



Conference on Domain-Specific Languages

October 15–17, 1997

Fess Parker's Doubletree Resort
Santa Barbara, CA

Sponsored by USENIX, the Advanced Computing Systems Association, in cooperation with ACM SIGPLAN and SIGSOFT

Keynote

The Promise of Domain-Specific Languages

PAUL HUDAK, *Yale University*

Attend 23 Technical Presentations on These Topics:

- Implementation Tools
- Language Design
- Experience Reports
- Compiler Infrastructure
- Case Studies and Surveys
- Abstract Syntax Trees
- Embedded Languages
- Logic and Semantics

Learn From These Invited Talks:

- Synchronous Languages: An Experience in Domain-Specific Language Design
GÉRARD BERRY, *École des Mines de Paris*
- Intentional Programming: An Ecology for Abstractions
CHARLES SIMONYI, Chief Architect, *Microsoft*
- Aspect-Oriented Programming: Improved Support for Separation of Concerns in Design and Implementation
GREGOR KICZALES, Principal Scientist, *Xerox Palo Alto Research Center*

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1. State Stache Home
2. Begin COMPRESS
3. Message GET_RO
4. Var
5. Iterator : SHAR
6. ) NODE
7. Begin
8. Send (GetOwa
9. InShare

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(kinds) ⁰	κ	::=	$\Omega \mid \kappa_1 \rightarrow \kappa_2 \mid \kappa_1 \otimes \kappa_2$
(con's) ¹	μ	::=	$t \mid \text{In} \mid \mu_1 \mid \mu_2 \mid \lambda t :: \kappa. \mu \mid \mu_1 [\mu_2]$
(types) ²	σ	::=	$T(\mu) \mid \forall v :: \kappa. \sigma \mid \sigma_1 \rightarrow \sigma_2$
(terms) ³	e	::=	$a \mid \lambda x :: \sigma. e \mid @v_1$
(values) ⁴	v	::=	$\Omega \mid \text{In} \mid \mu$



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"The purpose of this Conference on Domain-Specific Languages is to concentrate on the unique aspects of DSL design, implementation, and application in order to form a body of literature on domain-specific languages, and to refine the DSL technique."

**IMPORTANT
DATES TO
REMEMBER:**

**Hotel Discount
Deadline:**

*Monday,
Sept. 22, 1997*

Mastering Domain-Specific Languages for Software Engineering

Dear Colleague:



Today's programmers are designing and building systems of vastly greater scale and complexity than ever before—**systems with lifetimes in decades, involving millions of lines of code, implemented over distributed systems**, in which no single individual has a complete grasp of the code. To create reliable, scaleable, maintainable systems, a software engineer must apply a wide variety of tools and techniques. **One of these is the use of domain-specific languages.**

Domain-specific languages can be a vehicle for formal analysis and optimization methods; they can act as a bridge between visual interfaces and the underlying computation; they can serve as (possibly executable) modeling and prototyping languages; and they can serve as network service interfaces.

Domain-specific languages can act as scaffolding for the software engineering process (as with architectural description languages) or they may be used directly (as with layout languages such as HTML). Domain-specific languages enforce a separation of concerns, insulating the user from unnecessary detail and severing machine dependencies. **Domain-specific languages extend software design. The result is a formalism, a concrete artifact that permits representation, optimization, and analysis in ways that low-level programs and libraries do not.**

The purpose of this Conference on Domain-Specific Languages is to concentrate on the unique aspects of DSL design, implementation, and application in order to form a body of literature on domain-specific languages, and to refine the DSL technique.

The papers in this conference include **valuable case studies, surveys, insights in design, techniques for definition, tools for implementation, and studies in alternative and complementary approaches.** They were chosen for quality, originality, and relevance.

USENIX conferences are known for their practical focus. DSL '97 will be no exception. **You will walk away with a better understanding of when and how to use language as a software**

engineering tool. But more importantly, you will **become part of an emerging community dedicated to understanding the promise and practice of domain-specific languages.** This conference offers participation in the discourse on a subject of great potential and inherent appeal.

I invite you to DSL '97, and hope to meet you in Santa Barbara this October.

