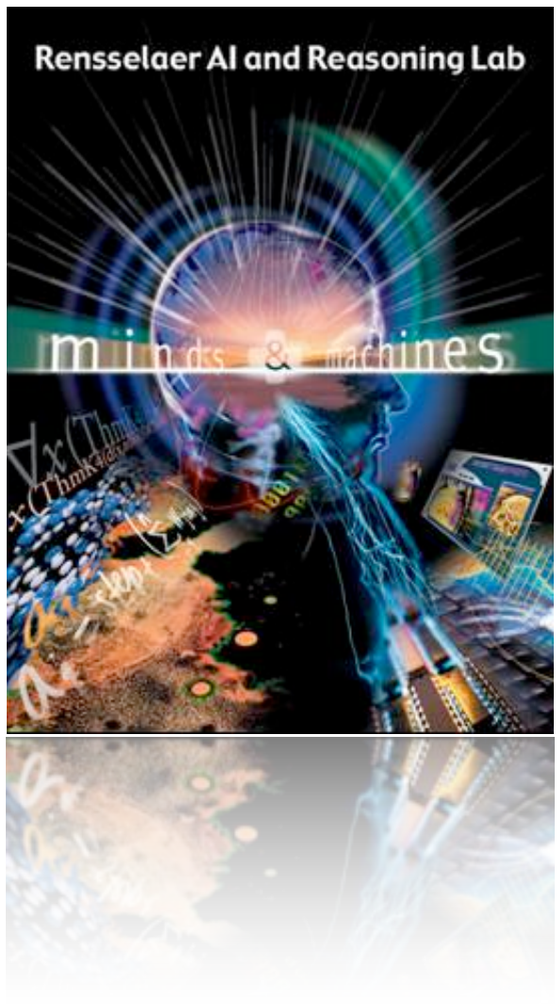
Creativity and Computer Programming; Automatic Programming



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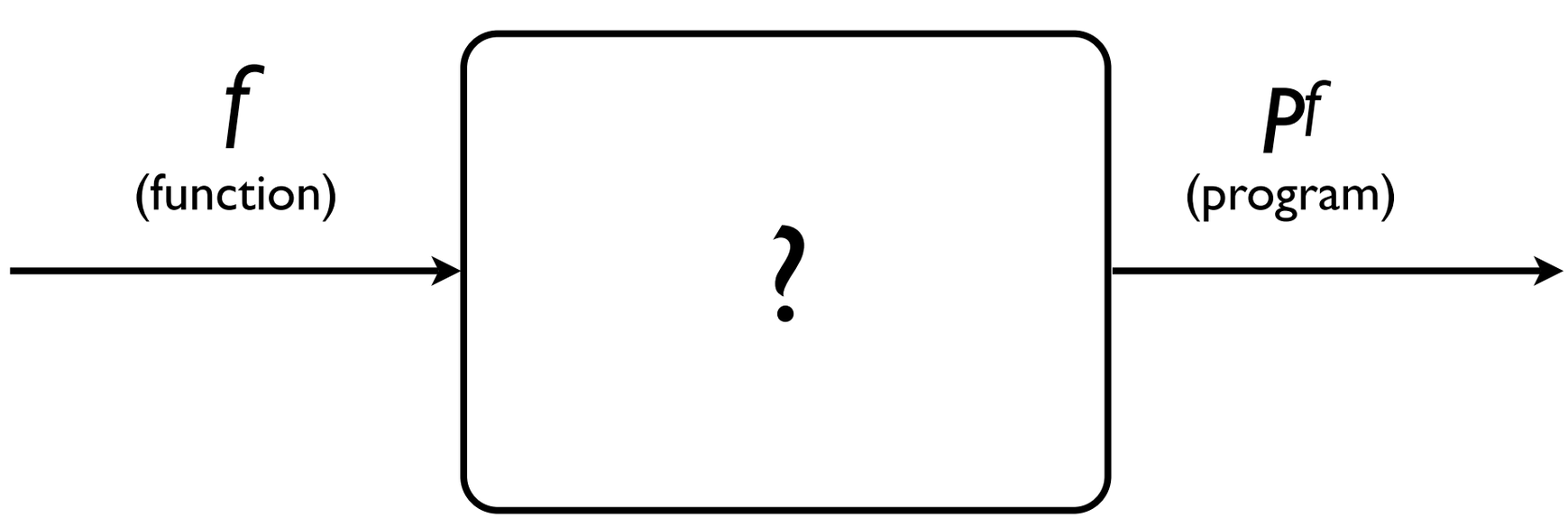
Rensselaer DEPARTMENT OF COGNITIVE SCIENCE

