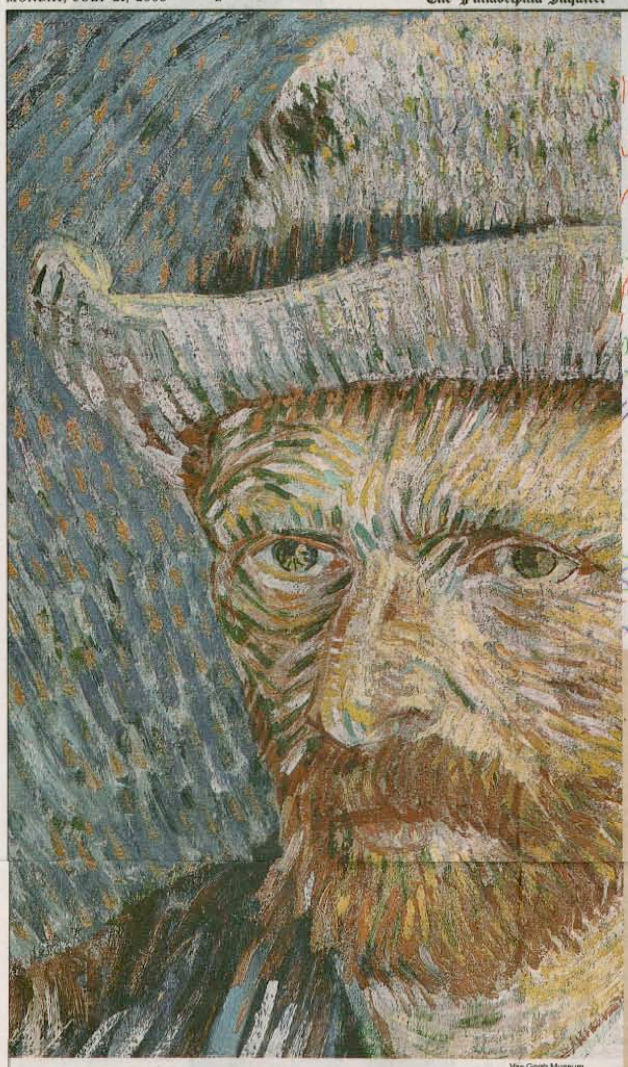

Van Gogh Museum

"Self-Portrait With Felt Hat" is one of the paintings that research teams at Penn State, Princeton and Maastricht University used to try to train computers to recognize authentic van Gogh art.

Computer enters the picture

It has been enlisted as a rookie cop in the detection of art copies and forgeries.

By Tom Avril
INQUIRER STAFF WRITER

The painting of the lean-faced, bearded man with the penetrating stare is unmistakably a self-portrait by Vincent van Gogh.

An art historian can tell by looking at the riot of bold, colorful brushstrokes.

Researchers at Pennsylvania State and Princeton Universities, however, use an analytical tool that surely the troubled Dutch master never imagined: The computer.

Their method is far from foolproof, but the two teams, along with a third one in the Netherlands, were able to distinguish dozens of van Gogh's works from those painted by others — including an infamous forgery.

A picture, after all, is more than a thousand words. It can be represented as bits of data, just like a bank account or music on a compact disc, and the researchers have sifted this information through the dispassionate filter of statistics.

The authors, who describe their results in this month's issue of the engineering journal

See **ART** on E2

philly.com
Can you spot the fake? A self test, video, plus the full paper: **http://go.philly.com/science**

Van Gogh's Style, Pixel by Pixel

Penn State's James Z. Wang and Jia Li are one of three teams to analyze the artist's work by computer.

They used black-and-white images of 23 known van Gogh paintings to "train" their software to recognize his style. After dividing each image into 2.5-inch squares, they used **two methods** to find statistical similarities between these works and 78 others — some by van Gogh, some by other artists with similar styles.

Brushstroke
One program was used to detect the edges of brushstrokes, so the computer could compare features such as length and curvature.

(A color map of brushstrokes is used as this story's background image above.)

