

Studies in Applied Philosophy,  
Epistemology and Rational Ethics

**SAPERRE**

John R. Shook  
Sami Paavola *Editors*

# Abduction in Cognition and Action

Logical Reasoning, Scientific Inquiry,  
and Social Practice

 Springer

**Knowledge, Reasoning  
and Decision-making**

**The Place of  
(Logical) abduction in  
the Cognitive Sciences**

**Atocha Aliseda, UNAM, México**

<http://www.filosoficas.unam.mx/~atocha/index-en.html>



# Outline

**Is abduction a logic of synthetic reasoning ?**

**Peirce and Abduction**

**Logical Models of Abduction**

**Intelligence vs. creativity in AI**

# Peirce and Abduction

“According to Kant, the central question of philosophy is ‘How are synthetical judgments a priori possible?’ But antecedently to this comes the question how synthetical judgments in general, and still more generally, **how synthetical reasoning is possible at all**. When the answer to the general problem has been obtained, the particular one will be comparatively simple. This is the lock upon the door of philosophy”.

(CP, 5.348, cited in Hookway, 1992: 18)

# Peirce and Abduction

**“ Abduction is the process of forming an explanatory hypothesis. It is the only **logical operation** which **introduces** any **new ideas**”**

**[CP 5.171]**

**“ The abductive suggestion comes to us like a flash”**

**[CP 5.181, 1903]**

# Peirce and Abduction

(Peirce, 1839--1914)

The **surprising** fact, **C**, is  
observed

But if **A** were true, **C** would be a  
matter of course

Hence, there is reason to  
suspect that **A** is true

# Peirce and Abduction

(Peirce, 1839--1914)

The **surprising** fact, **C**, is  
observed

But if **A** were true, **C** would be a  
matter of course

Hence, there is reason to  
suspect that **A** is true

**C** may be  
**Novel**  
**or**  
**Anomalous!**

# Peirce and Abduction

(Peirce, 1839--1914)

The **surprising** fact, **C**, is  
observed

But if **A** were true, **C** would be a  
matter of course

Hence, there is reason to  
suspect that **A** is true

**Additional Criteria:**

**A should be “testable”**

**A should be “economic”**

# Peirce and Abduction

(Peirce, 1839--1914)

The surprising **fact**, **C**, is  
**observed**

But if **A** were true, **C** would be a  
matter of course

Hence, there is reason to  
suspect that **A** is true

**C !**

**A  $\Rightarrow$  C**

-----

**A?**

# Peirce and Abduction

(Peirce, 1839--1914)

The surprising fact,  $C$ , is observed

But if  $A$  were true,  $C$  would be a matter of course

Hence, there is reason to suspect that  $A$  is true

$C!$

Cause?

$A \Rightarrow C$

Mech?

-----

$A?$

# Peirce and Abduction

**“ It is true that the different elements of the hypothesis were in our minds before; but it is **the idea of putting together** what we had never before dreamed of putting together which flashes the new suggestion before our contemplation. ”**

[CP 5.181]

# Peirce and Abduction

“[a]n act of intuition and one of inference”

[Anderson, 1986]

“Peirce’s dilemma” [Frankfurt, 1958].

two aspects: “intuitive and rational”

[Ayim, 1974; Paavola, 2005]

# Peirce and Abduction

“Clearly, if the new idea, or hypothesis, must appear in one of the premises of the abduction, it cannot be the case that it originates as the conclusion of such an inference; it must have been invented before the conclusion was drawn.”