Rensselaer Computer Science

The AP Challenge



This Problem is Much Harder Than Most Tackled by Cog Sci, AI, etc.

$$\{f | f : N \rightarrow N\}$$

(Information Processing)

Σ_1

Turing Limit

$\Phi \vdash \phi?$

$\exists k H(n, k, u, v)$

$H(n, k, u, v)$

This Problem is Much Harder Than Most Tackled by Cog Sci, AI, etc.

$$\{f | f : N \rightarrow N\}$$

(Information Processing)

Π_2

Σ_1

Turing Limit

$$\forall u \forall v [\exists k H(n, k, u, v) \leftrightarrow \exists k' H(m, k', u, v)]$$

$$\Phi \vdash \phi?$$

$$\exists k H(n, k, u, v)$$

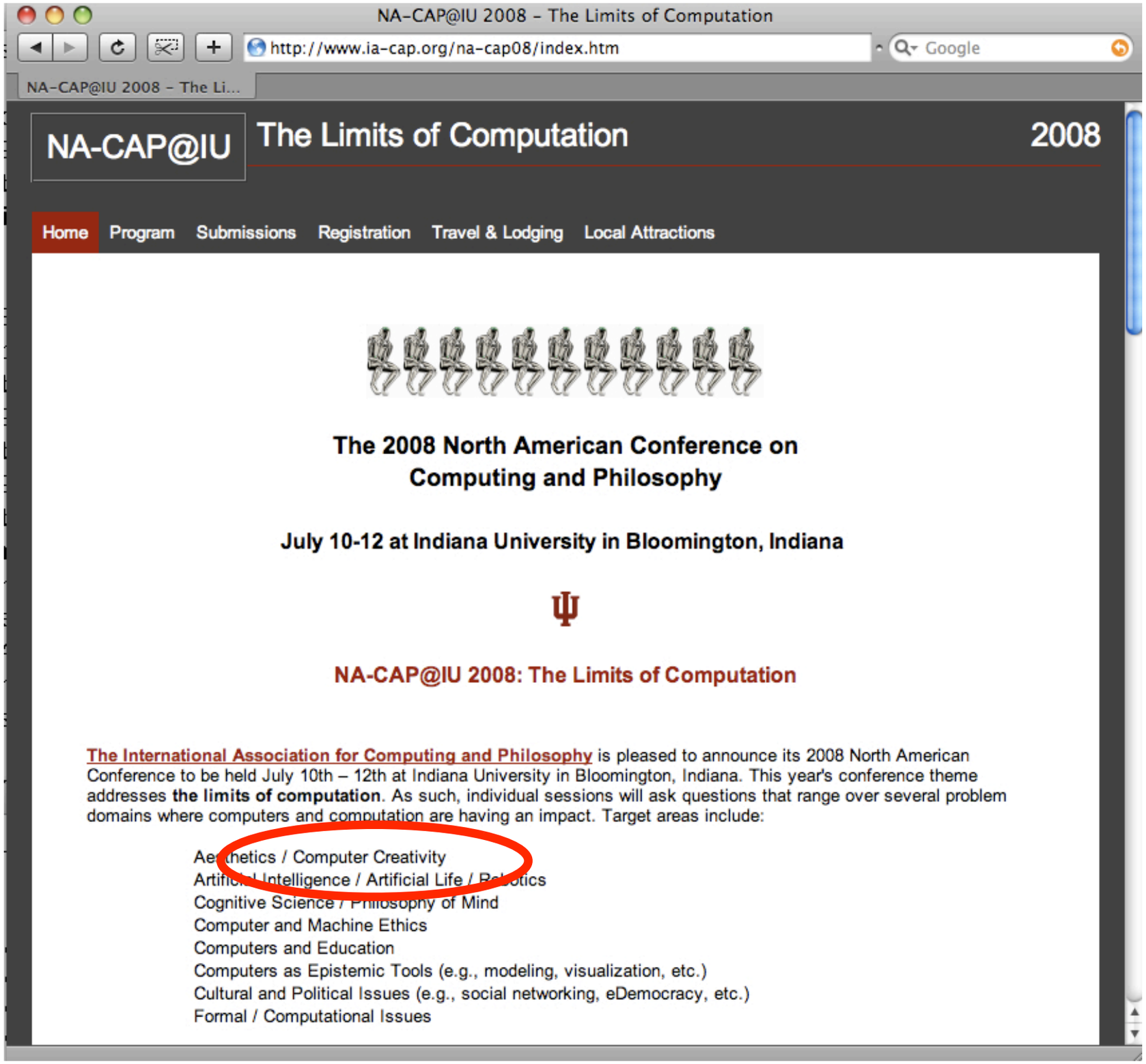
$$H(n, k, u, v)$$

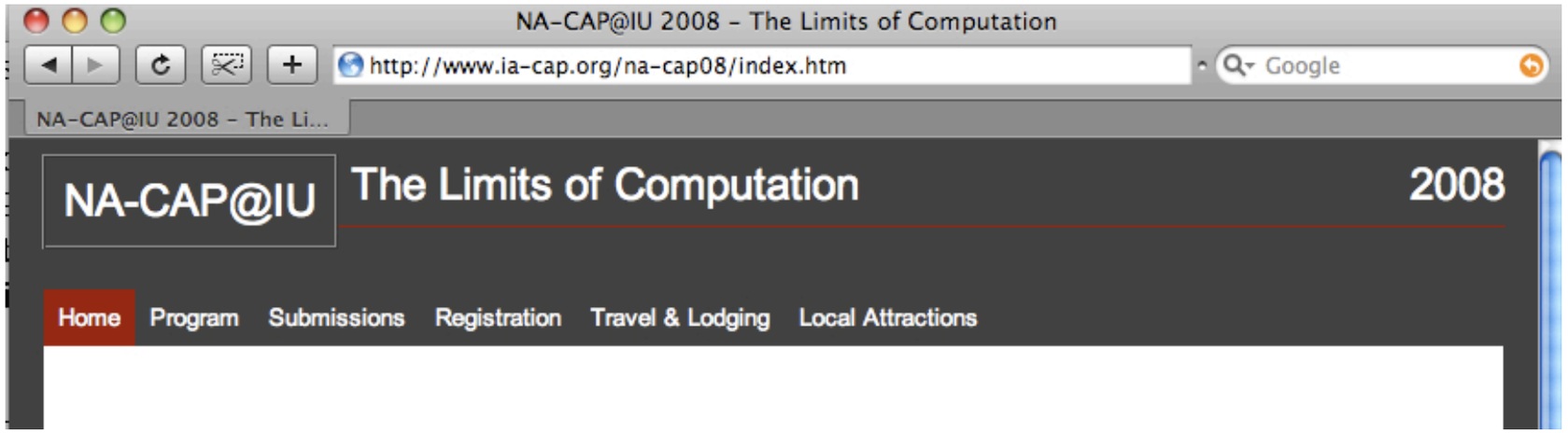
Perhaps Unsurprisingly, Then:

- State-of-the-art examples from 30–40 years ago:
  - List reversal and sorting
  - Factorial and Fibonacci
- State-of-the-art examples from today:
  - List reversal and sorting
  - Factorial and Fibonacci

