inspiring people

computer science

writing competition 2006/07

Winners

inspiring stories

Judges' Quotes

"I congratulate the EPSRC for organising this competition. Computers are a major part of all our lives and we need to inspire more young people to get involved with the computer industry. Encouraging writers and researchers to help us to explain the excitement of computer science can only be a good thing."

Professor Wendy Hall CBE FREng
Head of School
Electronics and Computer Science
University of Southampton

"It is not easy to describe how modern technology works – and what it can do for society – in a way that everyone can understand. As the entries for this award show, this is a skill that takes patience and dedication."

Professor David Howard
Head of Media Engineering Research Group
Department of Electronics, University of York

"Computer science has changed the world, but too often people see our discipline as dull and uninspiring. We must convey the excitement and profound importance of our subject. Great writing is an essential part of this and is a skill we need to foster. A competition like this is an excellent way to encourage and identify writing talent."

Professor Nigel Shadbolt
President, British Computer Society
Professor of Artificial Intelligence
University of Southampton

"The entries for the competition give fascinating insights into computer science research in the UK. They show that researchers can communicate their work to a wider audience. More researchers should join in the fun and tell the world what they get up to."

Michael Kenward OBE
Science Writer
Editor-at-Large, Science|Business

Computer science touches every aspect of modern life and yet research in computer science rarely makes it into newspapers or onto TV.

At home and at work, the invisible hand of computer science plays a role in almost everything we do. That influence will continue as research creates even more business opportunities and newer cultural phenomena.

We at the Engineering and Physical Sciences Research Council (along with our partner organisations, The Royal Academy of Engineering, the Institution of Engineering and Technology and the British Computer Society) knew that it is possible to write interesting articles about research in computer science.

Computer science is an enabling science whose mathematical origins are hard to explain. Its effects are both universal and staggering. And behind all of it there are some real human stories.

The Computer Science Writing Competition was EPSRC's way of encouraging people to write those stories and to explain their fascinating research to a wider audience.

We challenged professional writers and scientists to put into words not only why computer science research really matters but to tell us and you how it affects everyday lives. The winning essays presented in this brochure shows that we were right. With subjects that include systems that support people suffering from dementia, through the challenge of creating people friendly systems, to work on the nature of consciousness, these writers really have shown how much we owe to research in computer science.

Winner – Professional Science Writer

Computer-aided memories and the art of conversation

Multimedia computing can restore some of the pleasures of life to people suffering from dementia.

Paul Anderson

We all have what we jokingly refer to as 'senior moments'. We can't find our car keys, forget a word, or can't remember where we've met someone before. As we become older, this happens more often. In the back of our minds, we can't help wondering if it might be a sign of something a bit more serious.

For most of us, it isn't, but after the age of 65 there is a steep rise in the number of people who suffer from dementia, a serious and specific disease of the brain usually caused by a stroke or Alzheimer's disease. There is no cure for dementia, but in an EPSRC-backed project, a multidisciplinary team from the universities of Dundee and St Andrews has developed a way in which computer technology can support people with dementia and those who take care of them.

For Dr Norman Alm, a senior lecturer at the University of Dundee, this was a very human problem. "We were told that families would come along to visit their relatives and couldn't manage to have a conversation with them any more, and that it was awful for them," says Dr Alm. "And they said, you know, if you could find some way to restore, even in part, the enjoyment that the relatives used to have with the person, that would be great."

Dr Alm brought together a team of designers and software engineers from the University of Dundee and psychologists from the University of St Andrews. Together with input from care workers at Alzheimer Scotland's day centre in Dundee, they developed CIRCA, the Computer Interactive Reminiscence and Conversation Aid.

One problem for people with dementia is that they progressively lose their short-term memory. This affects their ability to undertake everyday conversations. They can't remember what happened a few minutes ago or they repeat things they've just said.

