Stephen Kell

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date of birth: 1st March 1984
nationality: British

Education

2006–10 **Computer Laboratory, University of Cambridge**
PhD in Systems Research Group, supervised by David Greaves. Thesis entitled "Black-box composition of mismatched software components".

2002–05 **Christ's College, University of Cambridge**
BA Hons., Computer Science, class I (all Parts). Included an extended individual project and dissertation "A general-purpose synthetic filesystem".

Academic and research positions

2018– **University of Kent**
Lecturer

2013–18 **University of Cambridge**
Senior Research Associate (2017–18), Research Associate (2013–17)
- Supported by EPSRC programme grant "Rigorous engineering for mainstream systems" (PI: Peter Sewell).
- Originated and led libcrunch project on efficient, precise dynamic type and bounds checking in idiomatic C code.
- Collaborated on linksem project defining executable formal specification of ELF linking; code used by other projects in group on binary emulators.
- Co-originated & supervised French's 2015 UROP project on tools for specifying and testing system call semantics; now employed as RA
- Informal role of supplying systems expertise within theory group.

2013 **Oracle (Labs) America**
Research Assistant
- In the Virtual Machines group, working on Graal multi-language dynamic compilation engine (principal collaborators: Haupt, Wimmer, Kessler)
- Recruited for expertise in object-code debugging metadata; key contributor to metadata generation in experimental SubstrateVM runtime.
- Also designed and implemented object file manipulation library, now embedded within project and included in Graal releases.

2012–13 **Faculty of Informatics, University of Lugano, Switzerland**
Postdoctoral Assistant
- Supported by SNF "Foundations of Dynamic Analysis" joint ETH/Lugano project (PIs: Binder, Hauswirth, Gross)
- Mentored PhD student projects on compositionality (Ansaloni), isolation (Marek) and dynamic optimisation (Zheng) of instrumentation-based dynamic analysis infrastructure on the Java Virtual Machine, and multi-language workload characterisation (Sarimbekov).
- Led design aspect of compositionality work, published at ECOOP.

2011–12   **Department of Computer Science, University of Oxford**
Postdoctoral Research Assistant
- James Martin Fellow, on verified software for sensor networks (PIs: Kwiatkowska and Trigoni).
- Led work on practical bug-finding via mixed static/dynamic type-error analysis, using symbolic execution (later begetting libcrunch project).
- Collaborated with former Cambridge project student (Irwin) on experience report from Python/C interoperable runtime project.

2006–10   **Computer Laboratory, University of Cambridge**
PhD student in Systems Research Group, supervised by David Greaves.
- Supported by EPSRC XenSE project grant (2006–08; PI: Hand), EPSRC Doctoral Training Award (2008–10) and Cambridge Philosophical Society research grant (2010).
- Thesis work (self-originated) on Cake language and tools for composition & adaptation of software components having non-matching interfaces.

2007   **Fraser Research, Princeton, New Jersey**
Senior Technical Associate
- Clean-slate internetworking research, under Sandy Fraser.
- Contributed to projects on network switching/routing emulation, tools for manipulating raw Ethernet packet streams, and capability-based secure middlebox designs.

2005–06   **Computer Laboratory, University of Cambridge**
Research Assistant
- Supported by EPSRC XenSE and ERC Open Trusted Computing project grants (PI: Hand); on security features for the Xen hypervisor.
- Collaborated on work to safeguard kernel security using hypervisor-level immutable memory and ratcheted data structures.
- Developed initial XenoLinux port of Nitpicker secure windowing system, subsequently handed off to NSA contractors.

Software engineering positions

2009–14   **Self-employed consultancy for Ellexus Ltd, Cambridge**
- Primary developer of back-end tracing engine in Cambridge start-up's developer tools product.
- Early work enabled by EEDA Innovation Voucher secured in cooperation with University of Cambridge technical services division.

2005   **ARM Ltd, Cambridge**
Software Engineer
- Embedded debugger development (summer internship), focused on testing and bug-fixing of upcoming debugger release.