Golden Opportunity

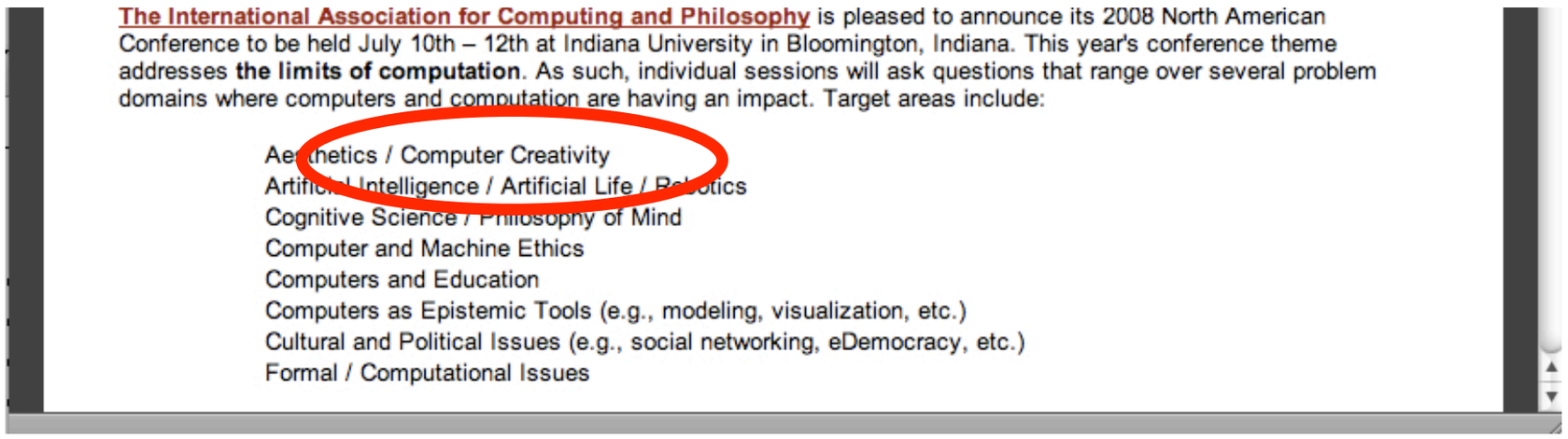
- Work on automatic programming has proceeded in complete isolation from study of creative human programmers.

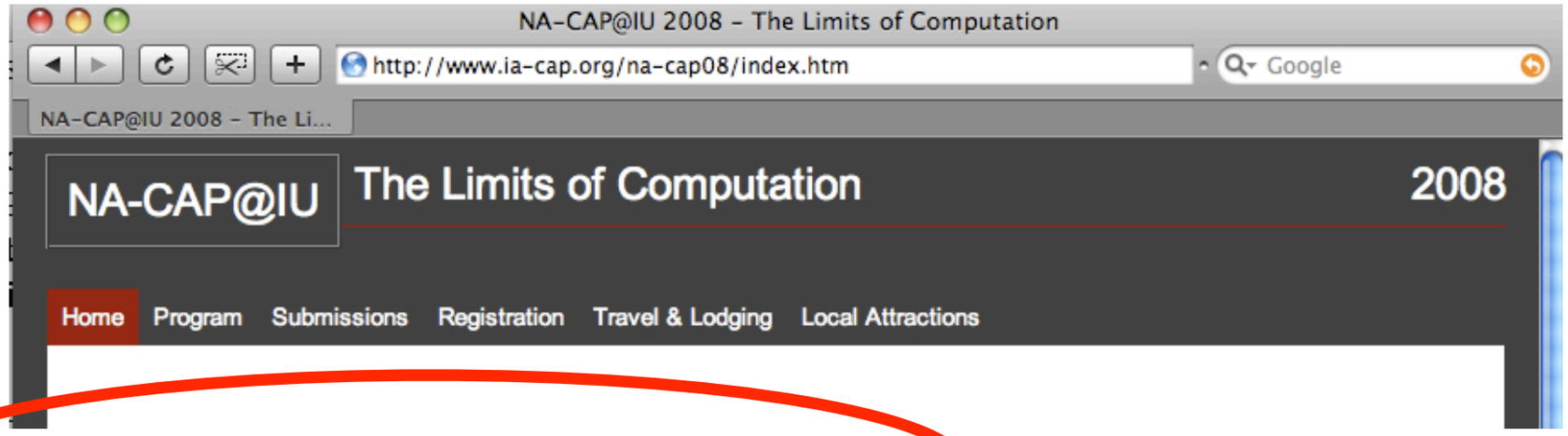

NA-CAP@IU 2008 - The Limits of Computation
http://www.ia-cap.org/na-cap08/index.htm
Google
NA-CAP@IU 2008 - The Li...
NA-CAP@IU
The Limits of Computation
2008
Home
Program
Submissions
Registration
Travel & Lodging
Local Attractions
The 2008 North American Conference on
Computing and Philosophy
July 10-12 at Indiana University in Bloomington, Indiana
NA-CAP@IU 2008: The Limits of Computation
The International Association for Computing and Philosophy is pleased to announce its 2008 North American Conference to be held July 10th – 12th at Indiana University in Bloomington, Indiana. This year's conference theme addresses the limits of computation. As such, individual sessions will ask questions that range over several problem domains where computers and computation are having an impact. Target areas include:
Aesthetics / Computer Creativity
Artificial Intelligence / Artificial Life / Robotics
Cognitive Science / Philosophy of Mind
Computer and Machine Ethics
Computers and Education
Computers as Epistemic Tools (e.g., modeling, visualization, etc.)
Cultural and Political Issues (e.g., social networking, eDemocracy, etc.)
Formal / Computational Issues