In the early stages of dementia, people are often aware that they make mistakes and are sensitive to how those around them react. This causes them to lose confidence and as a result many become quiet. But that only makes matters worse. By choosing to be quiet they exacerbate the problem.

Gabrielle Colston-Taylor, a project leader at Alzheimer Scotland's day centre, says: "When someone has Alzheimer's, their speech can become quite vague. You have to check – is that what you mean? Yes or No. It can take a bit of detective work. The two-way-ness of communication tends to disappear."

An established method for tackling this lack of conversation is reminiscence therapy. Typically, this involves using physical props (such as old photographs or memorabilia), painting or music therapy to bypass the short-term memory and to structure a conversation around the memories stored in the still-functioning long-term memory. However, although rewarding, such work can be enormously time consuming and difficult to organise in social care settings where there are considerable resource pressures.

CIRCA provides a multimedia version of established reminiscence techniques which carers or relatives can easily set up. In order to use CIRCA, the person with dementia sits with a carer and interacts with the computer software using a touch-screen display. Visually, the system works much like a website, with hyperlinks connecting items from old television programmes, films and popular songs.

The combination of sound, music, moving and still images is a key difference between CIRCA and traditional reminiscence therapy. The process works on different levels for different people, supporting their different abilities. The materials not only act as a memory aid, but also provide a 'psychological scaffold' within which the person can rely on their long-term memory to keep a conversation flowing. A picture of an old street scene with old cars and cafés, for example, can trigger a conversation about how they used to work in a café.

"It takes them on a journey that can vary each time, depending on what options they select," says Ms Colston-Taylor. "What was really remarkable was how competent people got at reaching out and touching the screen themselves to make changes. This is more than we expected them to do."

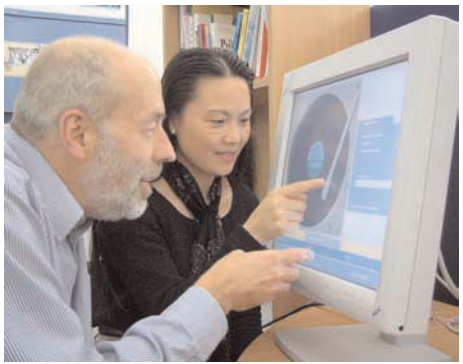
"Most technology used with people with dementia is about control, keeping them safe and avoiding risk, kind of like a monitoring thing," adds Ms Colston-Taylor. "This is a use of technology that is for pleasure and fun, and that also supports people. Dementia is such a distressing condition. If you can evoke a sense of well-being in someone with dementia, it's so valuable. It might not seem a lot, but if you can make someone smile for five or ten minutes, that's amazing."

For more information:

www.computing.dundee.ac.uk/projects/circa/

Paul Anderson

Paul Anderson is a writer and computer scientist. He has had a varied technology-related career as a software engineer, computer science researcher and university technology transfer officer. He is currently the Technical Director of Intelligent Content Ltd, where his role involves writing about technology, new ideas and the future. Paul writes bite-sized, easily digestible blog items at http://techlun.ch.



Joint Winner – Non-professional science writer

A model trapped in a robot's body

Research that hopes to create 'conscious' robots could help us to understand how our own minds work.

Jonathan Black

"You're not what you think you are," Owen Holland tells me. This idea will take some adjusting to. I always thought of myself as a pleasant, more-or-less rational, slightly skinny twenty-something, but, Professor Holland suggests, I could be just part of a simulation running in my own brain.

In order to keep track of my body and predict what might happen to it in the future, my brain runs a model of me, the world and my interactions with it. But the model is so convincing that I think it's the real thing – which means that my consciousness may actually be a sort of virtual reality. Shocking as it is, if this idea is right it may help Professor Holland to turn a cyclops made from plastic and bungee cord into a conscious robot.

The cyclops is CRONOS, the robot built by Professor Holland's team at the University of Essex with funds from the EPSRC for his research on machine consciousness. CRONOS looks strikingly mechanical and human at the same time. Its single-camera eye sits on a polymer skeleton. Through this wind elastic tendons and wiry nerves.

