Institution: University of Liverpool

Unit of Assessment: 11- Computer Sciences & Informatics

a. Overview

The Department of Computer Science is part of the School of Electrical Engineering, Electronics, and Computer Science which, together with three additional schools, constitute the Faculty of Science and Engineering. The Department has four closely interlinked research groups:

- The Agents Applications, Research and Technology Group (AgentART)
- The Complexity Theory and Algorithmics Group (CTAG)
- The Economics and Computation Group (EcCo)
- The Logic and Computation Group (LoCo)

Each group has critical mass in its research area (between seven and eleven members) and is led by at least two senior academics. While AgentART, CTAG, and LoCo have existed for more than 10 years, EcCo is a new group (founded in 2009). Members of different groups collaborate on joint research themes. For example, LoCo and AgentART work together with Electrical Engineering and Electronics in the autonomous systems area; CTAG, AgentART, and EcCo collaborate on algorithmic foundations for computational economics, and members of LoCo and AgentART together form a research cluster in knowledge representation and reasoning.

b. Research strategy

The Department's vision is to address key research challenges through our core expertise in Agents Technology, Algorithms, Computational Economics, and Logic, and apply the outcomes of our research to the benefit of the economy and society.

Building on our success in the RAE period (30% of our research activity was judged 4*), we aim to consolidate and further develop our position as a world-leading centre for research in these strategically selected research areas. Computational Economics research was part of the Algorithms group until 2008. At that point, exploiting the existing expertise in CTAG, and in the face of growing interest in algorithmic game theory, auctions, and computational social choice, we made the strategic decision to make a major investment (five new positions, detailed in Section c) by building an Economics and Computation research group.

The investment has been an overwhelming success: the group is the largest in Europe in its research area, and it has won multiple prizes for its work on the computation of Nash equilibria, including the Game Theory and Computer Science Prize (the most prestigious prize in the area) and the SIAM Outstanding Paper Award. Members of the Group have published more than 200 refereed publications in the REF period. Later in the REF period we have strengthened our research expertise in the other three research areas by investing in an inter-disciplinary Centre for Autonomous Systems Technology and extending our activity in Data Analysis and Database Theory (detailed below and in Section c). At the research group level, our strategy is to ensure that research groups:

- have a strategic focus on areas of research strength
- have critical mass of faculty at a range of seniority levels
- engage in knowledge exchange appropriate for their research areas
- are appropriately supported by research funding
- are active in PhD supervision at all levels
- collaborate nationally and internationally with leading research groups and users
- are given appropriate resources for travel and equipment

During the REF period, our strategy resulted in the following research highlights:

- A total of 13 best paper awards at leading conferences, including four at AAMAS (out of a possible six), four at ICALP, and two at KR.

- A total of 18 publications in AIJ/JAIR, the two internationally leading scientific venues in AI.
- A total of 77 papers in leading theory venues (JACM/SICOMP/Algorithmica/TCS), including five JACM and 11 SICOMP papers (24 of the total by new arrivals).

In more detail, the research achievements of our groups are as follows:

AgentART is led by Professors Dunne and van der Hoek. In multi-agent systems, the group has applied logical methods to represent and analyse Boolean Games and Normative Systems (AAMAS 2008 and 2009 best papers). In total, during the REF period, the group has published 57 full papers (15 by new arrivals) at AAMAS, the main venue for Agents research. The group has also led the complexity analysis for many important models of argumentation [**Dunne #1, #2**]. Further evidence for the quality of the research performance of AgentART is provided in the report "International Comparative Performance of the UK Research Base - 2011" prepared by Elsevier for the Department of Business, Innovation and Skills. This report investigates the strength within the UK in the competency areas of data mining, semantic web, and argumentation frameworks (all key-activities of AgentART). According to this report, the University of Liverpool scores highest in both the number of UK articles (29%) and UK citations (34%), ahead of University College London, University of Edinburgh and Imperial College.

