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Hall of Fame news

Hall of Fame Awards

We are now accepting nominations for the 16th Hall of Fame awards.

The awards take place annually to celebrate the success of companies founded by Computer Laboratory graduates and staff.

Category 1 – Company of the Year: the company must be a member of the Ring Hall of Fame. If a company is eligible but not currently listed, please contact us to ensure that it gets added.

Category 2 – Product of the Year: the product concerned must have been released commercially in the calendar year 2019 (or the previous 3 years), and principally developed by the company itself. The product must be hardware, software, licensable technology, or a service.

Category 3 – Better Future Award: recognises significant humanitarian, philanthropic or social enterprise work done by CL graduates and staff in 2019.

The winners of last year's awards were:

1. Company of the Year: PolyAI
2. Product of the Year: Pur3 Ltd for Pixl.js
3. Better Future Award: Gemma Gordon for her work on bridging virtual reality with climate change education in the LABSci Imagine project.

If you wish to submit a nomination for any of the categories, please send nominations (explaining why you have nominated the company or product) to ring-organiser@cst.cam.ac.uk. Nominations close on 7th February 2020.

Ringlet Events

Six Ringlet events take place each year in London and California. They are scheduled to take place in February, April, June, August, October and December in 2020.

For further details see:

www.cst.cam.ac.uk/ring/events

Ring Dinner and Hall of Fame Awards Ceremony

The Cambridge Ring dinner and Hall of Fame Awards ceremony will be held at Queens' College on Thursday 2nd April 2020.

The winners will be announced by Professor Ann Copestake, and the awards will be presented by guest speaker Steve Pope, Engineering Fellow at Xilinx Inc.

There will be a pre-dinner lecture from 5.15pm, given by Dr Marwa Mahmoud at the William Gates Building. Dr Mahmoud is an Affiliated Lecturer at the Department of Computer Science and Technology.

Drinks will be served at Queens' College from 7:00pm, with dinner served at 7:30pm.

Information on how to book tickets for the Ring Dinner will be sent out soon.

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Web: <http://www.cst.cam.ac.uk/ring/>

E-mail: ring-organiser@cst.cam.ac.uk

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News from the Department

Srinivasan Keshav appointed to the Robert Sansom Professorship

Professor Srinivasan Keshav joined the University of Cambridge as the Robert Sansom Professor of Computer Science with effect from 1 October 2019.

At Cambridge, Professor Srinivasan Keshav will work broadly on using techniques and technologies from computer science to encourage the adoption of renewable energy, reduce the carbon footprint of legacy systems, and to combat climate change. He will also continue his work on scalable blockchains and the use of blockchains in energy.



Professor Keshav's research focuses on computer communication networks and systems. His career began with undergraduate study at the Indian Institute of Technology in Delhi, and a PhD at the University of California, Berkeley.

After completing his PhD, Keshav joined the research staff at Bell Labs and held visiting faculty positions at IIT Delhi and Columbia University, before becoming an associate professor at Cornell University. In 1999 he left academia for a few years to co-found the software company Ensim Corporation. He returned to academia to take up the Canada Research Chair in Tetherless Computing at the University of Waterloo in Ontario from 2004 to 2014.

He also held the position of Cisco Systems Chair in Smart Grid at the University of Waterloo between 2012 and 2017.

Professor Keshav initiated KioskNet, a system that provides internet access in developing countries. He developed this project with students at the University of Waterloo. Keshav has authored two textbooks on computer networks: *An Engineering Approach to Computer Networking* (1997) and *Mathematical Foundations of Computer Networking* (2012). Both books are prescribed for the Computer Science tripos at Cambridge. He was also the Chair of ACM SIGCOMM from 2013 to 2017.

