CAN YOU

Believe it?

WITH ASSOCIATE PROFESSOR DEREK LEINWEBER

Need for speed

It's all in the name when it comes to super computing.

WHAT makes a supercomputer super? Hollywood's answer is clear: lots of flashing lights on ominous dark towers accompanied by the whirring of cooling fans. And this picture is not so wrong. The Thinking Machines Corporation (TMC) "Connection Machine" CM-5 was a real supercomputer that featured in *Jurassic Park*.

It was one of the most beautiful supercomputers ever built.

And the performance of the CM-5 was amazing. It represented the pinnacle of an era when supercomputers were built around exotic, specially-designed processing chips connected with advanced network designs. These sent the price of supercomputers into the realm of the super-elite.

Our University of Adelaide owned one, enabling cutting-edge research for the time.

Now, supercomputers are more economical.

Once, supercomputers were defined by specialty "vector array" processors designed exclusively for such machines.

Now they use "clusters" of off-the-shelf processors - much like those found in home computers.

As mathematical computation is what supercomputers are all about, the key performance indicator is the number of Floating-point Operations Per Second (flops). What is a flop? It is the simple addition, subtraction, multiplication or division of any two numbers.

Today's supercomputers are so fast that the speed is now measured in giga-flops (gflops): one-billion add, subtract, multiply or divide operations every second.

But scientists now dream of having access to a teraflop supercomputer. And Adelaide has one.

The Hydra Supercomputer at the South Australian Partnership for Advanced Computing (SAPAC) performs more than one-trillion (that's 1,000,000,000,000) calculations per second.

This is only possible through using hundreds, if not thousands, of cutting-edge central processing units (CPU's) working in parallel.

Each chip churns away on its own personal piece of the problem, accessing thousands of megabytes of memory - vital for feeding the chip with enough data to run continuously.

It's the rate of communication between these chips that remains a major bottleneck.

Modern massively-parallel supercomputers use optical fibres to keep the data flowing.

But what makes a supercomputer super?

It remains super only as long as it stays among the ranks of the fastest 500 machines. It's a race, and the championship title is a fleeting reward. Australia has five supercomputers, according to the 2005 rankings. And Adelaide's researchers have access to the world's 26th fastest machine.

It's the new SGI Altix supercomputer, managed by the Australian Partnership for Advanced Computing. Boasting 1536 Intel Itanium 2 processors, its can reach almost 10 teraflops.

But CPUs are rapidly approaching the speed limits imposed by the laws of physics.

The answer is to produce semi-conductor wafers holding multiple CPU's on a single chip.

And vector processors - once the very essence of a supercomputer - are making a comeback. Just as multilane superhighways move traffic, vector processors move numerical computations, circumventing traffic jams.

And they are part of the forthcoming Sony Playstation 3. This home games machine can do 218 gflops: 218 billion calculations per second.

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The march of progress

On May 11, 1997, IBM supercomputer Deep Blue defeated chess world champion Garry Kasparov, becoming the first computer ever to defeat a chess champion. Before this, no computer had been able to win a formal best-of-seven series with a grandmaster.

The supercomputer ranked 500th in June 2005 has the equivalent processing power as all 500 systems ranked as supercomputers when the list was first compiled in June 1993.

The new and previous number one is DOE's IBM BlueGene/L system. It can achieve 136.8 TFlop/s.