CTAG is led by Professors Gasieniec and Kowalski. During the REF period, CTAG members made major algorithmic advances in wireless communication [**Kowalski #2**, PODC 2011, ICALP 2011, ICALP 2013], including models with increased interference [Gasieniec PODC 2009]. In the field of network exploration we provided algorithms for optimal logarithmic space recognition of tree networks [**Gasieniec #1**]. Other significant contributions to the field of distributed computing comprise rumour spreading protocols [**Gasieniec #3**, **Kowalski #1**] and efficient algorithmic solutions to consensus problems [Kowalski SODA 2010, PODC 2009, PODC 2013]. The group also contributed to time and energy efficient job scheduling by proposing a more realistic mathematical model [**Wong #3**] adopted later by many researchers and deriving the first flow time scheduling algorithm that combines two major paradigms of speed scaling and sleep management [**Wong #2**]. In the area of complexity and computability theory, we solved a 60-year standing open problem on the undecidability of the identity correspondence problem [**Potapov #2**].

EcCo is led by Professors Deng, Krysta and Spirakis. During the REF period, in addition to the award-winning work on equilibrium computation mentioned above, the group made a number of other significant contributions to this area [**Savani #1, #3, #4,** SAGT 2012]. The group has made significant progress on understanding the quality of equilibria in congestion games [Christodoulou Algorithmica 2011, ESA 2011, **Gairing #3, #4**, SICOMP 2011]. In the area of algorithmic mechanism design, the group has made major advances for auctions [**Christodoulou #3**, **Krysta #3, #4,** SODA 2010] and for scheduling [**Christodoulou #1, #2, #4,** ESA 2008, Algorithmica 2009, TCS 2013].

LoCo is led by Professors Fisher and Wolter. Research in Description Logics and Ontology Languages resulted in 9 IJCAI papers, 7 KR papers, and 5 AIJ/JAIR papers. Major achievements include the semantic and algorithmic foundation of modularization techniques for description logic ontologies [**Konev #1, #2, #4, Wolter #1**] and the development of the combined approach to ontology-based data access [**Wolter #2, #3,** ISWC 2013 best paper]. Two PODS 2013 papers at the interface of ontologies and databases provide further evidence for the strength of the group in this area. Significant progress has been made on automata and game based program synthesis [**Schewe #2**, ICALP 2008**,** ICALP 2012] and our work on Büchi Complementation [**Schewe #1**, FoSSaCS 2009, ATVA 2012] has solved some of the main open problems in the field.

Strategy Evolution and Future Plans

We aim to maintain and further enhance our position in world-leading research. Additionally, our vision is to better use our research expertise to address economic and societal challenges. We will achieve this by developing specific mechanisms to translate our research expertise into work that directly addresses such challenges. Many of these challenges require an interdisciplinary approach. One step to address this has been the foundation of a joint School with the Department of Electrical Engineering and Electronics (EEE) which combines our strength with the more application-driven

expertise in EEE. Furthermore, to mobilize research expertise across groups within the Department and School towards focussed goals, we have established a number of interdisciplinary research themes, namely Autonomous Systems, Network Science, and Data Science. These themes are well-aligned with the Eight Great Technologies, which were announced in 2013 and are already shaping RCUK funding calls.

Autonomy now extends well beyond the traditional area of Robotics, covering areas such as autonomous vehicles, sensor networks, medical devices, intelligent buildings, and smarter cities. The Centre for Autonomous Systems Technology (CAST), which is led by Professor Fisher from LoCo, and was founded in 2012, addresses the resulting research challenges in an interdisciplinary Centre that involves Electrical Engineering, Engineering, Law, Psychology, and the Virtual Engineering Centre in Daresbury. Two senior academics recruited in 2013 in AgentART support Fisher in leading CAST. An additional lecturer will be recruited in 2014.

The newly founded Network Science and Technology (NeST) Centre builds on extensive expertise in the CTAG and EcCo research groups. It takes an application-based view that considers a wide range of modern networks, including, e.g., the Internet and web, global manufacturing networks, smart power grids, chemical and biological network structures and social networks. NeST will be led by Spirakis (EcCo), hired in 2013. Spirakis has a track record of significant contributions to this area [**Spirakis #1, #2**], and of working with government and EU research councils, see Section e. He will have support from senior academics Gasieniec and Kowalski (CTAG), and Krysta (EcCo).

