Performance Measurement

1. Don't trust computer, software, people
   (test both wall clock and CPU time)

2. Run on non-zero data
   (hardware sometimes detects special cases)

3. Output a result that depends on measurement
   (compilers eliminate "dead" code)

4. Break optimization that you do not want
   (call a function that can not be inlined, etc.)

5. Try for one user on CPU timing
   (watch out for OS, network, I/O devices !)

6. Use double difference, check count, for features
   (be paranoid, benchmarks can fool you)

7. Note discontinuities, algorithm complexity, n log n
   (exceed L1 cache, exceed L2 cache,
   exceed RAM virtual memory,
   exceed disk file cache in RAM, etc. etc. etc.)

$$\text{TIME} = \sum_{i=1}^{\#\text{INSTRUCTION TYPES}} \left(\text{CPI}_i \times \text{COUNT}_i\right) \times \frac{\text{SECONDS}}{\text{CLOCK CYCLE}}$$

$$\text{PERFORMANCE IMPROVEMENT} = \frac{\text{PERFORMANCE}_{\text{FASTER}}}{\text{PERFORMANCE}_{\text{SLOWER}}} = \frac{\text{EXECUTION TIME}_{\text{SLOWER}}}{\text{EXECUTION TIME}_{\text{FASTER}}}$$

Points	P1-166	P2-266	n Log n
	time in seconds		
16	1.53E-05	6.1E-06	6.4E-06
32	3.76E-05	1.49E-05	0.000016
64	8.58E-05	3.41E-05	3.84E-05
128	0.000199	0.000077	8.96E-05
256	0.000447	0.000169	0.000205
512	0.00108	0.00038	0.000461
1024	0.00342	0.00086	0.001024
2048	0.00824	0.00207	0.002253
4096	0.0177	0.00451	0.004915

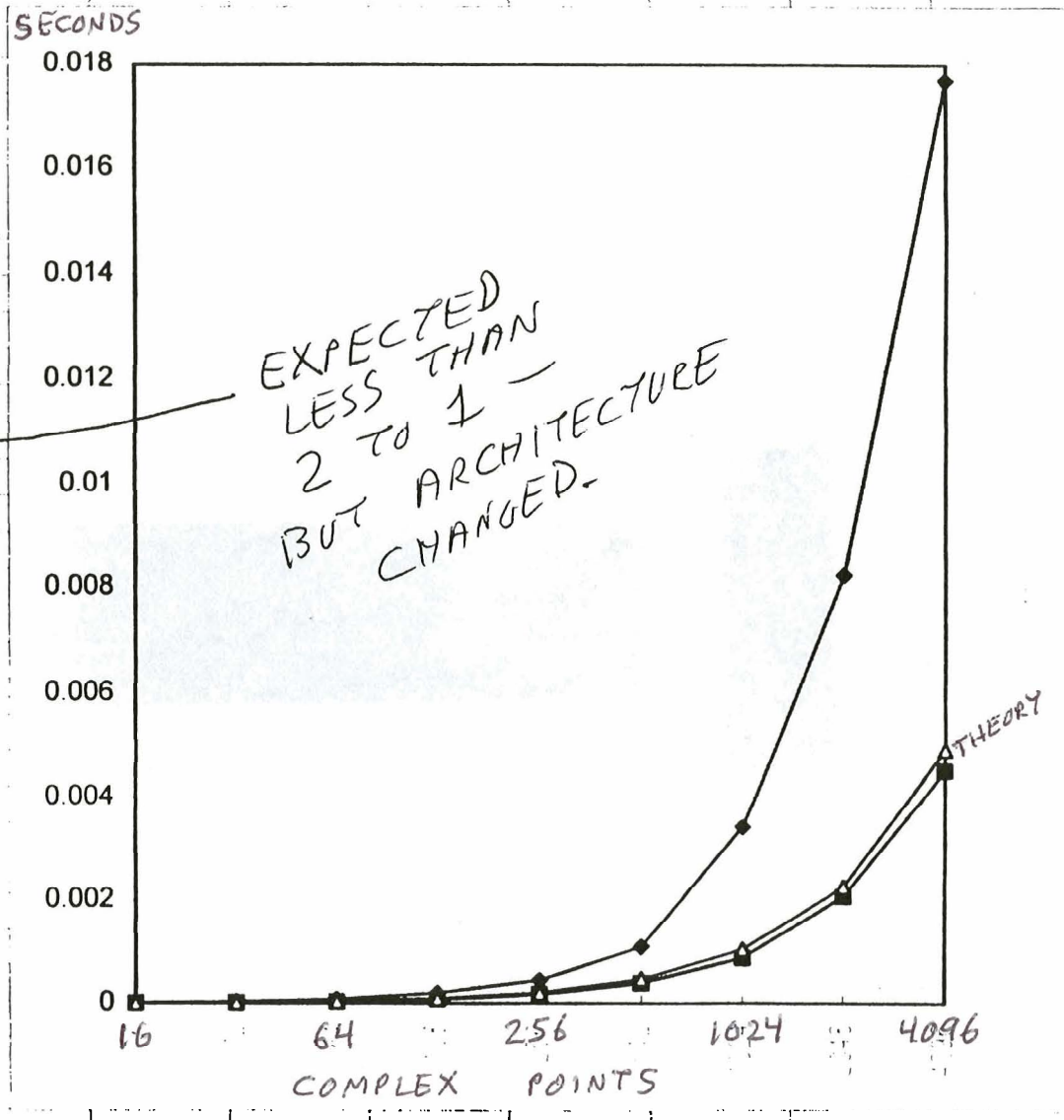
Speedup Ratios P266/P166	
1024	3.976744
2048	3.980676
4096	3.924612

