The Ring

Issue XXXVIII— January 2015

Ring news

Bay Area Ringlet

The second California Bay Area Ringlet was held on October 29th 2014 at Cereceria de MateVeza, a small microbrewery in the Mission District. Unbeknownst to event organiser Sunil Shah, this was the same night that the San Francisco Giants played the Kansas City Royals in the deciding match of the World Series (the Giants won).

Despite strong competition from the baseball game, around 30 Ring members came from far and wide (some from as far afield as Sacramento and Santa Cruz) to catch up with old friends, meet new ones and enjoy the bar's craft beer. Moreover, the event was attended by a broad range of age groups, the youngest attendee being under a year old (a future Cambridge student perhaps?), the oldest graduated in the 1970s.

The next event will be in the South Bay area in February, and Sunil's hoping for a good turnout.

If you have any suggestions for the next event, please email cam–ring@cl.cam. ac.uk.

Hall of Fame Awards 2015

The 11th Cambridge Ring Hall of Fame Awards celebrate the success of companies founded by Computer Lab graduates and staff. The winners will be announced at the Annual Dinner at Queens' College on March 25th 2015.

The award categories, along with the names of last year's winners, are:

1. Company of the Year (DeepMind Technologies)

2. Product of the Year (Masabi for JustRide)

3. Publication of the Year (Jaroslav Sevcík, Viktor Vafeiadis, Francesco Zappa Nardelli, Suresh Jagannathan, and Peter Sewell for "CompCertTSO: A Verified Compiler for Relaxed-Memory Concurrency'")

The judges can only make decisions on the information you give so please do be as detailed as you can.

Tell us who deserves recognition in 2015.

To make your nomination email cam–ring@ cl.cam.ac.uk

Nominations close at midnight on February 1st 2015.

Events calendar

2015

February

Thursday 5th, 6pm
London Ringlet

March

Wednesday 25th, 7pm
Annual dinner
Queens' College
Master of Ceremonies: Professor Andy Hopper CBE
Guest speaker: Demis Hassabis, co–founder DeepMind Technologies

Admission by ticket only
Contact cam-ring@cl.cam.ac.uk

April

Wednesday 1st, 6pm
London Ringlet

June

Wednesday 3rd, 6pm
London Ringlet

August

Tuesday 4th, 6pm
London Ringlet

October

Thursday 1st, 6pm
London Ringlet

December

Tuesday 1st, 6pm
London Ringlet

Who's Who

Kirsten Achtelstetter (N MA07) is acting Head of Technology at Mandara Capital.

Mohamad Afshar (K PhD98) is a VP at Oracle where he leads the product management team for Exalogic Elastic Cloud, Oracle Virtual Assembly Builder and Oracle Nimbula Cloud Director.

Stephen Allott (T BA80), Crown Representative for SMEs at Cabinet Office, was a speaker at the 'Trin Talk: Great Expectations' series. Stephen's talk detailed his experiences working in four global technology companies: Sun, Micromuse, Red Gate, and now Criteo. You can view the talk at: https://www.youtube.com/watch?v=lhuHEZ4wRDM

Jacob Andreas (CHU MPhil13) is doing a PhD at the University of California, Berkeley.

John Appleby (R MA98) is global head of SAP HANA at Bluefin Solutions.

Kai Arulkumaran (K BA12) is doing a PhD in Bioengineering at Imperial College London.

John Bates (G PhD94) is Chief Marketing Office and a member of the Group Executive Board at Software AG.

Bruno Bowden (Q BA00) is an equity partner at Data Collective in the San Francisco Bay Area. Data Collective is a venture capital fund that invests in entrepreneurs building Big Data companies

Omi Reza Chowdhury (PEM BA12) is a senior software at CA Technologies in New York.

David Cleevely (PhD82), founding Director Centre for Science and Policy at the University of Cambridge, has been appointed Chairman of the Board of Trustees of the Raspberry Pi Foundation. David is also Chairman of Raspberry Pi (Trading) Ltd.

Peter Conn (TH BA13 MEng14) is now working at Morgan Stanley as a technical analyst.

Ben Elliott (CL BA14) is a software engineering intern at UCL's interdisciplinary Extreme Citizen Science research group.

Mark Frey (G MPhil08) is a consultant at ERM Information Solutions in the San Francisco Bay Area.

Chris Galley (CHR MA87) is CTO at accesso.

