# Programming Languages Faculty

<table>
<thead>
<tr>
<th>Programming Languages Faculty</th>
<th>Affiliated Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umut Acar</td>
<td>Jonathan Aldrich</td>
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<tr>
<td>Guy Blelloch</td>
<td>Jeremy Avigad</td>
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<td>Steve Awody</td>
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<td>Richard Statman</td>
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- Richard Statman
Broadly construed, I research problems of scalability. Current foci include the design and development of abstractions, algorithms, languages, and systems for scalable parallel, dynamic, and interactive computation.

**Umut Acar**, Associate Professor (CS)

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*Scalable Parallelism, Dynamic Parallelism, Self-adjusting Computation*

My research has largely been in the interaction of Algorithms and Programming Languages, much of it in the area of parallel computing.

**Guy Blelloch**, Professor (CS)

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*Parallelism, Data Structures and Algorithms, Cache Efficient Parallel Algorithms*

I have been involved in the development of Concurrent Separation Logic, in collaboration with John Reynolds and Peter O'Hearn. I am currently investigating further extensions to this logic, and working out the semantic underpinnings needed to validate logics that combine concurrency with procedures and communication.

**Stephen Brookes**, Professor (CS)

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*Semantic models for programming languages and logics for reasoning about the behavior of concurrent programs*

My research improves the quality of software and the productivity of engineers by expressing and enforcing structural and behavioral aspects of software design within source code, typically through language design and type systems. I have contributed to object-oriented typestate verification, techniques for modular reasoning about state, and new object-oriented language models.
Karl Crary,  Associate Professor (CS)
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http://www.csd.cs.cmu.edu/people/faculty/karl-crary

My research interests are in applying programming language technology to improve the development, maintenance, and performance of software systems. I am particularly interested in the application of type theory to systems programming, in mechanization of the metatheory of programming languages, in type-oriented compilation strategies, in type-based certification of machine code, and in the design of practical, high- or low-level programming languages.

Matthew Fredrikson,  Assistant Professor (CS)
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http://www.csd.cs.cmu.edu/people/faculty/matthew-fredrikson

My research focuses on security and privacy issues that lead to failures in real systems. Some of the key outstanding challenges in this area lie in figuring out why promising theoretical approaches oftentimes do not translate into effective defenses. Much of my work is concerned with developing formal analysis techniques that provide insight into the problems that might exist in a system, building countermeasures that give provable guarantees, and measuring the effectiveness of these solutions in real settings.

Robert Harper,  Professor (CS)
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My current research projects are in computational higher type theory, and in the development of cost semantics for higher-level programming languages. More generally I am interested in constructive mathematics, programming language semantics, program verification, and mechanized proof. All of these subjects are unified in the setting of computational type theory.

Jan Hoffmann,  Assistant Professor (CS)
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My research areas are programming languages and formal methods. I am specifically interested in quantitative verification, type systems, static resource analysis of programs, proof assistants, and decision procedures.
I am interested in developing modeling and verification methods for a wide range of distributed systems including those that exhibit timing-dependent behavior and possibly interact with the physical world. I have also had continued interest in security. My current topic of interest in this area is accountability.

Ruben Martins, Assistant Professor (CS)
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Constraint Programming, Boolean Satisfiability and Optimization, Software Verification, Program Synthesis

The goal of my research is to improve constraint solvers and broaden their applicability in program analysis, synthesis, and security. I have developed several award winning MaxSAT solvers that are widely used in software package upgradeability, computational biology, and course timetabling. My most recent work focuses on program synthesis for data-science-related tasks. Specifically, I am interested in automating a variety of cumbersome data preparation tasks and making the life of data scientists simpler.

Frank Pfenning, Joseph F. Traub Professor of Computer Science (CS)
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Formal Reasoning about Languages for Distributed Computation

At the heart of my research lies the desire to understand the principles of programming languages. Programming languages are the key to the programming process and therefore of fundamental importance to computer science. Well-designed programming languages allow fast program development, ease software maintenance, and increase confidence in the correctness of implementations.

André Platzer, Associate Professor (CS)
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Logic in Computer Science, Cyber-Physical Systems, Programming Languages, Formal Methods

My research develops the logical foundations of cyber-physical systems to characterize their fundamental principles and to show how we can design computers that are guaranteed to interact correctly with the physical world. The solution to this challenge is the key to enabling computer assistance that we can bet our lives on. I pursue this challenge with the principled design of programming languages with logics that can provide proofs as correctness guarantees.
The goal of my research is to help programmers focus on the interesting functionality of programs. I am interested in designing programming constructs that provide provable guarantees while supporting efficient execution strategies. Application domains of interest include security, privacy, and biological modeling.

Public understanding and consumption determine the impact of research. Because of this, I am interested in improving science communication and facilitating commercialization of technical ideas. From 2013-2015 I co-directed NeuWrite Boston, a working group of scientists and science writers. To narrow the gap between academia and industry, I co-founded the Cybersecurity Factory, an accelerator for security startups.

Jean Yang, Assistant Professor (CS)
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Security, Privacy, and Biological Modeling

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