We plan to invest in Data Science, a research area driven by the fact that huge amounts of data are generated and stored by various organizations on a daily basis, but the techniques for accessing and analysing them are often inefficient. The Department has already significant expertise in application-driven data mining research (four KTPs with Coenen as PI and the European INMA project on Intelligent Steel Processing) and ontology-based data access research (Wolter). As a first step to strengthen our expertise and obtain critical mass we have recruited Bollegala and Hernich in 2013. Bollegala has made significant contributions to web data analysis [**Bollegala #1, #2, #3, #4**] and Hernich has made major contributions in data processing and exchange [**Hernich #1, #2, #4**].

These research themes also form an integral part of our impact strategy, which is outlined in detail in REF3a.

c. People, including:

i. Staffing strategy and staff development

Our staffing strategy is to recruit internationally excellent researchers at different levels of seniority that match our research strategy. Following that strategy - building the EcCo-group, developing CAST, NeST, and Data Science, and strengthening existing research groups - we have appointed:

- Six academics in the EcCo group. Two professors, Deng from City University Hong Kong and Spirakis from Patras (Greece), to provide academic leadership, and four new lecturers: Gairing from Berkeley (US), Savani from Warwick, Christodoulou from MPI (Germany), and Wojtczak from Oxford.
- Five academics in the AgentART group. Two professors, Parsons from New York and Tuyls from Maastricht, working in the autonomous systems area and providing further leadership for CAST, and three lecturers, Payne from Southampton, Grossi from Amsterdam (The Netherlands), and Bollegala from University of Tokyo (Japan), working in the targeted research areas data analysis, argumentation and semantic technologies.
- Two lecturers in LoCo. Schewe from Saarbruecken (Germany) and Hernich from Santa Cruz (US), who work in program synthesis and data processing and thus strengthen this group in those core areas of logic and computation.

Each of these appointments has made major contributions to their respective research area, as evidenced by high-quality outputs, prizes and awards (see Sections a and e). In the REF period staff from the Department have become professors at the University of Oxford (Wooldridge, L. Goldberg, P. Goldberg) and King's College London (McBurney). Ambuehl took up a research

position at Innovative-Web AG (Switzerland). Four staff members retired.

All academic members of staff, including research assistants, participate in the University's Professional Development and Review (PDR) process at least annually. In this process, staff complete an annual Portfolio of Activity, summarizing all aspects of their contribution, which then informs discussion with a professor in the Department regarding workload, research plans and achievements, and career progression and development. The PDR process acts as a mechanism to promote a shared strategy for research and ensure fairness and equal opportunities.

Teaching loads for research-active staff are uniformly light, not exceeding two modules (66 hours of lectures) per annum. This gives members of the Department substantial protected research time. In addition, the Department has a sabbatical programme, from which six academic staff have benefitted since RAE2008. This enabled, for example, van der Hoek and Kowalski to visit Groningen and Madrid and work on succinctness in modal logic [**van der Hoek #4**] and online scheduling [FCT 2013, SIROCCO 2013], respectively.

The University of Liverpool is a signatory to the Concordat to Support the Career Development of Researchers. The Department's mechanisms to support the career of fixed term and early career staff are as follows. All newly appointed academic staff are assigned a trained mentor. Mentors are senior academics who advise on research, teaching, and career development, and provide pastoral support. Often, new lecturers and their mentors jointly supervise PhD students. For new lecturers, the Department provides a half teaching load (no more than 33 hours lecturing per annum) in the first year of appointment. New staff participate in University and School induction and training courses, addressing such issues as: developing and managing research portfolios; managing research students and staff; and applying for research funding. An induction award of £6,000 is available to each new lecturer to support his/her research activities in the first two years after appointment. To support the development of leadership, after two or three years, new lecturers often take on leadership roles with the support of a senior academic, e.g. Savani is Impact Facilitator and Schewe is head of PhD admissions.

The effectiveness of our approach is evidenced by the fact that since RAE2008, four Lecturers have been promoted to Senior Lecturer, and five Senior Lecturers/Readers have been promoted to Professor. Many of our fixed term staff since RAE2008 now hold permanent lecturership or similar positions at other institutions (for example: Modgil, now Lecturer at King's College; Wyner, now Lecturer at University of Aberdeen; Telelis, now Researcher at Athens University; Bell, now Lecturer at Loughborough University; Jurdzinski; now Associate Professor at University of Wroclaw; Ventre, now Lecturer at Teeside University; Foulkes, now Lecturer at Liverpool Hope University).