John Garbutt (CC MA06) has recently joined Rackspace where he is principal engineer.

Gray Girling (Q PhD83) is now Engineering Principal at NXP Semiconductors.

Luke Halliwell (T BA01) is a senior software engineer at PDI/Dreamworks in the San Francisco Bay Area.

Dafydd James (R BA03) is CTO at nakedhearts.

Martin Kleppmann (CC BA06) is currently writing 'Designing Data–Intensive Applications.' You can find out more about the book at http://dataintensive.net/

Rich Mahoney (SE PhD94) is the director of the robotics program at SRI International.

John Mathieson (T BA81) is now Director of Automotive Product Architecture at NVIDIA in the San Francisco Bay Area.

Ronjon Nag (W PhD88) is the 2014 winner of the Mountbatten Medal. The Mountbatten Medal celebrates individuals who have made an outstanding contribution, over a period of time, to the promotion of electronics or information technology and their application that benefits the UK.

James Oldfield (BA04 Dip05) is working as a technical consultant at Cubica Technology.

Simon Osidero (F MA99) is the AI Architect at Flickr in the San Francisco Bay Area.

Christoph Siegert (CC PhD08) is working at Keystone Strategy in San Francisco.

Neil Taylor (CL MA79) is a software engineer at Thales e–Security.

Chris Waring (MA05) is a consultant at Thornhill Willow.

John Wilkes (PEM Dip79 W PhD82) is working at Google in Mountain View, California.

Hubbub

Jonathan May talks about crowdfunding for education and social good.

TR: What prompted your interest in philanthropic crowdfunding? Can you tell me about the beginnings of Hubbub?

JM: As a student at Cambridge I was involved in fundraising for a variety of student clubs, societies and causes. I always felt the approach was inefficient; there were so many different sources of funding and each required specific proposals, complex forms, and were only available at specific times of the year. I had identified a significant pain point, but hadn't stumbled on a way to solve it.

When crowdfunding really started to take off between 2008 and 2010, I realised that it might provide some answers to the problem above. We started out by simply testing whether students could crowdfund small, simple projects in the same way creatives and musicians were doing so on Kickstarter. The results were impressive not only from the student side but also from the philanthropic side where there was a real appetite to get involved in helping the next generation.

We realised that in order to scale the approach, we would need to partner with universities to gain deeper access both to current students and staff, and to develop alumni giving programmes.

TR: Hubbub offers [universities and other educational institutions] a 'white label' approach. How does your platform work? Is it specifically tailored to non–profits?

JM: The idea is to give universities control over the relationship with both projects and donors, as well as open up the huge alumni pools to the projects from the university. Collectively, alumni give UK universities over £750m a year; we wanted to help projects tap into this!

The platform has been designed to integrate with processes and technology frequently used by non–profit development offices and fundraisers — for example existing CRM software and campaign management tools. It also facilitates tax–efficient giving through GiftAid (UK) and 501c3 (US). The appearance, site copy and project moderation and control are all in the hands of the institution. Finally, the data (and therefore the relationships) are entirely owned by the institution, which is critical for donor stewardship and relationship management.

Everyone wins — the projects have access to an existing network of alumni, the alumni get access to exciting new ideas and can give to things they care about, and the university has a tool for donor acquisition, and a means to foster deeper relationships with existing donors.

The opportunity is enormous. Crowdfunding is really just the digitization of mass individual giving — and that space has been largely uninterrupted for decades.

TR: Most people are probably familiar with JustGiving: they've either donated money or have asked for donations towards a challenge for charity. Hubbub operates in the rewards–based crowdfunding space. How do universities 'reward' donors?

JM: Rewards are normally little physical gestures of thanks to donors; they offer incentives to give as well as reasons to reach out and maintain a relationship.

They are actually created by the projects themselves. This is why crowdfunding is so engaging for donors. Universities don't need to worry about creating reams of inspiring content themselves — the project owners use their own creativity to source everything from tshirts and other wearable items to posters, tickets to events, memorabilia, unique prototypes, recordings of music or DVDs of shows, etc.

Universities simply leverage the creativity and individualism of the project creators to inspire current and future donors.

TR: Crowdfunding works best if you have a specific project you need money for. What are your clients' experiences so far? Can you tell me something about their projects?

JM: Donors like to give to things where their money is going to make a difference, and where there is transparency. It's really great to be able to see the physical outputs of your donations.

