What is this thing called computing science?

Lars-Erik Janlert
Feburary 25 2015
a scientific track and a technological track
① trouble in mathematics: Hilbert, Russell, Turing
② machine technology: ripe for computers coming together, ignited and powered by
③ trouble in the world: WW2 and the cold war

extreeemely brief history of the birth of computing science
PROLEGOMENA TO CARDINAL ARITHMETIC  [PART II]

**56101.** \( \vdash R \neg \epsilon \equiv D' \cap R, C'R \epsilon 1 \)

**Dem.**

\( \vdash \#5516 \cdot \#111-1341. \mathcal{C} \)

\( \vdash (g, w, y) \cdot R = x \downarrow y \equiv (g, x, y) \cdot D' = t', \nu' = 0', C'R = t'y : \)

\[\begin{align*}
[\#111-45] & \equiv (g, x, y) \cdot D'R = t'x, \nu'R = t'y :
[\#52-1] & \equiv D'R, C'R \epsilon 1 \cdot C'R \epsilon 2 : \mathcal{C} \cdot \text{Prop}
\end{align*}\]

**56102.** \( \vdash \neg \epsilon D' \cap C' \equiv \nu' \)

**Dem.**

\( \vdash \#56101 \cdot \#37-106. \mathcal{C} \)

\( \vdash R \neg \epsilon 2 \equiv R \epsilon D' \cap R \epsilon C' \equiv 1 \).

\[\begin{align*}
[\#223-93] & \equiv R \epsilon D' \cap C' \equiv 1 : \mathcal{C} \cdot \text{Prop}
\end{align*}\]

**56103.** \( \vdash R \epsilon 2 \cdot \mathcal{C} \cdot \mathcal{C} \epsilon R \)

**Dem.**

\( \vdash \#56101 \cdot \#111-1341. \mathcal{C} \)

\( \vdash R \epsilon 2 \cdot R \epsilon D' \cap C' \epsilon 1 \cdot D'R \epsilon C' \epsilon 1 \cdot D'R \epsilon C' \epsilon 2 \).

\[\begin{align*}
[\#52-16] & \equiv D' \cap C' \epsilon 1 \cdot D'R \epsilon C' \epsilon 2 \cdot \mathcal{C} \cdot \text{Prop}
\end{align*}\]

**56104.** \( \vdash R \epsilon 0 \cdot \mathcal{C} \cdot R = \neg \Lambda \) \([\#5603] \)

**5611.** \( \vdash R \epsilon 2 \cdot (g, w, y) \cdot x \equiv y \cdot x \equiv y \cdot R = x \downarrow y \) \([\#203 \cdot \#5602] \)

**56111.** \( \vdash R \epsilon 2 \cdot \equiv D' \cap C' \epsilon 1 \cdot D'R \epsilon C' \epsilon 2 \cdot D'R \epsilon C' \epsilon 2 \).

**Dem.**

\( \vdash \#51-23 \cdot \#55-16. \mathcal{C} \)

\( \vdash R \epsilon 2 \cdot (g, w, y) \cdot x \equiv y \cdot x \epsilon \cup \epsilon t' \epsilon y = \Lambda \cdot D'R = t'x, \nu'R = t'y : \)

\[\begin{align*}
[\#111-45] & \equiv D'R \cap C' \epsilon 1 \cdot D'R = t'x, \nu'R = t'y : \)
[\#111-45] & \equiv D'R \cap C' \epsilon 1 \cdot D'R = t'x, \nu'R = t'y :
[\#52-1] & \equiv D'R \cap C' \epsilon 1 : \mathcal{C} \cdot \text{Prop}
\end{align*}\]

**56112.** \( \vdash R \epsilon 2 \cdot \equiv D' \cap C' \epsilon 1 \cdot C'R \epsilon 2 \).

**Dem.**

\( \vdash \#56111 \cdot \#54-43. \mathcal{C} \)

\( \vdash R \epsilon 2 \cdot \equiv D'R, C'R \epsilon 1 \cdot D'R \cup C'R \epsilon 2 \).

\[\begin{align*}
[\#38-16] & \equiv D'R, C'R \epsilon 1 \cdot C'R \epsilon 2 : \mathcal{C} \cdot \text{Prop}
\end{align*}\]