Texture
In a second technique, called "wavelet transform," they broke down the images into horizontal, vertical and diagonal components, then looked for statistical patterns in the changes from light to dark, down to the level of just a few pixels at a time.

SOURCES: James Z. Wang and Jia Li, Van Gogh Museum

A single-cut belly-button surgery for kidney donors

By Thomas J. Sheeran
ASSOCIATED PRESS

TONY DEJAK / Associated Press

Scott Bolender, 39, received a kidney from his niece, removed through her navel, in Cleveland.

CLEVELAND — Brad Kaster gave a kidney to his father last week, and he barely has a scar to show for it.

The kidney was removed through a single incision in his belly button, a surgical procedure Cleveland Clinic doctors say will reduce recovery time and leave little scarring.

"The actual incision point on me is so tiny I'm not getting any pain from it," Kaster, 29, said last week. "I can't even see it."

Kaster was the 10th donor to have the procedure done at the Cleveland Clinic by Inderbir S. Gill and colleagues. The 11th was done Thursday. Gill said the technique could make kidney donations more palatable by sharply reducing recovery time.

See **KIDNEY** on E3

Arctic critter carries its own antifreeze

Queen's University

The Canadian snow flea's blood yields a substance with many uses.

If the thought of spending a Canadian winter outside makes your blood run cold, fear not for the tiny snow flea.

The blood of this forest critter contains a handy protein that prevents the formation of ice crystals, enabling it to withstand an Arctic climate.

It's nature's version of antifreeze — effective down to at least minus-6 degrees Celsius (21 degrees Fahrenheit) — and it can now be made in the lab, scientists report this month in the Journal of the American Chemical Society.

The hope is that the substance will someday be used to preserve human organs for transplantation at lower temperatures, according to the authors, from the universities of Chicago and Pennsylvania.

Currently, organs cannot be cooled below zero degrees Celsius because crystals would damage the tissue. If hearts and other organs could be cooled further, they would last longer — likely enabling better matches between donor and recipient, says Louis Samuels, a heart surgeon at Lankenau and Paoli hospitals.

"This whole thing may transform the process," says Samuels, who was not involved with the research.

The scientists synthesized both the protein and its mirror image molecule, which they predict is less likely to provoke an immune response in a patient.

Both forms seem to work by binding to the surface of an ice crystal, thereby keeping it from growing. Other applications might be creamier ice cream and frost-resistant crops, says Penn's Jane Vanderkooi, one of the authors.

Snow fleas, by the way, are not "fleas" at all, but something called a springtail. The six-legged animals, once classified as insects, are really closer to crustaceans, says Ken Christiansen, professor emeritus of biology at Grinnell College.

Either way, it's one cool customer.

— *Tom Avril*

Personal Health

Advertised 'fun foods' lack serious nutrition

With cartoon characters printed on the package, the food you buy for your children may look like fun. But it is likely bad news for their bodies, Canadian researchers report in the current issue of the journal Obesity Reviews.

In the analysis of 367 products aimed at kids, nearly 90 percent were found to be of poor nutritional quality — having too much sugar, fat or sodium — even excluding candy and soft drinks.

Yet 62 percent of these poor foods made some sort of nutrition-related claim on the package, such as "made with real fruit juice" or "no artificial flavors."

The researchers from Carleton University used healthy-food cutoffs from the nonprofit Center for Science in the Public Interest. For example, a food failed to pass muster if over 35 percent of its calories came from fat, excluding nuts and nut butters.

— *Tom Avril*

Diabetic Hispanics may not know of risk of eye disease

Many U.S. Hispanics with diabetes are unaware that a potential complication of their condition is eye disease, and they do not get regular eye exams that could identify any problems.

That's the finding of a new survey led by Johns Hopkins University, published in the current Archives of Ophthalmology. The researchers focused on Hispanics because their rate of diabetes is especially high — 1.9 times the rate in non-Hispanic white people — and because for some, the language barrier impedes good care. One in five Hispanics over 40 has diabetes, and almost half of those have diabetic retinopathy — a condition that may be characterized by the swelling and leaking of blood vessels in the eye.