Sincerely,

Chris Ramming, *AT&T Labs Research*
Program Chair

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Program at-a-Glance

Tuesday, October 14

On-Site Registration	6:00 pm – 9:00 pm
Welcome Reception	6:00 pm – 9:00 pm

Wednesday, October 15

On-Site Registration	7:30 am – 5:00 pm
Technical Program	8:15 am – 5:00 pm
Conference Luncheon	11:30 am – 1:00 pm
Conference Reception	5:00 pm – 6:00 pm
BOF Sessions	8:30 pm – 11:00 pm

Thursday, October 16

On-Site Registration	7:30 am – 5:00 pm
Technical Program	8:30 am – 6:00 pm
Conference Reception	6:00 pm – 7:00 pm
BOF Sessions	8:30 pm – 11:00 pm

Friday, October 17

Technical Program	8:30 am – 12:30 pm
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8:15am–8:30am

Opening Remarks

Chris Ramming, Program and General Chair, *AT&T Labs Research*

8:30am–9:30am



Keynote Address: The Promise of Domain-Specific Languages

Paul Hudak, *Yale University, Department of Computer Science*

Are domain specific languages (DSLs) the long-awaited “silver bullet” for software engineering? Can DSL technology deliver its promise of greater productivity, higher quality, and enhanced maintainability? What are the design principles behind DSLs, and how does one implement them? What can go wrong, and how do we distinguish success from failure?

These are some of the questions that will be addressed in this overview of DSL technology. We will argue the point of view that a well-designed DSL should be the ultimate abstraction for a particular application domain, capturing precisely the semantics of an application, no more and no less. Topics to be covered include the basic principles underlying DSLs, examples of successful DSLs, general design principles, the notion of a domain-specific embedded language, and the importance of software tools for implementing DSLs.

Paul Hudak was instrumental in organizing and chairing the Haskell Committee, an international group of computer scientists who designed Haskell, a pure functional programming language. He is an editor of the Journal of Functional Programming, a member of the editorial boards of the International Journal of Parallel Programming and Lisp and Symbolic Computation, and a charter member of IFIP WG2.8 Working Group on Functional Programming. He has published over 100 papers, and has consulted for Los Alamos National Laboratory, IBM T.J. Watson Research Laboratory, and Intermetrics, Inc.

9:30am–10:00am

Break

10:00am–11:30am

Domain-Specific Language Design

Session Chair: Todd Knoblock, *Microsoft Research*

Service Combinators for Web Computing

Luca Cardelli, *Digital Equipment Corporation* and Rowan Davies, *Carnegie-Mellon University*

A Domain-Specific Language for Video Device Drivers: From Design to Implementation

Scott Thibault, Renaud Marlet, and Charles Consel, *IRISA/INRIA—Université de Rennes 1*

Domain-Specific Languages for *ad hoc* Distributed Applications

Matthew Fuchs, *Walt Disney Imagineering*

11:30am–1:00pm

Conference Luncheon

1:00pm–2:30pm

Experience Reports

Session Chair: Adam Porter, *University of Maryland*

Experience with a Domain-Specific Language for Form-Based Services

David Atkins, Thomas Ball, Michael Benedikt, Glenn Bruns, Kenneth Cox, Peter Mataga, and Kenneth Rehor, *Bell Laboratories, Lucent Technologies*

Experience with a Language for Writing Coherence Protocols

Satish Chandra and James R. Larus, *University of Wisconsin*; Michael Dahlin, *University of Texas*; Bradley Richards, *Vassar College*; and Randolph Y. Wang and Thomas E. Anderson, *University of California, Berkeley*

Lightweight Languages as Software Engineering Tools

Diomidis Spinellis, *University of the Aegean* and V. Guruprasad, *IBM T.J. Watson Research Center*

2:30pm–3:00pm

Break

3:00pm–5:00pm

Compiler Infrastructure for Domain-Specific Languages

Session Chair: Thomas Ball, *Bell Laboratories, Lucent Technologies*

A Slicing-Based Approach for Locating Type Errors

T. B. Dinesh, *CWI* and Frank Tip, *IBM T. J. Watson Research Center*

Typed Common Intermediate Format

Zhong Shao, *Yale University*

Incorporating Application Semantics and Control into Compilation

Dawson R. Engler, *MIT Laboratory for Computer Science*

Code Composition as an Implementation Language for Compilers

James M. Stichnoth and Thomas Gross, *Carnegie Mellon University*

5:00pm–6:00pm

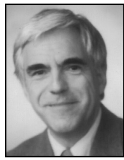
Reception (Dinner on your own)

8:30pm–11:00pm

Birds-of-a-Feather Sessions

Technical Sessions Thursday, October 16, 1997

8:30am–9:30am



Invited Talk: Synchronous Languages—An Experience in Domain-Specific Language Design

G rard Berry, * cole des Mines de Paris, Centre de Math matiques Appliqu es; INRIA, Projet Meije*

Domain-specific languages (DSLs) have already proved useful in many application areas. This talk will cover a range of issues in the design of DSLs and illustrate them using personal experience with the design of Esterel, which belongs to the class of synchronous reactive languages.

