

Proceedings of the

2016 Oxford Computer Science Conference

2016 OxCSC



Department of Computer Science
Wolfson Building
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Programme Committee

Chad Heitzenrater, *General Chair*

Charlie Kingston, *Conference co-Chair*

Aditya Sharad, *Conference co-Chair*

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Chair's Welcome

Welcome to the 2016 edition of the University of Oxford Department of Computer Science Conference (2016 OxCSC)! This year's offering is a mix of the traditional and non-traditional, with many exciting changes.

In the biggest change this year, we are very pleased to have sponsorship from G-Research and Winton Global Investment Management. It was through these partnerships that we have been able to expand this year's conference experience. Please take the time to stop by their stands in the atrium.

We are also excited to have Dr. James Mickens, Associate Professor of Computer Science at Harvard University. Dr. Mickens (otherwise known by his formal title, 'Galactic Viceroy of Research Excellence') is known for his entertaining and insightful treatments of hard problems in computer science. Many of us are fans of his writings, and are looking forward to the opportunity to hear his wisdom first hand.

This year's conference dinner event will be held at Lady Margaret Hall (LMH). For the first time we have been able to offer free tickets to all presenters, which we hope will promote further in-depth discussions and enhance the conference experience.

An expansion to the programme structure saw the introduction of a lightning talks session, with the goal of providing a venue for early results and a forum for feedback on research ideas.

With these new aspects, OxCSC 2016 builds on a tradition of departmental conferences. This year's programme has strong sessions reflecting the broad and varied areas of computer science research throughout Oxford, to include theory, satisfiability, privacy, image processing, protocol analysis, network analysis, and systems design. We were again able to accommodate each submission, supporting the development of research expertise among post-graduates. As a fully student-led, student-organised event, our goal is to showcase all of computer science at Oxford.

Such events do not happen without significant support, and I would like to extend my thanks to everyone who assisted in the preparation and organisation. My personal thanks to the Programme Committee, as well as the Computer Science Graduate Society (CoGS) and Joint Consultative Committee for Graduates (JCCG) members for their roles in organisation. On behalf of the committee I also want to recognise Julie, Sarah and Lyn for their excellent administrative support, without which none of this would be possible.

The committee is very enthusiastic about this year's programme, and we hope you enjoy the event.

Chad Heitzenrater
General Chair

Programme

Start	End	Session
9:00	9:05	<i>Welcome Address</i> , Chad Heitzenrater, General Chair
9:05	10:20	<p>Session: Theory (Chair: Matt Smith)</p> <p><i>On Planar Valued CSPs</i> Peter Fulla and Stanislav Živny</p> <p><i>Profunctor Optics: Making Sense of Data Accessors</i> Matthew Pickering</p> <p><i>Exact Learning of Polynomial Automata</i> Aditya Sharad and James Worrell</p>
10:20	10:40	Break
10:40	11:55	<p>Session: Privacy (Chair: Elizabeth Phillips)</p> <p><i>The Privacy Paradox and the Internet-of-Things</i> Meredydd Williams and Jason Nurse</p> <p><i>PPTMA: Privacy-Preserving Targeted Mobile Advertising</i> Yang Liu and Andrew Simpson</p> <p><i>SecuRank: Starving Permission-Hungry Apps Using Contextual Permission Analysis</i> Vincent Taylor and Ivan Martinovic</p>
11:55	12:30	<p>Lightning Talks (Chair: Charlie Kingston)</p> <p><i>Investigating the Impact of Gender Differences on Cyber Security Skills</i> Paula Fiddi, Marina Jirotko and Ivan Flechais</p> <p><i>Small-scale cyber security</i> Emma Osborn</p> <p><i>Distributed Anytime Generic Inference</i> Abhishek Dasgupta</p> <p><i>Cyber Insurance: A Tale of Two Jurisdictions</i> Daniel Woods</p> <p><i>Security protocols - are they secure?!</i> Nick Moore</p> <p><i>On the Fly Construction of Perceptually Uniform Color Spaces from User Surveys</i> William Rathje</p> <p><i>Cyber Security Oxford</i> Katherine Fletcher</p>