Cambridge students excel in European programming contest

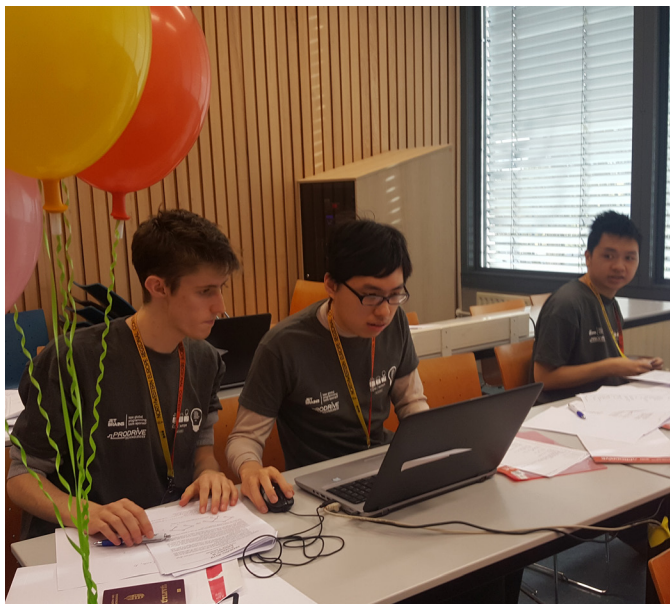
Three teams of Cambridge students enjoyed success at the Northwestern Europe Regional Contest (NWERC) in Eindhoven in November.

The Cambridge teams were amongst the most successful at the contest, coming in second, seventh and eighth place among 123 teams. The annual competitive programming contest sees teams of up to three university students aim to design algorithms to solve programming problems.

Team Treeniceratops, consisting of Maja Trela, Kacper Walentynowicz and David Wörn, finished second. They will attend the world final in Moscow between 21 and 26 June next year. Triniceratops (with a slightly different team composition and name) also excelled last year in the 2018 contest and placed first in the national round.

Team ??! placed seventh, and is made up of Dušan Živanovic, Vladimir Milenkovic and Dimitrije Erdeljan. Teammates Jeck Lim, Zoltán Molnár Sáska and Choong Yin Howe make up the third Cambridge team Treenity, which came eighth.

All three teams have strong ties with Trinity College, with all team members being either current or former students of the college. Two of the teams, Triniceratops (with a slightly different team composition and name) and Treenity, also excelled last year in the 2018 contest and placed first and second in the national round.



Team Treenity hard at work during the competition

The Northwestern Europe Regional Contest is part of the larger global International Collegiate Programming Contest (ICPC), a long-running contest that was established in 1977 and sees tens of thousands of participants every year. Participating teams represented sixty universities from ten countries, including the UK, Ireland, Germany, Sweden and the Netherlands.

These three teams also gave an excellent performance in the national round of this high-profile programming competition, which was held a few weeks ago in October and was hosted at the Department's own William Gates Building. Their success in the national round led to entry in the Northwestern Europe round, the semi-final, held in Eindhoven in November.

After winning second place in the Eindhoven semi-final, Team Treeniceratops has qualified for the world final, which will be held in Moscow next June. All the Cambridge teams received gold and silver medals.

PhD student Andrej Ivaskovic supported the teams as a coach, and helped organise the national round in Cambridge.

"I am very proud of the results of the Cambridge teams. They are all experienced competitive programmers, as many of them have previously competed in this contest and other competitive programming events.

There are many skills that need to be juggled in order to achieve top results such as these. Coding, problem solving and proficiency with algorithms are expected, but time management and teamwork are essential. This is reinforced by the unique scoring system at these kinds of contests, which is based on time taken to solve a problem and the number of incorrect submissions for any given problem.

The competition was hard this year: there were 11 problems that the contestants attempted in the span of five hours, and no team managed to solve more than nine. One question did not have a single correct submission by any of the teams.

I am delighted to say that I supervised a majority of the Cambridge participants in some of their undergraduate subject, who have shown a high level of academic aptitude and responsibility as well."

Alumni News

Alumna Rana el Kaliouby named in BBC's 100 influential women of 2019

Rana el Kaliouby is an AI pioneer and entrepreneur who works on artificial emotional intelligence. Dr el Kaliouby studied for her PhD in the Department of Computer Science and Technology, and co-founded the startup Affectiva ten years ago, which built on her PhD research. She has been recognised in the BBC's list of inspiring and influential women of 2019.

Alumni Careers

Marko Balabanovic (BA Computer Science 1990) has been appointed Head of Innovation and AI at Medopad, a digital health company in London working to help people live longer, healthier lives.

