The Ring

The Newsletter of the University of Cambridge Computer Laboratory Graduate Association
Governing Council: Chairman: Prof Andy Hopper (TH78)
Members: Stephen Allott (T80), David Colver (CHR80), Peter Cowley (F77), Richard Jebb (DAR88), Lorenzo Wood (CHR93)
Careers Committee Chairman: Peter Cowley
Members: Nathan Dimmock (JE01), Fiona Miller (T83)

Ring News

Professor Andy Hopper becomes Chairman of the Ring Governing Council

Head of Department, Professor Andy Hopper, has taken over as Chairman of the Ring Governing Council. He has taken up the reins from Dr Ian Pratt who will shortly be on sabbatical.

Many thanks to Ian for his hard work over the past year and a warm welcome to Andy.

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2005 Member get Member Campaign

The Ring is starting a 'Member-get-Member' campaign. Your involvement will help make sure the Ring succeeds and fulfils its potential to make a difference to members, their companies and the Lab.

The Ring has grown strongly since its launch in 2002 but, to continue this expansion, we need your active participation in our membership drive.

So, please tell your Cambridge friends about the benefits of being a Ring member. Some postcards are enclosed with this newsletter; we would be very grateful if you could send them to your contacts who you think might benefit from membership.

Thank you and good luck recruiting.

Annual Dinner

The Annual Dinner, which took place on March 15th, once again proved hugely popular with almost 70 members gathering in the attractive surroundings of Jesus College's Great Hall.

The evening culminated in the announcement of the winners of the 2005 Hall of Fame awards. The awards were presented by Stephen Allott, member of the Ring Governing Council and chairman and co-founder of Trinamo Ltd.

Jan Hruska, co-founder and CEO of Sophos, accepted the Hall of Fame Company of the Year Award on behalf of Sophos.

Duncan Grisby (left) accepted the Product of the Year Award on behalf of Tideway Systems. Daniel Lau received the Award for the 2004 Student of the Year.

The Award for the Most Notable Publication was accepted by Neil Dodgson on behalf of Rana El Kaliouby.

Ring Careers Committee

The Careers Committee, set up to provide assistance to members in helping them achieve or enhance their career potential, is looking for new members. If you are interested in joining the committee please contact the Committee Chairman, Peter Cowley at peter.cowley@camdata.co.uk.

Mentoring Scheme

The mentoring scheme, developed and implemented by Richard Mason, has been running successfully for 7 months. Since Richard returned to Canada (see Who's Who), I have been keeping a watching brief. However, I am delighted to announce that Fiona Miller (T83) is taking over as director of the scheme.

At present, five pairs are taking part in the mentoring scheme. Each has been meeting on a regular basis over the past few months. In addition we have others waiting in the wings to take part.

During the trial period, I have been a mentor and have found that both I and my mentee have made real progress in analysing where he is in his, already successful, career, where he wants to get to and how an achievable route can be developed between these points.

I have gained from this process, both in terms of picking up some useful specific technical knowledge and, as I guess a teacher experiences, witnessing positive progress.

Over the next few months we shall be deciding how to expand the scheme. If you are interested in taking part in the scheme – either as a mentor or mentee – please contact Fiona Miller (fiona_miller@doctors.org.uk) or the Ring office.

Peter Cowley, Chairman, Careers Committee

Event Calendar 2005

May 17th 2005
Time: 16:15
Venue: Computer Laboratory

Computer Assisted Radiology and Surgery

Speaker: Prof Heinz Lemke, Department for Computer Graphics & Computer Assisted Medicine, Technical University Berlin

Abstract:

This review presentation is based on recent workshops, think tanks, and projects focussing on information and communication technology for image guided surgery, in which the speaker participated. Specific references will be made to the 2004 UCLA Seminar on Imaging and Informatics, the OR 2020 "Operating Room of the Future" Workshop, and projects of the Technical University Berlin (TUB). The UCLA Seminar is a joint endeavour between the UCLA, the TUB and the CARS Organization, focussing on workflow analysis tools and the digital operating room. Selected presentations of these activities are summarized referring to redesigning perioperative care for a digital operating room, intraoperative ultrasound process and model, surgical workflow and surgical PACS, workflow automation strategies, visualisation solutions for the operating room, navigating the fifth dimension, and design of digital operating rooms and interventional suites. These developments necessitate a close link between radiology and surgery. Activities are, therefore, in progress towards enhancing DICOM and IHE towards the requirements of surgery. A brief outline will be given on standardization activities.

June 17th 2005

London Drinks Party

18:00-21:00
Venue: Heathfield House, 21 Clapham Common Westside, SW4 9AN

Hall of Fame Profile

Applied Generics

In the latest in the series of articles profiling companies founded by Computer Lab graduates, 'The Ring' was delighted to talk to Joe Dixon founder of Applied Generics. Joe is a graduate of Fitzwilliam.

TR: Joe, can you run me through your career up to the point of founding Applied Generics?

JD: I completed my PhD at the Computer Laboratory at the end of 1991. After a few year s at AT&T Bell Labs I came home to start Nemesys Research with some old colleagues that will be well known to "The Ring" (Cosmos Nicolaou, Ian Leslie and Derek "Mac" McAuley). We built and sold video codecs for ATM networks. After three years we were acquired by FORE Systems. At the end of 1999 in a fit of reverse migration I left FORE and headed north to Scotland.

TR: Tell me about Applied Generics and how you got started.

JD: When I arrived in Scotland I hooked up with two ex-Nemesys colleagues and now fellow "Ringers", Ian Atkinson and Bruce Adam. We were a company without an idea. After doing a few months of consultancy work we decided on the idea of analysing bulk mobile phone location data to derive road traffic conditions in real-time. These of course where the "happy times" when competitors like Trafficmaster has £1bn valuations. It is rather different now. In the first year we built our product around network simulations before moving into real networks with "pilot" ready code. Mobile networks have hundreds of companies approaching them daily. If all you have is an idea it is unlikely that you will get through the front door.

TR: Can you expand on your RoDIN24 system and give me an idea of market share and potential? What challenges does RoDIN24 face as a technology?

JD: The RoDIN24 road traffic monitor was originally designed to source location data from commercial location platforms which it would analyse and produce road traffic data. Unfortunately these platforms offered neither the capacity nor accuracy to drive our product. They also weren't deployed by many networks. Not a good start. One major technical challenge has been to source bulk low level signalling data from mobile networks. Having solved this we found ourselves in the position of being able to supply mobile location systems (NERO24) in addition to the original RoDIN24 product. In terms of the market our main drivers for RoDIN24 are the national highways agencies who have multi-billion dollar budgets and increasingly wish to have far better information in order to actively manage the road network.