Dr. G rard Berry is a researcher in programming languages, reactive and real-time programming, automatic verification, and other related areas. He is the architect of the highly-regarded Esterel language for programming reactive systems and is currently the director of the Applied Mathematics Center at  cole des Mines de Paris.

9:30am–10:00am

Break

10:00am–11:30am

Logic and Semantics for Domain-Specific Languages

Session Chair: Luca Cardelli, *Digital Equipment Corporation*

BDL: A Language to Control the Behavior of Concurrent Objects

Fr d ric Bertrand and Michel Augeraud, *Universit  de la Rochelle*

A Domain-Specific Language for Regular Sets of Strings and Trees

Nils Klarlund, *AT&T Labs Research* and Michael I. Schwartzbach, *University of Aarhus*

A Modular Monadic Action Semantics

Keith Wansbrough and John Hamer, *University of Auckland*

11:30am–1:00pm

Lunch (on your own)

1:00pm–2:30pm

Case Studies and Surveys

Session Chair: Takayuki Dan Kimura, *Washington University*

SHIFT and SMART-AHS: A Language for Hybrid System Engineering Modeling and Simulation

Marco Antoniotti and Aleks G ll , *University of California at Berkeley*

Design and Semantics of Quantum: A Language to Control Resource Consumption in Distributed Computing

Luc Moreau, *University of Southampton*, and Christian Queinnec, *Universit  de Paris 6, INRIA-Rocquencourt*

Architectural Domains: A Framework for Characterizing Architectural Description

Nenad Medvidovic and David S. Rosenblum, *University of California, Irvine*

2:30pm–3:00pm

Break

3:00pm–4:30pm

Abstract Syntax Trees

Session Chair: David Ladd, *Spyglass*

The Zephyr Abstract Syntax Description Language

Daniel C. Wang, Andrew W. Appel, Jeff L. Korn, and Chris S. Serra, *Princeton University*

ASTLOG: A Language for Examining Abstract Syntax Trees

Roger F. Crew, *Microsoft Research*

KHEPERA: A System for Rapid Implementation of Domain-Specific Languages

Rickard E. Faith, Lars S. Nyland, and Jan F. Prins, *University of North Carolina at Chapel Hill*

4:30pm–5:00pm

Break

5:00pm–6:00pm

Invited Talk: Intentional Programming—An Ecology for Abstractions

Charles Simonyi, Chief Architect, *Microsoft*



This talk will present Intentional Programming (IP). IP is a new way of representing a program as an abstract tree of nodes, where each node identifies what intention it is an instance of, and each intention defines, by user-definable methods, how it should look to the programmer and how it should be implemented. Because looks (formerly called "syntax") and implementation (formerly called "semantics") are infinitely variable, the only invariant is the computational intent in the programmer's mind, which the intention represents.

IP can be thought of as an ecology for abstractions. In contrast with programming languages, in IP the emergence of new abstractions does not invalidate existing legacy code. This talk will show how IP supports the speedier evolution of new domain-specific abstractions that simplify software engineering problems such as reuse, portability, and reliability.

As chief architect at Microsoft Research, Charles Simonyi is responsible for new approaches in programming technology. This year, he was elected to the National Academy of Engineering for his contributions to the development of widely-used desktop productivity software. Simonyi has endowed chairs for Public Understanding of Science at Oxford University, for Theoretical Physics at the Institute for Advanced Study at Princeton, and for Educational Technology at Stanford.