Dominik Wojtczak moved to the Department in 2010 from the University of Oxford with his EPSRC Postdoctoral Fellowship on a 'Rising Star' contract and was appointed a Lecturer in 2012.

To promote international collaboration, the Department regularly hosts visiting scholars, for example Bertrand (INRIA), Chen (Columbia), Chmutov (Ohio State), Cholvi (Castello), Czyzowicz (Quebec), Fotakis (Athens), Ibarra (University of California), Karhumaki, Hirvensalo (Turku), Kovacs (Frankfurt), Kranakis (Carleton), Kurganskyy (Academy of Science Ukraine), Lu (MSRA - Microsoft Research Asia), Nalon (Brasilia) Ning Chen (NTU Singapore), Peled (Bar Ilan), Qi (HKUST Hong Kong), Sangnier (Paris VII), Segal (Ben-Gurion), Voecking (Aachen), Yamakami (Fukui). Eight of these have been funded by Royal Society/EPSRC grants. All these visits have led to research publications, some including our PhD students. In addition to long-term visitors, the Department has a well-established weekly seminar programme with 148 speakers in the REF period (85 from overseas).

The University of Liverpool has held a Bronze Athena SWAN award since 2010. Our support for the principles of Athena SWAN is highlighted by the activities of Atkinson and Wong. Atkinson participated in the Aurora Women in Leadership Programme and leads our outreach activities for Computer Science in Schools. Wong represents our Department at the Leadership in Science Workshop, run by Imperial College Business School. She also leads research collaborations with

our sister university, Xi'an Jiaotong-Liverpool University. The School of EEE and CS is working on a submission for an Athena SWAN silver award.

ii. Research students

On average, we received 82 applications per year for PhD study during the REF period, 14 of which were from UK/EU students. Applicants who meet the predefined quality requirements and for whom a suitable supervisor has been identified are short-listed and then interviewed by a selection panel of senior academics that represent all the research groups. At interview, we assess two main criteria, the academic potential of the candidate, and the clarity of his/her vision of a suitable research project that matches the expertise, interests, and strategic aims of the Department.

The Department takes great care in training postgraduate students in research and encouraging the highest standards of scholarship. PhD students have (at least) two supervisors, both of whom are typically academic staff within the Department. Regular, usually weekly, supervision meetings are held to guide, shape and monitor student progress. In addition to two supervisors, students also have two advisors who assess and comment on progress and offer additional support and advice.

During the REF period, we introduced a new School-level Doctoral Training Programme, led by Kowalski. Within this programme, students attend approximately 20 Doctoral Training Seminars in which they give short presentations, discuss issues such as paper preparation and research planning, and in which they meet invited researchers from industry and academia. Students also attend a three day University organised workshop to develop research skills. In addition to presentations at national and international workshops and conferences (which are encouraged and funded by the Department), each student gives a formal presentation to the supervisory/advisory team at the end of Year 1, to the Department (for a general CS audience) during Year 2, and at a specialist research group meeting in Year 3. In Year 2, all students produce and present their research at the University Poster Day. In Years 2 or 3, all students take part in a one to three day career-related event organized by the University.

The progress of PhD students is monitored through formal supervisory meetings that are held at least 12 times a year. These are formally recorded using the Liverpool PGR System. At the end of each year, students submit a formal report. Advisors assess their progress based on this report and an interview with the student. The feedback from these interviews is reviewed by the Departmental Progress Committee.

The success of our approach is evidenced by the fact that in the REF period the average time to submission of the thesis from the initial registration was 3.5 years. 47% of our PhD students now have an RA or Lecturership position at universities and research institutions worldwide. Our research students have won many scholarships and prizes, including a Google Lime Scholarship for Students with Disabilities, the BCS-SGAI Prize for Best Student Papers in 2008 and 2011, the BCS-SGAI Best Application Paper Prize in 2009, and a University of Lincoln Library Prize in 2011.