TR: How has the competitive environment changed over the past year?

JD: We have seen other companies enter our space. A positive spin on this is that it gives us some market validation but we would not miss them if they were not there! We still hold a technological lead as our products operate at a far finer granularity and are also field proven in commercial deployments. The telecoms market has been difficult in the last few years but there are now signs that people want to try new things.

TR: What major trends do you see affecting the mobile phone location and road traffic information solutions business and how is Applied Generics positioned to capitalise on these trends?

JD: The "commercial" mobile location business is in a poor state generally. The networks do not know what they want to do and have not invested much in the way of marketing even when they do. Given the current security climate we see the main opportunity being for our bulk location technology as a component of national security systems. We have achieved significant success in this area but it is not something we are able to "advertise". To support this activity we have enhanced our location product to support advanced querying based on "trigger" type requests such as "tell me when anyone enters this area?". On the road traffic side we see continued, if not increased, interest from highways agencies in advanced traffic management solutions. This year should mark a watershed in terms of Applied Generics rolling out full national deployments of RoDIN24.

TR: What are Applied Generics' plans for the future?

JD: We now have a portfolio of three solutions all of which are hosted on the mobile phone network and share a common platform. We are pushing a worldwide channel strategy for our products and should be making announcements soon that show the progress we have made in this area. Support for 3G is of course a big thing. When we started there were a lot of companies developing for 3G at too early a stage. At present 3G penetration is small but I think people may be surprised at how quickly this changes over the next 18 months.

TR: If you could pin it down to just one thing, what is the most important thing that you have learned about business?

JD: A hard question. I could say execution, have the right team etc. Overriding everything though is have something that somebody (preferably more than one person) wants to buy and at a price that you can make money. Imagine yourself as the customer. If you do not have this then no matter what else you do you will not succeed.

Ring Interview

The Ring met up with member Michael Walker to find out about his plans to get reinvolved with technology. He had popped into the Ring office during a brief stop-over in Cambridge before making his way back to Heathrow and another long haul flight. Despite having only just returned from his weekend duties flying a Boeing 777 from New York, he looked fresh and awake – more than can be said for the Editor.

While Michael is a great user of technology – indeed technology has completely changed the role of a pilot - he is keen to take a more active part in its development.

But we're moving ahead of ourselves. How did Michael get from computer scientist to pilot. Well, the move wasn't even as simple as that. Michael Walker does not fit into the typical Computer Scientist mould – if such a thing exists. Born and bred in Northern Ireland, he went to Salford University to read Chemistry. Unfortunately, Michael and University Chemistry did not form a successful reaction and so, despite gaining a 1st, his only desire was to part company with the subject that had so excited him at school.

After a post-university gap year teaching English in Japan, Michael seized upon the UK government's scheme to sponsor scientists to switch out of the natural sciences into computer science. It was 1993 and, seeing the start of the technological boom, Michael believed that 'you can never go wrong' with computing skills. So, he came up to Cambridge and took the Diploma in Computer Science.

He enjoyed his time in Cambridge immensely. Indeed, Michael's positive experience was helped in no small part by his course tutor, Dr Neil Wiseman, whose great enthusiasm for his students had a significant influence upon him.
However, after his degree, Michael did not think he would make a career in computing. While a perfectly competent coder, he felt average compared with those who seemed to find it as easy as breathing. At the time, careers advice was not as accessible as it is today and so, unaware of the breadth and scope of possibilities afforded by the computing industry, Michael went into accountancy – a career that was to be very short-lived. After just 6 months he moved into the City.

Despite enjoying his job, Michael yearned for the skies. He had flown with the air squadron at University and still harboured a desire to become a professional pilot. This opportunity presented itself when he was accepted on to a BA sponsored scheme. On finishing the course in 1997 he went to work with Monarch airlines, flying the Airbus. From there he moved to BA and, apart from a year with the Territorial Army during the Iraq war (during which time he spent 6 months in Basra), he has flown for them ever since.

So, why now the desire to become more actively involved with technology? Well, ambition to become a long haul pilot has been achieved. While he doesn't want to stop flying, Michael would like to explore other things, for example computer security. He believes his experience with BA and his time in Iraq have made him more acute to the meaning of security in the real world.

Also, his time spent talking to Ring members has reignited his enthusiasm for technology and the creative opportunities that exist. He was amazed by the variety of companies and projects he heard about at the recent annual dinner. And finally, he blames Andy Hopper. Of all the Diploma course lectures, it was those of Andy Hopper that had the most significant impact on Michael. He related how Prof Hopper used to stop for 10 minutes in the middle of a lecture to talk about business. These 10 minutes fired him up and made him as enthusiastic about business as about technology. Having spent his career being fired up by the business of flying, his enthusiasm for technology has been reawakened.

If you would like to get in touch with Michael Walker, he can be contacted at michaelrewalker@hotmail.com

EDSAC II — a recollection

By Adrian Williams (Peterhouse 1957-60)

I had applied to Peterhouse, and came up to Cambridge in 1957 to read maths. When the Scholarship exams were held in the previous December (such arrangements existed in those days), I had been awarded an Exhibition — mainly (as the College was quick to tell me) on the basis that the strength of my general papers had helped my mathematics past the winning-post. My Director of Studies, the great Dr JC Burkill of Lebesgue integral fame (and, later, Master of Peterhouse) little cared to spend his time on Part I material; he easily persuaded me that an Exhibitioner would be better off sailing straight into Part II. And so it was that, in the summer of 1959, as the possessor of two very poor class results in Prelims and Finals respectively, I found myself approaching my third undergraduate year needing something to do.

Part III? Hardly, as a Junior Optimes. Apart from a change of Faculty, the choices were a one-year course in Statistics, and a Diploma in Numerical Analysis and Automatic Computing (DNAAC). I consulted an actuary friend, who advised me that anyone could learn statistics, whereas a year in computing would be leading-edge (or whatever term was in vogue at that time). I took his advice. Good call!

A couple of weeks ago, I walked down Corn Exchange Street to see what I could recognize. *Quantum mutatus ab illo!* The Corn Exchange is no longer a roller-skating rink, and the building that housed the Mathematical Laboratory has disappeared entirely, to be replaced by a building which, architecturally, is…different.