Special Session on Automatic Programming and Human Creativity

Thagard's keynote address will be followed by a special session that is partially supported by the National Science Foundation's CreativeIT program. This grant makes possible an exploratory investigation of human creativity in the area of computer programming, with the hope of exploiting study of human creativity in order to eventually make significant contributions to automatic programming. In order to try to break through present limits, session organizers, Selmer Bringsjord (Rensselaer Polytechnic) and Konstantine Arkoudas (MIT), are particularly concerned with understanding what conditions are conducive to discovering highly innovative programming solutions. Sample topics include: 1) Case studies in human creativity and computer programming; 2) Application of prior work in AI and creativity to the automatic programming problem; 3) New approaches to automatic programming based on systematic study of human ingenuity, discovery, and creativity; 4) Understanding the role of diagrammatic thinking and reasoning in visualizing data structures and transformations on such data structures during the creative/exploratory part of programming; and 5) Determining the role of non-deductive reasoning in programming creativity. Bringsjord and Arkoudas are hoping to develop a book or special journal issue based on submissions to this track. Papers and proposals are being accepted up to March 1st, 2008. See the submissions page for details.





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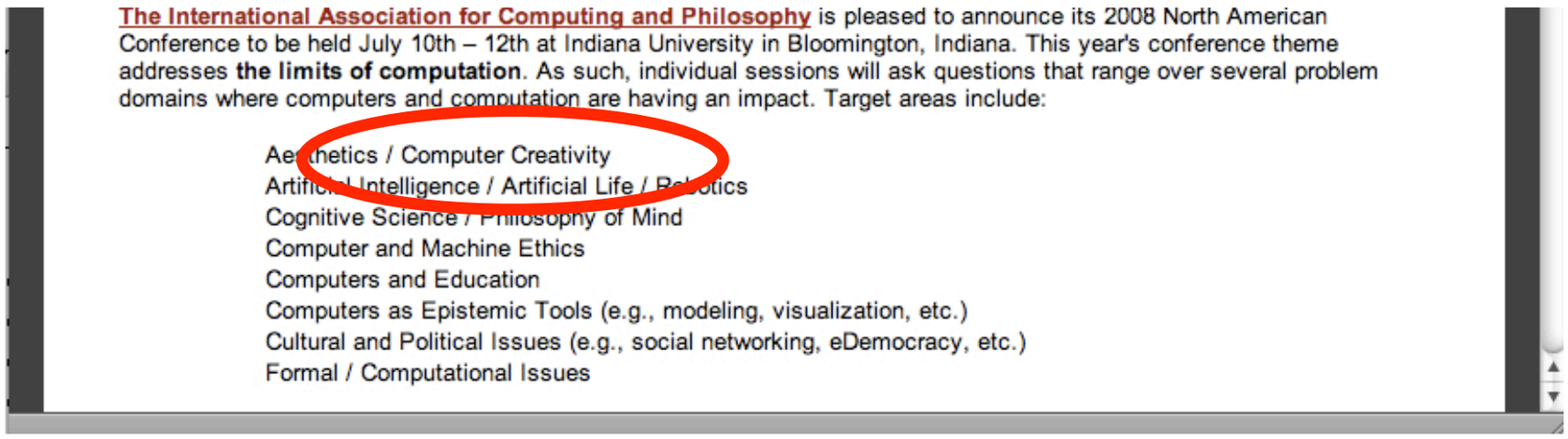


AAAI 2008 Fall Symposium
on Automated Scientific Discovery

OVERVIEW

There is a long and fascinating history of humankind's endeavor to explain and, with the advent of AI, ultimately mechanize the overarching processes that lead to scientific discoveries. This quest dates back to Aristotle's account of human de ductive reasoning (the theory of the syllogism, developed to model the discoveries of Euclid), and continues through modern AI, which, through impressive systems like LT, Bacon, GT, Eurisko, and Graffiti (and many theorem provers, model finders, and co mputational frameworks for machine-assisted reasoning), has placed some degree of such automation within reach. Over the past 60 years, starting with AI's inaugural conference, systems such as these have automated aspects of scientific discovery. Machines have generated novel and interesting conjectures (some which have spawned new scientific research areas), and increasingly efficient techniques have been invented to prove or refute them.