CRONOS moves around with the shearing sound of electric motors, but, as Professor Holland says, "It moves in a way that's spookily similar to our own." This is by design. Professor Holland believes that the sort of consciousness we develop depends on what our bodies are like, because we all build a model of ourselves within our brains. So if a conventional research robot, a "dustbin on wheels" as Professor Holland jokingly describes it, developed consciousness we'd never understand it. The robot's consciousness would just be too different from our own for us to be able to relate to it.

For CRONOS to take its place among the conscious, Professor Holland believes it will need an internal model like our own models of ourselves and the world. But how did we get our models?

Humans, it seems, don't learn everything just by exploring the world from birth. They come pre-loaded, as it were. "Basically we inherit the outlines of a model and we fill in the gaps", says Professor Holland. "The problem is that we simply do not know how much human beings are born knowing and how much they have to learn. And we've no idea how they learn what they're born not knowing."

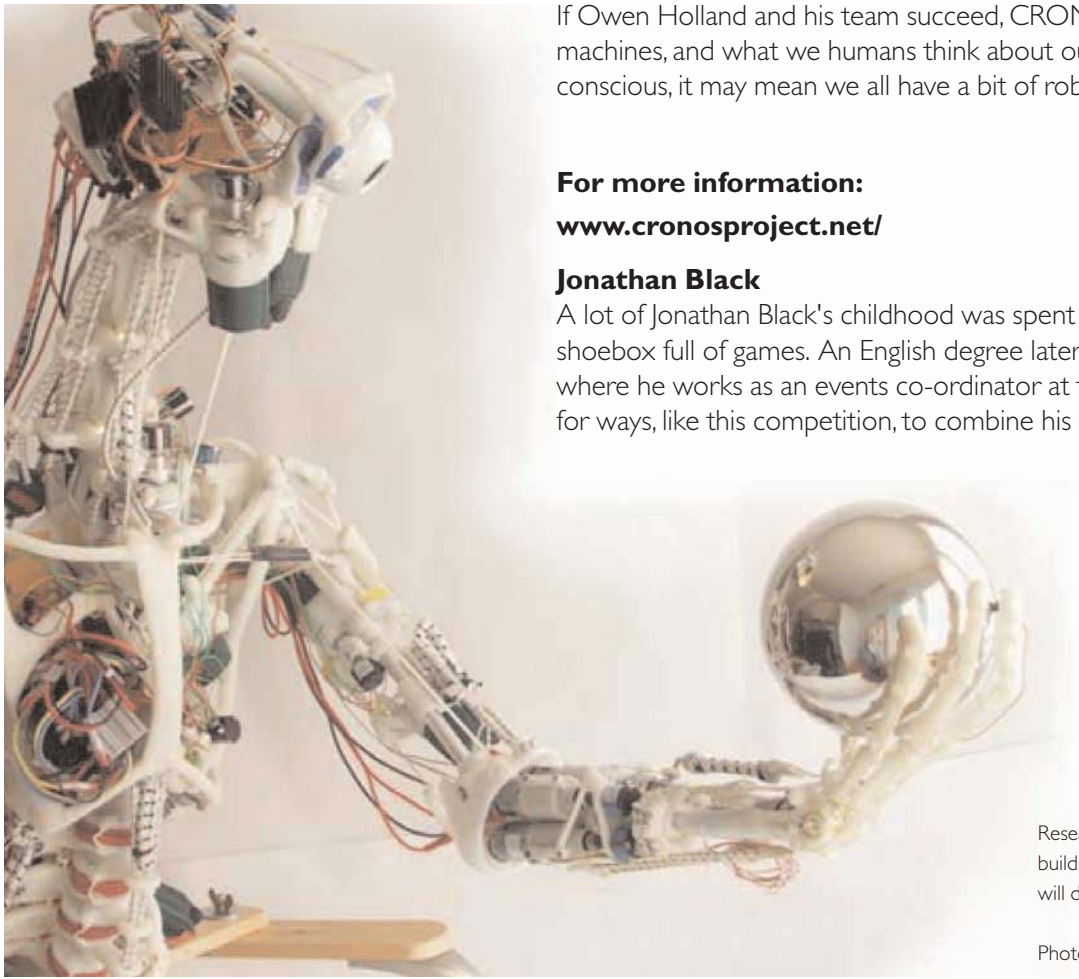
Professor Holland's team decided to teach CRONOS about physics. Our own physical models help us every day – say, when we pick up a box, or if someone tosses us a pen. To help CRONOS to build up a model like ours before trying it in the real world, Professor Holland and his team took software that makes the worlds in computer games obey Newton's laws, and endowed CRONOS with a model of its body. They then put simulated objects around the robot.