Start	End	Session
12:30	14:00	Lunch and Poster Session
		<p>Poster Titles:</p> <p><i>Data-efficient Bayesian verification of parametric Markov chains</i> Elizabeth Polgreen, Viraj Wijesuriya, Sofie Haesaert, and Alessandro Abate</p> <p><i>Personal Proxies for Decentralized Web Applications</i> Mario Gemoll</p> <p><i>Classifying Uveitis Biologics Registry Data using Data Analytic Techniques</i> Kamaliah Kamarudin and Min Chen</p> <p><i>Modelling Smart Buildings Dynamics</i> Nathalie Cauchi and Alessandro Abate</p> <p><i>Sonification for Network Monitoring: a Research Agenda</i> Louise Axon</p> <p><i>Are we managing the risk of sharing Cyber Situational Awareness? A UK Public Sector Case Study</i> Michael Davies and Menisha Patel</p> <p><i>Optimal Bounds for the No-Show Paradox via SAT Solving</i> Felix Brandt, Christian Geist and Dominik Peters</p>
14:00	14:40	<p>Keynote:</p> <p><i>Surviving The Hardware Apocalypse (I'm Coming To Your House)</i> Dr. James Mickens</p>
14:40	15:30	<p>Session: Security (Chair: Martin Dehnel-Wild)</p> <p><i>On Post-Compromise Security</i> Luke Garratt, Katriel Cohn-Gordon, and Cas Cremers</p> <p><i>The Days Before Zero Day: Investment Models for Secure Software Engineering</i> Chad Heitzenrater, Rainer Böhme, and Andrew Simpson</p>
15:30	15:50	Break
15:50	17:05	<p>Session: Miscellaneous (Chair: Kevin Milner)</p> <p><i>Ghostbuster: A Tool for Simplifying and Converting GADTs</i> Trevor McDonnell, Timothy Zakian, Matteo Cimini, and Ryan Newton</p> <p><i>Extracting Social Structure from Dark Web Forum Metadata</i> Elizabeth Phillips</p> <p><i>The Sensitivity to Boundary Errors of Image Segmentation Evaluation Measures</i> Varduhi Yeghiazaryan and Irina Voiculescu</p>
17:05	17:30	Poster Judging and Awards Presentation
17:30		Drinks Reception in Atrium
19:00		Drinks and Dinner at Lady Margaret Hall

Abstracts

Theory

On Planar Valued CSPs

Authors: Peter Fulla and Stanislav Živný

Abstract: Many decision and optimisation problems that are NP-hard in general become tractable if restricted to planar instances. For example, the Not-All-Equal Satisfiability and Max-Cut problems are NP-hard in general, but solvable in polynomial time with the planarity restriction. On the other hand, the Maximum Independent Set problem is NP-hard even on planar instances. We study a large class of problems known as Valued Constraint Satisfaction Problems (VCSPs) that include the previous three examples as special cases. Our goal is to understand the computational complexity of planar VCSPs. For Boolean domains, we give necessary conditions for tractability. For conservative languages over arbitrary domains, we give a complete complexity classification.

Profunctor Optics: Making Sense of Data Accessors

Author: Matthew Pickering

Abstract: Programming is all about accessing and manipulating data. It is common to write functions which access specific fields in a record, perform updates or build larger data structures from smaller parts. These operations are all examples of different kinds of optics. The optical framework is a method of classifying and organising such data accessing functions. It dictates which kinds of optics we should be able to compose together and what the result of such a composition should be. Programming with optics leads to well-structured and reusable programs as we separate *how* we want to access data with which kinds of operations we can perform on the target. Profunctor optics are a representation of optics based on profunctors which we can embed in Haskell. By exploiting the constraint solving machinery, we can embed different optics in a light-weight manner so that we can compose them together with ordinary function composition. In this talk I give a brief overview of the optical hierarchy, explaining the intuition behind different kinds of optics before explaining how we can embed this system into Haskell.