My recollection of the former topography is by no means sharp, but I can recall an entrance, square onto the street, roughly between today's Goods Entrance to the Department of Materials Science and Metallurgy and the rear stairs to the Titan Teaching Rooms. It was a three- or four-storey building, and the layout had been arranged and rearranged so that the entire building was configured, physically and spiritually, around EDSAC II

This great beast, notable at the time for the huge size of its main memory (4K), occupied the central core of two floors. The heart of the machine was on one floor, just about where the Babbage Lecture Theatre is today. It was a valve-machine, and the kit that cooled the valves (which took more power than was needed to run the computer) was on the floor below. Around this throbbing core were laid out various lecture rooms, offices, and the room that housed the students enrolled on the DNAAC.

There were eight or ten of us. There was just one other undergraduate. (By virtue of our junior status, we two were entitled to sit for the Diploma but could not expect to be awarded it). We all mucked along very well for the year (after Tony Pearson had drawn attention to my annoying habit of talking aloud to myself while programming). The atmosphere was entirely different from the undergraduate teaching I had experienced for the previous two years. Hitherto, it had been…inspiring, yes, but daunting as well, to sit at the feet of intellectual giants of the likes of Hoyle, Taunt, Batchelor, Polkinghorne, Atiyah, who swept in to deliver their 60 minutes' worth of distilled genius and then swept out again, leaving me to limp back to Peterhouse and salvage what I could from my wretched notes. In the Mathematical Laboratory, by contrast, the mood was informal and relaxed. Maurice Wilkes was a benign Directorial presence, though he seldom ventured out into the mêlée of the public thoroughfares. Eric Mutch was his *chef de cabinet*, a helpful uncle-figure. Peter Swinnerton-Dyer swanned around with panache, stopping by from time to time to chat to the DNAAC students. I can recall Ian Barron, but not what he lectured in. Professor Harry Huskey, a visiting professor from the United States, once covered the blackboard with a logic diagram and then (a very unusual gambit in those days) asked his audience, "Where should we make a connexion to produce the result we want?" To my delight, I found that I was not the only one totally at sea — he had lost the entire class. Harry was disconcerted, but gamely soldiered on.

I can't remember much of the Numerical Analysis part of the course, except that it included practicals that involved difference tables, and solving differential equations using Runge-Kutta-Gill, Adams-Bashforth and the like. For these sessions, we had the help of Facit calculating-machines. These were machines with a rotating barrel, and levers that cruelly punished one's fingertips in the setting of them, that one churned and slammed and churned again to do multiplications and divisions. Could we do square roots? I suppose there was an algorithm, but I have forgotten it. (I was well into my subsequent commercial career, in 1971, before I came across an electromechanical machine which did square roots; it cost about £800. In the late 1970s you could find an electronic machine for about £300 that could do the basic statistical functions. Today you can buy all this and ten times more for less than £20.)

I never figured out how the various lecture-series attracted their attendance. Besides the DNAAC students, there were others, mathematicians presumably but perhaps natural scientists and economists as well, whom I had never seen before and who would zoom in like visiting comets and zoom out, never to be seen again. (They never came to the practicals.) One of them was a female graduate who was so luscious that it made me salivate to look at her. No one before or since has ever had this effect on me. I feared to make any sort of approach. In an era when there were eight men to every woman in the University, and me still an undergraduate, what would have been the point? I think her name was Sylvia. Where is she now?

The main attraction of the DNAAC course was the opportunity to learn programming on EDSAC II. I have no idea how programmers exercise their craft nowadays — my most recent experience was 30 years ago, using FORTRAN and BASIC, which were a doddle because you simply assigned a name to a variable and wrote algebraic or logical statement using the names. On EDSAC II, you had to imagine a lattice of 4K pigeon-holes and keep track of what you were putting in them. The machine-code instructions comprised three parts: {number} letter(s) {number}. So, for example, 39f100 meant "Read in a value from tape and store it in pigeon-hole 100." (The most exotic instruction was 120f0. The input/output station had an oscilloscope attached to it, to which one could fix a camera: the instruction 120f0 meant "Take a photograph of whatever is appearing on the oscilloscope.")

With the program drafted, the programmer's next step was to punch it out on paper tape, using a teleprinter with a conventional keyboard. The machines that did the tape-punching could produce any combination of five holes, thus providing scope for 30 characters. ('All blank' and 'All holes' had no effect. The machine code used 0 - 9 and a subset of the 26 alphabetic characters.) Prudent programmers would leave an inch of blank tape between each block of characters making up a program-line because, if we made a programming error (and we frequently did), it would be necessary to excise the offending block and splice in a correction. Kids nowadays? — they don't know they've got it made.

To run the program, one had to take one's turn in a queue to access the input-reader. The reader was a light-sensitive device situated at a station at the centre-spot of a large high room with EDSAC II pumping away on one side of it and, against the walls of one other side, cabinets of those oscillating magnetic-tape devices that, for the man in the street, came to represent computer hi-tech in films of the mid-60s.

The great thing about queuing for EDSAC II was the huge supply of pulp science-fiction that various aficionados had accumulated over the years to help programmers while away the waiting time. I got acquainted with some real sci-fi classics in this queue. When you reached the head of the queue, you threaded in your tape, toggled a switch, and watched the tape as it whipped through at an astonishing speed. In due course — which could be seconds, or several minutes, but not much longer because the long jobs had to be deferred until the night shift — you got back a piece of punched tape as output. The smartest of us could read the holes; the rest had to print out the tape on one of the teleprinters. One usually specified the first input instruction as a line beginning with the letter 't' followed by the programme title, which was then printed out at the head of the results. One day in the study room, finding a tape lying about that belonged to my fellow-student and friend Brian Mayoh, another Peterhouse man, I doctored the leading blank strip so that the first thing he found on his printed results was COGITO ERGO SUM. I considered this to be very witty.

And to what end was this programming effort directed? We each had a dissertation topic to tackle. A few were self-selected. Susan Nightingale chose to write a program that harmonized Church of England chants according to the accepted rules of classical harmony. Besides my own, that is the only topic I can remember, probably because it appealed to me greatly and I was envious and admiring of her imagination in lighting on it. In the course of the year, her program tape became very long — so much so that I stepped in one day, unasked, to help her reel up the tape she had just prepared. I trod on it, and it tore right across. She said nothing but came as close to saying **** as any lady ever did in those innocent days, and looked strongly in my direction. Sorree!

For my dissertation, I had two midi-topics. The Preface records that "The first topic in this paper was suggested by Mr HPF Swinnerton-Dyer, and the second by Dr DJ Wheeler. My thanks are owing to them, and to my supervisor, Mr DF Hartley, whose continued interest and many valuable suggestions contributed a great deal to the completion of the paper." The first of the two topics, which was the more interesting to program, can be summed up as: "Given a sequence of integers 1,2,3…N, determine the size n of the largest subset, no three members of which are in arithmetic progression."

