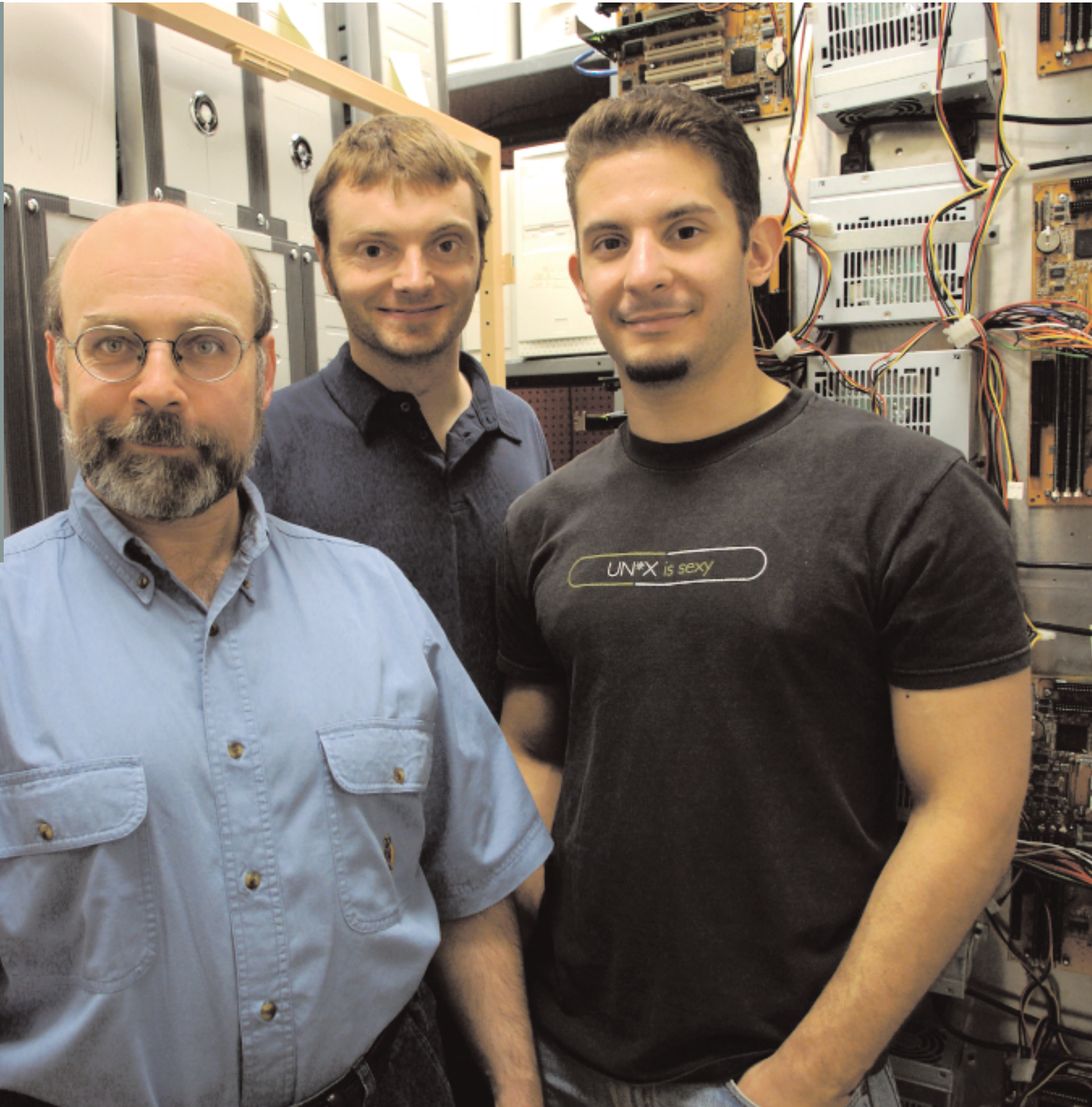


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- THE WORLD AS AN INDEX TO THE LIBRARY
- REFLECTIONS ON A CHANGE IN GENDER
- THE DAVISON ART CENTER IN PARIS
- NABOKOV'S INSIGHT INTO THE EMIGRÉ
- AN UNUSUAL WAY TO COPE WITH GRIEF



# A SUPERCOMPUTING WULF IN PC'S CLOTHING

HOW A PHYSICS PROFESSOR AND TWO OF HIS STUDENTS CREATED A FULLY FUNCTIONAL SUPERCOMPUTER OUT OF TRASHED PCS. BY DAVID PESCI

It has become a ritual at businesses and colleges across the world: get rid of computers that have become obsolete in just two or three years—and replace them with new machines.