Our PhD students contribute to our research strength and publish at highly competitive venues. We give one example from each research group: Gasieniec with PhD student Collins (ICALP 2010), Krysta with PhD student Briest [**Krysta #1**], van der Hoek with PhD student Iliev [**van der Hoek #4**], and Wolter with PhD student Piro (IJCAI 2011).

d. Income, infrastructure and facilities

The University made £5.2M of infrastructure investment in the Department during the RAE period, which included a move into new accommodation in 2006. As a result, we have an excellent physical research environment where each research group has dedicated meeting rooms for discussions and presentations, and PhD students and supervisors are closely located. During the REF period, additional investment has allowed us to develop space to locate research staff involved in the new EcCo group. We have also created a Mobile Computing/Human Computer Interaction Lab. In order to provide the appropriate infrastructure for CAST, £100,000 has been invested to establish Robotics Labs within our School and a new Robotics Simulation Lab at the Virtual Engineering

Centre at the Daresbury Laboratory. In addition, the University will fund the creation of a new Robotics Lab for airborne robots in 2014 for new arrival Tuyls.

The Department maintains and operates several computer clusters with 96 CPU cores solely for research purposes, supporting activities including multi-agent trading simulations, frequent-set meta data mining, benchmarking of reasoning systems for description logics and temporal logics, verification of swarm robot specifications, and simulations of heart cells. Where additional computing resources are required, the Department makes use of the University's high performance computing facilities. The University invested £1M into these in 2012.

The Department's research funding portfolio consists mostly of small-to-medium sized grants, totalling just under £1M per year. The bulk of this funding comes from responsive-mode research council grants. Our Department is particularly strong in foundational (theoretical) research, and small research grants are a perfect vehicle for funding such research. All four of our research groups were primarily supported through this mechanism:

- AgentART. Externally funded research activities are in multi-agent systems, argumentation, and data mining. Research in multi-agent systems was funded by four EPSRC projects (totalling £832,915), namely the projects Market Based Control of Complex Computational Systems, Logic for Automated Mechanism Design, Model Checking Agent Programming Languages (jointly with LoCo), and Evolutionary Ontologies for Open Agent Environments. We are a partner in the European Framework 7 project IMPACT on integrated methods for policy making (255,276 EUR). In data mining, research has been funded by the Framework 7 project INMA on Intelligent Steel Processing (364,016 EUR) and four KTP projects (totalling £480,000).
- The main externally-funded research activities of the CTAG group are Markov-chain simulation and the complexity of counting (supported by three EPSRC grants totalling £702,330), distributed algorithms and networks (supported by two EPSRC grants totalling £335,734), emerging issues in algorithmics (supported by three EPSRC grants totalling £230,940) and computational biology (supported by three grants from EPSRC, BBSRC and NERC totalling £385,584 and by four more grants from these sources, totalling £1,266,900, on which we are co-Investgators, together with PIs in biology and maths).
- The main externally-funded research activities of the EcCo group are algorithmic mechanism design and optimisation (supported by an EPSRC grant and a European grant totalling £319,893), decentralised approaches in algorithmic game theory (supported by an EPSRC grant totalling £398,279), and modelling cash liquidity (supported by ESRC, the Royal Bank of Scotland and Logica, totalling £283,348). We also had an EPSRC Postdoctoral Research Fellowship in trust metrics for public-key authorization protocols.
- The main externally funded activities within LoCo concern knowledge representation, automated verification/synthesis, and autonomous systems. The research into knowledge representation and reasoning (modularity of ontologies, ontology-based data access, and versioning) has been funded by EPSRC (two grants, totalling £599,423). Work on the automated verification of robotic and pervasive systems, together with synthesis of Markov Game structures, is also funded by EPSRC (three grants, totalling £1,152,988). Finally, the verification techniques developed in LoCo have been applied to autonomous systems. This work was funded by EPSRC (two grants, totalling £795,337).

We intend to continue to support our foundational research with funding from small to medium sized grants. In addition we created CAST and NeST and are developing the Data Science theme which have the explicit goal of preparing inter-disciplinary grant proposals on timely and novel themes. These will target diverse funding sources, and a particular focus will be on seeking funding from industrial partners.

e. Collaboration and contribution to the discipline or research base

Research Collaborations and Interdisciplinary Research.