Company spotlight: lowRISC

lowRISC is a not-for-profit company that uses collaborative engineering to build open source silicon designs and tools.

lowRISC is a spin-out from the Department of Computer Science and Technology, and is based in Cambridge.

Dr Robert Mullins, Reader in Computer Architecture in the Department, is a director and co-founder of lowRISC. Co-founders Dr Gavin Ferris and Alex Bradbury are also alumni of the Department, as are several members of the engineering team.

Open Titan project

On 5th November lowRISC launched the OpenTitan silicon root of trust (RoT) project. OpenTitan is a new effort built using the successful collaborative engineering model created by lowRISC in partnership with Google and other commercial and academic partners.

This effort sets a new bar for transparency in trusted silicon. lowRISC will serve as both steward and not-for-profit engineering contributor to OpenTitan, the world's first open source silicon RoT.

Silicon root of trust chips increase trust in the integrity of the infrastructure on which software runs. They can be used in a variety of devices: server motherboards, network cards, laptops, phones, consumer routers, IoT devices, and more. Potential security benefits from a silicon root of trust include:

- Establishing trust at the lowest level in the system - the silicon; independent of the main processor and operating system.
- Leveraging a secure foundation to ensure the integrity of the lowest level mutable firmware of the device.
- Giving the device a cryptographically strong identity. For example, this enables a datacenter control plane to verify provenance before a new machine is admitted into the fleet.

- Enabling secure storage, including physical attack resistance (e.g., a server in a third-party datacenter or moving through the supply chain).
- Providing tamper-evident logging, integrity measurements, integrated universal 2nd-factor devices, and other security services.

Open sourcing the silicon design makes it more transparent, trustworthy, and ultimately, secure.

Prof Andy Hopper appointed Chair of the Board

Professor Andy Hopper, CBE FRS FIET FREng, has joined the lowRISC Board of Directors as Independent Chair.

“I’m delighted to be joining lowRISC CIC,” said Professor Hopper. “As digital systems pervade every aspect of our lives trust and transparency become crucial. An open source approach allows for public inspection of the principles and implementations being used. I believe the future of digital systems will be underpinned by not for profit organisations that provide design transparency and enable real innovation. I am putting all my weight behind lowRISC because it is an indispensable component of our digital world.”

Andy Hopper is Professor of Computer Technology at the University of Cambridge, and was Head of the Department of Computer Science and Technology from 2004 to 2018. He is Treasurer and Vice-President of the Royal Society and a pivotal figure in the UK technology scene.



He was the Research Director of Acorn Computers from 1979-85, during which period the pioneering ARM1 RISC processor was developed.

Using deep learning to improve Parkinson's diagnoses

Professor Pietro Lio' and Devin Taylor

A paper presented at a Top Machine learning conference (Neurips 2019) in Vancouver addresses the problem of integrating very different medical evidences to predict early onset of neurological diseases such as Parkinson's and Alzheimer's.

Neuropathologies are complex systems depending on genotypic information such as genomic variants based on ethnicity, methylation patterns depending on inflammation and on lifestyle and other phenotypic factors.

Devin Taylor, who received high marks with Distinction in the ACS MPhil, has been able to show that a combination of deep learning and bioinformatics approaches could put together very distant data such as radiological image data and methylation data (for example obtained from lymphocytes in the blood) to obtain a better estimate of the severity of Parkinson's and an early diagnosis. Another important result has been an improvement in interpretability.

This study makes use of the Parkinson's Progression Markers Initiative (PPMI) database. PPMI is a longitudinal observation study with several hundreds of patients and healthy controls designed to identify Parkinson's biomarkers. The database consists of multiple modes of data, however, this study focuses on Single-Photon Emission Computed Tomography (SPECT) images of the brain and the corresponding DNA methylation (DNA-m) data. DNA-m data has been found to predict

the average biological age of the person; in particular in neuropathologies the ageing is accelerated. The method developed by Devin could also be used for an improved determination of the biological age.

Deep learning pervasiveness in all fields of medicine is hampered by low interpretability. Here Devin has introduced a complex model embedded in the deep learning architecture called Multi-Head Co-Attention Model (fig 1). This has led to an improvement in the result interpretation and a better evaluation of the potentialities and limitations in personalised medicine.

