



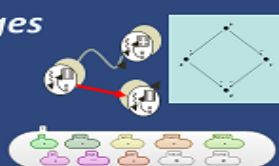
{P[x/E]} x:=E {P}



Programming Languages
Formal Methods
Software Engineering



$G(p \Rightarrow Fq)$



Impact Analysis of Software Technologies

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Main Types of Impact

- **Practice** impact: Practice adoption of tools/systems/technologies... for **practitioners**
 - Some examples discussed in this talk
- **Research** impact: inspiring/impactful ideas/directions/subareas... for **researchers**
 - Example: model checking
- **Societal** impact: inspiring/impactful ideas/thinking/awareness... for **general public**
 - Example: privacy, medical-device security, MOOCs, ...

ACM Software System Award



The image shows a screenshot of the ACM Awards Software System Award website. The header features the ACM logo (a blue diamond with 'acm' in white) on the left, the word 'AWARDS' in large white capital letters in the center, and a home icon with the word 'Search' on the right. Below the header, there is a navigation bar with five buttons: 'ALPHABETICAL LISTING' (highlighted in orange), 'YEAR OF AWARD', 'NOMINATING PROCESS', 'AWARDS SPONSORS', and 'AWARD COMMITTEE'. Above the 'ALPHABETICAL LISTING' button, there is a link that says 'BROWSE AWARD WINNERS BY:'. Below the navigation bar, there are two columns of award winners. The left column lists 'LLVM (2012)' with winners Vikram S Adve, Evan Cheng, and Chris Lattner, and 'Eclipse (2011)' with winners Greg Adams, John Duimovich, Erich Gamma, Kevin Haaland, Julian Jones, and Philippe Mulet. The right column lists 'Java (2002)' with winner James A. Gosling, 'SPIN (2001)' with winner Gerard Holzmann, and 'Apache (1999)' with winners Brian Behlendorf, Roy T. Fielding, Rob Hartill, David Robinson, and Cliff Skolnick.

acm

AWARDS

Software System Award

MORE ACM AWARD WINNERS

BROWSE AWARD WINNERS BY:

- ALPHABETICAL LISTING
- YEAR OF AWARD
- NOMINATING PROCESS
- AWARDS SPONSORS
- AWARD COMMITTEE

30 Awardees

LLVM (2012)
Vikram S Adve
Evan Cheng
Chris Lattner

Eclipse (2011)
Greg Adams
John Duimovich
Erich Gamma
Kevin Haaland
Julian Jones
Philippe Mulet

Java (2002)
James A. Gosling

SPIN (2001)
Gerard Holzmann

Apache (1999)
Brian Behlendorf
Roy T. Fielding
Rob Hartill
David Robinson
Cliff Skolnick

http://awards.acm.org/software_system/

ACM Software System Awardees

- 2012: LLVM
 - 2011: Eclipse
 - 2010: GroupLens Collaborative Filtering Recommender Systems
 - 2009: VMware Workstation for Linux 1.0
 - 2008: The Gamma Parallel Database System
 - 2007: Statemate
 - 1996 Turing Award: Amir Pnueli
 - 2006: Eiffel
 - 2005: The Boyer-Moore Theorem Prover (ACL2)
- 30 Awardees*

ACM Software System Awardees

- 2004: Secure Network Programming
- 2003: MAKE
- 2002: Java
- 2001: SPIN
- 1999: Apache
- 1998: The S System (R)
- 1997: Tcl/Tk
- 1995: NCSA Mosaic, World-Wide Web
- 1994: Remote Procedure Call
- 1993: Sketchpad
 - 1988 Turing Award: **Ivan Sutherland**
- 1992: Interlisp

ACM Software System Awardees

- 1991: TCP/IP
 - 2004 Turing Award: **Vinton Cerf & Robert Kahn**
- 1990: NLS
 - 1997 Turing Award: **Douglas Engelbart**
- 1989: PostScript
- 1988: System R, INGRES
 - 1998 Turing Award: **Jim Gray**
- 1987: SMALLTALK
 - 2003 Turing Award: **Alan Kay**
- 1986: TeX
 - 1974 Turing Award: **Donald Knuth**
- 1985: VisiCalc
- 1984: Xerox Alto System
 - 2009 Turing Award: **Charles P. Thacker**
 - 1992 Turing Award: **Butler Lampson**
- 1983: UNIX
 - 1983 Turing Award: **Dennis Ritchie, Ken Thompson**

Categorized Awardees

■ Development Environments/Tools

- 2012: LLVM
- 2011: Eclipse
- 2007: Statemate
- 2006: Eiffel
- 2005: The Boyer-Moore Theorem Prover (ACL2)
- 2003: MAKE
- 2001: SPIN
- 1992: Interlisp

■ Languages

- 2002: Java
- 1998: The S System (R statistical analysis)
- 1997: Tcl/Tk
- 1987: SMALLTALK