Exact Learning of Polynomial Automata

Authors: Aditya Sharad and James Worrell

Abstract: Given some finite information about a language of strings, or a function on strings, is there an efficient algorithm to learn an automaton that computes the entire language or function? This is an important problem in computational learning theory, analogous to studying how humans learn languages. Under Angluin’s “exact learning” framework for this problem, in which a learning algorithm queries a “Minimally Adequate Teacher” oracle, deterministic finite automata can be learned, as can the more

general “weighted automata”, which compute functions from strings into a field, using linear maps to update values at each state of the automaton each time a symbol is read.

I will present a natural extension of weighted automata: “polynomial automata”, which allow polynomials as state updates to compute a larger class of functions. Although some properties of these systems have been studied using abstract algebra, learnability remains open, as existing linear algebra techniques to exact-learn weighted automata do not work directly on polynomial automata. I will describe these existing techniques, then use commutative algebra to generalise them to polynomial automata, giving an algebraic characterisation of the functions computed by polynomial automata, results on their exact learnability, and approaches to learning more general types of automata.

Privacy

The Privacy Paradox and the Internet-of-Things

Authors: Meredydd Williams and Jason Nurse

Abstract: Privacy is a concept found throughout human history. Numerous polls suggest the general public value their privacy, with the NSA surveillance revelations accompanied by general outcry. Despite vocal claims, however, individuals often express behaviour to the contrary. Citizens share personal information on social networks and use free services which sell data to third parties. In previous work, we conducted a survey across the UK to ascertain the privacy perceptions of the general public. We found that regardless of how much individuals claim to value privacy, they still disclose sensitive information. This disparity between claim and action is known as the ‘Privacy Paradox’ and numerous contributory factors have been identified, including user interface design and risk saliency. Technological developments often undermine established practices and the rapid growth of ‘smart devices’ has this potential. We posit that the proliferation of Internet-of-Things technologies will aggravate many of those factors which contribute to the paradox, further exacerbating the situation. We explore the evolution of these two subjects, their potential intersection and what future implications this might have for privacy. We conclude by suggesting both technological and regulatory measures we believe necessary to ensure privacy is protected in a world of ubiquitous data collection.

PPTMA: Privacy-Preserving Targeted Mobile Advertising

Authors: Yang Liu and Andrew Simpson

Abstract: With the continued proliferation of mobile devices, the collection of information associated with such devices and their users?such as location, installed applications and cookies associated with built-in browsers?has become increasingly straightforward. By analysing such information, organisations are often able to deliver more relevant and better focused advertisements. Of course, such Targeted Mobile Advertising (TMA)

gives rise to a number of concerns, with privacy-related concerns being prominent.

To this end, we discuss the necessary balance that needs to be struck between privacy and utility in this emerging area and propose Privacy-Preserving Targeted Mobile Advertising (PPTMA) as a solution that tries to achieve that balance. Our aim is to develop a solution that can be deployed by users but is also palatable to businesses that operate in this space.

SecuRank: Starving Permission-Hungry Apps Using Contextual Permission Analysis

Authors: Vincent Taylor and Ivan Martinovic

Abstract: App stores contain many clusters of apps competing to provide the same functionality, such as flashlight or alarm clock. Within each cluster, permission usage by individual apps sometimes varies widely. Although permission warnings inform smartphone users of the access to sensitive resources required by apps, many users ignore these warnings due to conditioning or a lack of understanding. We study the variation in permission usage across 50,000 Google Play Store search results for 2500 searches each yielding a cluster of 20 similar apps. Using fine-grained contextual analysis of permission usage within clusters, we identified over 3400 (potentially) privacy-damaging apps, approximately 7% of the studied dataset. We show that users can be assisted in avoiding/replacing these apps with more privacy-preserving alternatives that still provide the required functionality. We implement our contextual permission analysis framework as a tool, called SecuRank, and release it to the general public in the form of an Android app and website. SecuRank allows users to audit their list of installed apps to determine whether they can replace any of them with a more privacy-preserving alternative. By running SecuRank on the entire Google Play Store, we discovered that up to 50% of apps have a more privacy-preserving alternative.