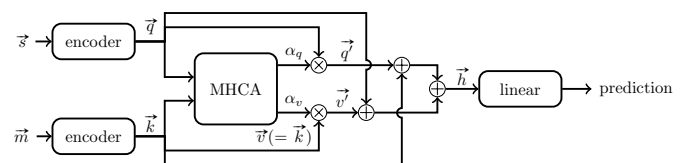


Figure 1

Although the methodology focuses on a Parkinson's case study, it offers opportunities to generalise to other complex diseases and comorbidities.

Neil Lawrence appointed first DeepMind Professor of Machine Learning

Following an international search, Professor Neil Lawrence has been appointed as the inaugural DeepMind Professor of Machine Learning at Cambridge, supported by a benefaction from the world-leading British AI company.

Professor Lawrence joins the University's Department of Computer Science and Technology from Amazon Cambridge, where he has been Director of Machine Learning for the past three years. He is also Professor of Machine Learning at the University of Sheffield, where he will retain a visiting position.

Professor Lawrence's research interests are in probabilistic models with applications in computational biology, personalised health and developing economies. At Sheffield, he led the ML@SITraN group, and helped to develop an Open Data Science Initiative an approach to data science designed to address societal needs.

"There's so much expertise at Cambridge, in all aspects of systems and data: that's why I'm so excited about joining," Lawrence said. "AI and machine learning have the potential to reshape almost every aspect of our lives, but we desperately need more machine learning specialists, or else the promise of AI will not be realised."

Professor Lawrence completed his PhD at Cambridge's Department of Computer Science and Technology in 2000. He has previously held positions at Microsoft Research Cambridge and the University of Manchester. In addition to his academic research, he hosts the Talking Machines podcast and is a contributor to the Guardian.

For the past five years, Professor Lawrence has been working with Data Science Africa, an organisation looking to connect machine learning researchers in Africa in order to solve problems on the ground. Professor Lawrence has an advisory role with the group, and says that many of the machine learning approaches used in Africa can have benefits in the developed world as well.

"With data and machine learning, you can have a more advanced data infrastructure in Africa than in some developed countries," he said. "It's rare in the UK or Europe that you're asked to look at a machine learning problem from end to end, but you can do that in Africa, and it leads to better solutions. That's the kind of approach I want to take to machine learning in my work at Cambridge."

Demis Hassabis, co-founder and CEO, DeepMind, said: "I'm delighted to see Cambridge announce its first DeepMind Professor of Machine Learning. Professor Lawrence's work



in computational biology and his thoughtful advocacy for advancing technology in the developing world have been commendable. It's an honour for DeepMind to be able to support the Department of Computer Science and Technology - from which I gained so much - in this way, and I look forward to seeing machine learning and AI flourish at Cambridge."

"Neil will have a transformative effect on machine learning and artificial intelligence research at Cambridge," said Professor Ann Copestake, Head of the Department of Computer Science and Technology. "He will build on our existing strengths in this area, and work with colleagues from across the University to develop new solutions in ethical and sustainable ways."

"It is vital we have a deep pool of talented scientists in universities and industry so the UK can continue to be a world leader in artificial intelligence, said Minister for Digital Mark Warman. "This Government is investing millions into skills and talent training, including a number of Turing AI Fellowships in partnership with The Alan Turing Institute, and I welcome the appointment of Professor Neil Lawrence as the inaugural DeepMind Professor of Machine Learning at Cambridge. This is one of a range of moves demonstrating the enormous strength of the UK's research base."

In addition to the gift to support the DeepMind Professorship, the company are also supporting four Master's students from underrepresented groups wishing to study machine learning and computer science at Cambridge. The first students supported through this programme will be starting their studies this coming term.

Cambridge Zero

By Sarah Collins

Cambridge Zero, the University's ambitious new climate initiative, will generate ideas and innovations to help shape a sustainable future

Cambridge is the brand-new holder of a dubious record. On 25 July 2019, the temperature at the University's Botanic Garden hit a new all-time record high for the UK: 38.7°C.

