IT WAS 40 YEARS AGO TODAY…
(that I learned to program in Fortran IV)

David Schmidt
Kansas State University
First, thank you for visiting!

“Kansas: equally far away from everywhere!”

--Dave Gustafson, Kansas State CS professor
This talk

• Our community, our conferences: what we accomplished
• What I learned, what I tried to do, and what I should have done better
• Some photos, some stories
What we’ve done in 40 years….

People say that Artificial Intelligence became successful when its achievements weren't called "Artificial Intelligence" anymore --- they moved into the mainstream.

This has happened with language-semantics techniques:

- *denotational semantics*: from "extending BNF to semantics" (Scott) to compiler generators
- *abstract interpretation*: now, even IT people use it (e.g., "Secure Programming with Static Analysis: The Expert Guide to Static Analysis for Software Security", by B. Chess and J. West, Addison-Wesley, 2007)
- *partial evaluation-based program transformation*: in every compiler writer’s toolkit
- *model checking*: used by Intel, Boeing, Airbus, …

In the 1970s, these were "theories" in the scientific sense, but now they are in the mainstream --- The people in this room helped make it possible!

Research progress is a community effort.
Our communities formed within conference series. My own reference points:

- SAS (Static Analysis Symposia), 1994
- MFPS (Mathematical foundations of programming semantics), 1985
- VMCAI (Verification, Model Checking, and Abstract Interpretation), 1998
MFPS

- Austin Melton's scheme to bring Dana Scott to Kansas State University
- Dana would come only if Steve Brookes and Carl Gunter were invited, too.
- Others came to the resulting ad-hoc workshop: Mike Mislove, Jimmy Lawson, David Benson, Michael Main...
- Austin edited an LNCS proceedings! He revived a community that had almost “died” after the completion of the *Compendium of Continuous Lattices* handbook.
Subsequent meetings: Tulane, CMU,…

I pushed hard to broaden MFPS’s scope into “semantics theory and applications”.

I. Categorical and Algebraic Methods

A Categorical Treatment of Polymorphic Operations
John W. Gray

A Categorical Approach to Realizability and Polymorphic Types
Aurelio Carboni, Peter J. Freyd and Andre Scedrov

Rule-Based Semantics for an Extended Lambda-Calculus
Cyrgy Révész

Semantics of Block Structured Languages with Pointers
Eric G. Wagner

Assertional Categories
Ernie Manes

Kan Extensions in Effective Semantics
Philip S. Mahy

II. Structure Theory of Continuous Posets and Related Objects

The Versatile Continuous Order
Jimmie D. Lawson

On the Smyth Power Domain
MichaelMislove

The Metric Closure Powerspace Construction
Robert E. Kent

A Powdomain Construction
Karol Hrbacek

Closure Properties of a Probabilistic Domain Construction
Steven K. Grahm

III. Domain Theory

Quasi Uniformities: Reconciling Domains with Metric Spaces
M. B. Smyth

Solving Reflexive Domain Equations in a Category of Complete Metric Spaces
Pierre America and Jon Rutten

Topological Completeness in an Ideal Model for Polymorphic Types
Ernst-Erich Doberkat

New Results on Hierarchies of Domains
Achim Jung

IV. Domain Theory and Theoretical Computation

Semantically Based Axiomatics
Stephen D. Brookes

Metric Spaces as Models for Real-Time Concurrency
G. M. Reed and A. W. Roscoe

DI-Domains as a Model of Polymorphism
Thierry Coquand, Carl Gunter and Glynn Winskel

Continuous Auxiliary Relations
Tatiana Kammar and Adrián Tung

Computable One-to-one Enumerations of Effective Domains
Dieter Spreen

V. Implementation Issues

MIX: A Self-Applicable Partial Validator for Experiments in Compiler Generation (Extended Abstract)
Neil Jones, Peter Sestoft and Harald Sandergaard

Semantics-Based Tools for a Specification-Support Environment
Joshua Reed

A Treatement of Languages with Stages of Evaluation
Lauriec Bradley

Operational Semantics and a Distributed Implementation of CSP
Gerlind Schreiber

The Semantics of Miranda’s Algebraic Types
Kim S. Bruce and Jon G. Riecke

VI. New Directions

Path Semantics
Adrienne Bosc and Paul Hudak

The Formal Description of Data Types Using Sketches
Charles Wells and Michael Barr

Initial Algebra Semantics and Concurrency
Mario Zampieri

High-Level Semantics: An Integrated Approach to Programming Language Semantics and the Specification of Implementations
Uwe F. Piebl and Peter Lee

An Action Semantics of Standard ML
David A. Watt

An Algorithmic Approach to the p-adic Integers
Steven Vickers

The Shuffle Algebra
David B. Benson
lots of folks, many are here

Me, Bob Tennent, Steve Brooks, Samson's head

Mike Main, me, Phil Mulry, Husain Ibraheem
Later, the MFPS meetings returned to mostly domain theory, and I regret not pushing harder on Mike Mislove to maintain the theory + applications balance.