Security

On Post-Compromise Security

Authors: Luke Garratt, Katriel Cohn-Gordon, and Cas Cremers

Abstract: This project attempts to bridge the gap between theory and practice in state-of-the-art key exchange protocols. In recent work we study communication with a party whose secrets have already been compromised. At first sight, it may seem impossible to provide any type of security in this scenario. However, under some conditions, practically relevant guarantees can still be achieved. We call such guarantees “post-compromise security”.

The Days Before Zero Day: Investment Models for Secure Software Engineering

Authors: Chad Heitzenrater, Rainer Böhme, and Andrew Simpson

Abstract: The majority of security practice — and spending — is focused on post-development products and enterprise approaches. The burgeoning Secure Software Engineering (SSE) community has sought to identify and espouse activities that address the introduction of vulnerabilities as a means of stemming the growing tide of security problems before they can be realised. It is widely believed that not only do such approaches hold promise to limit exposure and reduce security incidents, but that they represent a valid security investment that decreases overall security expenditure. While many initiatives are now underway to codify such SSE practices, a treatment of the economic considerations has yet to be conducted. We propose an initial model that captures SSE investment as a means of reducing defender uncertainty regarding vulnerabilities, while raising the cost to the attacker. This approach is instantiated as a companion process to traditional security models, and we use the Iterated Weakest Link (IWL) model of (post deployment) security investment to demonstrate how defender security investment can be optimised over the system's lifecycle. The results indicate both an increased return on security investment — the Return on Secure Software Process (ROSSP) — as well as reduced post-deployment costs.

(Approved for Public Release; Distribution Unlimited: 88ABW-2016-0892 20160229)

Miscellaneous

Ghostbuster: A Tool for Simplifying and Converting GADTs

Authors: Trevor McDonnell, Timothy Zakian, Matteo Cimini, and Ryan Newton

Abstract: Generalized Algebraic Datatypes, or simply GADTs, can encode non-trivial properties in the types of data constructors. Once such properties are encoded in a datatype, however, all code manipulating that datatype must provide proof that it maintains these properties in order to typecheck. We present a step towards gradualizing these obligations through a new tool — Ghostbuster — that produces simplified versions of GADTs which elide selected type parameters, thereby weakening the guarantees of the simplified datatype in exchange for reducing the obligations necessary to manipulate it. Like ornaments, these simplified datatypes preserve the recursive structure of the original, but unlike ornaments we focus on information-preserving bidirectional transformations; Ghostbuster generates type-safe conversion functions between the original and simplified datatypes which are the identity function when composed. I will motivate the usefulness of this conversion for programmers in the real world and will talk briefly about previous solutions programmers had at their disposal and how Ghostbuster solves many of the problems found in them. I will also show that beyond fixing many of the fundamental problems in the previous solutions, Ghostbuster is more scalable and orders of magnitude faster than any of the current methods for converting GADTs while simultaneously reducing executable size.

Extracting Social Structure from Dark Web Forum Metadata

Author: Elizabeth Phillips

Abstract: This presentation explores various Social Network Analysis (SNA) techniques in order to identify a range of potentially ‘*important*’ members of Islamic Networks within Dark Web Forums. We conducted our investigation on five forums collected in previous work as part of the Dark Web Forum portal and built upon the tool support created in our previous research in order to visualise and analyse the network.

Whilst existing work attempts to identify these structures through state-of-the-art Computational Linguistic techniques, our work relies on the communication metadata alone. Our analysis involved first calculating a range of SNA metrics to better understand the group members, and then apply unsupervised learning in order to create clusters that would help classify the Dark Web Forums users into hierarchical clusters.