Few expect this record to hold for long. As temperatures rise globally, extreme weather events – floods, storms, droughts and heatwaves – are becoming the new normal. The Intergovernmental Panel on Climate Change (IPCC) has clearly articulated that, if this continues, we risk venturing into a world of climate-driven food shortages, water stress, refugees, species loss and catastrophic shocks such as the collapse of the vast polar ice sheets.

Scientists have been warning for decades that man-made climate change is happening. But with a few exceptions, we have done little about it. In the past 18 months, however, there has been a noticeable shift.

“The basic science hasn't changed: what is starting to change is public opinion,” says Dr Emily Shuckburgh (pictured), one of the UK's leading climate scientists. “As the impacts of climate change are starting to be felt around the world, it's finally cutting through that we need to do something and we need to do it now. If we are to avert a climate disaster, we must sharply reduce our emissions, starting today.”

Shuckburgh recently joined the University from the British Antarctic Survey to lead an ambitious new programme: Cambridge Zero. The programme will harness the full breadth of the University's research capabilities across the sciences, engineering, humanities and social sciences to respond to climate change and support the transition to a resilient, sustainable future.

Cambridge Zero is not just about developing greener fuels, technologies and materials. It's about addressing every aspect of a zero carbon future: the impact it will have on our lives, our work, our society and our economy, and ensuring decisions are based on the best available knowledge.



Dr Emily Shuckburgh is Reader in Environmental Data Science at the Department of Computer Science and Technology

By developing a bold programme of education, research, demonstration projects and knowledge exchange focused on supporting a zero carbon world, the initiative's ambition is to generate and disseminate the ideas and innovations that will shape our future – and to equip a future generation of leaders with the skills to navigate the global challenges of the coming decades.

Its launch comes a few months after the UK became the first major world economy to legislate for net zero emissions. Eliminating greenhouse gas emissions by 2050 will mean a fundamental change over the coming decades in all aspects of our economy, including how we generate energy, and how we build decarbonisation into policy and investment.

See more about Cambridge Zero at <https://www.zero.cam.ac.uk/>

Sarah Collins is Communications Manager for the School of Technology.

AI for Environmental Risks Centre is launched



The Centre for Doctoral Training in Application of Artificial Intelligence to the study of Environmental Risks (AI4ER) was formally launched on Monday 30th September.

AI4ER is a partnership between the University of Cambridge and the British Antarctic Survey, and is funded by UK Research and Innovation (UKRI).

The launch of the AI4ER Centre for Doctoral Training was marked by an evening lecture, given by world-leading AI engineer Shakir Mohamed from Google DeepMind, and hosted at the Department of Computer Science and Technology. In this lecture, Shakir provided an insight into the current state of AI, and its future trajectory, with a focus on how these tools can be used to help tackle the greatest environmental challenges. The lecture was followed by a drinks reception.

Cambridge is a world leader in artificial intelligence and machine learning research, and many of our AI researchers work alongside world leaders in environmental monitoring and modelling, including from the British Antarctic Survey and elsewhere at the University.

The centre combines this work with the interests of dozens of external partners including Microsoft, DeepMind, The European Development Bank, Friends of the Earth, the European Space Agency, the Environment

Agency, resource industry leaders and policy partners, to form an outstanding alliance focused on leading the next generation of environmental data science forward.

The AI4ER Centre for Doctoral Training is co-directed by Emily Shuckburgh (Department of Computer Science and Technology), Scott Hosking (British Antarctic Survey) and Rich Turner (Department of Engineering).

Climate risk, environmental change and environmental hazards pose some of the most significant threats we face in the 21st century. At the same time, we have increasingly larger datasets available to observe the planet, from the atomic scale all the way through to global satellite observations.

The new Centre brings computer scientists, mathematicians and engineers together with environmental and geoscientists to train the next generation of thought leaders in environmental data science. They will be equipped to apply AI to ever-increasing environmental data and understand and address the risks we face.

Cambridge collaborates with Arm to improve computer security

£190m programme will create new CHERI-ARM CPU

A team of researchers at the Department of Computer Science and Technology are working with Arm and others to radically update the foundation of today's insecure digital computing infrastructure, funded by a new £190m UKRI Digital Security by Design (DSbD) programme. The UKRI will provide £70m funding and this is expected to be matched by up to £117 million from industry, from companies including Google and Microsoft.

