysis of Immediate field

Maximum value of immediate field: 1374389535

Minimum value of immediate field: -100000000

- Analysis of Displacement field

Maximum value of displacement: 134957120

Minimum value of displacement: -76

5.5 450.soplex ref.mps

- Distribution of instruction length

Instruction Length	No. of Instructions
1	77588905
2	441950597
3	399695020
4	16087417
5	3219650
6	40002857
7	17518640
8	3936912

- Distribution of the number of operands in an instruction

Number of Operands	No. of Instructions
0	3550
1	13
2	412394490
3	396043856
4	188349702
5	3208387

- Distribution of the number of register read operands in an instruction

Number of Register Read Operands	No. of Instructions
0	23145075
1	216228464
2	578646783
3	137998333
4	43950206
5	31137

- Distribution of the number of register write operands in an instruction

Number of Register Write Operands	No. of Instructions
0	68174449
1	765095822
2	166729727

- Distribution of the number of memory operands in an instruction

Number of Memory Operands	No. of Instructions
0	531478028
1	439270664
2	29251306

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	583179624
1	416820374

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	919047096
1	80952902

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 8

Average number of memory bytes touched: 5.27063

- Analysis of Immediate field

Maximum value of immediate field: 2147483647

Minimum value of immediate field: -640172613

- Analysis of Displacement field

Maximum value of displacement: 135855532

Minimum value of displacement: -344

5.6 456.hmm nph3.hmm

- Distribution of instruction length

Instruction Length	No. of Instructions
1	25078004
2	302860512
3	296150626
4	270389362
5	24861170
6	68360490
7	416472
8	11883365

- Distribution of the number of operands in an instruction

Number of Operands	No. of Instructions
0	34887
1	3491
2	566127530
3	432938134
4	712697
5	159485
6	23777

- Distribution of the number of register read operands in an instruction

Number of Register Read Operands	No. of Instructions
0	610916
1	75619856
2	562398620
3	281425965
4	79905960
5	14907
6	23777

- Distribution of the number of register write operands in an instruction

Number of Register Write Operands	No. of Instructions
0	75149689
1	755279830
2	169546705
3	23777

- Distribution of the number of memory operands in an instruction

Number of Memory Operands	No. of Instructions
0	376807911
1	623025115
2	166012

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	452336214
1	547662824

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	924304723
1	75694315

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 8

Average number of memory bytes touched: 3.99751

- Analysis of Immediate field

Maximum value of immediate field: 2147483647

Minimum value of immediate field: -987654321

- Analysis of Displacement field

Maximum value of displacement: 135294312

Minimum value of displacement: -580

5.7 471.omnetpp

- Distribution of instruction length

Instruction Length	No. of Instructions
1	154578970
2	308549836
3	382075656
4	34347979
5	45117290
6	48822925
7	26506929
10	421

- Distribution of the number of operands in an instruction

Number of Operands	No. of Instructions
0	802441
1	225858
2	518294496
3	281742809
4	172764838
5	25030754
6	1138810

- Distribution of the number of register read operands in an instruction

Number of Register Read Operands	No. of Instructions
0	28999918
1	197518529
2	540431429
3	219767245
4	8457509
5	3686566
6	1138810

- Distribution of the number of register write operands in an instruction

Number of Register Write Operands	No. of Instructions
0	165351614
1	665540133
2	167593443
3	376006
4	1138810

- Distribution of the number of memory operands in an instruction

Number of Memory Operands	No. of Instructions
0	449247900
1	542987098
2	7765008

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	661701029
1	337160167
2	1138810

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	780920679
1	219079327

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 8

Average number of memory bytes touched: 4.22175

- Analysis of Immediate field

Maximum value of immediate field: 2147483647

Minimum value of immediate field: -2092037281

- Analysis of Displacement field

Maximum value of displacement: 136090116

Minimum value of displacement: -104

5.8 483.xalancbmk

- Distribution of instruction length

Instruction Length	No. of Instructions
1	145732141
2	321503282
3	445006038
4	31952225
5	24122963
6	23640859
7	7652736
8	261441
9	61097
10	67218

- Distribution of the number of operands in an instruction

Number of Operands	No. of Instructions
0	22128305
1	748205
2	423182839
3	411388196
4	102060286
5	24221305
6	16270864

- Distribution of the number of register read operands in an instruction

Number of Register Read Operands	No. of Instructions
0	29605847
1	236638079
2	457453895
3	249941956
4	1203096
5	8886263
6	16270864

- Distribution of the number of register write operands in an instruction

Number of Register Write Operands	No. of Instructions
0	113714569
1	684602489
2	185409732
3	16273210

- Distribution of the number of memory operands in an instruction

Number of Memory Operands	No. of Instructions
0	493959446
1	477707109
2	27856250

- Distribution of the number of memory read operands in an instruction

Number of Memory Read Operands	No. of Instructions
0	635050913
1	364471892

- Distribution of the number of memory write operands in an instruction

Number of Memory Write Operands	No. of Instructions
0	830575088
1	168947717

- Analysis of Memory Bytes Touched

Maximum number of memory bytes touched: 8

Average number of memory bytes touched: 4.16475

- Analysis of Immediate field

Maximum value of immediate field: 2147483647

Minimum value of immediate field: -1431655765

- **Analysis of Displacement field**

Maximum value of displacement: 139655605

Minimum value of displacement: -1392