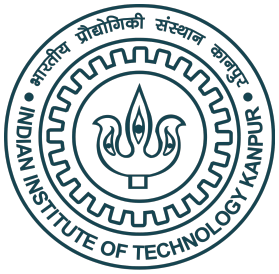

CS422 Computer Architecture

Assignment 1

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Roll No: 200471

Contents

1 Distribution of different categories of instruction on different benchmarks

Ins Type/Benchmarks	perlbench		bzip2		gcc		mcf		soplex		hmmer		omnetpp		xalancbmk		cactusADM		leslie3d		libquantum	
	Num Ins	*Percentage*	*Num Ins*	*Percentage*	*Num Ins*	*Percentage*	*Num Ins*	*Percentage*	*Num Ins*	*Percentage*	*Num Ins*	*Percentage*	*Num Ins*	*Percentage*	*Num Ins*	*Percentage*	*NumIns*	*Percentage*	*NumIns*	*Percentage*	*NumIns*	*Percentage*
1. Loads	357640512	22.8789	452706117	26.8848	136930602	9.14537	415212715	27.2225	546825843	33.2034	54767076l	33.7367	372374052	23.2419	371735118	24.036	1040897164	43.8793	736426450	38.0104	279866859	19.8618
2. Stores	205719910	13.1602	231174094	13.7287	360404241	24.0708	110404152	7.2145	100071986	6.07639	75698745	4.66307	229791137	14.3425	175344601	11.3376	331288220	13.9655	201007606	10.3749	129203330	9.1694
3.NOPs	956525	0.0611905	36514	0.00216845	188285	0.0125753	1477639	0.0968783	7974	0.000484183	34317	0.00211394	802403	0.0500824	20444498	1.32192	2265	9.54816e-05	83321	0.00430058	0	0
4. Direct calls	12720544	0.813754	791601	0.0470106	4528661	0.302462	12556302	0.823228	3194683	0.193982	144622	0.00890876	21327730	1.33118	13942128	0.901482	531584	0.022409	913	4.71242e-05	556662	0.0395056
5. Indirect calls	2844086	0.181941	13	7.72028e-07	503334	0.0336169	0	0	126	7.65075e-06	959	5.90747e-05	3689260	0.230267	9012471	0.582736	193	8.13596e-06	17	8.77449e-07	0	0
6. Returns	15564627	0.995695	791610	0.0470112	5031990	0.336078	12556302	0.823228	3194802	0.193989	145581	0.00896783	25016990	1.56145	22950526	1.48396	531777	0.0224172	930	4.80016e-05	556664	0.0395058
7. Unconditional branches	30555993	1.95472	21299217	1.26489	4763011	0.318114	8314495	0.545122	12973390	0.787747	205862	0.0126812	22189659	1.38498	9040792	0.584567	535271	0.0225645	169181	0.00873222	834555	0.0592274
8. Conditional branches	129974734	8.3147	129923131	7.71572	133291505	8.90232	178243016	11.6861	103134883	6.26237	144361426	8.89271	117335243	7.32354	172226762	11.136	4305620	0.181504	41549317	2.14455	157417383	11.1717
9. Logical operations	100056462	6.40078	71000729	4.21651	132011785	8.81685	75119495	4.92505	13878288	0.842693	1158703	0.0713765	60009460	3.74552	39236880	2.53701	1626454	0.0685635	435798	0.0224936	146293199	10.3823
10. Rotate and shift	4284335	0.274076	61831968	3.672	2356298	0.157373	3516414	0.230546	10421475	0.632794	294106	0.018117	7139684	0.445627	5899484	0.381454	1059310	0.0446554	5168392	0.266765	107083362	7.59958
11. Flag operations	860707	0.0550608	6130	0.000364041	185054	0.0123595	0	0	23126119	1.40422	5669	0.000349212	20159859	1.25829	1762349	0.113951	5	2.10776e-07	32	1.65167e-06	0	0
12. Vector instructions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13. Conditional moves	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14. MMX and SSE instructions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15. System calls	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16. Floating-point	928834	0.059419	0	0	5	3.33942e-07	0	0	308051244	18.7049	40212	0.00247707	96963544	6.05203	7691879	0.497348	851723583	35.9046	394808215	20.3779	0	0
17. The rest	701085410	44.8496	714315009	42.4209	717071668	47.8921	708216337	46.4327	522017064	31.697	853607584	52.5825	625366169	39.0326	697290795	45.086	139683954	5.88841	557783950	28.7898	587258177	41.677