The researchers interviewed 553 Hispanic residents of Baltimore, 204 diabetics and 349 without the disease. Only 36 percent of newly diagnosed diabetics knew that eye disease was a potential consequence; the percentage rose to 52 percent among those who had known they had diabetes for more than a year. Just 30 percent of the diabetics had been to the eye doctor in the previous year.

— *Tom Avril*

The secret to health might be all in your head

If you've thought that research claiming health benefits from things like being happy is a bunch of hooey, look at a study out of New England in the current Annals of Family Medicine.

Doctors asked 2,816 adults over 35 with no heart attack history how they rated their risk of an attack or stroke in the next five years compared to peers.

Nearly half the men who rated their risk as "low" would have been classified by tests as high risk. Yet when researchers checked the accuracy of their predictions against death records 15 years later, it turned out that men who *believed* they were at lower-than-average risk actually had a three times lower rate of death from heart attacks and strokes even after smoking, cholesterol and other factors were considered.

No such link was found for women, which the researchers speculate may be because the study began in 1990, when heart disease was seen as a threat mainly for men.

The authors' working theory has to do with perception of risk. When a healthy outcome can be achieved by a simple behavior, such as getting a shot, a heightened sense of risk can be a motivating factor, they write.

But preventing cardiovascular disease involves complicated factors involving diet, exercise, drugs, and knowledge of evolving medical theory. With progress hard to achieve, a heightened sense of risk is less likely to motivate and more likely to cause stress and fear, the researchers say — and to trigger unhealthy coping behaviors like overeating, alcohol abuse, and avoiding the doctor.

Believing you are at less risk may make it so.

— *Don Sapatkin*

Suicide risk could rise with sight trouble

Visual impairment affects more than a person's eyesight. It can hinder daily activities, cause social isolation, depression and more dependence on others, and lead to more falls.

Now, researchers have concluded that it heightens a person's risk of suicide — by up to 18 percent.

Byron L. Lam of Bascom Palmer Eye Institute at the University of Miami School of Medicine and colleagues reviewed data from 137,479 participants of national surveys done between 1986 and 1996.

During 11 years of follow-up, they identified 200 suicide deaths. Analyzing those, they found that while the visual impairment raised a person's suicide risk, the indirect health effects were a more significant risk factor.

The authors suggest better treatment of visual problems may reduce suicide risks.

— *Sandy Bauers*

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JAMES Z. WANG

The Penn State team of James Z. Wang and his wife, Jia Li, used the computer in statistical analysis of van Gogh paintings. With two other research teams, they were able to distinguish dozens of his works from those painted by others.

Could the computer spot the real van Goghs?

ART from E1

IEEE Signal Processing, are quick to say that they don't want to replace art historians. Their methods aren't sophisticated enough to do so even if they wanted to.

"Sometimes, a computer is pretty smart," says Penn State's James Z. Wang, one of the authors. "Other times, it may not be."

Yet he and his colleagues predict the computer will become an important tool alongside other scientific techniques that have long been used in art scholarship, such as chemical analysis of paint fragments or the use of X-rays to count threads in a canvas.

They've already won converts at Amsterdam's Van Gogh Museum, which has the world's largest collection of the artist's work.

"It was much more successful than I would have expected," says Ella Hendriks, the museum's head of conservation.

But before it could happen, there was a big question. How do you get a bunch of engineers and statisticians to communicate with people in the subjective realm of art?

Answer: Start with someone who is a member of both worlds.

■

C. Richard Johnson never went to an art museum as a child, and he pursued an early interest in the sciences by attending Georgia Tech.

But once there, he did a study-abroad program in Germany that he calls a "life-changing experience."

"Sometimes, a computer is pretty smart. Other times, it may not be."

He spent hours at a museum in Berlin, becoming captivated by the works of Rembrandt. Later at Stanford University, he earned a Ph.D. in electrical engineering but also found time for his newfound love, with a minor in art history.

Yet it was not until 2005, during a sabbatical from his job as a Cornell University engineering professor, that Johnson looked through the literature for ideas on how he could marry his two talents.

