THE UNIVERSITY of EDINBURGH
College of Science & Engineering

Proposal for New Degree Programme

Stage 1

Contents

OVERVIEW OF PROGRAMME

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ABOUT THE PROGRAMME		
Title of programme	PhD in Lightweight Verification	
Intended Award	PhD	
Alternative awards	PGDip, PGCert, MSc by Research	
School	Informatics	
Programme Director	Prof. Philip Wadler	
Programme start dates	01/09/2019	
SCQF level of highest award	12	
Total credit value of programme *(for highest award)*	720	
Partner institution(s) if any	University of St Andrews, Heriot-Watt University, Glasgow University, Strathclyde University	
Mode of delivery ***(Please ✓ those which apply to this programme)***	On campus	X
	Online	
	Blended learning	

	FT	X
	PT	
	Intermittent	
Expected length of programme	FT	**4 Years**
	PT	
	Intermittent	

Description of the programme and its structure (maximum 150 words)

The UK is a global leader in software development and associated research. Software provides a massive economic contribution, estimated at £34bn in 2015. The safe, secure and correct operation of software is critical since *the quality of individual lives as well as entire economies now depend on software robustness and reliability.* However, achieving this is very difficult. Software errors lead to system failures and security compromises which, in turn, can quickly result in huge financial losses or even major catastrophes. Our vision is to advocate *lightweight* formal methods as value-adding adjuncts to existing development processes, thereby maintaining investments in tools and training while transforming the software quality that they can deliver.

The programme will produce a cohesive world-leading community of PhD students, researchers, and academics, who will collectively tackle this challenge. It will incorporate masterclasses from world experts and industry, provided a unique level advanced research training in lightweight verification.

Career, employability and opportunities for continuing professional development.

Reliable, safe, secure and correct software is essential to a modern digital and knowledge-based economy, underpinning future developments in artificial intelligence, robotics, cybersecurity, data science, the Internet of Things, and many other areas. Lightweight verification specialists are thus in high demand in major companies and government organisations, often leading research and innovation activities, e.g. in Microsoft, Facebook, Google X, Intel, and Dropbox. Within academia, lightweight verification experts are highly successful at attracting funding for their research and in producing high-quality research papers. Many therefore form their own internationally-recognised research teams, and obtain senior and respected academic positions.

BUSINESS CASE

This section should be used to outline the business case for the proposed programme. Before completing this section market research should have been undertaken.

STRATEGIC PLANNING, RECRUITMENT & COMPETITOR ANALYSIS	
Programme Title	PhD in Lightweight Verification
Programme Proposer	Prof.Philip Wadler
Strategic Planning	Expanding doctoral training is a strategic goal of the university and the college. The proposed program is in an area of high demand and is linked to a proposal for a EPSRC Centre for Doctoral Training (CDT), which would provide funding of approximately £5.4M (plus industry sponsorships) for an intake of 15 students per year over 5 years over the 5 partner universities.
Recruitment *Please provide a detailed commentary on your marketing and recruitment strategy.*	As evidenced in the case for support that has been submitted to UKRI, there is high demand for graduates with the skills that the CDT will produce, from academia, government and industry. This extends nationally and internationally, and includes large technology companies, such as Facebook, Microsoft, Google, Intel, ARM, Xilinx, IBM and Leonardo, all of whom have a significant UK presence, as well as SMEs and local startups such as CodePlay, Symphonics, IOHK etc. It also includes government agencies such as NCSC and DSTL. PhD Graduates in the area become leading academics and industrial leaders, and these high status role models will serve to attract additional students to the programme. The programme will form a unique and well-funded opportunity to undertake advanced research under world-leading academics. The goal is to create a cohesive and effective cohort of PhD students and graduates who will collectively push back the frontiers of knowledge in an area of key importance to Computer Science, to society and to the economy. This will provide a unique selling point that differentiates the programme from any other offering. Recruitment will be carried out nationally and internationally, but will also draw on BSc/MSc graduates from the partner institutions. Across the 5 partner institutions alone, there is a pool of around 650 BSc/MSc students graduates each year, with significant numbers obtaining high quality first class or distinction degrees. National recruitment will link with VeTSS (the EPSRC-funded Research Institute in Verified Trustworthy Systems that is run by Imperial College and provides UK-wide connections, https://vetss.org.uk). International recruitment will exploit our excellent network of research connections with high-quality institutions in Europe, the USA, South America, Asia, Australia and New Zealand, as well as links with the $10M NSF-funded DeepSpec Expedition in . We will also exploit opportunities that are offered by each of the five universities to promote the programme through their regular international recruitment fairs, local recruitment agents, brochures etc.

Competitor Analysis *A competitor analysis report provides a better understanding of the marketplace and competition, from the going rate for tuition fees to the unique selling points and marketing strategies of competitor programmes.*	There is currently no direct competitor programme anywhere in the world. By combining research expertise from over 50 research-active academics at 5 Scottish Universities (including Edinburgh) who possess complementary expertise and capabilities, the programme will create a unique and world-leading PhD programme built around a cohesive cohort of research students. Individual PhDs in relevant areas are offered by many world-leading institutions, including Imperial College London, Oxford University, Cambridge University, University of Pennsylvania (USA), Princeton (USA), Yale (USA), MIT (USA), Chalmers University (SE), Utrecht University (NL), École Normale Supérieure (FR), Eötös Lórand University (HU), Ludwig-Maximilians Universität (DE) etc.			
Competitor Fees *Provide the fee structure (in British pounds) of three competitors, preferably those mentioned in the competitor analysis. These may be UK or International competitors.*	Institution	Programme	Fees	
			Home	International
	University of Oxford	PhD in Computer Science	£4,260	£21,450
	Imperial College, London	PhD in Computer Science	£4,260	£23,500
	University of Pennsylvania	PhD in Computer Science	£30,381	£30,381

FEES AND COSTING		
Programme fees *Fees are expressed per academic year in British pounds. For PGT programmes, a Programme Costing Template will also be required for Fee Strategy Group.*	Home-Scotland / EU	
	Home-RUK	
	Overseas	
Fees for each new PGT programme are sent by College to the Fee Strategy Group (FSG) for review and approval. The FSG has developed a Programme Costing Template to give FSG insight into the anticipated profitability of a programme and where it sits within its market. The Fees Costings template, and guidance from FSG on filling out the template is included in		 FSGProgrammeCostingTemplateFinalHS

the spreadsheet attached to the right.	