Categorized Awardees

■ Operating/Runtime/DB Systems

- 2009: VMware Workstation for Linux 1.0
- 2008: The Gamma Parallel Database System
- 1999: Apache
- 1988: System R, INGRES
- 1983: UNIX

■ Construction Paradigms

- 2004: Secure Network Programming
- 1995: World-Wide Web
- 1994: Remote Procedure Call
- 1991: TCP/IP

Categorized Awardees

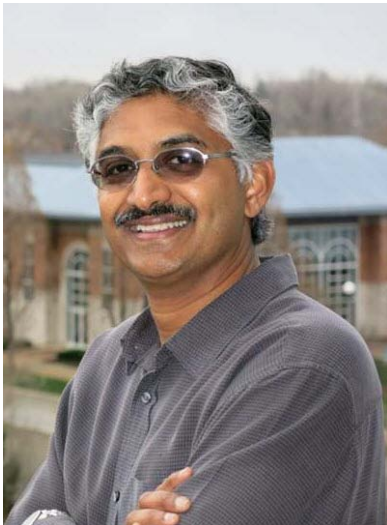
■ Applications

- 2010: GroupLens Collaborative Filtering Recommender Systems
- 1995: NCSA Mosaic
- 1993: Sketchpad
- 1990: NLS
- 1989: PostScript
- 1986: TeX
- 1985: VisiCalc
- 1984: Xerox Alto System

2012 LLVM (UIUC)

- The openness of the LLVM technology and the quality of its architecture and engineering design are key factors in understanding the success it has had both in academia and industry.

<http://llvm.org/>



Vikram Adve



Chris Lattner



Evan Cheng

Dev Env/Tools:

University Origin vs. Company Origin

- University origin:
 - 2012: LLVM (UIUC) → Apple, etc.
 - 2007: Statemate (Weizmann Inst. Science) → I-Logix
 - 2005: Boyer-Moore Theorem Prover (ACL2) (UT Austin) → Computational Logic Inc.
- Company origin:
 - 2011: Eclipse (IBM)
 - 2006: Eiffel (Eiffel Software) → ETH
 - 2003: MAKE (Bell Labs)
 - 2001: SPIN (Bell Labs)
 - 1992: Interlisp (BBN)

Dev Env/Tools:

Open Source vs. Commercialization

- Open source/community contribution:
 - 2012: LLVM
 - 2011: Eclipse
 - 2005: Boyer-Moore Theorem Prover (ACL2)
 - 2003: MAKE (part of Unix)
 - 2001: SPIN
- Company commercialization
 - 2007: Statemate
 - 2006: Eiffel
 - 1992: Interlisp

Dev Env/Tools: Building a Community

- 2012: LLVM
 - Yearly LLVM Developer s' Meeting
 - <http://llvm.org/devmtg/>
- 2011: Eclipse
 - Yearly EclipseCon Conference
 - <https://www.eclipsecon.org/>
- 2001: SPIN
 - Yearly SPIN Symposium on Model Checking of Software
 - <http://spin2014.org/>

No Necessary Strong Correlation with Top Venue Publications

- 2012: LLVM
 - Lattner and Adve. LLVM: A Compilation Framework for Lifelong Program Analysis & Transformation, *CGO 2004*
- 2005: Boyer-Moore Theorem Prover (ACL2)
 - Kaufmann and Boyer. The Boyer-Moore Theorem Prover and Its Interactive Enhancement, *Computers and Mathematics with Applications*, 1995
- 2001: SPIN
 - Holzmann. The SPIN Model Checker: Primer and Reference Manual. Addison-Wesley, 2004.

No Necessary Strong Correlation with Top Venue Publications

- 2007: Statemate
 - Harel. Statecharts: A Visual Formalism for Complex Systems", *Science of Computer Programming* 1987
 - Harel et al. Statemate: A Working Environment for the Development of Complex Reactive Systems, *ICSE* 1988.
- 2006: Eiffel
 - Meyer. Object-Oriented Software Construction, Prentice Hall, 1988

Statechart

Statecharts in the Making: A Personal Account

David Harel

The Weizmann Institute of Science

The process leading to the eventual publication of this paper is interesting in its own right. For almost two years, from early 1984 until late 1985, I repeatedly submitted it to what seemed to be the most appropriate widely read venues for such a topic. These were, in order, *Communications of the ACM*, *IEEE Computer* and *IEEE Software*. The paper was rejected from all three of these journals. In fact, from *IEEE Computer* it was rejected twice — once when submitted to a special issue on visual languages and once when submitted as a regular paper. My files contain quite an interesting collection of referee reports and editors' rejection letters. Here are some of the comments therein:

Stemate

Statecharts in the Making: A Personal Account

"I find the concept of statecharts to be quite interesting, but unfortunately only to a small segment of our readership. I find the information presented to be somewhat innovative, but not wholly new. I feel that the use of the digital watch example to be useful, but somewhat simple in light of what our readership would be looking for."

"The basic problem [...] is that [...] the paper does not make a specific contribution in any area."