I also regret not lobbying harder to retain Springer LNCS as the conference’s publisher.

On a personal level: I returned to Kansas as a result of the first meeting. This was the beginning of the Kansas languages group. Thanks to MFPS, I made connections with Phil Mulry, Dave Naumann, Bob Tennent (who sent John Hatcliff), Michael Huth (who came to Kansas twice, once as a post-doc and once as faculty), and others.
Gammel Avernæs, Oct. 1987

• Dines Bjørner, Andrei Ershov, and Neil Jones organized the first partial evaluation workshop, one week at an isolated conference site. There were a dozen scientists from the USSR.
• Lots of amazing talks, lots to eat and drink
• Creation of a new research community
See the PEMC book for a listing of the participants.
Consequences of PEMC

• A banquet with Peter Sestoft as a "comedy partner"
• *Many* spin-offs: TOPPS/DIKU lab and others, PEPM conferences, Atlantique Project (Carolyn Talcott)
• Personal level:
  1. most significant meeting of my academic life w.r.t. people & topic
  2. multiple visits to Denmark and DIKU, learning about p.e. (Andrzej Filinski, Robert Glück, Thomas Jensen, Torben Mogenson, Mads Rosendahl, Peter Sestoft, etc). Olivier Danvy and Karoline Malmkjær come to Kansas.
  3. multiple contacts with Charles Consel and Thomas Jensen in Rennes
  4. I loved the "applied semantics" aspect of the Futamura projections.

me and Alberto Pettorossi at PEMC
3. SAS 1996: Aachen, Germany


2. SAS 1995: Glasgow, UK


1. SAS 1994: Namur, Belgium


3. WSA 1993: Padova, Italy


2. WSA 1992: Bordeaux, France

Michel Billaud, Pierre Cast?ran, Marc-Michel Corsini, Kaninda Musumbu, Antoine Rauzy (Eds.): Actes WSA'92 Workshop on Static Analysis (Bordeaux), September 1992, Laboratoire Bordelais de Recherche en Informatique (LaBRI), Proceedings. Published by Atelier Irisa, IRISA, Campus de Beaulieu, Series Bigre Vol. 81-82 Contents

1. JTASPEFL/WSA 1991: Bordeaux, France

Michel Billaud, Pierre Cast?ran, Marc-Michel Corsini, Kaninda Musumbu, Antoine Rauzy (Eds.): Actes JTASPEFL91 (Bordeaux), October 1991, Laboratoire Bordelais de Recherche en Informatique (LaBRI), Proceedings. Published by Atelier Irisa, IRISA Campus de Beaulieu, Series Bigre Vol. 74
• I attended the first “SAS” meeting in Namur. I met Patrick Cousot. (I discussed with him my interest in his ICCL94 paper.) There were wonderful lunches and not enough time to eat them!

• I met many people at the next SAS meeting, in Glasgow. Patrick told me that my formulations were “a mess!” (that is, they were worthy of repair, which he did, of course). His and Radhia’s work were/are a major influence. I also enjoyed the Neilsons’ and Samson Abramsky’s applications.

• At the Aachen meeting, I met Bernhard Steffen and Tiziana Margaria and I later studied Bernhard’s MC=DFA formulation. This led to multiple visits to Dortmund, and I began to understand how Model Checking should be used.

• Many interactions with SAS people, at Paris (Cousots, Francesco Logozzo, Antoine Miné, Xavier Rival,…), at Rennes (Daniel Le Métayer, Charles Consel, Thomas Jensen), at Verona (Roberto Giacobazzi, Isabella Mastroeni), the Neilsons at Lyngby. I learned more than can fit on this slide!

• It was gratifying to see SAS establish a community and broaden it. (For me, this was where I wanted MFPS to go --- into “applied semantics”)

Roberto Giacobazzi organized this meeting, and I helped.
VMCAI

- Started at a workshop on Long Island in 1997. My student, Husain Ibraheem, presented a paper. (*I met a student on the train who announced the demise of denotational semantics!*)

- Email next year from Tino Cortesi: "Dave, Please agree to be on steering committee for new conference series, VMCAI. No questions, please, just say yes. --Tino"

- I did say yes. Lots of work! I am a member of the Board of Directors of the VMCAI Corporation. But the result is a surprisingly successful series of meetings, now co-located with POPL each January. New friends: Radha Jagadeesan, Kedar Namjoshi, Allen Emerson, ....