In order to create our social networks, we investigated the effect of repeated author resolution and various weighting schemes on the ranking of forum members by creating four social networks per forum and evaluating the correlation of the top n users (for $n = 10, 20, 30, 40, 50$ and 100). Our results identified that varying the weighting schemes created more consistent ranking schemes than varying the repeated author resolution.

The Sensitivity to Boundary Errors of Image Segmentation Evaluation Measures

Authors: Varduhi Yeghiazaryan and Irina Voiculescu

Abstract: Evaluating the accuracy of an image segmentation task involves the analysis of similarities and differences between the segmentation result and some form of ground truth. The same kind of analysis can also be used for comparing the results of different segmentations. There is currently no established evaluation framework; the choice of similarity or difference measures is largely task dependent, focusing on specific features of segmented regions and revealing limited types of segmentation errors.

This paper considers a number of established evaluation measures most frequently used in medical image segmentation, determined by a literature survey; we also propose a new hybrid similarity measure. We analyse their performance on a synthetic dataset constructed carefully so as to simulate regions with a range of different kinds of segmentation errors.

We conclude that our new measure demonstrates higher sensitivity to a larger variety of error types in comparison to existing measures; it also allows for easier implementation and improved efficiency. Furthermore, we show how the new measure assigns a significantly clearer and reliable ranking to segmentation results when errors around region boundaries are within focus.

Posters

Data-efficient Bayesian verification of parametric Markov chains

Authors: Elizabeth Polgreen, Viraj Wijesuriya, Sofie Haesaert and Alessandro Abate

Abstract: Obtaining complete and accurate models for the formal verification of systems is often hard or impossible. We present a data-based verification approach that addresses incomplete model knowledge. A data-generating system is modelled as a parametric Markov chain, and the system properties are expressed in Probabilistic Computational Tree Logic (PCTL). We propose a novel verification algorithm that quantifies the confidence that the underlying system satisfies a given property of interest, exploiting the partial knowledge of the system to minimise the amount of sampled data required. First, model checking generates a feasible set of parameters corresponding to models satisfying the given PCTL property. Simultaneously, a probability distribution over the parameter set is obtained from sample data using Bayesian inference. The results of both steps are combined to compute a confidence that the underlying data-generating system satisfies the property. Our approach offers a framework to integrate Bayesian inference and formal verification, and in our experiments our new approach requires one order of magnitude less data than standard statistical model checking to achieve the same confidence.

Personal Proxies for Decentralized Web Applications

Author: Mario Gemoll

Abstract: My MSc project explores the idea of an architecture for internet applications based on the assumption that every user has their own server. The hope is that this would facilitate the realization of novel applications such as decentralized social networks and mitigate some of the issues, especially concerning privacy, present in today's architectures.

Classifying Uveitis Biologics Registry Data using Data Analytic Techniques,

Authors: Kamaliah Kamarudin and Min Chen

Abstract: Data visualization plays an important role to assist human limited cognitive and perceptions ability for complex dataset. For this research, we obtained a testing data for eye inflammations. Based on our interviews with the medical consultant, we concluded that the experts do not have a suitable classification scheme for their data and so far, they have been relying much on their heuristic knowledge to classify their patients. Therefore, we aim to assist our medical consultants to identify and classify their patients records into suitable treatment stages. We used three visualization techniques, namely Parallel Coordinate, Treemap and Sunburst visualization for the preliminary results. Our aim for the visualizations are to assist the medical consultants to view their data more objectively, hence enabling them to identify important variables, their correlations and finally, build a suitable classification scheme for their data. This research describes the case study that we undertook, outlined the requirements for our

ongoing project as well as preliminary visualization results for the testing data used in this case study.