There was scope here for some elegant mathematics in devising shortcuts to eliminate sterile combinations, but the reader will quickly perceive that, beyond a certain point, and on any computer, the program was bound to get bogged down in its own loops. However, I did break new ground in the field of human endeavour by determining the solutions for N= 21 to 23 (which are each n = 9) and for N=24 (which is n = 10, of which the example my program found was: 1 - 2 - 5 - 7 - 11 - 16 - 18 - 19 - 23 - 24). EDSAC II took about 25 minutes to obtain these new results. I had thought of booking a slot in the night shift to explore higher values of N but, by the end of 25 minutes, I was fielding some pretty waspish comments about my programming from the next-in-line, Dr Feinstein and, as she was a Doctor and therefore probably doing something Really Important, I held my tongue and retired hurt.

Towards the middle of the summer term, one of us (Michael Wesley, I think) conceived the idea of hiring a punt and going up to Grantchester in the evening with a few bottles and Peter Swinnerton-Dyer on board, in the hope of getting Peter to divulge the contents of the forthcoming examination papers. Peter very sportingly agreed; we had a fantastic voyage; Peter divulged nothing; but alas, on the way back as darkness was falling he took the pole and, as we hit that stretch of willows just above Coe Fen, suffered the indignity of being swept off the stern and into the Granta, where he lost his spectacles. I think we did a whip-round next day; I hope it was enough to reimburse him.

We all reached the required Diploma standard, and the time came to decide what do next. Brian Mayoh eventually became Professor of Computing at the University of Aarhus. I never came across the other members of the course in later years, though I did once spot Ann Maybrey across the tracks at a railway station.

My own thoughts were turning to a career in this burgeoning and exciting field of computing, and I discussed the prospect with my father, who was a suburban dentist and therefore uniquely qualified to give a view on careers in industry and commerce.

"I dunno, Adrian," said my dear old dad. "Computers? D'you think they're going to catch on? You don't want to spend the rest of your life sticking your foot in customers' doors, do you?"

So I dumped computing, and became an actuary instead.

Laboratory Research

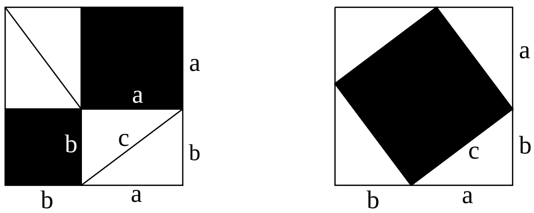
Can machines reason like humans in mathematics?

Mateja Jamnik
Lecturer and EPSRC Advanced Research Fellow

We encounter mathematics in every aspect of our lives. Some of the deepest and greatest insights in reasoning were made in mathematics. Thus, it is not surprising that emulating such powerful reasoning on machines is one of the important aims of artificial intelligence and automated reasoning. Human mathematicians frequently use *diagrams* when solving problems, they also *learn* general concepts from examples of more specific ones. Sometimes, they may use *analogy* or *symmetry* in solving problems. I am interested in such, so-called "informal" aspects of human reasoning. These reasoning techniques are powerful, yet few automated systems attempt to benefit from their power by emulating them. This can perhaps be explained by the fact that we do not have a deep understanding of informal techniques and their use in problem solving. In order to advance further the state of the art of automated reasoning systems, I think it is important to integrate some of the informal human reasoning techniques with the proven successful formal techniques, such as different types of logic. This will not only make computer reasoning systems more powerful, but such systems could then serve as tools with which we can study and explore the nature of human reasoning.

There are two approaches to this difficult problem. First, the cognitive approach which aims to devise and experiment with models of human cognition. The second approach is a computational one from the direction of automated reasoning. This approach builds computational systems that model part of human reasoning. In my research, I take this second approach: my aim is to build systems which model how people reason and could hopefully be turned into tools for both, scientists and students. Scientists could investigate how people go about solving problems, and students could solve mathematical problem in a more intuitive way.

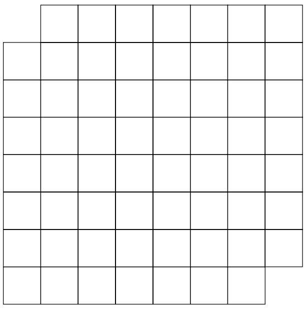
One of my earliest unforgettable "aha" experiences as a child was in my maths class – we were talking about Pythagoras' theorem, when the teacher drew the following on the blackboard:



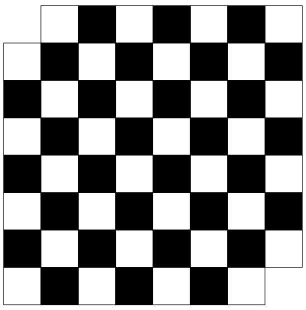
$$a^2+b^2=c^2$$

This diagrammatic proof is so clear, elegant and intuitive that with little help even a child can understand it.

Here is another beautiful problem: can a checkerboard, where we removed two diagonally opposite corner squares still be covered with dominoes? Here is the picture of this, so-called, mutilated checkerboard:



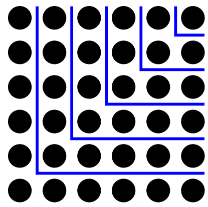
And here is an elegant solution: colour the mutilated checkerboard with alternative black and white squares, like chessboard, and also colour the dominoes' one square black and the other square white.



It is clear now, that to cover our mutilated checkerboard with dominoes, there would have to be the same number of black and white squares. But there are more white squares than black ones, so the answer is *no*, the mutilated checkerboard cannot be covered with dominoes! This problem is very easy for people to understand, but there is yet to be a system implemented which can solve this problem in such an elegant and intuitive way.

Theorems in *automated theorem proving* are usually proved with *formal logical proofs*, so-called symbolic proofs. In contrast, our examples mentioned above demonstrate how intuitive human reasoning is employed in solving problems and proving theorems. A subset of such informal reasoning are problems, which humans can prove by the use of geometric operations on diagrams, so called diagrammatic proofs. The picture below presents another example of a diagrammatic proof, in particular, of a theorem concerning the sum of odd naturals

$n^2=1+3+5+\ldots+(2n-1)$.



$n^2=1+3+5+\ldots+(2n-1)$

The proof consists of repeatedly applying *lcuts* to a square (an *lcut* removes an *ell* shape which is formed from two adjacent sides of a square – see the picture above). Notice that an *ell* represents an odd natural number since both sides of a square of size n are joined ($2n$), but the joining vertex was counted twice (hence $2n-1$).