In these virtual surroundings, CRONOS can learn how much force it takes to pick up a particular object, for example. Later on, if the robot happens on a similar object in the real world, it can use its model to predict what to do.

The theory is that human consciousness emerged out of just this sort of model-based strategy for survival. We may not start life with a detailed model of the world, like that of computer game, but Professor Holland hopes that CRONOS will show that starting with a model can lead to something we might recognise as the beginnings of consciousness.

Even the robots might benefit from this research. Professor Holland warns that if we're going to have machines that are conscious in the way that we are, then we'll have to think about their quality of life. "If we, or someone else, succeed in producing the same kind of consciousness in a machine then, of course, it's potentially capable of suffering." Among the researchers who work on making conscious machines, he explains that there is a push to set down ethical guidelines now, while the field is still young.

Professor Holland is excited by the prospect that his research could bring us closer to understanding our own minds, and how they work. "My main motivation in doing this research is that I'd like to understand how consciousness arises. By trying to produce it artificially, we will gain some insight into consciousness. Even if we don't succeed, it's another way of looking at the problem."



If Owen Holland and his team succeed, CRONOS could change how we see machines, and what we humans think about ourselves. If CRONOS can be conscious, it may mean we all have a bit of robot inside us too.

For more information:

www.cronosproject.net/

Jonathan Black

A lot of Jonathan Black's childhood was spent with a Commodore 64 and a shoebox full of games. An English degree later, he left Canada for London, where he works as an events co-ordinator at the Royal Institution and looks for ways, like this competition, to combine his writing with his geekery.

Researchers are testing whether a robot that builds an internal model of itself and the world will develop signs of conciousness.

Photography: Van Cols Ltd

Joint Winner – Non-professional science writer

Who broke my TV?

Computer games can provide insights into how we could design computer systems that don't reduce users to tears.

Paul Curzon

My TV used to work. It was quite simple. Now I can barely use it. I bought a set-top box – a computer really. Now, there are times when I'm driven to tears. The buttons on the remote control that I understood yesterday do completely different things today. I even missed Dr Who. It recorded something else.

It was me who "broke" the TV of course, except it's not broken. It works perfectly. I just put it into the wrong mode, somehow. I also forgot to set a record channel before hitting 'record'. My fault. I keep making mistakes. I'm incompetent with gadgets. Lots of other people think they are too. But are we really the problem?

It turns out that computer games such as SpaceInvaders can help us to understand why we get things wrong. They can help us to answer such questions as: Why do we make mistakes even when we know the correct actions? Can we develop tools to detect in advance when gadgets will lead to people making errors?

These are among the questions we are addressing in the EPSRC Human Error Modelling Project at Queen Mary, University of London and University College London. The project brings together psychologists and computer scientists to investigate the causes of human error and to build that knowledge into tools to spot design problems.

One thing is clear, many of the errors we make are not random. They are systematic, in that they have underlying causes to do with our psychological processes. Ever forgotten to switch your

headlights off? Forgotten an original having taken the photocopy? Left your card in the chip-and-pin machine? These are some of the many everyday things we forget to do. Exactly when such errors will be made is unpredictable, but their having systematic causes means we can predict they will happen eventually.