2001–04
(various spells)   **Opal Telecom Ltd, Irlam, Manchester**
Software Engineer
- Development of customer-facing web authentication system (summer 2004; deployed to customers shortly thereafter), web service messaging middleware (summer 2003; deployed internally); and resource monitoring systems for live telephony switch (2001–2).

Departmental teaching contribution

Project supervision

(Co-)supervised & (in most cases) originated many final-year Bachelor's (Part II) projects, many with research element: fifteen students to date (2008–10, 2014–18).

Peer-reviewed research outputs resulted in two projects so far [VMIL 11, EuroLLVM 16]

Co-originated & supervised French's 2015 UROP project; now employed as RA.

Author of internally circulated articles advising on topic selection and dissertation.

Undergraduate & MPhil teaching

Frequent tutor/supervisor of several undergraduate (Cambridge: Tripos) courses, 2005–10 and 2014–present; topics as follows:

- Programming in C and C++;
- Algorithms;
- Concepts in Programming Languages;
- Concurrent & Distributed Systems;
- Digital Communications I (2005–10) / Computer Networking (2014–15);
- Operating Systems I / II / Foundations (2005–10);
- Concurrent Systems & Applications (2005–10);
- Further Java (2016–17).

While in Oxford (2011), tutor (Magdalen College) for Digital Systems course, spanning hardware, operating systems, compilers, runtimes.

Author of a large selection of supervision exercises (mostly during 2005–10), often as learning-oriented complement in cases where lecturer provided only past examination materials; many now migrated into repository used by various supervisors in Cambridge.

Guest lectures

In Cambridge:

- 2017: guest lecturer on Linking, in MPhil advanced compilers course;
- 2010: guest lecturer on Modularity, in PhD students' lecture series to MPhil class.

Practical classes

Demonstrator and assessor of various practical courses in Cambridge:

- assessor of Natural Science first-year numerical computing exercise (2008, 2009, 2010), taken by entire physical Natural Science year group;
- teaching assistant in double-credit MPhil practical course on Building an Internet Router (2009–10);
- relief assessor of Java programming exercises (2010).

Collegiate University (Cambridge)

Postdoctoral affiliate of the Senior Combination Room at Christ's College (2015–18), associated with teaching duties for that College.

Longstanding supervisor for several other Colleges (Jesus, King's, Corpus Christi).

University contribution (Cambridge)

University governance

Elected member of the Board of Scrutiny (2015–17; as Secretary 2016–17), a key governance structure of the University of Cambridge, elected by its governing body (Regent House).

- Collectively responsible for scrutinising the University of Cambridge's financial and decision-making activities on behalf of the Regent House, via an annual report.
- Serving as Secretary of the Board during 2016–17: individually responsible for relief chairing of meetings, liaising with interview guests (e.g. Vice-Chancellor), managing Board-internal web resources.

Departmental representation

Chair (2017–18) of the Postdoc Forum at the Computer Laboratory, an official channel representing research staff needs to departmental administration and representing department in cross-University chairs' network meetings.

Served (2015–18) on department-wide induction mentoring scheme for new research staff.

Postdocs of Cambridge

Service on the committee of this University senior society, whose mission is to build representation and community among postdoctoral researchers.
As Events & Networking officer (2015–17):

- managing programme of both social and research/networking events, chairing subcommittee;
- planning, finances, leadership, risk assessment for events small and large (5–150+).

As Treasurer (2017–18):

- overall responsibility for Society's financial administration;
- invoicing and accounting for large events (e.g. National Postdoc Meeting 2017). General participation including Research Policy & Representation activities

Research

Research funding

Actively engaged in writing self-originated research proposals

- contributing to in-preparation programme grant proposal (PI: Sewell)
- EPSRC Fellowship proposal (drafted) on multi-language programming support
- other in-preparation proposals to Linux Foundation and Oracle Labs

Interests

Primary interests: all aspects of programming infrastructure, languages & tools, including compilers, runtimes and operating systems. Specific topics of interest:

- debugging techniques for unsafe languages;
- interface specification techniques generally;
- semantics of low-level code, esp. system call and linker services;
- techniques for heterogeneous composition (across languages, APIs, ...);
- infrastructure for reflective (meta-)programming.