In my past research, I built a system called DIAMOND, which can prove examples such as the one above about the odd naturals using geometric operations, just like in the example. With this system I showed that such diagrammatic reasoning about mathematical theorems can be automated. In DIAMOND, concrete, rather than general diagrams are used to prove particular instances of a universal statement (e.g., in the example in the picture above, the instance is $n=6$). The "inference steps" of a diagrammatic proof are formulated in terms of geometric operations on the diagram (e.g., the *lcut*s in the diagrammatic proof in the figure above). A general schematic proof of the universal statement is induced from these proof instances by means of particular logical rules. Schematic proofs are represented as recursive programs which, given a particular diagram, return the proof for that diagram. It is necessary to reason about this recursive program to show that it outputs a correct proof. One method of confirming that the abstraction of the schematic proof from the proof instances is sound is proving the correctness of schematic proofs in the meta-theory of diagrams.

DIAMOND can tackle only theorems which can be expressed as diagrams.

However, there are theorems which may require a combination of symbolic and diagrammatic reasoning steps in the same proof attempt, so-called heterogeneous proofs. I am currently investigating how a system could automatically reason about such proofs, and learn them in general from examples of proofs. An example below demonstrates a heterogeneous proof that consists of a combination of symbolic and diagrammatic inference steps. The theorem states an inequality: $(a+b)/2 \geq \sqrt{(ab)}$ where $a,b \geq 0$. The first few symbolic steps of the proof are:

$$(a+b)/2 \geq \sqrt{(ab)}$$

$\downarrow$ square both sides of $\geq$

$$(a+b)^2/2^2 \geq ab$$

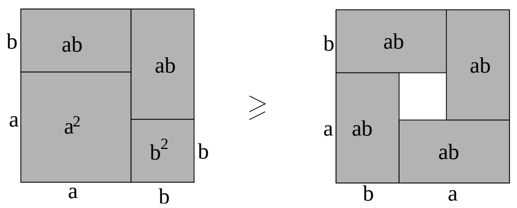
$\downarrow$ x4 on both sides of $\geq$

$$(a+b)^2 \geq 4ab$$

$\downarrow$

$$a^2+2ab+b^2 \geq 4ab$$

The second part of the proof, which is presented in the figure below, shows diagrammatically the inequality $a^2+2ab+b^2 \geq 4ab$.



$$a^2+2ab+b^2 \geq 4ab$$

Rather than learning low-level proofs, I aim for a system that can learn diagrammatic *proof plans*. *Proof planning* is an approach to theorem proving which uses high-level *proof methods* rather than low-level logical inference rules to find a proof of a conjecture at hand. It is a technique that searches for a proof plan, and a proof plan consists of some combination of proof methods. A *proof method* specifies and encodes a general reasoning strategy that can be used in a proof, and typically represents a number of individual inference rules (e.g., mathematical induction can be represented as a proof method). Our heterogeneous proof plans will be formed from geometric operations plus symbolic inference steps. The system will be able to learn such proof methods from examples of the use of lower-level methods.

Wouldn't it be exciting, if a system could learn such diagrammatic operations automatically? Moreover, if this was possible, then wouldn't it be even more exciting if a system could automatically discover new heterogeneous, that is, diagrammatic *and* symbolic proofs of some interesting theorems? This could give us new insights not only into the problems of mathematics and their solutions, but also into the nature of human reasoning. Understanding this is at the heart of artificial intelligence! We could begin to answer questions such as: how does one come up with an elegant solution to a problem? It is these questions, issues and goals that I find important, interesting and exciting.

Xen and the Art of Open Source Software

There is much debate within the academic community and the computer software industry about the best approach to exploiting software IP. Some individuals and major companies have chosen to protect their IP by licensing their patented inventions. Others have opted for the open source approach, making source code freely available to other developers through the GNU General Public License (GPL). When the Computer Lab's Xen Virtual Machine Monitor software project took off two years ago, the team decided that it would take the open source General Public License route.

Key to understanding how the GPL works is the word 'free' – in this context it means 'freedom' and not 'price'. The GPL is designed to ensure that developers are free to distribute copies of their software and that other users can receive the source code or can get it if they want. The GPL is sometimes called a 'viral' license because anyone can use the software or modify it at anytime, but no matter what an individual or company does to the source code, they must in turn give away what they have written. It is impossible to get out of the GPL agreement, so once a developer has modified GPL software source code, they cannot then copyright or patent it and call it their own.

"The original objective of the Xen project was to develop software for a public Internet-scale computing platform that could be used by anyone wanting to run a server or an application, with an easy-to-use icon-based interface," explained Dr Steven Hand of the Xen Project Team. "Xen software enables a single machine to host multiple operating systems concurrently – slicing a single computer into numerous 'virtual' computers, each running separate operating systems that cannot be accessed or interfered with by other users. Xen provides high performance and can be dynamically sized according to the users' computing requirements."

Virtualisation is nothing new in computing terms but traditionally this approach has been applied to high-end enterprise-level computing; companies such as IBM and EMC have developed virtual networks to add enhanced security to a shared network, and storage virtualisation provides increased manageability and fault resilience. The key to Xen software is that it can run on an ordinary desktop computer powered by an x86 microprocessor.

One of the major benefits of Xen software is that it enables servers to be taken down for maintenance, or for any other reason, without users having to suffer any significant down time. In a competitive environment where downtime equals loss of earnings the advantage of this is obvious. Already, Xen software is appealing to smaller companies that need high availability but may not necessarily have the resources to retain the expertise to maintain it in-house. In particular Xen software has caught the eye of Virtual Server Providers (VSPs) who sell portions of server space to small and often competing companies.

Although under the terms of the GPL anyone can download the Xen source code, users may want support and professional services. The Xen team has set up a company, XenSource, with venture capital from Paolo Alto in the US, to provide these value-added services. The plan is to base R&D in Cambridge and sales and marketing in the US, where the bulk of Xen Source's clients are based. Other successful open source companies such as MySQL and JBoss have already adopted similar business models. The Xen team is also looking to build an industry consortium to help fund further research.

Dr Hand estimates that between 500 and 1,000 users worldwide are contributing to the development of Xen at the moment and there have been between 10,000 and 25,000 downloads of Xen software. "This community is of enormous help to our team because it means that there are many experienced Xen users on hand to answer the queries from users who are less familiar with Xen. This frees us up to deal with more fundamental issues that might arise," he added.