All of these 'mistakes' are systematic in the sense that they have similar causes that are linked to our limited working memory. As Professor Ann Blandford an expert in human-computer interaction and an investigator on the project, points out "They all involve forgetting to do a 'tidying up' task after we have achieved our main goal, like arriving at the destination or getting the photocopy. We are more prone to forget such things than the goal itself. As our limited memory capacity fills, it is those extra things that we forget."

Design changes can and do reduce the likelihood that we will make these mistakes. That's why cash machines give back the card before the money, for example. Otherwise you could think that you have finished what you set out to achieve, getting the cash you came for, and forget that you have to recover your card.

One idea we are exploring in the project is that we can write systematic aspects of human behaviour as a mathematical model. Such a 'formal user model' is just a precise description of some of the systematic ways that experiments show people behave when interacting with a range of devices.

By combining the user model with a mathematical description of how a gadget behaves, automatic tools can do mathematical reasoning about the whole system. They can determine which errors people will make when they behave like the user model. The neat thing about such a tool is that it can explore all the possible interactions that result from the different types of behaviour described in the user model, and not just the sequence in the gadget's instruction manual.

A key idea is that the model is not describing erroneous behaviour itself. The behaviour could be right or wrong. The point is that it is plausible behaviour – there is a good reason to behave like that given a person's goals and knowledge at the time. It is only in the context of a particular device that it becomes either correct or faulty behaviour. With one device, an action could be wrong. With a better design it may be perfectly okay.

Where does a computer game such as SpaceInvaders come in? Games are a good way to investigate the situations where people systematically make mistakes.

The games we've used in our research range from the realistic – like a fire engine dispatch console simulation game – to fun arcade games like SpaceInvaders. By controlling the situations where the opportunities to make errors arise in the games, we can tease out their causes.

We can collect data from people playing these games in both lab conditions and in more natural situations over the internet. You can even try our SpaceInvaders experiment yourself (www.cs4fn.org/humanerror/). Will you always remember to switch on your gun after rescuing an astronaut, how ever often you play? You know now that you have to!

So, if you thought video games were nothing but bad news – the sign of wasted youth – think again. They are helping computer scientists understand how to design tools to help ensure both everyday and safety critical technology is easier to use.

Computer Science is more than just understanding computers. To design computers that are usable you have to understand people too. Poorly designed technology may be no more than irritating if it just means you fail to record Dr Who. When it leaves whole swathes of people believing they can't use computers it is a problem for society. When the gadget concerned is in an emergency dispatch centre, design that ignores the causes of human error could kill.

For more information:
Paul Curzon (pc@dcs.qmul.ac.uk)

Paul Curzon
Paul Curzon is a Reader of Computer Science at Queen Mary, University of London. His cs4fn website (www.cs4fn.org) created with Peter McOwan aims to enthuse people about the fun side of computer science. His research mixes formal methods and interaction design. He loves teaching from Primary School to PhD level.

Winner – Third prize

I know you got soul

Musicians and computer scientists are working together to build creative musical machines

Kerri Smith

The audience applauds as two jazz musicians take to the stage. Poised with saxophone and trombone, they begin to improvise – in three parts. The mystery third performer may not look like your average musician, but it can certainly play like one.

Behind the players with their instruments stands a computer screen. But this third member of the trio isn't any old computer, called Swarm Music, it can be creative and interactive and can do things that have always been considered uniquely human traits.

The screen displays a cube-shaped structure, crowded with colourful dots that move in time with the music. The colourful moving dots that are the key to its amazing 'improv' ability.