- Quite a balancing act --- MC people, static analysis people, ACM people. But there has been some true cross-fertilization.
Summary

These conferences have been important and satisfying because they stimulated research and generated communities, doing it better than the more well-known “umbrella meetings” (PLDI, POPL, LICS).
Slightly more personal “reflections”

I started small....

(My sister is now department head of philosophy at William and Mary College, Williamsburg, Virginia.)

Easter Sunday, 1957

Last year of high school
I went to college, interested in computers, but Fort Hays (Kansas) State University had no computing major. I did math, which in the end was better for me (multiple courses in algebra and symbolic logic).

1971

Albertson Hall, the math building

The Brass Rail: study hall (ask for “red beer”)
1972 + 40 = 2012
I learned to teach by selling cameras in a department store....
We worried about Vietnam…

… we barely avoided the trip overseas.
Then I discovered computing science…
I started M.S. studies at Kansas State in 1976.

I was a teaching assistant for Beth Unger. I know no computing terminology, no technology --- only Fortran IV and COBOL.
Why I decided to attempt a Ph.D.

1. I could be paid to teach
2. I could sleep late each morning
3. I felt a “fire in my belly” to do research!
How I met Neil Jones (it was “dumb luck”!)

• I told Bill Hankley my intention to get a Doctor’s degree; Bill said I should “take a course in computability theory from either Jones or Muchnick at the Univ. of Kansas.”

• I phoned Neil (because “J” comes before “M”!), and contacted him just as he was leaving for Aarhus for the summer.

• I met Neil in person 3 months later, and he hired me as a Research Assistant.
DAIMI, Ny Munkegade, Århus, 1979-80
Mogens Nielsen, Associate Professor
Lærkevej 18
8382 Hinnerup

Private phone: 
Office number: B 2.19
Office phone: 

Departmental duties:
Teaching Dat. 2.

Field of interest:
Theoretical computer science.

Peter David Moses, Associate Professor
Rosenvangs Allé 9
8260 Viby J.

Private phone: (06) 147342
Office number: B 2.12
Office phone: 195

Departmental duties:
Second part 'Semantics' course. SIS Project. Guidance of Master's theses.

Field of interest:

Ole Lehmman Madsen, Research Assistant
Ørenedalen 16
8620 Lystrup

Private phone: (06) 224561
Office number: 2.36
Office phone: 163

Departmental duties:
Teaching, research.

Field of interest:
Compilers, programming languages, concurrency, system description languages.

Karen Kjar Møller, Secretary
Trygsvej 3
8230 Aabyhøj

Private phone: (06) 158797
Office number: 2.10
Office phone: 172
Aarhus was ideal for learning…

- Smart people: Neil, Peter Mosses, Robin Milner (visiting), Nigel Derrett, Flemming and Hanne Nielson (students)
- Unmatched library of journals, texts, and conference proceedings
- Neil taught me denotational semantics and data-flow analysis and organized a compiler-generation workshop
- I used Neil’s approach to calculate a Krivine machine. (Olivier noted this work some years later.) I learned Action Semantics and CCS.
Edinburgh, 1982-83

- Robin lacked two postdocs for SERC research projects; Neil suggested me for doing theorem proving using LCF.
- I shared an office with Colin Stirling. ("Hoare logic is the greatest achievement of computing science!"")
- Met many people: Alberto Pettorossi, Stewart Anderson, Alan Bundy, Rod Burstall, Matthew Hennessy, Alan Mycroft, Gordon Plotkin, Alley Stoughton, Mike Smyth, Muffy Thomas, etc.

Robin receives his Turing Award in Kansas City. I was there.
“Intensive” Friday-evening discussions generated more research (and more forgotten research!) than anywhere before or since.
Return to Kansas, 1986

This photo was taken in 1988, but Austin is missing....

**FRONT ROW:** Myron Calhoun, Maarten van Swaay, David Gustafson, Maria Zamfir-Bleyberg, Elizabeth Unger. **BACK ROW:** Bill Hankley, Rod Howell, Masaaki Mizuno, Joe Campbell, David Schmidt, Virgil Wallentine.
Early challenges, early success

• Very friendly environment, but a somewhat lonely place to work (no critical mass, no internet, rudimentary email)

• Department head, Virg Wallentine, provided lots of support, even though he knew nothing of “denotational semantics”

• I worked like a maniac and invited lots of visitors (many round-trips to Kansas City airport!)