The University of York's Department of Physics ran a project called Astrocampus, raising over £7000 to open their observatories to young people from surrounding colleges and schools to inspire them to get involved. https://yustart.hubbub.net/p/astrocampus/

Somerville College Oxford ran a project to take their choir to the US on tour, raising over £6500. https://somerville.hubbub.net/p/somervillechoirtour/

At the other end of the spectrum, we still support individual students to raise money for their own causes, even if we don't get work with their universities. Zoe Davidson raised just under £350 to create her prosthetic jewellery collection. https://hubbub.net/p/zoecreative-prostheticsjewellery/

TR:What happens if a project doesn't achieve the minimum needed?

JM: We ask projects to enter their goal, as well as the minimum they need. The reason for a minimum is to protect both sides: donors don't want to give to projects that don't have enough resources to proceed, and project creators don't want the obligation to do a project and deliver rewards if there isn't enough resource to do so.

The goal is the project's aspirational target — what the creator really wants.

When people donate to a project, we don't take payment immediately. We simply create the pre–authorisation to take payment later. As long as the project reaches at least its minimum within the deadline, we process payments. If the project doesn't reach the minimum, we simply cancel the pre–authorisations, and no money changes hands.

If projects don't have a real minimum, and just need to collect as much as they can, we allow them to set the minimum at zero. It's only there to protect the users, not for us to be prescriptive.

We think there's huge scope for museums and science centres to get involved, as well as colleges and schools.

TR:What are the fees?

JM: We provide free crowdfunding to anyone involved in education at https://hubbub.net — the only fees you pay are gateway fees to PayPal or Stripe. Hubbub makes nothing off these projects at all.

When we provide whitelabel platforms, we charge universities on a sliding scale according to the service levels they want from us. We also work in some cases with university departments, enterprise bodies, student unions and other sub–groups of a university.

TR:What other philanthropic groups would benefit from adopting Hubbub?

We have just started working with charities, landing our first national charity customer which will go live in December 2014. We think there's huge scope for museums and science centres to get involved, as well as colleges and schools. We would welcome discussions with anyone interested in exploring this. In particular, we think there could be good scope for crowdfunding a proper cataloguing and digitization project of the substantial and incredible archives of the Computer Laboratory itself!

TR: Earlier this year Hubbub joined forces with Crowdcube, the leading equity crowdfunding platform. Can you tell me about this partnership?

JM: We are exploring with Crowdcube how to bring equity and investment crowdfunding to the university space. It sounds very appealing, but it's quite complex when you start mixing it with technology transfer and commercialization departments.

The one key difference between using equity crowdfunding and raising angel investment/ seed VC investment is the shift in the control and timing dynamic.

Moreover, for universities to promote investment opportunities, they need to be careful about financial promotions legislation, as crowdfunding is regulated by the FCA.

The partnership is to share resources and facilitate the creation of an offering that works for institutions and the FCA.

TR:What was your own experience of crowdfunding? I see Hubbub crowdfunded its own investment.

JM: It was really interesting. We recently raised £405k through Crowdcube. Raising money like this is hard work — but then raising money any way is hard work. We learned a lot from the process, and acquired some major new investors we couldn't have reached any other way.

The one key difference between using equity crowdfunding and raising angel investment/seed VC investment is the shift in the control and timing dynamic. When raising money by conventional means, the power over timing and terms lies with the small number of people you

have time to talk to — angels or VC investors. Crowdfunding inverts that — large investors sign up to essentially the same terms as smaller investors, and the deal is clearly laid out and structured in such a way that there is a hard deadline they have to meet. This weeds out those who are not interested enough, or who want to negotiate on terms, or who can't move fast enough to complete the round, and leaves you with those who like and understand the deal and can move fast. As an entrepreneur, it is very refreshing to work with people like this.

TR: What is the outlook for philanthropic crowdfunding campaigns over the next year or two?

JM: The opportunity is enormous. Crowdfunding is really just the digitization of mass individual giving — and that space has been largely uninterrupted for decades. Just 1% of all alumni giving is currently done online, which is exactly where charitable giving was 15 years ago.

It is hard to imagine in another 10 years any university, charity, school or museum not having an online giving site, showcasing the amazing work and projects going on inside that institution. The question is less whether this will happen, and more who will be the provider of the technology to facilitate it. We think Hubbub is ideally positioned to be the provider both in the UK and internationally, and we welcome input, advice, connections or even investment from those who would like to help us succeed.