The introduction of the GPL has caused some sections of the software industry to re-think the traditional 'shrink-wrap' approach, where users have to pay for each copy of the software that they use. "Many software developers believe that people shouldn't be able to own software because it is such a fluid and dynamic thing," said Dr Hand. "But historically there have been problems with open source code because some companies have made proprietary modifications, which they have gone on to sell as a product. The GPL minimises the chance of this happening," he added.

To many the GPL approach may seem counter-intuitive but Dr Hand believes that it actually enables the Xen team to maintain control precisely because users have to give away the source code after they have completed their modifications.

As for the future, the GRID computing community has also recognised the potential of Xen software. Professor Ian Foster, of the Argonne National Laboratory at the University of Chicago, who pioneered the concept of GRID computing and who developed the Globus Toolkit (a set of services and software to support Grids and Grid applications), is now running a research trial using Xen software to support Globus.

For more information about Xen, visit the website: http://www.xensource.com

Hall of Fame News

(The full list of companies can be found on www.camring.ucam.org)

Apama has been acquired by US-based Progress Software Corporation (PSC) in an all-cash transaction for approximately \$25mio, net of cash acquired. Apama now becomes part of PSC's ObjectStore operating unit. John Bates (*PhD94*) will become VP of event processing products within PSC's ObjectStore division and Giles Nelson (*PhD98*) will become director of business development for ObjectStore's event processing products.

Congratulations to **Applepro**, founded by Roman Marszalek (*CTH Dip99*). Applepro have won a contract to develop CRM software for ABM AMRO's Structured Credit marketing group in the City. The project will be developed in Java with IBM's WebSphere, and will sit upon ABN AMRO's proprietary framework. Development is expected to last about two and a half months. The team for this project will consist of four programmers, one designer and one usability expert. The tech lead (Ian Mouton) and director/usability expert (Roman Marszalek) met in 2000 while working together at Trilogy in Austin, Texas.

There will be at least one more phase of development, but features will be defined once this first phase has been completed. Applepro will be looking for sales skills and mentoring for future projects!

CacheLogic has closed a \$5.6mio Series B funding round, led by 3i Plc. CacheLogic is a provider of carrier-grade network intelligence and traffic management solutions to alleviate broadband traffic issues and minimize costs for ISPs.

Sophos has been awarded the VB 100% award for the 27th time. The VB 100% award recognises anti-virus products that detect all "In the Wild" viruses during both on-demand and on-access scanning in Virus Bulletin's comparative tests.

Zeus Technology has been positioned in the leader's quadrant in Gartner, Inc.'s Magic Quadrant report, "Web-enabled Application Delivery Magic Quadrant for 2H04". The Magic Quadrant evaluates vendors based on their "completeness of vision" and "ability to execute" that vision.

In Brief

The Ring caught up with **Dr Hermann Hauser** who recently gave a CMI Distinguished Lecture on the challenges of growing a start-up business into a larger company.

In 1999, Dr Hauser, the venture capital godfather of Cambridge, bemoaned the fact that "Cambridge's ingredients haven't gelled", leaving Cambridge "barely on the map" compared with Stanford and the other universities around Silicon Valley."

According to Dr Hauser, things look very different now. With time and patience Cambridge has created a culture which pairs outstanding technology with entrepreneurship. Barriers to growth have been overcome by the ability to attract quality management. As an example, Dr Hauser cited Solexa, the gene sequencing company which spun out of the Department of Chemistry. The fact that Solexa had appointed Applied Biosystems Inc's John West as CEO was testament to Cambridge's success, commented Dr Hauser. He does not believe such a senior figure would have entertained such a move 5 years ago.

And what about the 'next big thing'. Dr Hauser needs no time to think about this. It's plastic electronics. A fundamental breakthrough has been achieved with plastic transistors and Dr Hauser sees the potential to create a new very exciting sector.

The Ring also caught up with **Justin Wise** who gave an update on his latest venture.

"Over the past six years I have been involved in founding and running Curious Software, a UK company that develops graphics and animation software for the television and film industries. I have been closely involved in product design and implementation, as well as building the company to its current success. Our flagship product, Curious World Maps, rapidly became the world market leader in the field of broadcast television news, and I'm excited to say that Curious Software is now to be acquired by vizrt, a leading European player in the world of 3D broadcast graphics.

Over my 10 years in software development companies, I have become increasingly interested in how the way we work together in teams and how we develop human potential influences our effectiveness, our productivity, and our creativity. How do we make software and technology companies places which encourage and sustain rich, open communication, in which we are able to learn by giving and receiving valuable feedback, and in which we allow the true talents of our people to be expressed and bring value to the work that we do? How do we deal with the often marked differences in style and priorities between people in different parts of our organisations? I am often struck by how limiting the lack of communication between R&D and Marketing teams can be, for example. How do we develop people and teams to maximise their potential and create sustained excellence? How do we bring the best of the sciences and tools of people development to the world of software and technology development?

In January of this year I left Curious Software to found my own company and consultancy exploring these issues, and providing advice, input, and training to companies involved in software and hi-tech research and development. Our aim is to provide the very best training, learning experiences, and tools to develop the capabilities, potential, and excellence of the people and teams who are responsible for keeping our companies at the leading edge of technical development. You can find full details of the company at www.mindsource.co.uk.

If you have any questions, thoughts, or comments I'd be very grateful to hear them. You can reach me by email at justin@mindsource.co.uk"

Who's Who

Stephen Allott (*T MA80*) has co-founded Trinamo Ltd, a technology sales consultancy, of which he is Chairman. He has also been appointed a City fellow of Hughes Hall College. Stephen continues to develop his people centric approach to economic development (see publications).

David Barker (*Q BA80*) is a Director at MEI.

Ahal Besorai (*R BA94)* is President and CEO of Inclarity Plc.

Timothy Bond (*CHU MA85*) is Senior Architect at Navimedix Inc in the US.

Adam Cohen-Rose (*CL BA95)* is Senior Developer at Kizoom Ltd, a software company that develops services that make it easy for the public to find transport information.

David Cottingham (*CHU BA04)* is a PhD Student at the University of Cambridge Laboratory for Communications Engineering.

Ben Cotton (*EM MA95)* is Head of Interface Development at Oyster Partners.

Joshua Davidson (*DAR Dip03)* is an IT Utilization Specialist for the Northern California & Central Valley Minority Business Development Centers.

Stuart Dyer (*Q Meng93)* works in International Sales at Granta Design Ltd.

Robert Folkes (*EM BA82)* is Director of La Truffe Noir, an Australian consulting company which provides IT and management consulting services. Robert also started the 1st Truffier in New South Wales.