• I travelled as much as possible (Edinburgh, Glasgow, DIKU; later: Rennes, Paris, Verona, …)

• Crucial local interactions with Austin Melton, George Strecker, Masaaki Mizuno, and Rod Howell. Worked hard to integrate topology and category theory into language design/analysis/implementation. (“Work with what you got!”)
1991 onwards: A critical mass

• Olivier Danvy comes as a visiting professor
• Michael Huth and Jürgen Koslowski work as post-docs (also, Pascal Fradet comes from Rennes)
• Good students arrive: Anindya Banerjee, Kyung-Goo Doh, Susan Even, Adrian Fiech, John Hatcliff, Karoline Malmkjaer, ….
• Arrival of the WWW was a major help.
• When Olivier departed, Alley Stoughton took his place (later, Michael then Anindya then Matt Dwyer then John Hatcliff then Torben Amtoft, etc.!) 
• Later: funded collaborations with U.C.Berkeley (Alex Aiken, Evan Chang, George Necula, …) and MIT (Daniel Jackson and Martin Rinard)
What the languages group accomplished at Kansas

• Within the Department, they set the model for team-oriented research, showed that “theory can get funded,” and they lifted the Dept. into the middle of the national rankings.

• In the research community, they contributed to program analysis, program transformation, software model checking, and program security.

• The group’s graduates have done well and have contributed to the community.

• The group is “Neil’s Kansas legacy.”
There was some socializing…

Younger versions of some of the people here today…

(where’s the furniture?)
but when the party hats came out...

Masaaki Mizuno, Chet Murthy (*2), Dean Lass, Jan Chomicki, Anindya Banerjee, Jürgen Koslowski
things sometimes got out of control....

The front-office staff try to dispose of me once and for all !!!
I was rescued and Masaaki admits that it was his idea!

(whatever research that was done that evening has gone lost)
Olivier’s pinball machine was a more constructive research alternative

Olivier, Sergey Kotov, Masaaki, and me

Anindya, Kyung-Goo, and Karoline
The “Eight Ball Deluxe” research machine.
My research was a mere reworking of what I learned and loved…

- Neil introduced me to denotational semantics and data-flow analysis and showed me how to do research. This was enough to keep me busy for my whole life.

- I loved the Scott-topology of domains and Mike Smyth’s explanations of it. There are applications everywhere.

- I loved Peter Mosses's original formulation of Action Semantics, and I still visualize language semantics in terms of facet flows and combinators.

- Abstract interpretation was “right” from the beginning, and the Verona work on Galois-connection completeness is as beautiful as computing theory gets.

- Bernhard Steffen’s characterization of MC = DFA just keeps giving and giving….
What I wish I could have done better

1. There is a need for a comprehensive book on abstract interpretation, but I never pushed hard enough to make it happen, by me or by others.

2. I now realize what Dines Bjørner was saying at Neil’s Fest: the CS community has allowed the science in Computing Science to be overwhelmed by technology to the point that neither educators, practitioners, nor observers can distinguish the first from the second. I let this happen in my own Department --- Java, IDEs, graphics libraries, etc., dominate.
So, why did it come to this?

Aside from intensive (capitalistic) pressure from students and employers, the CS community has always lacked a “cornerstone calculus” that all its practitioners must learn, apply, and share.

Math relies on the differential and integral calculus to define its community. Physics uses Newton’s and Maxwell’s laws.

What is the cornerstone of CS? Turing’s machine? The GCC compiler? (What artifact defines our community/our shared culture?)

The answer goes back to Gödel: computing is the study of constructive proof, that is, the realization of specifications by algorithms, that is, \( \text{PROGRAMS} = \text{PROOFS} \).

Whether it’s Hoare Logic, or Dijkstra’s wp-calculus, or Martin-Löf’s Intuitionistic Type Theory, we should be learning and using the cornerstone calculus at the beginning, not at the end.
Nearing the End (of the talk, not me!)

**Neil’s Two Rules (plus one more)**

1. Be true to yourself. (“*Do what you like.*”)
2. Don’t sweat the small stuff. (“*Will it matter five years from now?*”)
3. Keep doing what you are supposed to be doing, even if you don’t feel like doing it or you don’t understand why you’re doing it.
Finally, THANK YOU

*to the Visitors*: for your invitations to visit and for explaining your ideas

*to the Department Heads, Virg Wallentine and Gurdip Singh*: for your support through “thick and thin”

*to the Locals*: for your camaraderie and tolerance of my all-too-frequent complaining

*to my Former Students*: for agreeing to work on non-trendy topics and for tolerating my management style

*to Everyone*: for travelling from equally-far-away for this event!
My wife, Linda, can’t be here, but she says, “hello” (from South Africa)!
Maybe later today....

research at Aggie Station Tavern, 1119 Moro St. (A)