"A research contribution must contain 'new, novel, basic results'. A reviewer must certify its 'originality, significance, and accuracy'. It must contain 'all technical information required to convince other researchers in the area that the results are valid, verifiable and reproducible'. I believe that you have not satisfied these requirements."

1995 WWW

- “The paper that Tim Berners-Lee and Robert Cailliau submitted to the [**ACM Hypertext**] conference was rejected, and they had to set up shop with their NeXT machine on a table at the venue where they would demonstrate the world wide web to passing delegates. This web page was set up for offline demonstration purposes. The hypertext community were unimpressed with the web; it looked rather simple.

After the conference, however, Tim went knocking on doors. One of those doors belonged to Paul Jones at the University of North Carolina. Paul had a NeXT and Tim demonstrated the world wide web on it using this page.”

<http://first-website.web.cern.ch/blog/1991-web-page-found-password-lost>

Aspect-Oriented Programming



aspect-oriented programming



Scholar

About 26,000 results (0.03 sec)

ECOOP 1997 Keynote Paper

Articles

[BOOK] [Aspect-oriented programming](#)

[G Kiczales](#), J Lamping, A Mendhekar, C Maeda... - 1997 - Springer

Case law

We have found many **programming** problems for which neither procedural nor object-oriented **programming** techniques are sufficient to clearly capture some of the important design decisions the program must implement. This forces the implementation of those design decisions to ...

My library **New!**

Cited by 7650 Related articles All 117 versions Cite Save

Any time

[PDF] [Aspect-oriented programming](#)

J Irwin, [G Kickzales](#), J Lamping... - Proceedings ..., 1997 - [andremoraes-tcc.googlecode.com](#)

Since 2013

Abstract To date, the primary idea for organizing software systems has been to break the system down into modular units such as subroutines, procedures, objects, clients and servers etc. We note that all of these correspond relatively directly to blocks of executable ...

Since 2012

Cited by 78 Related articles All 8 versions Cite Save More

Since 2009

Custom range...

<http://www.cs.ubc.ca/~gregor/papers/kiczales-ECOOP1997-AOP.pdf>

Model Checking

- Edmund Clarke: “The birth of model checking was quite painful at times. Like most research on the boundary between theory and practice, theoreticians thought the idea was trivial, and system builders thought it was too theoretical. Researchers in formal methods were even less receptive. Research in the formal- methods community in the 1980s usually consisted of designing and verifying tricky programs with fewer than 50 lines using only pen and paper. If anyone asked how such a program worked in practice on a real computer, it would have been interpreted as an insult or perhaps simply as irrelevant.”

Hoffman . Q&A Talking Model-Checking Technology. CACM 2008.

<http://cacm.acm.org/magazines/2008/7/5378-qa-talking-model-checking-technology/fulltext>

More ...

- Open Source
 - 2012: LLVM
- Commercialization
 - 2009: VMware Workstation for Linux 1.0 (Stanford)
 - Yuanyuan Zhou et al. PatternInsight (UIUC/UCSD)
 - Li et al. CP-Miner: a tool for finding copy-paste and related bugs in operating system code. OSDI 2004
 - Dawson Engler et al. Coverity (Stanford)
 - Engler et al. Bugs as Deviant Behavior: A General Approach to Inferring Errors in Systems Code. SOSP 2001.
 - Gail Murphy et al. Tasktop (UBC)
 - Kersten and Murphy. Mylyn: a degree-of-interest model for IDEs. AOSD 2005.
 - Andreas Zeller et al. Testfabrik (Saarland)

Ideas Have Many Parents...

- Researchers
- Scientific and technical communities
- Technology transfer agents
- Students with new degrees
- New hires with different perspectives
- Early adopters
- Commercializers

<http://www.sigsoft.org/impact/>

Summary



The header of the ACM Awards Software System Award website. It features the ACM logo on the left, the word "AWARDS" in large white letters, and "Software System Award" below it. A home icon and a search bar are on the right. Below the header is a navigation bar with five categories: "ALPHABETICAL LISTING", "YEAR OF AWARD", "NOMINATING PROCESS", "AWARDS SPONSORS", and "AWARD COMMITTEE".

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AWARDS

Software System Award

Search

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Apache (1999)
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Roy T. Fielding
Rob Hartill
David Robinson
Cliff Skolnick



http://awards.acm.org/software_system/

Thank you!

Questions ?



<https://sites.google.com/site/asergrp/>

The banner features several logos and text elements:

- On the left, a collage of logos including Python, Ruby, and others.
- A logo with a stylized 'I' inside a blue square.
- The text $\{P[x/E]\} \quad x:=E \quad \{P\}$ in white.
- The text **Programming Languages**, **Formal Methods**, and **Software Engineering** in white.
- A logo of a computer monitor.
- A logo of a bug with a yellow lightning bolt.
- The text $G(p \Rightarrow Fq)$ in white.
- A diagram of a diamond-shaped graph with nodes and edges.
- A row of five colorful, rounded rectangular buttons.