But would the purging be done so often if the system administrators knew that these so-called obsolete machines could easily be linked together to create a supercomputer that would otherwise cost hundreds of thousands, if not millions of dollars?

That's the idea that a Wesleyan professor of physics and two of his students pursued. What began as an experiment using computers headed for the nearest dumpster has blossomed into a dynamic and growing collection of PCs with varying individual computing power that have been connected to create one of the 100 most powerful computer clusters in the world. Perhaps best of all, the cluster is doing the work of a \$1-million-plus supercomputer for about one-twentieth of what one of those machines would cost.

Wesleyan's cluster, known as "WesWulf," had its beginnings in late 1998 when Vasilios Hoffman '02, then a physics undergrad, read about so-called "Beowulf clusters" touted by NASA. The concept was to get supercomputing power out of PCs by linking them physically and reprogramming them in UNIX to act as a single, multiprocessor computer. Hoffman also heard that Wesleyan had just hired a new physics professor who had a generous start-up budget.

"I was still living in Germany and had barely accepted the faculty position at Wesleyan when I got an e-mail from a very excited student named Hoffman who proposed that I use a percentage of my start-up funds to build something called a Beowulf cluster," says Rinehold Blümel, professor of physics. "I remember thinking, 'Pushy, these Wesleyan students.' And I soon forgot all about his e-mail."

A few months later, when Blümel began settling in to his new position, he

realized that his work in computational physics would require him either to rent expensive time on a supercomputer or somehow come up with the funds to buy one. Suddenly his generous start-up budget was looking very tight.

"It was then that I remembered Vasilios's e-mail," he says.

Blümel contacted the undergraduate student and began to ask more questions about computer clusters. Hoffman spoke excitedly about NASA's experience with the clusters and how the PCs properly linked could produce the same computing power of a single supercomputer. He also produced documentation supporting his claims. Blümel was genuinely intrigued.

"Maybe it was the NASA endorsement or the torrent of UNIX jargon and enthusiasm that Vasilios bubbled over with," Blümel says. "In any case I thought I'd give it a whirl."

A qualified whirl, that is.

Blümel wanted tangible proof that a cluster would work as advertised, before

Creators of the WesWulf supercomputer cluster: Professor of Physics Rinehold Blümel, Thomas Clausen GR '03, and Vasilios Hoffman '02



ACCORDING TO BLÜMEL, THE 40-NODE CLUSTER DUBBED “WESWULF II” THAT HE, CLAUSEN, AND HOFFMAN BUILT IN LATE 1999 FOR \$20,000 GAVE THEM THE COMPUTING POWER OF A SUPERCOMPUTER THAT WOULD HAVE COST 50 TIMES THAT AMOUNT.

he committed any part of his budget. He asked Hoffman to build a proof-of-concept system. Hoffman told him it wouldn't be a problem. All they had to do was a little dumpster diving.

“It could be done with castoffs—computers that had recently been replaced and slated for disposal,” says Hoffman.

Luckily, Henk Meij, Wesleyan's social science computing manager, saved Hoffman and Blümel the trouble of picking through the trash. Meji had just replaced several 486mhz PCs. Blümel and Hoffman had their pick. They grabbed 12 of the machines and in the summer of 1999 built the test cluster.

“We were very proud of it,” Blümel says. “What would have otherwise ended up in a landfill was now a 12-node cluster that was as powerful as the top-of-the-line desktop that I had bought in January 1999, for \$10,000. And the cluster didn't cost us a single cent.”

They decided to call their creation “WesWulf I.”

Convinced that the idea would work,

Blümel took \$20,000 of his start-up money and bought 40 Pentium-III computers in the early fall of 1999. He also brought on board his graduate student, Thomas Clausen, a UNIX wiz who had trained at the prestigious Niels Bohr Institute in Denmark. Clausen used open source software and wrote original computer code.