Much of our work is driven by research challenges that can only be addressed in collaboration with other disciplines and through international collaboration, e.g., nearly all of our REF outputs and at least half of our research grants have collaborators from outside of our unit. In the interdisciplinary EU project IMPACT, Atkinson has applied her expertise in argumentation theory to build the IMPACT Toolbox which is used by policy analysts and members of the public to improve the quality, transparency and efficiency of policy deliberations. We also apply argumentation theory to issues arising in Law and AI through collaboration with researchers in Law (e.g., Rotolo from Bologna, and Prakken from Groningen) and AI (e.g., Woltran and Dvorak from the AI group in Vienna). Our work in epistemic logic and related formal systems for multi-agent systems is driven by applications in both Agents Technology and Philosophy, in particular Epistemology. Van der Hoek is Editor-in-Chief of Synthese, a high impact journal in Epistemology, and he and Grossi collaborate with philosophers worldwide, e.g., Kooi (Groningen), Liu (Beijing), and van Benthem (Amsterdam).

AgentART and LoCo apply logic-based verification techniques to analyse the safety and reliability of robotic systems and collaborate, for example, with Eder, Pipe, and Winfield (Bristol Robotics Laboratory), Veres (Engineering, Sheffield) and Gao (Surrey Space Centre). Our work on Description Logic addresses research problems that arise in the semantic technologies area, the semantic web, and data integration. Here we apply techniques from computational logic, automata theory, and database theory to provide the logical underpinning for the W3C OWL (Web Ontology Language) standard. This work is done in close collaboration with Baader (Dresden), Lutz (Bremen) and Toman (Waterloo).

Major algorithmic advances in wireless communication were enabled through a series of reciprocal research visits involving renowned research leaders and their teams including Lynch (MIT), Peleg (Weizmann), Chlebus (Colorado), Pelc (Quebec), Lingas (Lund), Segal (Ben-Gurion), and Czumaj (Warwick). Major collaborators on consensus and rumour spreading problems comprise Guerraoui (EPFL), Berenbrink (Simon Fraser), and Elsaesser (Salzburg). Our work on efficient network exploration and patrolling methods was facilitated by periodic meetings in Liverpool, Ottawa, and Bordeaux with the research groups of Czyzowicz (Quebec), Kranakis (Carleton), and Kosowski (INRIA). Our work on scheduling and power-management algorithms benefited from long-term collaborations with Tak Wah Lam (Hong Kong). Wong has developed better gene annotation methods and identified several new genes in collaboration with Caddick, Hall, and Rigden from the School of Life Sciences at Liverpool and Galperin (National Center for Biotechnology Information, Maryland, USA).

During the REF period, the EcCo group has contributed to the cross-fertilisation between Economics and Computer Science, by significantly advancing our understanding of complexity in mechanism design and equilibrium computation for games and markets, which are cornerstones of traditional Economic analysis. Our work on equilibrium computation has been in collaboration with Chen (Columbia), Papadimitriou (Berkeley), Daskalakis (MIT), Monien (Paderborn), von Stengel (LSE), and Vetta (McGill). The group's work on mechanisms is in collaboration with Koutsoupias (Oxford), Conitzer (Duke), and Vöcking (Aachen).

Exemplars of leadership.

Since 2008, members of the Department have influenced the direction of their respective research fields by serving as either program committee (co-)chair (PCC) or conference chairs (CC) of the following international events: CC for AAMAS 2008 (Parsons, new arrival); PCC for AAMAS 2010 (van der Hoek); CC for AAMAS 2012 (van der Hoek); PCC for ICALP 2008 (Goldberg); CC for ICALP 2009 (Spirakis, new arrival); PCC for ICALP 2010 and SAGT 2010 (Spirakis); CC for PODC 2012 (Kowalski); PCC for RANDOM 2011 (L.Goldberg); PCC and CC for FCT 2013 (Gasieniec, Wolter).
In addition, members of the Department were either PCC or CC of more than 31 conferences and workshops, including FAW 2009, FOMC 2011, JURIX 2010, 2011, ICEC 2011, CLIMA 2008, 2009, 2012, WINE 2012, LOFT 2008, 2010, 2012, DL 2012, RP 2009-2013, and TIME 2011. We have

also collectively served on more than 350 programme committees, e.g. AgertArt and LoCo members have served on the PCs of LICS, CSL, KR, and the SPCs of AAMAS, IJCAI, and ECAI, and CTAG and EcCo members have served on the PCs of STACS, ICALP, PODC, SPAA, ESA, RANDOM-APPROX, ACM EC, SAGT, WINE and the SPC of STOC, SIROCCO, and PODC.

