Timings and memory usage for the NAS Parallel Benchmarks on a network of Sun Ultra Workstations

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Abstract

This documents the testing of the NASA Ames NAS Parallel Benchmarks on a network of Sun Ultra Workstations. Testing was performed using the CS Department Gemini lab and as many memory sizes and parallel grid configurations were used as was possible.

1 The Benchmarks

This data is for the NAS Parallel Benchmarks [1], (version 2.3). The benchmarks were acquired directly from NASA Ames and compiled for SUN Solaris 2.5.1. The tests were run at the University of Tennessee in the Gemini lab which is composed of 12 workstations and an ATM switch. The workstations are a Sun Ultra 2 Model 2170 and 11 Sun Ultra Enterprise 2 Model 2170s. Each workstation consists of two 167-MHz UltraSPARC-1 processors with 256-Mbytes memory, 100 Mbps Ethernet interface and two 2.1-Gbyte internal fast/wide SCSI-2 disks. Logins were restricted to a single user for these test. Only a single processor was used on each workstation and only the Enterprise workstations were tested.

The latest version of the benchmarks has eight tests; FT, MG, LU, SP, BT, EP, IS, and CG. FT is a kernel benchmark, 3-D FFT PDE. MG is another kernel benchmark, Multigrid based on the NX reference implementation. The application benchmarks are CG, conjugate gradient, LU, an lu solver, SP, a pentadiagonal solver, BT, a block tridiagonal solver, EP, 'embarrassingly parallel' which implements the random-number generator described in the NAS Parallel Benchmark document RNR Technical Report RNR-94-007, and IS, an integer sort. [1]

[1] Baily, David, T.Harris, W.Saphir, et.al. *The NAS PARALLEL Benchmarks 2.0*, Report NAS-95-020, December, 1995.

Version 2.3 of the benchmarks added another test size W(orkstation) to the three previous sizes. Depending on the particular problem, this may have been the only size tested. The number of processors for each test varies according to the problem. BT and SP require a square (4,9, ...) number of processors while the rest need a power-of-two (2,4,8, ...) number of processors.

2 Test Data

The correspondence between class and problem size is given in Table 1 and the data gathered from the tests are in Table 2 and Table 3. Problem sizes in Table 1 are directly from the results generated by the benchmarks as are the running times. Running times DO NOT include time to gather memory data or to print results.

Benchmark	Class	Problem Size
MG	W	2^{28}
BT	A	64^3
BT	W	24^3
CG	A	14000
CG	W	7000
EP	A	2^{28}
EP	B	2^{30}
EP	C	2^{32}
EP	W	2^{26}
FT	W	$128x128x32$
IS	A	2^{23}
IS	W	2^{20}
LU	A	64^3
LU	B	102^3
LU	W	33^3
SP	W	36^3

Table 1: Problem Sizes

Memory sizes in the following tables are in megabytes per processor. "Data Memory" is the amount of memory used in the running process for data. This includes the initialized data segment, the uninitialized data segment and the heap. "Total Memory" is the "Data Memory" plus the text segment. When checkpointing these applications, one would normally only checkpoint the "Data Memory".

Memory sizes were computed using a C function that was called at the end of the computation. This function acquired the pointers to the ends of the text, data and uninitialized memory segments, called sbrk(0) to determine the size

of the heap and used the utility "size" to determine the actual sizes of the text, data and uninitialized data segments then computed the values for the results.

Table 2 documents the BT and SP benchmarks which require a square number of processors and Table 3 documents CG, EP, FT, IS, LU, and MG which need a power-of-two number of processors.

Benchmark	Class	NP	Data Memory	Total Memory	Time (sec)
BT	A	4	80.7	81.2	1011.91
BT	A	9	37.1	37.6	542.44
BT	W	4	6.6	7.1	48.53
BT	W	9	3.8	4.3	24.01
SP	A	4	6.0	6.6	123.50
SP	A	9	3.8	4.3	60.96

Table 2: Test Data: BT, SP

Benchmark	Class	NP	Data Memory	Total Memory	Time (sec)
CG	A	2	30.6	31.0	37.42
CG	A	4	16.9	17.2	36.42
CG	A	8	8.9	9.3	13.93
CG	W	2	9.3	9.7	11.05
CG	W	4	5.4	5.8	8.13
CG	W	8	3.0	3.4	5.48
EP	A	2	1.4	1.7	276.27
EP	A	4	1.4	1.7	138.24
EP	A	8	1.4	1.7	58.58
EP	B	2	1.4	1.7	1107.84
EP	B	4	1.4	1.7	551.36
EP	B	8	1.4	1.7	275.01
EP	C	2	1.4	1.7	3735.08
EP	C	4	1.4	1.7	2207.96
EP	C	8	1.4	1.7	1104.00
EP	W	2	1.4	1.7	34.80
EP	W	4	1.4	1.7	14.70
EP	W	8	1.4	1.7	8.60
FT	W	2	15.8	16.2	7.07
FT	W	4	10.4	10.7	5.25
FT	W	8	5.9	6.2	3.18
IS	A	2	80.3	80.6	34.75
IS	A	4	42.3	42.6	28.00
IS	A	8	25.3	25.6	20.21
IS	W	2	10.3	10.6	4.12
IS	W	4	7.8	8.1	3.35
IS	W	8	4.7	5.1	2.74
LU	A	2	27.1	27.6	1235.08
LU	A	4	14.1	14.6	615.96
LU	A	8	8.1	8.6	312.15
LU	B	2	96.8	97.3	5219.27
LU	B	4	50.6	51.0	2684.72
LU	B	8	28.6	29.1	1387.73
LU	W	2	5.0	5.5	164.31
LU	W	4	2.9	3.3	90.07
LU	W	8	1.9	2.4	60.14
MG	W	2	4.6	5.0	8.44
MG	W	4	2.8	3.2	7.82
MG	W	8	1.5	1.9	3.89

Table 3: Test Data: CG, EP, FT, IS, LU