More information about Hubbub can be found at https://hubbub. net/

Fusepump

Robert Durkin explains how Fusepump helps retailers win the digital marketing race.

TR: Rob, did you always want to work for yourself?

RD: Yes, I've always been entrepreneurial. When I was about 14, I would call local businesses that didn't have a website and offer to build them one, quickly moving into ecommerce sites. I set up my own ecommerce website (selling DVDs) while I was still at school, which used dynamic price comparison to create offers as people browsed the site.

Growing up, I was definitely inspired by my dad, who had his own small business as an Independent Financial Advisor, and my uncle, who was an entrepreneur doing really exciting things in Information Technology. His success was what got me interested in starting a business… and hopefully having a life like his!

TR: Did you and Chris (Conn) discuss the idea while at Cambridge or did this come later?

RD: I developed my dynamic pricing idea as part of my dissertation at Cambridge, which was titled 'Generic Price Comparison in an Online Marketplace'. I used this opportunity to build a platform for web data extraction and I was lucky enough to meet Chris towards the end of university. Chris came on board to help me develop the technology further and, while he did that, I went out and sold our product!

Chris is FusePump's CTO and still one of my best mates — he is a technical genius!

TR:Where did the inspiration come from to found FusePump?

RD: Initially it came from the fact that I was so busy with school work, I needed to develop software to keep my website up to date! This technology — which used a dynamic pricing strategy — formed the basis of my university dissertation, and the idea for FusePump.

The first version of the web–scraping software allowed ecommerce retailers to keep their pricing competitive, as it would perform dynamic pricing adjustments whenever a customer performed a product search. However, the market wasn't really ready for this when we first developed it. Luckily, the technology had other applications, such as creating product data feeds for successful and efficient multi–channel marketing.

We pitched our services to big companies and secured our first clients in 2009. The company has grown a lot since then — we now have 60 staff, more than 100 clients, and three key business areas.

We started the business with a small amount of cash (no funding from VCs or investors) and therefore we had to grow organically and make enough money from sales to cover our overheads.

TR: Can you explain what FusePump does?

Our web–scraping technology helps online retailers make more money — they can get their products in front of more people, in more channels, with us collecting, managing and optimising their product information. We generate hundreds of millions of pounds worth of ecommerce sales each month, thanks to our high–quality product data feeds and multi–channel marketing tools.

We also help brands improve their online performance, by giving them useful insights as to how their retail partners are promoting their products. Our third and newest business area is FusePump Digital, which uses product data in more creative ways, in dynamic display adverts, clever on–site widgets, or other digital assets.

TR: What have been the main challenges?

RD: Our biggest challenge was managing the balance between production capacity and the demand for our services. Sometimes we had to turn business away, because we couldn't hire and train staff quickly enough to meet demand. This was frustrating but it meant we never had to compromise on quality.

We started the business with a small amount of cash (no funding from VCs or investors) and therefore we had to grow organically and make enough money from sales to cover our overheads. It was the right approach for us and incredibly satisfying, but it is a very difficult way to grow a business!

We've also had to keep diversifying as competitors entered the market, which has been challenging but very interesting.

TR: As you developed strategies, did you have a business exit strategy?

RD: Yes, we always knew we wanted to sell the business after 3 to 5 years, which is exactly what has happened: we were acquired by Wunderman (part of WPP) around our 5th birthday.

There was a lot of acquisition interest in the early days but I knew I didn't want to sell too soon. We were constantly reviewing our strategy regarding funding and selling: as an entrepreneur, you always need to think at least 12 months ahead.

The deal with WPP was done at the ideal time because we were at a size where we needed a more strategic approach in order to continue growing. WPP brings a wealth of opportunities and provides access to global resources, which will be instrumental in the next phase of our growth.

TR: How do you see things developing following your acquisition?

RD: I am still CEO and am spending a lot of time developing new opportunities: WPP's (sensible) approach is to acquire a growing business and then let them keep doing what they're good at. Our plan was clear before our acquisition, and now we have WPP's buy–in for our plan, as well as access to their assistance, expertise and reach, which is very helpful.

TR: What are your goals now?

