Theoretical Computer Science

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What we do

- Develop logical and mathematical techniques to model and reason about the process of computation
  - Games
  - Categories
  - Logics
- Prove theorems that say our formalisms have good properties
  - They faithfully model particular situations
  - They agree with each other
  - They are computationally tractable
- Demonstrate our work in practice
  - To verify code
  - To model languages (both programming and natural)
  - To optimise systems

What makes us different?

- An established track record of developing foundational techniques and following them through to practical application

Separation logic based reasoning

- Develop a logic that will deal cleanly with
  - Memory allocation on the heap
  - Other resources
- Apply it to standard algorithms (Schorr-Waite garbage collection)
- Develop it to use on small real examples (memory issues in Device drivers w Microsoft)
- Scale it to use in locating memory issues across an entire code-base (Monoidics)
- Transfer it to use as part of a major company's standard development (Facebook)

Quantitative Information Flow

- Develop theory combining statistical information measures (entropy) and techniques from computational semantics and complexity to describe information leakage by a program

- Apply to analyse information leakage in real programs
  - GCHQ cyber-security

Other examples

- Quantum Linguistics
- Session types
- Game theory

How do we know we're successful?

- Public recognition
  - Distefano RAEng Silver Medal, Needham Prize
  - Honda ETAPS award
- Personal Fellowships
  - Over 50% of our faculty hold or have held
- Successful Alumni
  - Full professors at Oxford, Southampton, UCL
- Funding
  - Well over £10m into the work I have just been talking about
- Participation in flagship projects
  - UK Cybersecurity centres
  - Programme grant