“It took me about three months to set the cluster up and get it to run the way I wanted,” says Clausen, who is now a postdoctoral fellow in the physics department. “If we were to do this today, however, it would be much easier. There is more open source (i.e., free) code available on the Internet. Or one can buy the software on a single disc and install it much like Microsoft products are installed.”

Clausen stops and smiles.

“This works much better than Windows, however.”

According to Blümel, the 40-node cluster dubbed “WesWulf II” that he, Clausen, and Hoffman built in late 1999 for \$20,000 gave them the computing

power of a supercomputer that would have cost 50 times that amount. It was also completely scalable. Blümel and Clausen have periodically added computers so that today it is a 90-node cluster that can perform about 80 billion operations per second.

“This is enough computing power to rank us among the top 100 cluster computers in the world,” Blümel says.

Along with Blümel's own work in computational physics and other physics department computing, the cluster has been used by faculty in the astronomy department who are modeling galaxies, and by biology professors who are doing molecular modeling. But Beowulf clusters are perfect for any large data-crunching tasks.

“Stock calculations, geological surveys typically done by oil companies, genetics research—these are all areas that could use these clusters,” Hoffman, who is now Wesleyan's UNIX administrator, says. “I even read about a guitar string company that switched over from desktops to a cluster and saw immediate savings and increases in productivity.”

Blümel says that the relatively cheap cost of Beowulf clusters makes them perfect for universities and small businesses. Best of all, adding machines to the cluster is easy. All that's needed is a working air conditioning system to keep the machines cool and a dedicated space for the PCs. WesWulf II is kept in a windowless 8-by-12-foot room.

“If you figure that recently decommissioned PCs are about three generations behind the top of the line,” Blümel says, “then 10 castoffs would make a cluster as powerful as a new machine. Fifty castoffs outstrip a brand new top-of-the-line computer by a very respectable factor of five.” Blümel smiles as he closes the door to WesWulf II's room.

“What could be better?” he says. “This is such an attractive option for economically and ecologically forward-thinking folks like, well, all of us!”

ALL OVER TOWN CATALOG NUMBERS AS ART

There is something strangely familiar about the string of numbers and letters on the wall at Neon Deli in Middletown. A similar string is posted in O'Rourke's Diner. And at the Destinta Theater. And



Art installation grabs Takahiro Haneda '06.

AKIKO SASAMOTO '04

all over the Wesleyan campus. Secret code? A new Homeland Security initiative? International phone numbers? No, the answer is library books.

The new numbers are part of an intriguing art installation created by Jeffrey Schiff, a professor of art. Each number—there are more than 500 of them—corresponds to a specific book in

one of Wesleyan's four libraries. The books, in turn, relate to something about the physical location where the call numbers were placed.

For example, the number placed above the meat slicer at Neon Deli, GT2860 R36 2003, is the call number for *How We Eat: Appetite, Culture, and the Psychology of Food*, by Leon Rappoport. At O'Rourke's, NA7855.G87 2000, is for *American Diner: Then and Now*, by Richard J.S. Gutman. A number on a tree by a local parking lot, QK477.2.6 T73 1999, refers to *Tree-ring Analysis: Biological, Methodological, and Environmental Aspects*, edited by R. Wimmer and R.E. Vetter.