2 Distribution of CPI

Ins Type/Benchmarks	CPI
perlbench	26
bzip2	30
gcc	24
mcf	25
soplex	29
hmmer	28
omnetpp	27
xalancbmk	26
cactusADM	41
leslie3D	35
libquantum	22

3 Data and Memory Footprint

Ins Type/Benchmarks	Instruction Footprint		Data Footprint	
	Num Blocks	*Memory Size(in bytes)*	*Num Blocks*	*Memory Size(in bytes)*
perlbench	2833	90656	31168	997376
bzip2	759	24288	2537194	81190208
gcc	2965	94880	1137979	36415328
mcf	65	2080	11672847	373531104
soplex	1052	33664	5690297	182089504
hmmer	488	15616	84066	2690112
omnetpp	901	28832	554205	17734560
xalancbmk	2312	73984	718845	23003040
cactusADM	1227	39264	4421507	141488224
leslie3D	2640	84480	2483518	79472576
libquantum	68	2176	1048593	33554976

4 Properties of the ia32 ISA

4.1 Distribution of instruction length

Instruction Length(in bytes)	Benchmark Applications										
	perlbench	bzip2	gcc	mcf	soplex	hmmer	omnetpp	xalancbmk	cactusADM	leslie3D	libquantum
1	117321335	38611266	129984220	80626434	77371481	25078459	154578820	146239389	1658078	34716289	61187350
2	256568362	219201467	592999440	485393436	441847305	302860554	308551225	316175635	263441843	503707406	442810016
3	274789550	436965617	123898854	315526338	399365809	296150916	382074564	445733723	78112008	58912863	437559998
4	52883892	75326994	116369328	50531211	16290585	270388798	34347878	33247307	15678293	82555	51733084
5	78555164	22047487	10803828	22076553	3265470	24861235	45117276	25259924	1609528	412264	834756
6	185894170	141357324	15206938	5249816	40374755	68360207	48822858	24826790	603728527	400346895	1113144
7	33987487	51341610	10679523	40596212	17547730	416480	26506959	8107077	35771739	1821778	4761654
8	28	15085632	57871	0	3936913	11883355	0	274982	0	0	0
9	0	0	0	0	0	0	0	64374	0	0	0
10	12	62610	0	0	0	0	421	70803	0	18	0

4.2 Distribution of the number of operands in an instruction

Num Operands in Instruction	Benchmark Applications										
	perlbench	bzip2	gcc	mcf	soplex	hmmer	omnetpp	xalancbmk	cactusADM	leslie3D	libquantum
0	956525	36514	188285	1477639	7974	34887	802403	20444498	2265	83321	0
1	1073635	6147	4598759	0	16	3512	225879	786359	23	33	0
2	520898845	597647475	348610687	484784796	413956608	566126763	518294341	428080104	83585112	317860787	467945152
3	355087650	382870405	403955492	457347095	395345427	432938368	281743909	403806000	461382389	492868126	476703754
4	103132804	2693858	33621972	43834168	187458996	713115	172763973	105966394	454498420	189186765	54794434
5	15566284	14191400	204769524	12556302	3231027	159551	25030581	25013902	531777	992	556662
6	3284257	2554208	4255283	0	0	23808	1138915	15902747	30	44	0
7	0	0	0	0	0	0	0	0	0	0	0

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

Num of Register Read Operands in Instruction	Benchmark Applications										
	perlbench	bzip2	gcc	mcf	soplex	hmmer	omnetpp	xalancbmk	cactusADM	leslie3D	libquantum
0	10058686	5189068	2131289	3759879	23329011	610947	29000191	28193605	18274762	357048	0
1	260422984	183351677	168576175	148510621	216167129	75620186	197518837	233428541	42914496	58705777	314502871
2	537343805	533608153	471816345	677530562	577713212	562398803	540431945	461726706	532137836	653894949	461095402
3	179166294	215105841	61971372	170198938	139318752	281425792	219765999	250596941	397790888	270600318	223845197
4	7119094	46791261	91010073	0	43435621	79905539	8457501	1265096	8881869	16441860	556532
5	2604880	13399799	200239465	0	36323	14929	3686613	8886368	135	72	0
6	3284257	2554208	4255283	0	0	23808	1138915	15902747	30	44	0
7	0	0	0	0	0	0	0	0	0	0	0

