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Math student savours quadrillionth piece of pi

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REMEMBER PI? Most adults have a vague recollection from math class. Some can even rhyme off the first few digits of the never-ending number produced when the circumference of any circle is divided by the diameter.

And then there's Colin Percival.

By enlisting help from 1,734 personal computers in 56 countries, the 19-year-old recently calculated the quadrillionth digit of pi, a number so huge it's defined with 15 zeros. The previous record was the 40 trillionth digit, also calculated by Percival. Both digits, we now know, are zero.

The math whiz is the first to admit that knowing the quadrillionth digit of pi doesn't advance the state of human knowledge significantly, not least since the calculation is done in binary numbers (0s and 1s) rather than the familiar decimal system ordinary people count in.

"It's a good way to get into the *Guinness Book Of Records*, I hope," says the final-year mathematics student at Simon Fraser University in Burnaby, B.C.

Behind such self-deprecation lies an obsession with a number that, in mathematical jargon, is described as both irrational and transcendental, a number that crops up throughout mathematics, physics, statistics, engineering, architecture, biology, astronomy and even the arts.

Percival's feats made him the newest and youngest member of Canada's distinguished pi fraternity, which includes a Quebec mathematician who briefly held the record for memorizing the longest stretch of pi and two brothers recognized worldwide for pioneering pi research.

For this small elite, pi is a mountain they must climb en route to a magical realm. Author David Blatner suggests why in his book *The Joy Of Pi*:

"In the story of pi, we find both the mythical and the mystical, the profound and the profoundly silly. Pi teaches us about the limits of our own comprehension, clearly marking the boundary between the finite and the infinite."

Percival has a more prosaic explanation.

"Calculating big pi has always been something mathematicians did to show off," he says.

"Isaac Newton calculated 15 digits one afternoon when he was bored."

Almost no one has any practical need to know the value of pi beyond 10 decimal places, which would give the distance around a circular Earth within a centimetre.

Forty places of pi are enough to figure out the circumference of the Milky Way galaxy to subatomic precision.

Yet there are practical reasons for doing the pi calculation itself, even if the actual result isn't all that vital.

For instance, the intense number-crunching needed to calculate pi with billions of multiplications, divisions and additions is the ultimate stress test for computer hardware and software. An obscure flaw in the original Pentium chip was revealed by a similar type of computational challenge.

As well, searching for faster and simpler ways of calculating pi has spurred generations of mathematicians to solve other computational puzzles encountered along the way. These by-products get applied in all sorts of engineering and scientific areas, such as a complex formula used in Canada's new science satellite to track pollution.

But Percival had two more practical reasons for launching his assault on the pi mountain three years ago.

He wanted to spotlight the power of what is called distributed computing, which works something like an

old-fashioned barn-raising with everyone pitching in to knock off a big job in record time.

"The aggregate computing capacity of idle PCs is way more than all the supercomputers in the world combined. We just need a way to let them work together," Percival says.

And he also wanted to demonstrate the power of an astonishing algorithm developed two years earlier at Simon Fraser.

An algorithm is essentially a piece of computer software that does multiple mathematical operations.

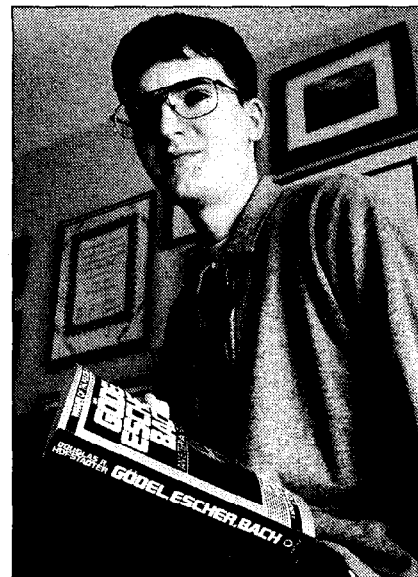
In 1995, mathematicians David Bailey of NASA and Peter Borwein and Simon Plouffe from Simon Fraser surprised the world mathematical community by finding an algorithm that will churn out isolated digits of pi, without having to compute and keep track of all the preceding numbers.

Plouffe, now in the mathematics department at the Université de Québec at Montreal, initially became a pi celebrity 25 years ago by reciting from memory the first 4,018 digits of the number.

And throughout the 1980s and early 1990s, Borwein and his mathematician brother Jonathan competed against two Russian mathematicians, also brothers, to develop the highest powered pi algorithms.

Percival was well-positioned to take advantage of this algorithm breakthrough.

He began studying mathematics at Simon Fraser in 1994, while still only



VANCOUVER PROVINCE FILE PHOTO

COLIN PERCIVAL: "It's a good way to get into the *Guinness Book Of Records*, I hope."

in Grade 9 for other subjects. Over the years, he gravitated to the problems of computing big numbers on computers, working with Peter Borwein.

Using a souped-up version of the Simon Fraser algorithm, Percival spent two years writing a simple and fast computer program that would operate between keystrokes or mouse clicks. In March, 1998, he advertised on the Internet for volunteer users.

People responded from 56 countries. Over two years, their slices of "idle" time on 1,734 computers added up to the 1.2 million processing hours necessary to calculate the quadrillionth digit of pi.

"I don't think anyone will challenge that record," Percival says. "It could be done on a couple of days on a supercomputer — but anyone with access to a supercomputer has more important things to do."

Not that the newest member of Canada's pi fraternity is stopping. He has his eyes set on two goals — a math Ph.D. from Oxford University and wresting the record for the most consecutive digits of pi away from the current holder, Yasumasa Kanada of the University of Tokyo, by using the same technique of distributed computing.

"Calculating a long string of digits requires a lot of communication between computers," Percival says. "That wasn't possible when you had to dial up to the Internet. But now that more and more people are continuously connected, it should be possible."

"I'm working on it."

What is pi?

- *Pi* is the ratio of the circumference of a circle to its diameter. Expressed another way, it equals the circumference of a circle divided by its diameter. Or, you could calculate the circumference of an object by multiplying its diameter by pi.
- *Pi* is constant. No matter what the size of the circle, the circumference divided by the diameter will always equal pi.
- *Pi* equals 3.14159265358979323846... the decimal is infinite, meaning that it never ends or repeats. Unlike pi, numbers such as 8.976 or 3.5 have a limited number of digits to the right of the decimal.