Modelling Smart Buildings Dynamics

Authors: Nathalie Cauchi and Alessandro Abate

Abstract: Improving energy efficiency and user comfort of Heating, Ventilation and Air Conditioning (HVAC) is a primary objective for society. This objective requires an added level of intelligence to the buildings infrastructure, which has opened up new problems and challenges related to the optimised performance of Smart Buildings and HVAC systems. The first step in developing Smart Building architectures that achieve optimal performance is to construct a quantitative modelling framework of the smart building themselves. Different techniques have been employed which include - black box modelling, grey-box modelling, and simulation based modelling (such as TRNSYS and Energy Plus software). In this work we present a data-driven modelling technique that has been employed to model the thermal performance and air quality of two rooms within the Department of Computer Science, at the University of Oxford. A technique based on maximum likelihood and the extended / unscented kalman filter has been developed to estimate and infer unknown model parameters. The resulting models have been further validated and simulated in order to quantify their performance in predicting the system dynamics. These models now serve as a test bed on which we intend to further apply model reduction and abstraction techniques such that they can be used to perform construct correct by construction controllers.

Sonification for Network Monitoring: a Research Agenda

Author: Louise Axon

Abstract: The use of sonification systems in Security Operations Centres (SOCs) may improve computer network monitoring capabilities. In SOCs, networks are generally monitored using a combination of anomaly detection techniques, Intrusion Detection Systems, and data presented in visual and text-based forms. In the last two decades, there has been significant progress made in the development of sonification systems to further support network monitoring tasks, with a range of systems proposed. Many of these systems have not been sufficiently validated and there is a lack of uptake in SOCs. We summarise the gaps in prior research in this area, and propose a research agenda for developing useful and useable sonification systems for network monitoring. In particular, we identify three areas in which further research is required. Firstly, the development of an aesthetic approach to designing sonifications suitable for continuous real-time network monitoring. Secondly, the formalisation of an approach to designing sonifications in this space. Lastly, the refinement of sonification systems, and validation of their usefulness for network monitoring tasks, through comprehensive user testing.

Are we managing the risk of sharing Cyber Situational Awareness? A UK Public Sector Case Study

Author: Michael Davies and Menisha Patel

Abstract: The development of effective cyber situational awareness, that makes a significant contribution to the decision making process around information risk management, is an important goal for organizations across all sectors. The sharing of such information between and within organizations is seen as a key security enabler. This paper considers a case study of a UK Public Sector organization. The aim is to establish if the decision to share cyber situational awareness has been taken from an information risk management perspective, and to examine whether or not the organization is suitably well-placed, to manage the consequences of information loss, occurring as a result of the sharing process.

Optimal Bounds for the No-Show Paradox via SAT Solving

Authors: Felix Brandt, Christian Geist and Dominik Peters

Abstract: Voting rules allow multiple agents to aggregate their preferences in order to reach joint decisions. Perhaps one of the most important desirable properties in this context is Condorcet-consistency, which requires that a voting rule should return an alternative that is preferred to any other alternative by some majority of voters. Another desirable property is participation, which requires that no voter should be worse off by joining an electorate. A seminal result in social choice theory by Moulin (1998) has shown that Condorcet-consistency and participation are incompatible whenever there are at least 4 alternatives and 25 voters. We leverage SAT solving to obtain an elegant human-readable proof of Moulin's result that requires only 12 voters. Moreover, the SAT solver is able to construct a Condorcet-consistent voting rule that satisfies participation as well as a number of other desirable properties for up to 11 voters, proving the optimality of the above bound. We also obtain tight results for set-valued and probabilistic voting rules, which complement and significantly improve existing theorems.

Keynote

This year the committee is very excited to host Dr. James Mickens, who will provide the 2016 OxCSC Keynote address.