Nevertheless, the sobering fact remains that such advances fall far short of approaching the creativity and innovation of even amateur scientists. We believe that AI is ripe for revolutionary progress in automated and semi-automated scientific discovery, in no small part because the field now has on hand systems that mark advances in various parts of discovery-parts that, when interconnected, may make for some very exciting new systems. We also believe that dialogue between researche rs behind these systems could lead to a new generation of powerful AI discovery systems.

This symposium will survey the state of the art in systems that cover some aspects of the entire process of scientific discovery (including, e.g, representation, exploration, conjecture generation, validation, and publishing/reporting). Of pa rticular interest is how the current technologies can fit together to form an environment by which the human reasoner's vision and reach can be augmented, and what goals should be set in order to move closer to the complete mechanization of general sci entific discovery--or at least closer to a time when machines can truly operate as intelligent assistants in the search for new discoveries.

Useful Links
- AAAI Home Page
- AAAI 2008 Fall Symposia

Important Dates
- Submissions deadline May 20th, 2008
- Symposium November 7-9, 2008

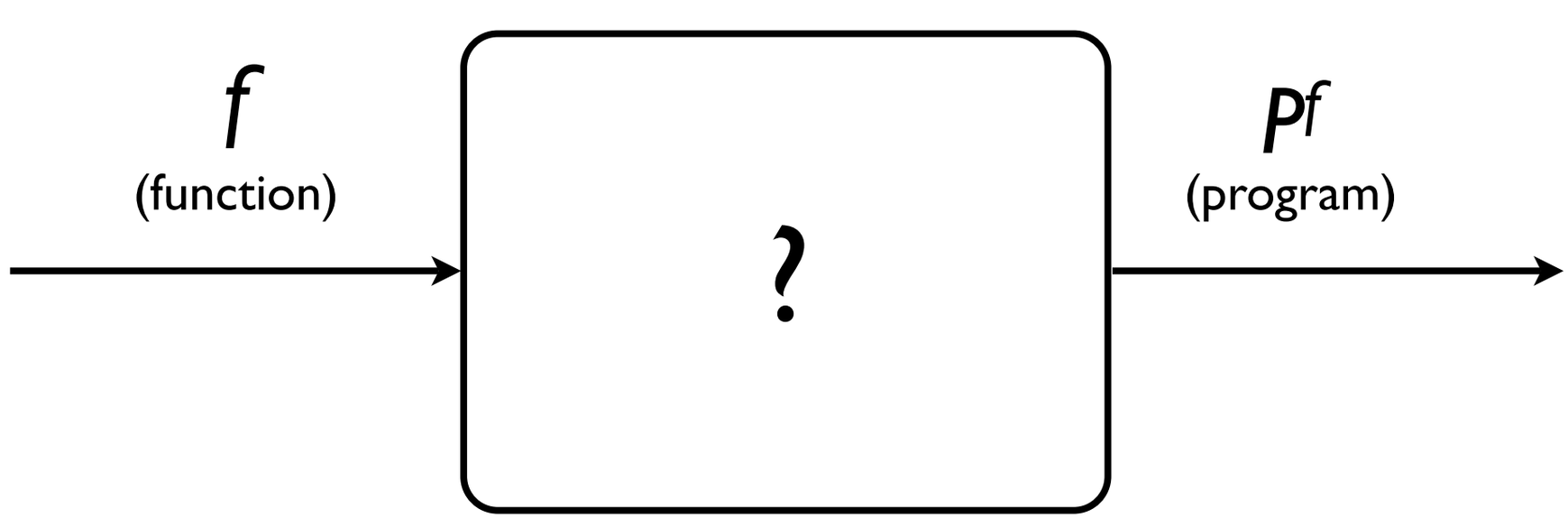
Event Details
- Friday through Sunday
- November 7-9, 2008
- Westin Arlington Gateway
- Arlington, Virginia

Morals?

Human creativity and discovery is dizzyingly heterogeneous. *Every* mode of inference and problem solving can be involved.

Heretofore machine creativity and discovery systems have pretty much been one-note (e.g., single-logic, single-inference mode) systems.

Our Experimental Paradigm



Results?

Coming.

But creative programmers apparently reason and problem-solve in purely abstract, domain-independent fashion. Their brains during the relevant periods are just different than those of mediocre performers.