RD: I'd like to see FusePump continue to go from strength to strength and become successfully integrated with Wunderman/WPP when the time comes. I'm still incentivised to grow the business, and I have ambitious plans for expansion into new markets and verticals, with our award–winning BuyNow solution, for example. This lets brands

become more active in ecommerce marketing, as our technology gathers the brand's product offers from the websites of their retail partners. Manufacturers can then promote their own products (across their website, social media, display advertising and so on) and simply refer consumers to a retail partner to complete the deal. Brands get full visibility of the purchase process, so it complements our Ecommerce Intelligence solution, which helps brands to better understand how their retail partners are selling their products (and their competitor's products).

On a personal note, I'm still investing in successful digital start–ups — I have a passion for supporting exciting young entrepreneurs — and hope to keep doing this. I'd also like to play Jean Valjean in the West End! That would be amazing.

Go to http://www.fusepump.com/ for more about Fusepump.

EDSAC Replica Project

Andrew Herbert is leading the project to recreate the pioneering EDSAC computer, at the National Museum of Computing in Bletchley Park

Ring members will know that EDSAC was the Computer Lab's first computer. Designed and constructed by a team led by Maurice Wilkes and Bill Renwick, EDSAC first ran on 6th May 1949. EDSAC was the first electronic computer of the modern type to provide a regular computing service and enabled a number of Cambridge scientific advances and is acknowledged as a contributor to three Nobel Prizes.

Following a suggestion by Hermann Hauser the EDSAC Replica Project was started in 2011 with a board of Trustees chaired by Hermann, a Management Committee, chaired by David Hartley, and the author who having recently retired from Microsoft, took on the role of project manager.

Now, four years later, an EDSAC reconstruction is being commissioned by a team of volunteers at The National Museum of Computing at Bletchley Park, with the aim of having it working by the end of 2015 and on public display. Visitors to the museum can see the machine in its dedicated gallery, which was opened by Hermann in November 2014.

Very little documentation of the EDSAC internals survives. There is an "EDSAC Report" which was probably written as the machine was being designed and during the early stages of commissioning. It gives an overview of the logical design and the individual chassis but little about circuits. There are some on glass plates in the University Library, and from forensic examination of these and knowledge of period electronic design techniques, the project team has deduced plausible designs for the common circuit elements. More recently, John Loker, a retired Computer Lab engineer, unearthed 20 or so drawings he rescued from the Lab when EDSAC was scrapped. While these relate to circuits modified later in EDSAC's life they have been very useful in confirming our designs.

A surviving chassis in the Computer Lab gave the information needed to be able to reconstruct the metal work for these and the racks into which they were inserted. Surprisingly it has been easy to obtain the required thermionic valves. EDSAC was built using circuits borrowed from wartime radar that continued to be used into the 1960s and there are electronics surplus dealers still able to supply "new old stock", some with manufacturing dates as early as 1943.

The biggest challenge for the project is the EDSAC delay line store. Comprising long tubes ("tanks") of mercury acting as acoustic delay lines, these were the defining feature of EDSAC. Nearly one third of the chassis is dedicated to recirculating words of store as pulse trains travelling through the tanks. The speed of execution is governed by the time taken for words of store to pass through a tank before they can be read or overwritten. Reconstructing a mercury delay line store is not feasible: mercury is expensive and hazardous; the precision engineering required for the tanks and the piezoelectric transducers within them is beyond the resources of a volunteer–led project. Moreover, the temperature sensitivity of the store was a significant operational issue. Instead the reconstruction uses steel wire "magnetostrictive" delay lines which are easier to construct and more operationally convenient. Fortunately Maurice Wilkes knew mercury delay lines were the best of a poor set of options and designed the interface between EDSAC and its store to be quite general, enabling us to connect our delay lines to the same regeneration and addressing circuits as the original.

For input and output we have modified period Creed devices. As in the original we download the initial orders from a bank of rather noisy uniselectors.

The project has been fortunate to be supported by a number of generous donors including Computer Lab alumni and friends. Of the target of £250,000, £204,000 has been raised to date.

To learn more about the project visit www.edsac.org where there is detailed technical information, photographs and videos of the reconstruction. Come and visit the Museum — see www.tnmoc.org for opening times etc. If you want to be involved as a volunteer or are able to help us with a donation please contact Andrew Herbert via Andrew@herbertfamily.org.uk.

Hall of fame news

Bango

Bango took the top prize in the 'Most Effective Use of Payment Technologies' category at the Effective Mobile Marketing Awards (EMMAs).