Martin Fulford (*PET BA74*) is a Senior GIS Consultant at Magik Circle.

Fiona Glencross (*N BA96)* is an Executive Director at Goldman Sachs, where she works as a technology analyst.

Liam Goddard (*CHU BA04)* is working as an analyst at Accenture.

Oren Goldschmidt (*PEM BA97)* is Managing Partner of blueorange technologies.

James Green (*F MA96*) works for Amrivox, a provider of leading edge Voice over IP solutions.

Tom Griffiths (*JE BA03)* is reading for a PhD at the University of Edinburgh. He has also founded Insight Studios, a company which does web and graphic design for SMEs and start-ups.

Hermann Hauser (*Phd77)* and **Jan Hruska** (*DOW BA78)* were members of "The Growing Business Awards 2004" judging panel.

Feng Hou (*G Dip03*) is a software design engineer at Nokia Network.

Hank Liao (*SID MPhil02*) is a research student at the University of Cambridge Computer Laboratory.

Richard Mason (*Q BA84 MBA04*) is President of MAXIMUS BC Health, a subsidiary of MAXIMUS Inc, an American company that specializes in providing outsourced services for government. He is directing the transition to MAXIMUS of a 10-year, $324 mio outsourcing contract to administer two government healthcare programs in BC, Canada.

Charles McLachlan (*CL BA85*) is a Director at Cornerstone Consultants (UK) Ltd.

Chris Morgan (*JE BA01*) is working for Metaglue (working on software for digital video processing) before traveling to New Zealand.

Tony Morris (*DOW MA81, Dip85)* is currently studying Fine Electric Arc Welding (aluminium and stainless steel).

Yi Hoo Ong (*CHU BA04)* is a software engineer at Amadeus.

Matthew Rowen (*CC BA04)* is a software engineer at Symbian.

Norman Sanders (*TH Dip57*) is a project manager for ProjX. Previously, he was Head of the Computing Department and Offshore Technology Department at the Norwegian Technical University. Prior to that he was Director of Computer, 727/737 Division at The Boeing Company.

Lucy Saunders (*N BA84)* is Principal Consultant at PR company Mahseer Ltd.

Christoph Schmidt (*DAR Dip03)* is working as a financial analyst for Old Mutual Asset Management.

Lane Schwartz (*CHU MPhil02)* is working as a software engineer for IBM in Minnesota, USA.

Mar Stringer (*RA Computer Laboratory 02-04)* is a Research Fellow in the Informatics Department, University of Sussex.

Robert Thatcher (*CHU BA98)* is an Associate at Morgan Stanley, where he works as a software architect and quantitative developer.

Prof CK Toh (*K PhD96*) holds the Chair in Communications Networks at the Department of Electronic Engineering, Queen Mary University of London.

Robin Williamson (*CHU PhD85*) is Vice-President of Engineering at Coremetrics in the US.

Publications

"The Hitchhiker's Guide to SQL Server 2000 Reporting Services" (http://www.amazon.com/exec/obidos//ASIN/0321268288) authored by Peter Blackburn (*CTH89*), was first published in October 2004 and is proving to be a great success. In less than 6 months the publishers have needed to order several print runs to keep up with the sales demand. The next print run will be the 4th!

Peter is currently speaking at conferences and to training development teams to use SQL Server 2000 Reporting Services. So, if you should need such training you can contact Peter at Peter@boost.net

Computer Laboratory News

Funding win for transport research

The Computer Laboratory is celebrating a major funding award from the Engineering and Physical Sciences Research Council (EPSRC), which will kick-start a programme of research in the transport sector.

Dr Jean Bacon, Reader in Distributed Systems, is Principal Investigator for the Transport Information Monitoring Environment-Event Architecture and Context Management (TIME-EACM), which has won funding of just under £1mio. Jean Bacon, along with colleagues from the Computer Lab and the Department of Engineering, will partner with Birkbeck College, with British Telecom as project partner.

The goal of this five year project is to investigate, design and implement a secure but open interface to support the controlled sharing of monitored data from any form of transport. Currently, transport providers are concerned only with their own data and sensors are typically installed for a single purpose. In the long-term, the software will enable passengers to query travel conditions for their whole journey, wherever they are, and provide automatic status updates as they travel.

Concrete outcomes of the work will be an event-based middleware that hides low-level sensor aggregation from applications, integration of high-level context models with query support, and an evaluation of this support based on prototype, but real-world, applications that fully exploit the architecture. The middleware developed for the project will be made available as open source software as it has potentially wide application for other traffic monitoring projects and for a range of event-driven applications where sensors have been used to monitor state.

The TIME-EACM project is a central plank of the Transport Information Monitoring Environment (TIME) programme, headed up by Professor Ian Leslie. The aim of the programme is to improve the understanding of transport network performance in the long-term by developing novel traffic data monitoring, management and modelling systems.

Initially, TIME will use Cambridge as a compact and convenient test bed – with severe congestion problems – for this research. Projects under the programme have not been pre-defined but are likely to include; sensor design and content distribution, applications and interfaces. Transport providers and other industry partners with interest in the transport sector are being actively sought for collaboration in defining and implementing such projects.

Conferences

Dr Neil Dodgson is on the programme committee for Stereoscopic Displays and Applications as well as the committee of Eurographics 2005.

The Stereoscopic Displays and Applications conference is held every January in San Jose as part of the Society for Imaging Science and Technology/The International Society for Optical Engineering's International Symposium on Electronic Imaging: Science and Technology. This is the premier venue for presenting recent advances in stereoscopy.

Eurographics 2005 is the principal European conference on computer graphics and second only to ACM SIGGRAPH in terms of its importance to the graphics community. Eurographics 2005 will take place at Trinity College Dublin from 29th August-2nd September.

Computer Laboratory's Supporters' Club

The Supporters' Club annual recruitment fair took place on January 27th. The event was a great success with around 25 companies taking part.

The next fair will be held on November 30th 2005, while the Supporters' Club dinner will take place on March 2nd 2006.

If your company is looking to recruit graduates, or has summer placement opportunities, and would like to attend the fair please contact the Supporters' Club at:
supporters-club-organiser@cl.cam.ac.uk

Further information on the Supporters' Club can be found at:
http://www.cl.cam.ac.uk/ext/supporters-club/

Obituary

Reprinted by permission from The Independent, Obituaries, 22 December 2004.