6:00pm–7:00pm

Reception (Dinner on your own)

8:30pm–11:00pm

Birds-of-a-Feather Sessions (BOFs)

8:30am–10:30am

Embedded Languages and Abstract Data Types

Session Chair: Steve Johnson, *Transmeta Corporation*

DiSTIL: A Transformation Library for Data Structures

Yannis Smaragdakis and Don Batory, *University of Texas at Austin*

Programming Language Support for Digitized Images or, The Monsters in the Closet

Daniel E. Stevenson and Margaret M. Fleck, *University of Iowa*

Modeling Interactive 3D and Multimedia Animation with an Embedded Language

Conal Elliott, *Microsoft Research*

A Special-Purpose Language for Picture-Drawing

Samuel Kamin and David Hyatt, *University of Illinois at Urbana-Champaign*

10:30am–11:00am

Break

11:00am–Noon

Invited Talk: Aspect-Oriented Programming—Improved Support for Separation of Concerns in Design and Implementation

Gregor Kiczales, Principal Scientist, *Xerox Palo Alto Research Center*



A basic goal of software design is to be able to separate different kinds of design concerns into their own parts of the design. A basic goal of programming language development is to allow programmers to write programs that “look like the design” to as great a degree as possible.

This talk explores the degree to which we have been successful at meeting these combined goals. How well have we managed to separate concerns in software design and implementation? The talk will show that current technology does a good job of separating different kinds of functionality (what this module does vs. what that module does), but has been less successful at separating concerns having to do with systemic properties such as synchronization, network usage, replication, and memory usage.

The talk proposes the new concept of “aspect,” and shows that by adding it to existing concepts like component, module and object, we can achieve better separation of such systemic issues. The talk will also show how aspect-oriented programming languages can be used to support designs based on aspects.

Gregor Kiczales is a principal scientist at the Xerox Palo Alto Research Center. His research interests are in software architecture, programming languages, and software engineering. He was one of the designers of the Common Lisp Object System (CLOS), and was the implementor of PCL, a high-performance portable implementation of CLOS. He is a co-author of The Art of the Metaobject Protocol.

Noon–12:30pm

Closing Remarks and Prizes

Chris Ramming, *Program Chair, AT&T Labs Research*

About USENIX

USENIX is the Advanced Computing Systems Association. Since 1975 USENIX has brought together the community of engineers, system administrators, scientists, and technicians working on the cutting edge of the computing world.

USENIX conferences have become the essential meeting grounds for the presentation and discussion of the most advanced information on the developments of all aspects of computing systems. SAGE, a special technical group within USENIX, is dedicated to the advancement and recognition of system administration as a profession.

The USENIX Association and its members are dedicated to:

- Problem-solving with a practical bias
- Fostering innovation and research that works
- Communicating rapidly the results of both research and innovation
- Providing a neutral forum for the exercise of critical thought and the airing of technical issues.

Joining is easy. When you register, be sure to check off the membership box on the registration form and pay the non-member fee.

Conference Organizers

Program Committee

Chris Ramming, *AT&T Labs Research*,
Program and General Chair

Thomas Ball, *Lucent Bell Laboratories*

Gérard Berry, *CMA, École des Mines de Paris*

Jon Bentley, *Lucent Bell Laboratories*

Peter Buneman, *University of Pennsylvania*

Luca Cardelli, *Digital Equipment Corporation*

Steve Johnson, *Transmeta Corporation*

Takayuki Dan Kimura, *Washington University*

Todd Knoblock, *Microsoft Research*

David Ladd, *Spyglass*, Speaker Chair

Adam Porter, *University of Maryland*

Jan Prins, *University of North Carolina at Chapel Hill*

Important Information

Conference Proceedings

One copy of the proceedings is included with your Technical Sessions registration fee. To order additional copies, contact the USENIX Association at 510.528.8649, or send email to: office@usenix.org

Birds-of-a-Feather Sessions (BoFs)

Wednesday and Thursday evenings

Do you have a topic that you'd like to discuss with others? Our Birds-of-a-Feather Sessions may be perfect for you. BoFs are very interactive and informal gatherings for

attendees interested in a particular topic. Schedule your BoF in advance by sending email to Chris Ramming, jcr@research.att.com. Visit the conference web site for the list of BoFs. URL: <http://www.usenix.org/events/dsl97/>.

Social Events

Meet the conference speakers and connect with other members of the software community. There will be a Welcome Reception on Tuesday evening, a conference luncheon and reception on Wednesday, and a reception on Thursday evening.

Hotel and Travel Information

Hotel Information

Hotel Discount Reservation Deadline:

➔ **Monday, September 22, 1997** ➔

After the reservation deadline, hotel rates will be much higher! Make your reservation early and carefully read the hotel's cancellation policy shown below.