The EMMA award comes hot on the heels of a number of recent successes for Bango, including the announcement that Samsung has integrated with the Bango Payments Platform, unlocking one–click payment in their app store.

Bromium

Bromium Inc has been recognised by LinkedIn as one of 'The Bay Area's 10 Most InDemand Startups of 2014'. Meanwhile, Bromium's CEO Gaurav Banga has been recognised as one of the '100 Most Intriguing Entrepreneurs of 2014' at the Goldman Sachs Builders + Innovators Summit.

Cambridge Broadband Networks

CBNL has been shortlisted for the Pushing the Mobile Limits Award by Telecoms. com after pioneering large scale point–to–multipoint microwave converged networks.

The Award identifies solutions that have pushed the boundaries of network functionality, affording a glimpse of future mass market improvements.

Embecosm

James Pallister, a Research Engineer and Technical Advisor to Embecosm, has won the NMI Young Engineer of the Year award.

NMI is the active industry association representing the UK Electronic Systems, Microelectronics and Semiconductor Communities.

GeoSpock

GeoSpock has raised £708.5k new funding, the investment led by notable UK entrepreneurs including Dr Darrin Disley, CEO of Horizon Discovery Group plc; Dr Jonathan Milner, ex–CEO and founder of AbCam plc; and Peter Keen, CEO of Cambridge Innovation Capital.

GeoSpock has also received £74k investment as part of its entry into the TechStars London Winter 2014 prograe. Entry into the programme followed two months of in–depth technical vetting from sector experts, with less than 1% of many hundreds of entrants making the cut.

Hitch

Hitch, an iOS app offering an extremely affordable and convenient transportation solution, has been acquired by Lyft.

Linguamatics

Linguamatics and the Intellectual Property & Science business of Thomson Reuters have recently announced a collaboration to advance pharmaceutical clinical trial R&D, with the launch of CortellisTM Informatics Cliniccal Text Analytics for I2E.

The new solution, available through Thomson Reuters Cortellis applies Linguamatics I2E text mining platform to relevant information to assist researchers in finding actionable insights.

Operis

Operis has opened a North American office, located in Canada.

Situated in the Toronto financial district, the office will serve as the base to satisfy growing demand for its modelling, model auditing and advisory services in connection with US and Canadian energy and infrastructure transactions.

Swiftkey

Swiftkey has been part of the project to enhance the communication system used by Professor Stephen Hawking.

For the past two years, the SwiftKey team has collaborated with Professor Hawking and Intel to make it easier for him to write and communicate.

SwiftKey built a personal 'language model' for Professor Hawking based on his extensive works — including documents not published in the public domain. The software learns from him to ensure it predicts contextually relevant words. It is also able to analyse the content of the specific book or lecture that he might be working on, further tailoring its predictions and autocorrections.

Trampoline

Trampoline has launched its Scale Up Britain platform.

Scale Up Britain is the first resource to track and identify all high–growth businesses in the UK. The platform generates administrative boundaries and heat–maps on the fly in the browser. As the user zooms in successively small administrative units automatically appear; starting with EU regions followed by local authorities and finally electoral wards.

Alongside a heat map showing where high–growth businesses are located, the platform also provides a 'Top 50' raking highlighting the fastest growing businesses.

Research Skills course

James Lingard: Mirage — an operating system for the cloud

The user/kernel mode divide is a key feature of most modern operating systems. What happens when you reconsider such a fundamental principle?

Our story begins with hardware virtualization: running multiple virtual machines (VMs), each with the illusion of total control, on a single physical device managed by a hypervisor such as Xen. Hardware virtualization led to the creation of public "cloud computing" services, such as Amazon EC2, which nowadays run millions of VMs.

Anil Madhavapeddy, founder of the Mirage project, noticed a trend in cloud computing: each VM tends to be used for a single purpose — a web server, or a database, say. Creating a new VM is now so easy and so cheap that there is no need to bundle multiple applications onto a single machine. Yet each VM comes with an entire operating system, including much functionality that is not needed by a given application. Furthermore, the reason for the user/kernel mode divide is to isolate applications from one another; if there's only one application, is this still necessary?

In Mirage, the boundary between application and kernel is blurred. Functionality that traditionally belongs in the kernel is moved into a set of libraries. An application links against just those libraries that it needs, and the whole is compiled into a unikernel that can be run as a Xen VM image.