Measured data:
P1-166 Micron Pentium I, 166MHz
P2-266 Dell Pentium II, 266MHz

32 bit floating point
same executable on both machines
Data fit in L2 cache on both machines

Note that a speedup of less than 2 was expected but actual speedup was about 4 due to architecture change

FFT's on non zero data



What can affect benchmarks?

1. Computer Architecture
2. Clock speed
3. Number and depth of pipeline
4. Cache size
5. Memory bandwidth
6. Which compiler
7. Which compiler settings
8. Choice of Operating System
9. Operating system settings, quanta
10. Environment, other processes

	2.4GHz P4	1.4GHz Athlon
Windows XP	940	1410
Suse Linux	200	200

All times in microseconds, smaller is better
4096 point complex FFT time from benchmark
fft_time.c source code available on WEB.
The same Microsoft C binary executable was used on both Windows computers, the same gcc binary was used on both Linux computers. Expect results to vary with different benchmarks

AlphaStation 500 5/333

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IMPORTANT

Tested Configuration: Alpha 21164 64-bit 333MHz CPU; 112KB on-chip cache, 2MB secondary off-chip cache; 128MB ECC RAM, expandable to 512MB; 2.1GB 3···inch Fast-Wide SCSI hard disk; 4x CD-ROM, 3½-inch floppy; one 64-bit and three 32-bit PCI slots; 10Base2 and 10Base-T Ethernet ports; two serial ports, one parallel port, Fast-Wide SCSI-2 (two channels at 20MB/sec); 16-bit audio in/audio out ports; Digital UNIX pre-installed; PowerStorm 3D30 eight-plane 2-D graphics; 17-inch 1,280x1,024 color monitor.

Price: $22,615

Options: Various advanced graphics and network options. Base configuration with 64MB RAM, 2.1GB hard drive, 3½-inch diskette, CD-ROM, 3D30 2-D graphics board priced at $19,525 (monitor and keyboard extra).

Evaluation: The AlphaStation 500 5/333 is an excellent performer and has excellent expandability for a unit of its size. Digital UNIX 4.0 is robust and has strong interoperability and security features. For those who want to drive a midrange workstation in the fast lane and are looking for competitively priced high-end graphics upgrades, the AS500 may be the best choice.