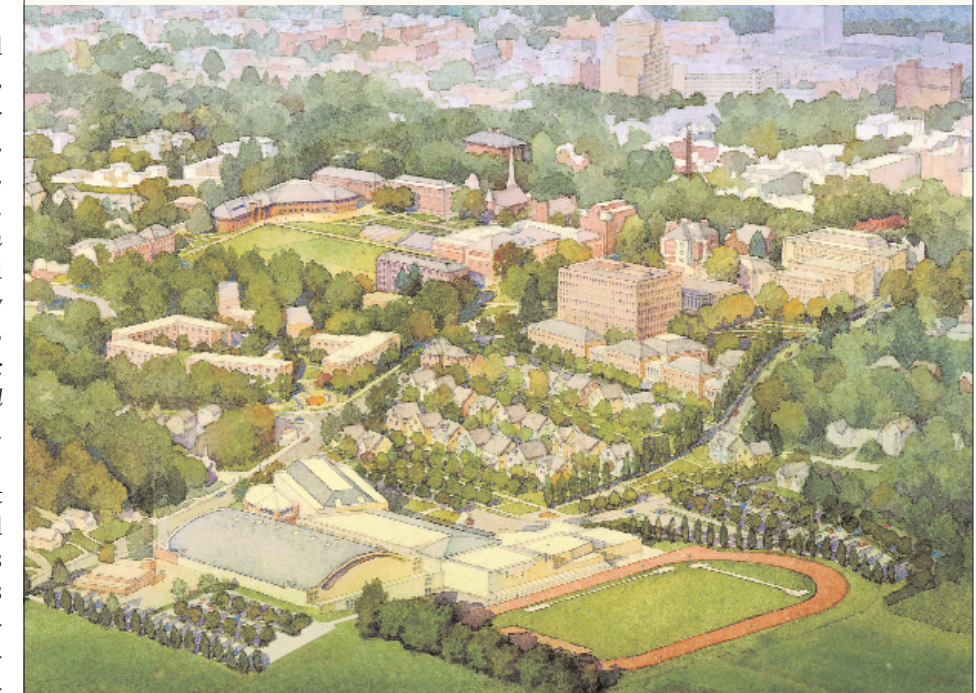
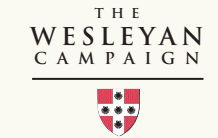
Schiff says the installation came out of his desire to do a project that would “explore the institution of the library as an index to the larger world.” It also has roots in a project he did in the mid-1990s that used art to explore the foundations and presuppositions of Diderot's *Encyclopedia*.

The idea is to challenge people to see the profound influence of the library on their daily lives and draw them into the library.

“The basic strategy has been to mark the world in terms of the library,” Schiff says. “This project aims to reverse the customary view that the library is an index to the world, and instead to see the world as an index to the expanding universe of the library.”

It also offers a clear element of fun.

More than two years in the making, the installation was created by Schiff and three of his students: James Jacobus '03, Myra Rasmussen '04, and Aki Sasamoto '04. It is just one component of an eight-part installation called the *Library Project*, which was on display at Olin Library this fall. All are supported by The Christian Johnson Foundation, Wesleyan's Office of Academic Affairs, and Olin Memorial Library.



EMILY FORESTER '99 GRATEFUL FOR SUPPORT FROM WESLEYAN COMMUNITY

As executive director of the Boston office of Summer Search, a leadership-development program for high potential but at-risk high school students, Emily Forester '99 helps young people transform their lives through experiential education opportunities and long-term mentoring. Emily has recently increased her annual giving through WAF in gratitude for the support her organization has received from the Wesleyan community. “I have a real appreciation for what the Wesleyan community means, way past graduation,” Emily said recently.

CHAPEL PEWS NAMED IN RECOGNITION OF DONOR GIFTS

Jonathan Guest '73 and Julian Anthony '28, P'57 have each made substantial gifts to the Campus Renewal Fund, which supports improvements to university facilities while preserving Wesleyan's architectural heritage. Pews in the recently restored Memorial Chapel will be named in honor of Jonathan and Julian to provide lasting tributes to these loyal and generous alumni.

MEMORIAL GIFTS HONOR WILLIE KERR

William “Willie” Kerr served Wesleyan for 40 years, as a professor of history, a senior administrator, and an adviser to Psi Upsilon fraternity. Since his death, many former students and colleagues have made gifts to the university in his name. The gifts include two Wesleyan Scholarships, one given by Michael Pruzan '87 and Robert and Tracey Pruzan, of the Class of 1985, and one from an anonymous donor; a shell named “Willie Kerr,” given to the crew team by former team member and Psi U brother David Nuelle '84; the Kerr Grant, established by Psi U to support first-year students from Connecticut's Middlesex County; and the renovation of Shanklin 107, now the Kerr Lecture Hall, through the generosity of Andrew Parkinson '80 and Thomas Parkinson '82. Psi U also named its faculty/student dining lounge in memory of Mr. Kerr.