[Frankfurt, 1958: 594]

# Peirce and Abduction

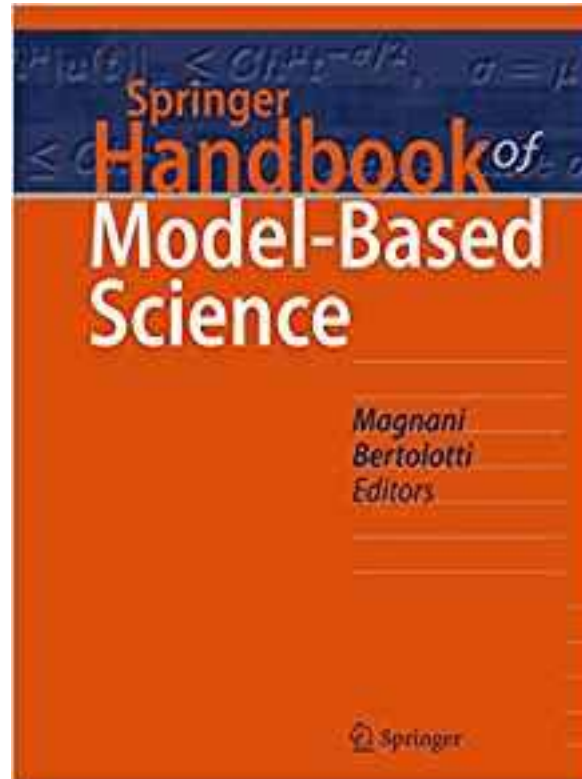
*“In this sense, the ‘A’ in A-C(sic) is logically prior to the ‘A’ in the conclusion. However, it is also clear that **the two ‘A’s’ are one and the same.***

...

*Therefore, in temporal terms, they may be simultaneously arrived at; it does not follow that A ‘must have been invented before the conclusion was drawn.’*

[Anderson, 1987: 35]

# Logical Models of Abduction



Aliseda, MBS, Part C: The Logic of Hypothetical Reasoning,  
Abduction and Models, 2017

And later ... in 2022

# Logical Models of Abduction

- 10 The Logic of Abduction: An Introduction. Atocha Aliseda, **U.N.A.M.**
- 11 Qualitative Inductive Generalization and Confirmation  
Mathieu Beirlaen, **Bochum**, Germany
- 12 Modeling Hypothetical Reasoning by Formal Logics T. Gauderis, **Gent**, Belgium
- 13 Abductive Reasoning in Dynamic Epistemic Logic  
Angel Nepomuceno-Fernández Fernando Soler-Toscano, **Sevilla**, Spain  
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- 14 Argumentation and Abduction in Dialogical Logic  
Cristina Barés Gómez, **Sevilla**, Spain, Matthieu Fontaine, **U.N.A.M.**
- 15 Formal (In)consistency, Abduction and Modalities  
Juliana Bueno-Soler, Limeira, Walter Carnielli, Marcelo E. Coniglio, Campinas,  
Abilio Rodrigues Filho, Pampulha, Belo Horizonte, **BRASIL**

# Peirce and Abduction

“... On Peirce’s view it is possible for the hypothesis and its abductive application to occur together. Therefore, **abductions may be insightful and original and still have logical form.**”

[Anderson 1986: 157]

# Abduction and Creativity

New representations, like new problems, do not spring from the brow of Zeus, but emerge by gradual —and very slow— stages [...]. Most scientific activity goes on within the framework of established paradigms. Even in revolutionary science, which creates those paradigms, the problems and representations are rooted in the past; they are not created out of whole cloth.

(Simon, 1977: 301–302)

# Intelligence vs. creativity in AI

The quest for A-intelligence

The quest for A-creativity



**JackRabbit2**  
Stanford Vision and Learning Lab, 2018

# The quest for A intelligence



## # Can machines think?

(Computing Machinery and Intelligence.  
Mind, 1950)

Can a **finite state digital machine**, through a series of instructions (perhaps long, but finite), **give coherent answers to questions asked by a human and deceive him**, making him think that his interlocutor is a human and not a machine?

# TURING TEST

Is there are a machine (program)  
that can simulate human intelligence?

X realiza las preguntas



# TURING TEST

**Is there are a machine (program)  
that can simulate human intelligence?**

How does it work? ChatGPT is  
an LLM created to mantain  
conversations with its users.

X realiza las preguntas



Aprobada si X no detectaba  
quién le respondía

Its IA is trained in a data text  
set set and is able to generate  
text similar to the one a human  
would produce to respond  
those questions posed.