CIRCLE NO. 250 ON INQUIRY CARD

not changed its size much from previous models. The real story is inside the case.

The most important aspect of the system hardware continues to be the Alpha processor. The AS500 now is available in four 64-bit CPU configurations: 266MHz, 333MHz, 400MHz, and 500MHz. Although the primary focus of our review is the 333MHz model, we also ran tests on a 400MHz system and discuss test results filed with SPEC for the new 500MHz model. All lab testing was performed using Digital UNIX 4.0.

The AS500 also introduces new graphics features. Although earlier AlphaStation models used the PCI bus common in PCs, DEC's new PCI-based PowerStorm graphics adapters were introduced concurrently with the AS500 and its little brother, the Model 255. These boards include the value-priced PowerStorm 3D10 (standard in the entry-level AlphaStation 200) for 2-D and low-end 3-D; the 3D30 for fast 2-D graphics for MDA, GIS, and EDA applications; the 4D20 for fast 3-D wireframe and true-color 2-D and 3-D; and the high-end 4D60T board for high-end 3-D graphics with shading and texturing. The design and the resulting price structure are the most significant aspects of these boards. The 3-D-capable 3D10 lists for $399, the 3D30 lists for $795, and the 4D20 lists for $2,495. The 4D60T board, priced at $11,995, is intended to compete with the major players in the graphics market—the High Impact and Maximum Impact board sets from Silicon Graphics Inc. (SGI) and the Visualize-48 board set from Hewlett-Packard. The 4D60T is a two-board assembly (consuming two slots), whereas the high-end solutions from HP and SGI are three-board sets, leaving only one or two slots for other forms of expansion. DEC's graphics strategy with the AlphaStation line is to leverage the power of the Alpha processor by doing some of the calculations for graphics primitives on the CPU, providing for a less expensive design on the graphics boards.

On the software side of the system, Digital UNIX 4.0 includes new features and enhancements over previous versions. Noteworthy improvements in 4.0 include the Common Desktop Environment (CDE) as the default user interface; improved system management, with a new and easier interface; and enhanced security features.

Operation

Putting an AS500 into operation is a simple matter. Hardware installation follows industry norms, and all connectors on the rear panel of the system are well labeled. A spiral-bound User Information manual accompanies the system, providing additional details about system setup, along with the usual information about installing optional hardware components and performing system upgrades.

The only problem we encountered was configuring the Ethernet connection. The system includes connectors for both thinnet (10Base2) and twisted pair (10Base-T). The system defaults to the thinnet port, which is not mentioned in the AS500 User Information manual. Recalling a similar situation with the AlphaStation 250 4/266, we checked the console monitor commands in the User Information manual, found nothing, and resorted to an older AlphaStation manual for the information we needed. Executing the command

```
set ewa0 twisted
```

at the monitor prompt (the hardware-level prompt available prior to booting the operating system) allowed us to use twisted pair.