USENIX has negotiated special rates for conference attendees at Fess Parker's Doubletree Resort. Contact the hotel directly to make your reservation. You must mention USENIX to get the special rate. The hotel will not hold any reservation request for arrival after 6:00 pm without a one-night room deposit guaranteed to a major credit card.

Hotel Cancellation Policy

Please note hotel's cancellation policy of 72 hours prior to your arrival date. Your guaranteed one night's room and tax deposit is non-refundable if you should fail to notify the hotel's reservation department at least 72 hours prior to your arrival.

Fess Parker's Doubletree Resort

633 East Cabrillo Boulevard
Santa Barbara, CA 93103

Toll Free: 800.879.2929

Phone: 805.564.4333 **Fax:** 805.564.4964

Single Occupancy \$135.00

Double Occupancy \$135.00

(plus state and local taxes, currently at 10%)

Note: All requests for hotel reservations made after the Sept. 22 deadline will be handled on a space and rate available basis only.

Travel Information

Discount Airfares

Special airline discounts will be available for USENIX attendees. Please call for details:

JNR, Inc. Toll Free:

800.343.4546 (USA and Canada)

Telephone: 714.476.2788

Travel Connections

AMTRAK has rail connections to Santa Barbara from both San Francisco and Los Angeles. Santa Barbara is approximately 100 miles north of the Los Angeles International Airport and 350 miles south of San Francisco.

Santa Barbara Airport

Fess Parker's Doubletree Resort is located about 15 minutes from the Santa Barbara Airport. The airport is served by several airlines including American, America West, Delta, United, and US Air.

Santa Barbara Airport Shuttle

The hotel has complimentary shuttle service to and from the Santa Barbara Airport. Reservations are required. When you have confirmed your airline reservations, please contact the hotel's Bell Stand directly to make your shuttle reservation. Be prepared to provide the name of your airline, flight number, and arrival time. You can call for shuttle pick-up upon your arrival at the Santa Barbara Airport, but you may have a 25 minute wait for the shuttle's arrival. Taxi service is estimated to be \$25 one way and takes about 15 minutes.

What to See and Do in Santa Barbara

- Santa Barbara Museum of Art, Historical Museum, and Museum of Natural History
- Stearns Wharf—Restaurants, shops, fishing pier, and maritime-related businesses
- Mission Santa Barbara—Called "Queen of the Missions" for its graceful beauty
- El Paseo—"The Street in Spain," shopping arcade reminiscent of Old Spain
- Zoological Gardens and Andree Clark Bird Refuge
- Santa Barbara County Courthouse—Spanish-Moorish "palace" built in 1929
- 30 Santa Barbara County Wineries—Easily reached from Hwys 101, 154 or 246

Registration Information

Student Discounts and Stipends

The USENIX student stipend program covers travel, living expenses, and registration fees to enable full-time students to attend USENIX meetings. Detailed information about applying for a stipend is available at the USENIX Web site: www.usenix.org, by reading comp.org.usenix.org, or sending email to students@usenix.org.

USENIX offers a discount rate of \$75 for full-time students. You must include a copy of your current student ID card with your registration. This discounted registration fee is not transferrable.

Registration Fees (October 15–17)

Member*	\$355
Non-member**	\$425
Full-time student	\$ 75
(copy of student ID required)	

* The member fee applies to current individual members of USENIX, EurOpen national groups, JUS and AUUG.

**Join USENIX or renew your membership. Pay the non-member registration fee and just check the USENIX membership box on the registration form to renew your existing membership or receive a one-year individual association membership.

Registration fees include:

- Admission to all Technical Sessions
- One copy of conference proceedings
- Admission to the conference luncheon and receptions

Payment by check or credit card must accompany the registration form. Purchase orders, vouchers, telephone, and email registrations cannot be accepted.

For more conference information, contact:

USENIX Conference Office
22672 Lambert St., Suite 613
Lake Forest, CA 92630

Phone: 714.588.8649

Fax: 714.588.9706

Email: conference@usenix.org

Web: <http://www.usenix.org>

Office Hours: 8:30am–5:00pm Pacific Time

REFUND / CANCELLATION POLICY If you must cancel, all refund requests must be in writing, with your signature, and postmarked no later than October 6, 1997. Telephone and email cancellations cannot be accepted. You may fax your cancellation or substitute another in your place. Contact the Conference Office for details: 714.588.8649.