When a musician plays a note, the computer translates it into a dot in the cube-shaped space on the screen, positioning it in 3-dimensional space according to its pitch, volume and duration. Each of these features of the note corresponds to a different axis of the cube, so each different note has its own unique space. The computer generates a 'swarm' of other particles that are drawn to these dots, and then turns the swarm's movement into musical output, choosing one swarm particle at random to play from its synthesizer.

Naturally organised

Tim Blackwell, a computer scientist and keen saxophonist at Goldsmith's College, London, is the brains behind the tuneful technology. He believes that we can draw parallels between music and patterns in nature. When birds flock or insects swarm, he says, they organise themselves in a similar

way to the notes that musicians play when they improvise a new piece. There's no leader or master plan for their movement, they just organise themselves into a pattern as they go along.

"Music is self-organising," says Tim. "It involves patterns, repetition, and variation. When I came across these swarm animations, they struck me as very musical."

The rules for the swarm's particles are simple, gravitate towards the centre of your swarm, don't crash into other particles, and aim for particular targets. In this case the targets are the larger coloured blobs that represents notes played by the other musicians.

Blackwell and his colleague Michael Young, of the Department of Music at Goldsmith's, are developing their idea as part of an EPSRC-funded research network called Live Algorithms for Music (LAM). The idea is to produce computers that don't need telling what to do in musical terms. They can work independently and can interact with human performers, providing novel components to inspire the musicians.

Computers aren't totally new to live music. But previously musicians controlled them, or called upon computers to produce predictable accompanying tracks for human performers.

Blackwell's 'swarm music' goes beyond this subordinate level. He wants LAM computers to be "able to collaborate, rather than just being slaves," he says. Crucially, the algorithms don't just react to the musical inputs in the same predictable and programmed way. Instead LAM's algorithms do the silicon equivalent of the listening, playing and musical thinking of a human performer.

Creative computing

LAM's music may be an acquired taste. But it raises the question, if computers can jam quite happily on their own, what else might they be capable of?

Staying in the musical domain, LAM could offer a solution to 'composer's block'. "It could be an ideas generator," Blackwell suggests. "You play ideas in, and the computer finds permutations, or gives you further ideas for developing your song."

Blackwell is aware of the commercial potential of his machines for amateur and professional musicians. "Computers have really opened up the world of recording to everyone," he says. It could even help to launch the next generation of artistes who, like the Arctic Monkeys or Sandi Thom, hope to make a name for themselves on the internet. "Many artists make their first hit record in their bedroom. So I definitely feel there's a market there," says Blackwell.

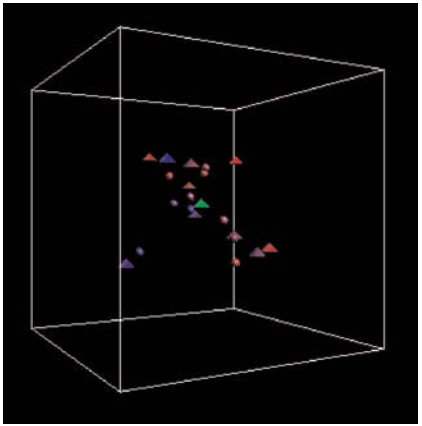
The new breed of computer needn't stop at helping humans to be more musical. Blackwell is already developing swarms that interact not with humans but with other swarms, to produce entirely computer-generated tunes that have no input from people at all.

This creative capacity could also have applications in other realms. The research behind LAM might hint at ways to give computers other faculties, even consciousness. Or they could help us to understand traits such as creativity and innovation in people. "It's the classic challenge of artificial intelligence," says Blackwell, "of trying to get a machine to respond and behave like a human."

For more information:

www.timblackwell.com

Kerri Smith
Kerri Smith is a science writer and podcast editor at Nature. She has an MSc in Neuroscience from the University of Oxford and another in Science Communication from Imperial College London. "One of the best things about working at Nature is hearing how enthusiastic researchers are about their work, and being able to convey their passion to others," she says.



A swarm in action. Coloured triangles represent the musicians' notes, the spheres are the computer's responses.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