The idea of a "library operating system" isn't new, but only now is it becoming practical. Virtualization means that an operating system no longer needs to support a myriad hardware devices, just the virtual devices provided by Xen. This makes real–world OS development attainable for a research team.

Starting from a clean slate meant that the Mirage team could make another radical innovation. Almost everything in Mirage, from application code down to device drivers, is written in OCaml. Although unconventional in operating systems programming, the use of OCaml brings many advantages. Perhaps most importantly, its strong type system eliminates the possibility of bugs such as buffer overruns, the source of many security holes in traditional operating systems.

Although still in pre–alpha stage, the Mirage project already has some impressive results. Specialization means that binary sizes and memory footprint are tiny, and boot times are very low: a Mirage web server is only a few hundred kB in size and can boot in under 1 second. Elimination of unnecessary overheads gives a performance boost too: a DNS server written with Mirage has been shown to outperform NSD, a popular high–performance implementation for Linux, by nearly 10%.

From here there are many exciting possibilities. OCaml's module system makes it possible to easily recompile a Mirage application to run in different environments, such as on a Raspberry Pi or smartphone. Another project aims to enable tiny VMs to run in far greater densities than is currently possible. So it seems that in future, the operating system kernel may be no more than a mirage.

The MPhil in Advanced Computer Science has just one compulsory module: Research Skills. This module aims to teach the range of skills required for a successful research career: critical reading, summarisation, and review of research papers; writing of technical documents and research papers; presenting research findings in seminars and at conferences; and the design and analysis of experiments.

The best three essays from the last academic year are being published in 'The Ring'. This is the last of those three essays.

Computer Laboratory news

Annual Report of the Faculty 2013–2014 Selected Highlights

Personnel

As of October 31st 2014, there were 169 members of staff: 41 academic; 25 academic–related; 3 research fellows; and 100 post–doctoral researchers.

Honours, Awards and Competitions

- Alastair Beresford and Andrew Rice received the Pilkington Prize for excellence in teaching

- John Daugman received the 'Large Data Analysis (LDA) Award' from the International Society for Optical Engineering. Professor Daugman was also inducted into the US National Inventors Hall of Fame.

- Professor Andy Hopper was named in the Science Council's list of the UK's 100 leading practising scientists.

- Chloe Brown, supervised by Professor Cecilia Mascolo, received the Best Paper Award at the 2014 ACM International Joint Conference on Pervasive and Ubiquitious Computing (Ubicomp 2014)

- Professor Jon Crowcroft and Dr Anil Madhavapeddy won the 'HiPEAC Paper Award'

- Ionel Gog, supervised by Dr Robert Watson, was awarded as Google Europe Fellowship in Distributed Systems

- Flora Pnjou Tasse, supervised by Professor Neil Dodgson, was awarded a Google Europe Fellowship in Computer Graphics.

- The team from the Alta Institute based at the Computer Laboratory won the shared task competition at the International Conference on Computational Natural Language Learning (CoNLL 2014, Baltimore) on automatic grammatical error correction in non–native English text.

- Three Cambridge teams excelled at the Northwestern European Regional Contest 2013 (NWERC). Cambridge qualified for the ACM–ICPC world finals.

Research

Research grant income in the last financial year was £7.8mio, an increase of £1.5mio on the previous year. Just over half of this (51%) came from the UK Research Councils, with industry (UK and overseas) accounting for a further 24%.

Teaching

Undergraduate numbers continue to increase steadily. In 2014, 80% of students achieved a First or a II.1.

The full Annual Report of the Faculty 2013–2014 can be found at www.cl.cam.ac.uk

Cambridge Coding Academy

Cambridge Coding Academy (CCA) held its first workshop in November 2014 and, since then, it's been full steam ahead: to meet demand, 20 workshops are scheduled for January and February 2015.

CCA's programme is also expanding to include three distinct workshops: build a game, build a web app, and interactive data visualisation. To support these workshops, CCA has started to grow its tutor team, and a call for student ambassadors to spread the word has just been launched.

This year CCA will also be working with the Computer Laboratory to run a coding summer school for school children.

Cambridge Coding Academy is supported by JetBrains, Redhat, GitHub, Cantab Capital Partners, the Royal Society of Arts, Cambridge University Computer Laboratory and Careers Service, as well as the Judge Business School's Accelerate programme.

If you are interested in getting involved, please contact CCA co–founder and Computer Lab student, Raoul–Gabriel Urma (rgu20@cam.ac.uk).