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

Num of Register Write Operands in Instruction	Benchmark Applications										
	perlbench	bzip2	gcc	mcf	soplex	hmmer	omnetpp	xalancbmk	cactusADM	leslie3D	libquantum
0	135762361	132331421	125990438	70906602	68995940	75149177	165349973	115349862	149849558	68909601	101552908
1	685224342	712782444	416853225	770283679	764813996	755280002	665542407	680604513	791740402	735960122	655482280
2	175725524	152331917	452756941	158771207	166190112	169547017	167592692	188141136	58409900	195130187	242408536
3	2396001	2554225	4399398	38512	0	23808	376014	15904493	126	158	556278
4	891772	0	0	0	0	0	1138915	0	30	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0

4.5 Distribution of the number of memory operands in an instruction

Num of Memory Operands in Instruction	Benchmark Applications										
	perlbench	bzip2	gcc	mcf	soplex	hmmer	omnetpp	xalancbmk	cactusADM	leslie3D	libquantum
0	453482450	399852528	518978185	487182343	530764399	376808163	449250077	483709195	273540869	378021668	616075356
1	530772934	516406577	464571982	500382447	439461023	623024769	542984799	488162107	690600430	548828714	358779103
2	15576873	83736817	16381429	12435210	29774626	166109	7765125	27627262	35858717	73149684	25145543
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0

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

Num of Memory Read Operands in Instruction	Benchmark Applications										
	perlbench	**bzip2**	**gcc**	**mcf**	**soplex**	**hmmer**	**omnetpp**	**xalancbmk**	**cactusADM**	**leslie3D**	**libquantum**
0	644052834	547289805	863000997	584787285	583204436	452336163	661700907	630225414	424465478	446851228	720133143
1	354887674	452706117	136930599	415212715	416795612	547662878	337160179	369273150	575534508	553148838	279866859
2	891749	0	0	0	0	0	1138915	0	30	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0

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

Num of Memory Write Operands in Instruction	Benchmark Applications										
	perlbench	**bzip2**	**gcc**	**mcf**	**soplex**	**hmmer**	**omnetpp**	**xalancbmk**	**cactusADM**	**leslie3D**	**libquantum**
0	794576749	768821828	639527355	889959848	917785385	924304932	780922961	825355083	813216720	858020822	870796672
1	205255508	231174094	360404241	110040152	82214663	75694109	219077040	174143481	186783296	141979244	129203330
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0

4.8 Memory Bytes Touched

Benchmarks Applications	**Memory Bytes Touched**	
	Maximum(in bytes)	***Average(in bytes)***
perlbench	8	3.73791
bzip2	8	3.48541
gcc	8	3.95964
mcf	4	4
soplex	8	5.26066
hmmer	8	3.99751
omnetpp	8	4.22175
xalancbmk	8	4.15691
cactusADM	8	7.35779
leslie3D	10	5.55829
libquantum	4	3.60445

4.9 Max/Min Immediate and Displacement

Benchmarks Applications	**Immediate Field Value**		**Displacement Field Value**	
	Maximum	***Minimum***	***Maxiumum***	***Minimum***
perlbench	2147483647	-2147483648	135918104	-1408
bzip2	1431655766	-858993459	135000192	-4848
gcc	1073741823	-2147483587	138634432	-1744
mcf	1374389535	-100000000	134957120	-76
soplex	2147483647	-1074790400	135855532	-344
hmmer	2147483647	-987654321	135294312	-580
omnetpp	2147483647	-2092037281	136090116	-104
xalancbmk	2147483647	-1431655765	139657912	-1392
cactusADM	1431655766	-2147483648	135701372	-2620
leslie3D	2147483647	-2147483648	135182404	-1760
libquantum	124	-1	134982404	-64