Professor David Wheeler

Computer pioneer and inventor of the 'closed subroutine'

In October 2003, David Wheeler was inducted into the Hall of Fellows of the Computer History Museum, California, for his contributions to computer science, particularly the "closed subroutine" – one of the first and most enduring software inventions. For Wheeler it was one of the closing pages of a story that began in November 1946 when, as a Cambridge undergraduate, he had attended the inaugural lecture of Douglas Hartree, the newly appointed Plumian Professor of Mathematical Physics. Hartree had then recently returned from the United States, where he had seen the latest electronic computing developments, and he was convinced computers would revolutionise the way science was done.

Wheeler was hooked, and he found his way to the University Mathematical Laboratory, where one of the new computing machines was already being designed under the direction of Maurice Wilkes. Wheeler quickly made his presence felt, by pointing out a bug in the arithmetic circuits. "I must have been a pest!" he recalled. Two years later, he became one of the first two research students in the laboratory and stayed for the remainder of his life.

David Wheeler was born in Birmingham in 1927, the second of three children of Arthur and Agnes Wheeler. He was educated at King Edward VI Camp Hill Grammar School, Birmingham, and, following wartime dislocation, Hanley High School, Stoke-on-Trent. In 1945 he won a scholarship to Trinity College, Cambridge, where he read Mathematics and graduated as a Wrangler.

In October 1948, Wheeler became a research student in the Mathematical Laboratory under the supervision of Wilkes and joined the team that was building the Edsac computer: Wilkes had already decided that, because of the limited resources available to the laboratory, instead of building a machine of the highest performance they would build a computer quickly and cheaply, and then conduct research into programming and applications. Programming would prove to be Wheeler's forte and Wilkes let him take the lead.

The first problem that Wheeler faced was how to avoid having to write programs in binary codes, the only thing that the machine directly understood. Besides using a symbolic programming notation – an innovation it is easy to overlook – he also had to create a set of "Initial Orders" to translate symbolic programs into binary. The Initial Orders had to be written in the ludicrously small space of 30 instructions.

Edsac sprang into life on 6 May 1949. The machine was soon pressed into regular operation, providing the world's first electronic computing service. As operational experience built up, it became clear that programmers would be much more productive if they were provided with a library of subroutines – small, pre-written programs for mathematical functions and the tabulation of printed results.

Wheeler tinkered with the Initial Orders to allow the use of subroutines. Using just 41 instructions (a tiny additional amount of memory had become available), he was able not only to support subroutines, but also to add many additional features. The new Initial Orders were of breathtaking cleverness. The neatest feature was his implementation of subroutines, which used a technique later known as the "Wheeler jump".

The Initial Orders had something of the elegance of a perfectly honed theorem in mathematics. They were much more than an ingenious response to the memory constraints of the Edsac. It was as if these constraints had induced Wheeler to produce a programming artifact of real genius. His work would shape the programming landscape for several years and, to a degree, it still shapes it.

In 1951, the group wrote the first textbook on programming, *The Preparation of Programs for an Electronic Digital Computer* – usually known after its three authors as "Wilkes, Wheeler and Gill" or simply WWG. (The third author, Stanley Gill, was another young researcher who later became Professor of Computing Science at Imperial College.)

The book arrived on the scene just as the first American computers were coming into service, and the Cambridge programming techniques were widely adopted. For example, the IBM 701, the office-machine giant's first electronic computer, made use of closed subroutines and the Wheeler jump. Even today, closed subroutines persist at the heart of almost all programming systems.

In 1951, Wheeler secured a research fellowship at Cambridge, and during 1951-53 spent two years as a visiting assistant professor at Illinois University, where he contributed to the design of the Illiac computer. In 1956 he was appointed Assistant Director of Research in the Mathematical Laboratory. A successor machine, Edsac 2, was under construction, and Wheeler again designed the programming system. This time he had 768 words of memory at his disposal. He probably got more personal satisfaction from the larger canvas, and the result was another programming masterwork.

In 1966 Wheeler was appointed Reader in Computer Science, and elected a Fellow of Darwin College the following year. The laboratory was at the centre of his whole professional life, as teacher, scholar, and research supervisor. A gentle manner and genuine humility belied his formidable analytical powers and problem-solving ability.

Wheeler's academic career was to consist of a string of important contributions to computer science and practice, of which the programming systems for the Edsac computers were just the first. His work was pivotal to the realization of the ambitious technical goals the laboratory set itself. He played an important role in the operating system for the laboratory's Titan computer, Britain's leading time-sharing computer project of the 1960s. He worked on the Cap computer in the 1970s, another breakthrough in computer design, and on the Cambridge Ring, a forerunner of the networked computer systems of today.

In 1978 Wheeler was appointed Professor of Computer Science, and in 1981 was elected a Fellow of the Royal Society. Beyond the laboratory (now renamed the Computer Laboratory), he was a consultant for Bell Labs and the Digital Equipment Corporation in the United States. At the latter he worked with Mike Burrows to devise the Burrows-Wheeler Compression Algorithm, a now-standard technique for reducing the size of computer files.

He never lost his talent for writing perfect programs, and one commentator described Wheeler's data compression program as "mathematical/computer magic". Close to retirement in 1994 he invented with Roger Needham an elegant cryptography technique later widely used and called Tea, for Tiny Encryption Algorithm.

Wheeler retired in 1994, becoming Professor Emeritus. His later years were blighted by failing eyesight, but he still spent most days in the laboratory, including his last.

Martin Campbell-Kelly

A Celebration of David Wheeler was held in the Computer Laboratory on April 18th 2005.

Job Postings

Searching for Talent

John Snyder (*Chr87*) is looking for any Ring members who can cut code, likes XML, web services, RSS, weblogs or the information retrieval (search) space and who has one to many days available per month to help on bespoke projects. Chris Charlton (*Q93, 99*) has joined John to help build applications around Dr Martin Porter's latest search system – GRAPESHOT (www.grapeshot.co.uk). Martin is a graduate from the Lab who in the 1980's wrote his seminal "Porter Stemmer" algorithm and the database search system called MUSCAT. Martin and John built Muscat up into a business from 1992, which they sold in 1997. Grapeshot is the fruit of work over the past four years, and just starting to be seen by the technical folk at Google, MSN and Oracle. John would be interested to hear from any Ring member based in Cambridge who wanted to get involved in some way.

John can be contacted on john.snyder@grapeshot.co.uk

Kizoom

XP Java Developers

Kizoom specializes in developing software to deliver travel information to people on the move.

It now seeks a variety of Java Developers to work as part of its XP team.

You will be designing and developing web-based applications using Eclipse, Spring, Hibernate, MySql, JSTL, JBoss and other best-practice tools and frameworks.

To find out more, please go to the Job Bulletin Board on the Ring website: www.camring.ucam.org