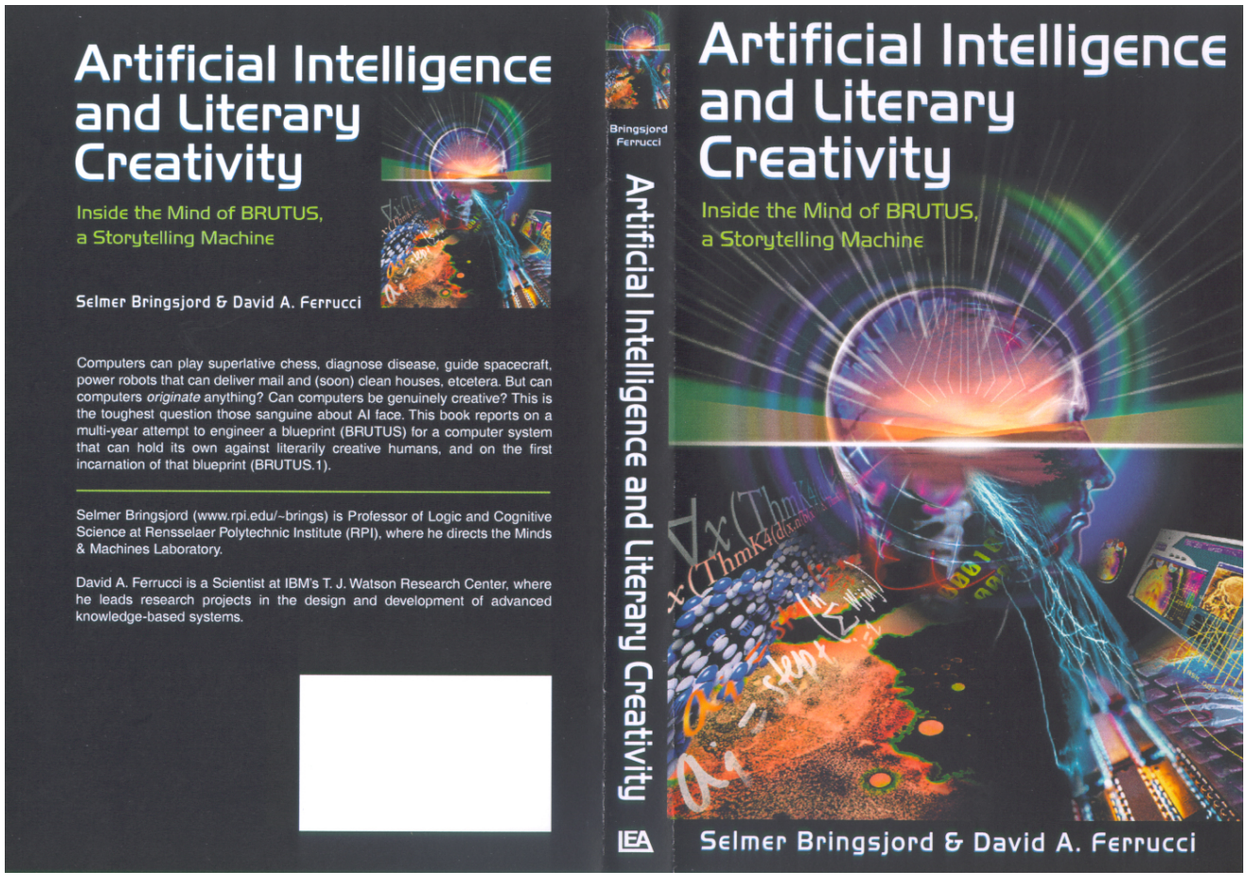
On Defining Creativity

- Let's not be unreasonably demanding:
  - There is no consensus definition of intelligence—and yet we have AI.
  - There is no consensus definition of cognition—and yet we have cognitive science.
  - There is no consensus definition of 'computer'—and yet we have computer science.

Nonetheless, a Suggestion: Necessary Condition

- A process is a creative one only if it solves at least a significant range of cases of a general problem that is *provably Turing-uncomputable*.
- A person is creative only if he/she solves at least a significant range of cases of a general problem that is *provably Turing-uncomputable*.
- A system is creative ...
- ...

This Condition Fits Prior Work



(Pubs defending proposition that literary creativity is a Turing-uncomputable process.)