24 jul 2023

# The quest for A creativity



## # Creativity and learning

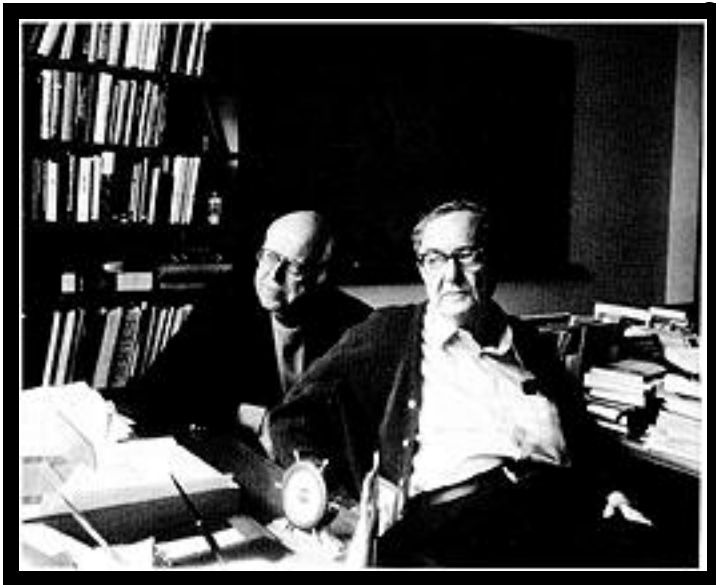
• "What we want is a machine that can learn from experience"

... "The possibility of letting the machine alter its own instructions provides the mechanism for this."

# Summer RP on Artificial Intelligence: Darmouth (1956) John Mc Carthy (1927-2011)

“on the basis of the **Conjecture** that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it ... For the present purpose the artificial intelligence problem is taken to be that of making a machine behave in ways that would be called intelligent if a human were so behaving.”

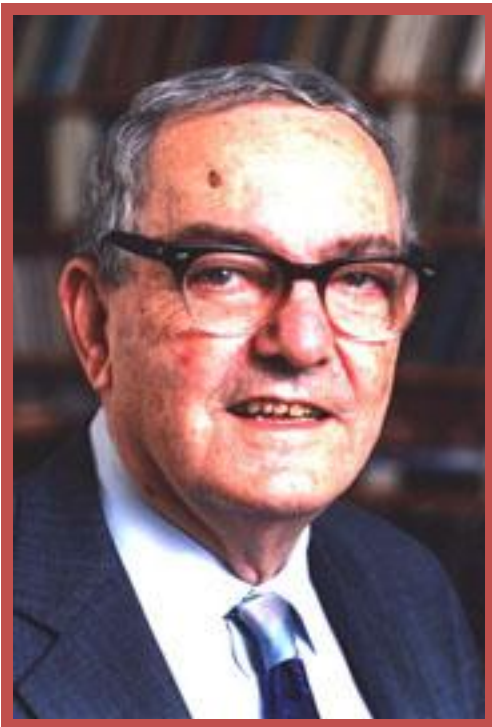
# Simon & Newell 1958



[In **ten years** time]

“most psychological theories will have the form of a computer program.”

# The quest for A creativity



Is there a logic of  
scientific discovery?

Let`s simulate some  
scientific discoveries

(Simon 1973)

# Summer RP on Artificial Intelligence: Darmouth (1956) John Mc Carthy (1927-2011)

“artificial intelligence research has so far been only moderately successful; its rate of solid progress is perhaps greater than most social sciences and less than many physical sciences. This is perhaps to be expected, considering the difficulty of the problem.” (1990)

# Summer RP on Artificial Intelligence: Darmouth (1956) John Mc Carthy (1927-2011)

“[unfortunately we] understand human mental processes only slightly better than a fish understands swimming. ” (Nilsson 2012, p.15)

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and Philosophy of Science

Selene Arfini *Editor*

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 Springer

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**Thank you**

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