Secondary interests, with links to adjoining fields and disciplines

- History and philosophy of [computer] science:
  - speaker at History and Philosophy of Programming (HaPoP) conference 2016
  - invited speaker to history & philosophy track at CodeMesh 2017
  - co-founder (with Petricek) of Salon des Refusés workshop (at <Programming> 2017 and 2018), on criticism-based appraisal of programming technologies
- Human–computer interaction
  - invited participant in CRA/CCC prospecting workshop on 'Inclusive Access to Rich Online Content and Services' (2015), setting US national funding directions at intersections of programming, interaction and accessibility
  - service on programme committee of PLATEAU workshop at SPLASH 2015
- Scientific computing
  - speaker at Testing and Verification in Computational Science workshop 2016 (Cambridge)
  - continuing to build informal links e.g. via blog interest

Active participant across several department research groups

- e.g. since 2013 seminar speaker in Cambridge to Programming Languages, Systems, Digital Technology and Theory group audiences

Collaborators

Current collaborators are as follows.

- Cambridge: various activities across REMS and CHERI projects
- JKU Linz (Rigger, Mössenböck), U. Kent (Marr): on dynamic compilation of C integrating inline assembly and linkage features.
- Lugano (Binder / Dynamic Analysis Group): infrastructure for dynamic analysis
- INRIA (Paris: Francesco Zappa Nardelli) testing, specifying and verifying debugging information; also (+ INRIA Sophia Antipolis: Manuel Serrano) precise garbage collection using (extended) debugging information.
- various (Basman / Raising the Floor; Clark / OCAD University, Toronto; Lewis / U. Colorado): software re-use and authorship in highly distributed environments

Service

- **Journal reviewing**
  - The Art, Science & Engineering of Programming (2018–19 editions)
  - ACM Transactions on Architecture and Code Optimization (2015–)
  - Software: Practice & Experience (2018)
  - Automated Software Engineering journal (Springer) (2014)
- **Conference/symposium programme committees**
  - OOPSLA external review committee 2019
  - SPLASH workshops committee 2016
  - Symposium on Partial Evaluation and Program Manipulation 2016
  - Onward! Essays '15
  - Principles and Practice of Programming in Java '13
  - European Conference on Computer Systems 2012 (shadow PC)
- **Workshop programme committees**
  - Salon des Refusés 2017 and 2018 (at <Programming>)
  - Evaluation and Usability of Programming Languages and Tools (PLATEAU) workshop 2015 (at SPLASH)
  - Runtime Environments, Systems Layering, and Virtualized Environments (RESoLVE) workshop 2012 (at ASPLOS)
- **Organisational roles**
  - Co-organiser of Virtual Machines & Language Implementation workshop (2018)
  - Co-organiser of Salon des Refusés workshop 2017
  - publicity chair, Software Composition 2013
- **External reviewer roles**
  - IEEE/ACM Automated Software Engineering conference (2018)
  - ACM Symposium on Applied Computing (2012)
  - ACM SIGCOMM (2011)
  - European Symosium on Programming (2010)
  - European Conference on Computer Systems (2009)

Industrial engagement and outreach

Speaking and communicating

Experienced speaker and communicator addressing both research and developer audiences

- industry-facing conference speaker at Strange Loop 2014, CodeMesh 2017, CoreDump 2018 (upcoming)
- blog and publications often read and discussed via web media: Hacker News (front-page stories on three occasions), Lambda the Ultimate, lobste.rs, Reddit, etc.
- speaker at open-source project developer meetings (EuroLLVM 2016, GNU Cauldron 2017)

Advising companies

Scientific adviser to Ellexus (2009–14); included initating technology transfer collaboration between Ellexus and Lugano colleagues (2013)

Publications

As with much of computer science, most of the competitive venues for new work in my principal research areas are conferences rather than journals. As a brief summary of major venues: SPLASH is an umbrella conference comprising OOPSLA, Onward! and various smaller events. OOPSLA is a primary top-tier conference venue for full-length research papers around programming, programming languages and programming systems (formerly focused on object-oriented programming, but now diversified). Onward! is a sibling event at SPLASH focused on "innovative ideas that challenge existing beliefs, or early work well written and well argued for", accepting both full-length technical papers and also long-form reflective writing (in its "Essays" track). ECOOP is a European conference covering similar ground to OOPSLA. Some well-established workshops in and around the same community are: VMIL (Virtual Machines and Intermediate Languages), at SPLASH most years; PLOS (Programming Languages and Operating Systems), usually at conferences within the systems research community.