He discovered the work of Penn State's Wang and his wife, Jia Li, who were performing statistical analysis of Chinese paintings. At Princeton, math professor Ingrid Daubechies was pioneering the use of statistics to analyze images from various fields of science and medicine, such as MRIs. And at Maastricht University in the Netherlands, computer scientist Eric Postma had started to analyze the works of van Gogh.

Museums around the world had begun to digitize their collections to aid in conservation and research, but the notion of crunching those reams of data was in its infancy.

So Johnson approached the Van Gogh Museum and offered to organize a conference. In exchange for the use of high-resolution scans from dozens of paintings, the three university teams — Penn State, Princeton and Maastricht — would present their research at the event in Amsterdam.

Like most people, the museum officials were unfamiliar with the statistical techniques involved, but Johnson sold the deal.

"He can talk between the two sides," Wang says. "He is serving as a bridge."

■

Each team got 101 images from the Amsterdam museum and from another institution in the Netherlands, the Kröller-Müller museum. They included 82 that had always been identified as van Goghs, six non-van Goghs that had a similar style, and 13 for which the attribution had been questioned at some point.

A description of the technique is not for the faint of heart, but briefly speaking, it involves the use of "wavelets" — mathematical templates that identify characteristic patterns in the painting at a range of scales, from coarse to very fine.

Each team used a slightly different version of the method. Wang and Li, for example, decomposed the images into three components — horizontal, vertical and diagonal — while the Princeton team used six orientations.

Van Gogh's style changed over the years, so Wang and Li used a range of 23 representative paintings to "train" their computer program in what to look for.

The scans were in black and white to allay the museum's concerns that high-resolution color images would leak out to someone who might use them to make reproductions. Wang and Li represented each pixel as some number from zero (black) to 255 (white).

One finding was that when an artist had tried to copy van Gogh's style — whether honestly or with intent to pass off the work as authentic — the painting displayed telltale characteristics at a very small scale.

It wasn't something you could see with the naked eye, says Princeton's Shannon M. Hughes, a Ph.D. student in electrical engineering. But in small clusters of pixels, the computer revealed what she calls "wobbles."

"If someone was trying to copy someone else's work, you can imagine that he or she is probably painting more slowly, more tentatively," Hughes says. As the painter speeds up and slows down during a brushstroke, she speculates, he might deposit varying amounts of paint, whereas van Gogh's own works revealed no such pauses.

All three teams did better than average at picking the real thing. Using several variations of its approach, for example, Princeton correctly classified as many as 55 out of 65 van Goghs. Penn State also used an additional non-wavelet method that identified the outlines of brushstrokes.

All three presented their results at the conference last year. Their paper was published this month.

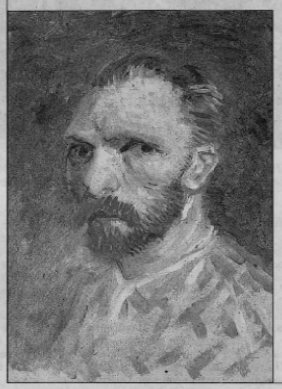
The research lends itself to more than just telling apart real van Goghs from others. The teams are now pursuing additional challenges, such as telling when certain works were painted. Art historians disagree on when to place three of van Gogh's canvases, either to 1888 when he was in Paris, or a year or two later when the artist painted in Arles and St. Rémy.

Other ideas might include analyzing images for certain shades of color or the shapes of objects they depict, Cornell's Johnson says.

It's all still in the rough stages, but as long as museums are amenable, he and his colleagues vow that they will continue.

"Every art historian who does attribution is going to tell you they can see the hand of the artist in the painting," he says. "Is there a way we can support that?"

Amsterdam, Van Gogh Museum (Vincent van Gogh Foundation)



Amsterdam, Van Gogh Museum (Vincent van Gogh Foundation)

Two errors the computer made: Gauguin painted the portrait of van Gogh, above, but the work was identified as van Gogh's. The van Gogh self-portrait, left, was mistakenly deemed to not be by him.

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