Additional Programme Costs (PGR only)

Additional costs to the student should be noted and justified in the table below. These should consist of items that are over and above the basic provision that should be available to all students and should reflect the special additional costs associated with the specific programme of study. Individual items over £200 should be noted on a separate row.

Item	Cost	% of Total
Total:		100%

ANTICIPATED AND PROJECTED ENROLMENTS

What are the anticipated and projected enrolments over the next three years?

	Year 1	Year 2	Year 3
Home	**11**	**11**	**11**
International	**4**	**4**	**4**
Supporting Research What market research has been planned or completed to support the predicted student numbers?	These figures represent the numbers of students that will be funded for the CDT as a whole, including the industrially funded places that have been guaranteed to us. About 20% of the total would accrue to Edinburgh (3 per annum). There is significant existing demand from students to study in the area: the 50 supervisors are world-leading in their areas, and already each attract significant numbers of high quality applications and research students. Moreover, a key aim of the CDT is to apply lightweight verification techniques in popular application areas, including artificial intelligence, robotics, fintech, cybersecurity and digital healthcare. This will boost popularity. The programme would initially run for 5 years, funded by UKRI under the usual CDT rules. At that point, a proposal will be submitted to extend the CDT for a further five years. If no further funding is obtained, then the programme may be considered to be no longer viable.		

PLANNING AND RESOURCES	
New Courses	Delivery of the training element will be through "masterclasses" to be run on a weekly basis and shared between the five institutions. If a new course/module is needed to capture that structure formally at Edinburgh, then a suitable application will be made to the Board of Studies.
Facilities and Equipment	The PhD students will be accommodated in the School of Informatics (and will also have desks allocated at the other institutions on a demand basis). There is no need for specialist equipment, but provision has been made within the CDT funding application to pay for video-conferencing facilities to support the delivery of the programme.
Staff	Administrative staff and teaching support staff for this programme will be funded by the accompanying EPSRC CDT grant. This CDT involves > 50 supervisors, across five universities, which means that the risk created by staff changes, retirements, sabbaticals etc. is low.
Resource Sharing	This program will share resources with the existing PhD programmes in Informatics. Some resource sharing between CDTs at the college level is also anticipated. The study programme will include new "masterclasses".

COLLABORATIVE PROGRAMMES
Additional information is required for new programmes that are collaborations with external institutions or organisations which will result in a joint award and/or where taught components are shared. International partnerships must have a Memorandum of Understanding (MoU) in place before the programme can be approved by College. Should the proposal be progressed to Stage 2 a draft Memorandum of Agreement (MoA) will need to accompany the submission. Separate guidance is available for the development of collaborative programmes. http://www.ed.ac.uk/governance-strategic-planning/collaborative-activity/guidance-templates
This programme will be jointly undertaken with St Andrews University (administering institution), Glasgow University, Heriot-Watt University, and Strathclyde University. Agreements for other CDTs already exist with St Andrews and Heriot-Watt. Each institution will award its own degree for the students that it admits to the programme: we do not anticipate awarding joint degrees.

CONSULTATION AND APPROVAL

Programme Title:	
Programme Proposer:	

STAGE 1: CONSULTATION

Please confirm consultation with relevant stakeholders has taken place.

Stakeholder	**Yes**	**NA**
School Director of Professional Services	☐	☐
School Academic Administration Staff	☐	☐
Information Services (including Academic Support Librarians)	☐	☐
Student Body (SSLC/Student representatives)	☐	☐
Partner School Staff (E.G. Joint Programmes/shared courses etc)	☐	☐
Employers	☐	☐
Industry and Professional Bodies	☐	☐
External Consultation	☐	☐
Please note any other consultation		

Please provide a brief comment on the consultation process

Please provide a brief comment on the consultation process with External consultants

STAGE 2: SCHOOL BOARD OF STUDIES REVIEW AND APPROVAL

Confirmation of approval of the proposal at the School Board of Studies should be entered below.

Date of BoS:
Convener Name:
Comment and Approval (BoS Minute): *Please provide either a link to the minutes of the Board or a copy of the relevant text from the minutes.*

STAGE 3: HEAD OF SCHOOL REVIEW AND APPROVAL

Head of School: *Please print name*
Comment and Approval:
Signature:

STAGE 4: COLLEGE CURRICULUM APPROVAL BOARD REVIEW AND OUTCOME

Date of CCAB:	
Convener Name:	
Stage 1 Outcome (please select as appropriate)	
Permission to proceed to Stage 2	☐
Permission to proceed to Stage 2 with conditions	☐
Proposal rejected with recommendations	☐

Proposal rejected	☐
Comment:	

Document Control		
Date approved: Start date:	Amendments:	Date for next review: April 2018
Contact name & role: Matt Elliot	Department: College Academic Affairs	Email: Matt.Elliot@ed.ac.uk
If you require this document in an alternative format please email: deanqa@exseed.ed.ac.uk		