All articles are peer-reviewed unless stated otherwise.

Articles in journals, conferences and major symposia

[VEE 18] M. Rigger, S. Marr, S. Kell, D. Leopoldseder, and H. Mössenböck. A survey of x86-64 inline assembly in C programs. In *Proceedings of the ACM SIGPLAN/SIGOPS International Conference on Virtual Execution Environments*, VEE '18. To appear.

[Onward! 17] S. Kell. Some were meant for C: the endurance of an unmanageable language. In *Proceedings of the 2017 ACM International Symposium on New Ideas, New Paradigms, and Reflections on Programming & Software*, Onward! 2017, New York, NY, USA, October 2017. ACM.

[OOPSLA 16a] S. Kell. Dynamically diagnosing type errors in unsafe code. In *Proceedings of the 2016 ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, and Applications*, OOPSLA 2016, pages 800–819, New York, NY, USA, 2016. ACM.

[OOPSLA 16b] S. Kell, D. P. Mulligan, and P. Sewell. The missing link: Explaining ELF static linking, semantically. In *Proceedings of the 2016 ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, and Applications*, OOPSLA 2016, pages 607–623, New York, NY, USA, 2016. ACM.

[Software 16] Y. Zheng, S. Kell, L. Bulej, H. Sun, and W. Binder. Comprehensive multiplatform dynamic program analysis for Java and Android. *IEEE Software*, 33(4):55–63, 2016.

[Onward! 15] S. Kell. Towards a dynamic object model within Unix processes. In *2015 ACM International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software (Onward!)*, Onward! 2015, pages 224–239, New York, NY, USA, 2015. ACM.

[Onward! 14] S. Kell. In search of types. In *Proceedings of the 2014 ACM International Symposium on New Ideas, New Paradigms, and Reflections on Programming & Software*, Onward! 2014, pages 227–241, New York, NY, USA, 2014. ACM.

[GPCE 13] L. Marek, S. Kell, Y. Zheng, L. Bulej, W. Binder, P. Tůma, D. Ansaloni, A. Sarimbekov, and A. Sewe. ShadowVM: Robust and comprehensive dynamic program analysis for the Java platform. In *Proceedings of the 12th International Conference on Generative Programming: Concepts & Experiences*, GPCE '13, pages 105–114, New York, NY, USA, 2013. ACM.

[ECOOP 13] D. Ansaloni, S. Kell, Y. Zheng, L. Bulej, W. Binder, and P. Tůma. Enabling modularity and re-use in dynamic program analysis tools for the Java Virtual Machine. In *Proceedings of the 27th European Conference on Object-Oriented Programming*, ECOOP'13, pages 352–377, Berlin, Heidelberg, 2013. Springer-Verlag.

[OOPSLA 10] S. Kell. Component adaptation and assembly using interface relations. In *Proceedings of 25th ACM International Conference on Systems, Programming Languages, Applications: Software for Humanity*, OOPSLA '10. ACM, 2010.

[JUCS 08] S. Kell. A survey of practical software adaptation techniques. *Journal of Universal Computer Science*, 14(13):2110–2157, September 2008.

Peer-reviewed book chapters

[PhilStud 1x] S. Kell. Unix, Plan 9 and the lurking Smalltalk. In L. De Mol and G. Primiero, editors, *Reflections on Programming Systems*, Philosophical Studies Series. Springer. Accepted for publication.

Other peer-reviewed articles

[no key] S. Kell. The inevitable death of vms: a progress report. In *Conference Companion of the 2nd International Conference on Art, Science, and Engineering of Programming, Nice, France, April 09-12, 2018*, pages 61–62, 2018.