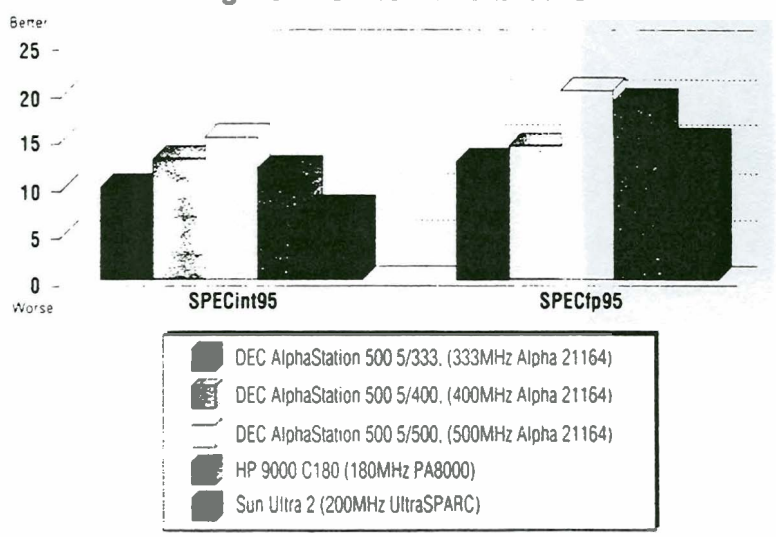
The Sun Ultra 2 Series 2200 workstation shows scores of 14.7 for SPECfp95 and 7.81 for SPECint95 for its 200MHz UltraSPARC CPU. Thus, the 333MHz model of the AS500 scores somewhat lower than the fastest Sun Ultra on floating-point calculations, somewhat higher than the Ultra on integer tests, and lower than the fastest HP PA-RISC 8000 machine in both categories. The 400MHz version of the AS500 is only slightly lower than the fastest Ultra on floating-point tests but substantially higher on integer calculations. The HP C180 also is higher on floating-point tests than the 400MHz AS500 but somewhat lower than the DEC on integer tests. The scores for the 500MHz version of the AS500 make it the best in both categories.

The AS500 also is impressive in basic graphics performance. Using the standard 3D30 2-D graphics adapter, we achieved an Xmark score of 30.17 for the 333MHz model. For comparisons on this benchmark, consider previous test scores of 14.93 for the Sun Ultra 1 Creator 3D (167MHz UltraSPARC, see our review in the June 1996 issue, p. 33), 11.00 for the SGI Indigo^2 Impact (see our review in the May 1996 issue, p. 49), and 4.92 for the Network Computing Devices (NCD; Mountain View, CA) HMXpro21 high-end X terminal (see our review in the September 1995 issue, p. 57).

How It Rates

The basic design of the AS500 is good. The footprint of the system unit is small enough to let the keyboard be positioned in front of the unit on a standard-sized desk with room to spare. Similarly, the height of the unit lets the monitor be set on top of it without placing the monitor uncomfortably high. We were not impressed by the swing-up door that hides the diskette and CD-ROM drives. Although stylish, the door obscures the activity light on the diskette drive.

Figure 2: SPEC Benchmarks



Comparison machines are selected on the basis of being in the same general performance range and being of a similar design or intended application. Such machines are not intended to be exactly comparable in features and functionality to the system under review, however. SPEC results for comparison systems are taken from prior issues of UNIX Review *or official results published by the manufacturer. These published results are assumed to conform to SPEC reporting rules but may utilize various levels of optimization and may use special compilers and optimizing preprocessors. Hardware configurations also may differ substantially between reported systems.*

Installation of the system is simple and straightforward, rating an excellent on our scale. Connectors on the rear panel of the system follow industry standards and are clearly labeled, making cable hookup intuitive for an experienced installer. Additionally, the Digital UNIX documentation provides thorough guidelines for installing and configuring the operating system.

Printed documentation accompanying the system is limited to the hardware-level User Information manual described earlier and manuals for Digital UNIX (Release Notes, Documentation Overview, Technical Overview, and Installation Guide). Online documentation includes traditional UNIX and xman manual pages, the standard CDE-based Help Manager, and an extensive set of HTML-based, Digital-specific manuals. The HTML manuals, accessed through Netscape Navigator 1.12I, are thorough and well-written and include a comprehensive table of contents. We were particularly impressed by the concise yet easy-to-understand description of enhanced security features in Digital UNIX. Yet we were disappointed that no search engine is provided for the HTML manuals to find specific topics within that documentation set.

Expandability of the AS500 is excellent for a small desktop workstation. The chassis provides space for three hard disks in addition to the standard 3½-inch diskette drive and the CD-ROM drive. RAM can be expanded to 512MB, common for a workstation of this size but potentially limiting for some high-end engineering and scientific applications. The external SCSI port supports Fast-Wide SCSI-2