Mainstream computer systems are chronically insecure. Conventional hardware instruction sets and the C/C++ programming languages, dating back to the 1970s, provide only coarse-grained memory protection. This turns many coding errors into exploitable security vulnerabilities.

CHERI is an ongoing research project that revises the hardware/software architectural interface with hardware support for capabilities that can be used for fine-grained memory protection and scalable software compartmentalisation.

CHERI has been developed over a 10-year research project, led by Principal Investigators Robert N. M. Watson, Simon Moore, and Peter Sewell at the University of Cambridge Department of Computer Science and Technology, and by Peter G. Neumann at SRI International.

CHERI aims to provide practically deployable performance and compatibility for software, as well as being microarchitecturally viable for mainstream architectures and microarchitectures. CHERI is a hardware-software-semantics co-design project, combining hardware implementation, adaptation of mainstream software stacks, and formal semantics and proof.

The mainstream processor technology in all mobile phones and tablets is based on the Arm architecture. The Digital Security by Design programme will explore ideas for updating the Arm processor technology to include

new security technologies based on CHERI. This aims to demonstrate that many of the security attacks that plague modern systems can be prevented.

Arm, funded by the programme, will create a hardware platform prototype called "Morello", in which a mainstream high-performance processor and software stack is enhanced with CHERI security technologies. The programme will fund additional work around CHERI experimentation and prototyping through open calls from Innovate UK, EPSRC, and ESRC, and will support industrial transition and academic research around the prototype.

As part of Digital Security by Design, in a £2.7m Innovate UK grant, the University of Cambridge team (with colleagues at the University of Edinburgh, Arm, and Linaro) will develop formal models and machine-checked mathematical proofs to confirm that the new design does provide the intended security properties.

The team will validate and evaluate design choices in Morello by adapting the experimental CHERI software stack, which includes CHERI versions of the open-source FreeBSD operating system and applications such as WebKit, to the platform. This is the first time that formal proof will have been applied to the security of a mainstream architecture, or that real-world C/C++-language software will have protected at scale with an industrial-scale capability processor.

The UK Government will work with Arm as part of a broader Government plan to improve digital security and protect British businesses and data.

Digital Security by Design should enable mass-market adoption of CHERI, taking it from academic prototypes to industrial systems, and improving the security of the devices we all depend on.

Project that combats fake news wins ERC Grant

Dr Andreas Vlachos wins an ERC Grant for AVeriTeC, which will revolutionise automated fact checking

Dr Andreas Vlachos has been awarded an ERC Consolidator Grant for the project “Automated Verification of Textual Claims” (AVeriTeC).

AVeriTeC will transform automated fact checking in fields including politics, economics and science, by enabling the verification of more complex claims than previously attempted.

Verification of textual claims is the task of assessing the truthfulness of a statement in natural language. It is commonly conducted manually by journalists on claims made by public figures such as politicians, with the aim of reducing misinformation.

However, the proliferation of social media has created the need to apply verification to a larger volume of claims coming from a greater variety of sources, thus calling for automation.



Dr Andreas Vlachos is a Senior Lecturer at the Department of Computer Science and Technology. His research specialisms include machine learning, natural language and computational journalism.



Research in automated verification of textual claims is at an early stage. The methods developed either assess the truthfulness of the claim without considering evidence, or handle very simple claims such as “the UK has 3.2 million EU immigrants” that requires the retrieval of a single factoid from a knowledge base. While useful, claims are often more complex, and taking evidence into account is necessary in ensuring the verdicts are credible.

AVeriTeC will revolutionise automated fact checking by enabling the verification of highly complex claims, which require multiple pieces of evidence, such as “the United Kingdom has ten times Italy’s number of immigrants”.

Dr Vlachos’s team will achieve this by developing methods able to generate multiple questions per claim, retrieve answers from both knowledge bases and textual sources, and combine them into verdicts. As these tasks are interdependent, they will develop novel machine learning approaches able to handle them jointly, so that the verdicts are accompanied by suitable justifications in the form of questions and answers.

Answers generated by the fact checking process will be formulated in natural language, to ensure that the process is transparent and explainable to users. The evidence provided for the process of verification can be useful in itself.