[PLOS 13] S. Kell. The operating system: Should there be one? In T. Harris and A. Madhavapeddy, editors, *Proceedings of the Seventh Workshop on Programming Languages and Operating Systems*, PLOS '13, pages 8:1–8:7, New York, NY, USA, 2013. ACM.

[PASTE 13] A. Sarimbekov, A. Sewe, S. Kell, Y. Zheng, W. Binder, L. Bulej, and D. Ansaloni. A comprehensive toolchain for workload characterization across JVM languages. In S. N. Freund and C. S. Pasareanu, editors, *Proc. ACM SIGPLAN-SIGSOFT Workshop on Program Analysis for Software Tools and Engineering*, PASTE '13, pages 9–16. ACM, June 2013.

[VMIL 13] Y. Zheng, L. Bulej, C. Zhang, S. Kell, D. Ansaloni, and W. Binder. Dynamic optimization of bytecode instrumentation. In *Proceedings of the 7th ACM Workshop on Virtual Machines and Intermediate Languages*, VMIL '13, pages 21–30, New York, NY, USA, 2013. ACM.

[VMIL 12] S. Kell, D. Ansaloni, W. Binder, and L. Marek. The JVM is not observable enough (and what to do about it). In *Proceedings of the compilation of the co-located workshops*, SPLASH '12 Workshops, New York, NY, USA, 2012. ACM.

[VMIL 11] S. Kell and C. Irwin. Virtual machines should be invisible. In *Proceedings of the compilation of the co-located workshops*, SPLASH '11 Workshops, pages 289–296, New York, NY, USA, 2011. ACM.

[FREECO 11] S. Kell. Composing heterogeneous software with style. In C. Bockisch, L. Bergmans, and S. Apel, editors, *Proceedings of the 1st International Workshop on Free Composition*, FREECO '11, pages 5:1–5:5, New York, NY, USA, 2011. ACM.

[Onward! IIP 09] S. Kell. The mythical matched modules: overcoming the tyranny of inflexible software construction. In *Companion to the 24th Annual ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages, and Applications*, OOPSLA 2009, pages 881–888. ACM, October 2009.

[ICSE NIER 09] S. Kell. Configuration and adaptation of binary software components. In *Companion to the 31st International Conference on Software Engineering*, pages 211–214. IEEE, May 2009.

[SYANCO 07] S. Kell. Rethinking software connectors. In F. Arbab and C. Baier, editors, *Proceedings of the 1st international workshop on synthesis and analysis of component connectors*, pages 1–12. ACM, September 2007.

Tool demonstration papers, extended abstracts etc.

[SPLASH 15] H. Sun, Y. Zheng, L. Bulej, W. Binder, and S. Kell. Custom full-coverage dynamic program analysis for Android. In *Companion Proceedings of the 2015 ACM SIGPLAN International Conference on Systems, Programming, Languages and Applications: Software for Humanity*, SPLASH Companion 2015, pages 7–8, New York, NY, USA, 2015. ACM.

[APLAS 15] H. Sun, Y. Zheng, L. Bulej, S. Kell, and W. Binder. Analyzing distributed multi-platform Java and Android applications with ShadowVM. In X. Feng and S. Park, editors, *Proc. 13th Asian Symposium on Programming Languages and Systems*, volume 9458 of *Lecture Notes in Computer Science*, pages 356–365. Springer, November 2015.

Peer-reviewed conference abstracts

[HaPoP 16] S. Kell. The operating system: why there should be one (or two), June 2016. Presented at HaPoP-16.

[EuroLLVM 16] C. Diamand, S. Kell, and D. Chisnall. Run-time type checking with clang, using libcrunch. Presented at EuroLLVM 2016, March 2016. Presentation abstract, slides and video available at http://www.llvm.org/devmtg/2016-03/ as retrieved on 2016/8/26.

Invited papers

[no key] S. Kell. Critique of 'files as directories: some thoughts on accessing structured data within files' (2). In *Conference Companion of the 2nd International Conference on Art, Science, and Engineering of Programming, Nice, France, April 09-12, 2018*, pages 175–179, 2018.

Technical reports, dissertations etc.

[PhD 12] S. Kell. *Black-box composition of mismatched software components.* PhD thesis, University of Cambridge, UK, 2012.