Copy this form as needed. Type or print clearly.

Registration Form Conference on Domain-Specific Languages, October 15-17, 1997

The address you provide will be used for all future USENIX mailings unless you notify us in writing.

Name First Last

First Name for Badge Member Number

Company / Institution

Mail Stop Mail Address

City State Zip Country

() ()

Telephone No. Fax

Email Address (1 only please) A B C D

Attendee Profile

Please help us serve you better. By answering the following questions, you help us plan our activities to meet members' needs. All information is confidential.

- I do not want to be on the attendee list.
- I do not want my address made available except for USENIX mailings.
- I do not want USENIX to email me notices of Association activities.

What is your affiliation (check one):

- academic commercial gov't R&D

What is your role in the purchase decision (check one):

- 1. final 2. specify 3. recommend 4. influence 5. no role

What is your primary job function (check one):

- 1. system/network administrator 2. consultant 3. academic/researcher
- 4. developer/programmer/architect 5. system engineer
- 6. technical manager 7. student 8. security 9. webmaster

How did you first hear about this meeting (check one):

- 1. USENIX brochure 2. newsgroup/bulletin board 3. .login:
- 4. Web 5. from a colleague 6. magazine

What publications or newsgroups do you read related to DSL?

Upcoming Events

1998 Annual Technical Conference

June 15-19, 1998
New Orleans, Louisiana

4th USENIX Conference on Object-Oriented Technologies and Systems (COOTS)

April 27-30, 1998
Santa Fe, New Mexico

Refund/Cancellation Policy

If you must cancel, all refund requests must be in writing, with your signature, and postmarked no later than October 6, 1997.

Telephone and email cancellations cannot be accepted. You may fax your cancellation or substitute another in your place. Contact the Conference Office for details: 714.588.8649.

Registration Fees (Wednesday-Friday, October 15-17)

Current member fee..... \$355.00 \$ _____
(Applies to individual members of USENIX, EurOpen national groups, JUS, and AUUG)

Non-member fee* \$425.00 \$ _____

*Join or renew your USENIX membership, AND attend the conference for the same low price. Check here:

Full-time student** fee, pre-registered or on-site..... \$75.00 \$ _____

Full-time student** fee including USENIX membership fee..... \$100.00 \$ _____

**Students: Attach a photocopy of current student ID

TOTAL DUE \$ _____

Payment must accompany this form

Payment (U.S. dollars only) must accompany this form. Purchase orders, vouchers, email, and telephone registrations cannot be accepted.

Payment enclosed. Make check payable to USENIX Conference.

Charge to my: VISA MasterCard American Express Discover

Account No. / Exp. Date

Print Cardholder's Name

Cardholder's Signature

You may fax your registration form to 714.588.9706 if paying by credit card. To avoid duplicate billing, please do not mail an additional copy.

Please complete this registration form and return it along with full payment to:

USENIX Conference Office
22672 Lambert St., Suite 613
Lake Forest, CA USA 92630
Phone: 714.588.8649
Fax: 714.588.9706



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Santa Barbara, California

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**Hotel Discount
Deadline: Sept. 22**

**4 easy ways
to get more information:**

1. Phone: 714.588.8649
2. Fax: 714.588.9706
3. Email: conference@usenix.org
4. Workshop URL:
<http://www.usenix.org/events/dsl97/>

USENIX Conference Office
22672 Lambert Street, Suite 613
Lake Forest, CA 92630
Office Hours: 8:30 am-5:00 pm, Pacific Time

Non-Profit
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Association

$(kinds)^0, \kappa ::= \Omega \mid \kappa_1 \rightarrow \kappa_2 \mid \kappa_1 \otimes \kappa_2$
 $(con's)^1, \mu ::= t \mid Int \mid \mu_1 \mid \mu_2 \mid \lambda t :: \kappa. \mu \mid \mu_1[\mu_2]$
 $(types)^2, \sigma ::= T(\mu) \mid \forall v :: \kappa. \sigma \mid \sigma_1 \rightarrow \sigma_2$
 $(terms)^3, e ::= v \mid \lambda x :: \sigma. e \mid @v_1$
 $(values)^4, v ::= \dots$

Please pass this along to a colleague.