Since 2008, our expertise has been recognised through invitations to give a total of 73 plenary talks at international conferences and workshops, including the following: FAW 2008 and SAGT 2011 (Deng); WG 2008 and SIROCCO 2009 (Gasieniec); APPROX 2010 (L Goldberg); SAGT 2010 (P Goldberg); JURIX 2010, DALT 2011, and JELIA 2012 (van der Hoek); ASL Logic Colloquium 2009 and CSL 2011 (Wolter); ICALP 2013 and CSR 2013 (Spirakis, new arrival).

Members of the Department serve on the editorial boards of 24 prestigious journals, including AIJ (Dunne); ACM Transactions on Algorithms (L Goldberg); Algorithmica (Deng and Spirakis); SIAM Journal on Computing (L Goldberg); TCS (Deng and Spirakis); and Journal of Autonomous Agents and Multi-Agent Systems (Parsons and van der Hoek). We also serve as Managing Editor of Internet Mathematics (Deng), as (co)-Editor-in-Chief of Electronic Commerce, Research and Applications (Payne), and as (co)-Editor-in-Chief of Synthese (van der Hoek).

Since 2008, the Department has hosted the most important meeting at the interface of Law and AI (JURIX 2010), the main European event in algorithms (ALGO 2010), and one of the main events in Computational Game Theory (WINE 2012), as well as a number of other international events (such as COMSOC 2008, ICEC 2011, and FCT 2013).

During the REF period, many of our early career researchers and new arrivals have received prizes recognizing their research: Schewe received the GI Dissertation Award 2008 - an annual award for the best computer science dissertation in Germany, Austria, and Switzerland. Fearnley (RA with Schewe) received the ICALP 2013 Track B best paper award. Wojtczak received the ICALP 2009 Track B Best Student Paper Award. He also received the 2012 International Conference on Hybrid Systems: Computation and Control Best Paper Award for his paper Optimal Scheduling for Constant-Rate Multi-Mode System. Bollegala received the IEEE Computer Society Japan Chapter Young Author Award 2011 and the Best Paper Award at GECCO 2011. Hernich received the Best Student Paper Award at ICDT 2010.

In addition, each of our four research groups has received prizes recognising outstanding research: Members of the Department won the AAMAS best paper awards in 2008, 2009, 2011, and 2013 (Dunne, van der Hoek, and Wooldridge in 2008; van der Hoek, and Wooldridge in 2009, Wooldridge in 2011; Krysta in 2013). Payne received the 2011 and the 2012 SWSA 10-Year Award for the papers 'DAML-S: Semantic Markup for Web Services' and 'Semantic Matching of Web Services Capabilities'. This award recognizes papers from ISWC 10 years prior. L. Goldberg received the ICALP 2010 and 2012 Track A best paper awards. Krysta received the ICALP 2012 Track C best paper award. P. Goldberg received the 2008 Game Theory and Computer Science Prize and a 2011 SIAM Outstanding Paper Prize for the paper 'The Complexity of Computing a Nash Equilibrium'. He also received a 2008 ACM-EC (ACM Conference on Electronic Commerce) Outstanding Paper Award. Spirakis (new arrival) won the Gold Creative Showcase Award in the 5th ACM Conference on Advances in Computer Entertainment Technology (ACE) 2009. Wolter received the KR 2008 and KR 2010 Ray Reiter Best Paper Awards and the ISWC 2013 Best Paper Award. New arrival Tuyls received the Best Demonstration Award, AAMAS 2012, won the World Championship in the Robocup@work Competition in 2013, and was winner of the German Open Robocup@work Competition 2013.

During the REF period, Deng has become a Fellow of the ACM. Our new arrival, Spirakis, became a member of the ACM Europe Council in 2008 and a member of Academia Europaea in 2010. Spirakis is vice president of the Council of EACTS and vice president of the European Forum for ICST. Fisher, van der Hoek and Wolter are BCS Fellows. Five members of the Department have served on EPSRC panels. Spirakis served as a member of the Panel for ERC/IDEAS for Senior Scientists in 2009, and was on the EATCS Award Committee in 2011.