Title: *Surviving The Hardware Apocalypse (I'm Coming To Your House)*

Abstract: Moore's Law is finally dead, at least according to the subway graffiti that I saw last night. What are we going to do about this tragedy? Avoiding the subway is not an option. I argue that, despite the end of Dennard scaling, and the rise of dark silicon, and the general contempt that quantum mechanics has for the dreams of mortals, there is a faint glimmer of hope, a glimmer that I discovered because I just read a book by Oprah and I feel like anything is possible. I will explain how we can extend the lifetime of current semiconductor technologies by aggressively pushing software functionality into hardware. By abandoning general purpose ISAs and implementing all (or almost all) of an application in hardware, we can execute that application faster, with less power, and [insert inspirational phrase here.] To prove my claims, I will offer no proof, but rather a series of semi-coherent observations inspired by an electrical engineering book that I found in a dumpster in 1987. In conclusion, everything is getting worse, but also better, except for the subway graffiti, AND WHO KEEPS LEAVING BOOKS IN DUMPSTERS?

Biography: James Mickens is an IEEE Knight of the Republic, an ACM Templar for Non-Open Access, and a Royal Proceeding of Her Majesty's Royal Proceedings. His appreciation for syntactically correct code has led him to be called "a semicolon in human form." His online shopping habits have too many dimensions to be k-means clustered, so he is only shown ads about dinosaurs and ancient siege machines. This does not bother James Mickens, and explains why he spends his summers attacking France with triceratops horns.

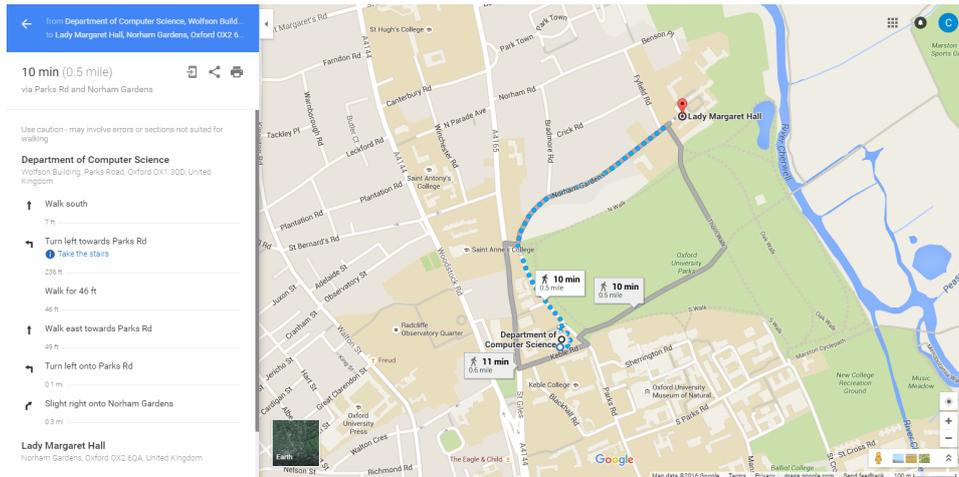
The sponsorship for the 2016 OxCSC Keynote address has been kindly provided by Winton Global Investment Management.



Conference Dinner

This year's conference dinner will be hosted at Lady Margaret Hall. A drinks reception will be held starting at 1900, with dinner commencing at 1930.

LMH is accessible via a 10 minute walk, either by way of Parks Road & Norham Gardens or via the Oxford University Parks. Directions to LMH are below.



The conference dinner and reception is kindly sponsored by G-Research.



Awards

The following awards will be selected from the participants of OxCSC by a panel of judges. Each award recipient will receive a certificate and £100.

Best Abstract

Best Presentation

Best Poster

The judges for this year's awards are:

- **Professor Sir Nigel Shadbolt**, *Principal of Jesus College, Oxford and Professorial Research Fellow in the Department of Computer Science, University of Oxford*
- **Professor David Kay**, *Director of Graduate Studies in the Department of Computer Science, University of Oxford*
- **Dr. James Mickens**, *Associate Professor of Computer Science at Harvard University and 2016 OxCSC Keynote Speaker*
- **Iztok Kucan**, *Head of Data and Reporting Technology for Winton Global Investment Management*

These awards were made possible by kind sponsorship from Winton Global Investment Management.



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