**56113.** \( \vdash 2, = \nu \cap C' \epsilon 2 \)

**Dem.**

\( \vdash \#56112 \cdot \#12. \mathcal{C} \)

\( \vdash R \epsilon 2 \cdot \equiv R \epsilon 2 \cdot C'R \epsilon 2 \).

\[\begin{align*}
[\#37-106 \cdot \#39-122] & \equiv R \epsilon 2 \cdot C'R \epsilon 2 \cdot C'R \epsilon 2 : \mathcal{C} \cdot \text{Prop}
[\#223-83] & \equiv R \epsilon 2 \cdot C'R \epsilon 2 : \mathcal{C} \cdot \text{Prop}
\end{align*}\]

**56114.** \( \vdash 2, = \nu \cap D' \epsilon t'x \)

**Dem.**

\( \vdash \#56-7. \mathcal{C} \)

\( \vdash D'R \epsilon t'x : \equiv R \epsilon D' \epsilon t'x : \)

\[\begin{align*}
[\#111-45] & \equiv (g, x, y) \cdot D'R = t'x, \nu'R = t'y : \)
[\#5516] & \equiv (g, x, y) \cdot D'R = t'x, \nu'R = t'y : 1 \downarrow \epsilon 2 \).
\]}
“science,” from lat. scientia (knowledge), in the 19th century came to mean what was earlier known as philosophy of nature: physics, chemistry, geology, biology, etc.

“social science”: economics, political science, sociology, psychology (?), etc.

“humanities”: languages, literature, philosophy, religion, law (?) history (?), etc.

what is “science”? 
- nomothetic—idiographic
- Naturwissenschaft—Geisteswissenschaft/Kulturwissenschaft
Naturwissenschaften study the *given*—the “nature” of the world and its constituents
  • astronomy, physics, biology, chemistry, etc.

Kulturwissenschaften study the *made*—human creations
  • history, archeology, linguistics, art history, sociology, etc.

Where does computing science belong?

**what kind of science is computing science?**
Observation: as Naturwissenschaften mature, they tend to become sciences also of the possible and of making—i.e. Kulturwissenschaften or “sciences of the artifical” (Herbert Simon)
- science—non-science (demarcation)
- science—technology
Savoir pour prévoir pour pouvoir—know in order to predict in order to achieve (Auguste Comte)
Universal tool or Worldview?
material tool: the computer
contceptual tool: computational thinking

computing science as a very, very useful tool
“Known in the 1950s and 1960s as ‘algorithmic thinking,’ it means a mental orientation to formulating problems as conversions of some input to an output and looking for algorithms to perform the conversions.”

“Today the term has been expanded to include thinking with many levels of abstractions, use of mathematics to develop algorithms, and examining how well a solution scales across different sizes of problems.”

(Peter Denning)
middle 1980s: Kenneth Wilson (Nobel laureate in physics) advocates the formation of university departments of “computational science”—not to be confused with existent “computer science” departments

“Computational science is seen in the other sciences not as a notion that flows out of computer science, but as a notion that flows from science itself. Computational thinking is seen as a characteristic of this way of science. It is not seen as a distinctive feature of computer science.” (Peter Denning)
- does the tool-view diminish computing science as a science in its own right?
- may the promotion of “computational thinking” actually do us a disservice—a repeat of the unfortunate identification with “programming” (that we are still stuck with)?
for a long time a mechanistic worldview was dominant: the world is a big machine, problems are basically mechanical problems with mechanical solutions or explanations possibly, we are now watching a new, computational worldview taking form: the world is understood in informational and computational terms, problems are basically problems of information and computation, with corresponding solutions or explanations
Thermos—keeps hot things hot, cold things cold. How does it know?
Turing: computational mechanisms based on reflections on, modeled on, human computing
ANN, genetic and evolutionary algorithms, Lindenmayer algebras, swarm algorithms—some example of computational mechanisms based on other forms of naturally occurring computations
molecular biology...
social processes, economics,...
flocks of starlings
physics (?)

is computing science more “natural” than we think?
B C Smith: there are natural sciences—and there are intentional sciences

(a) Traditional “natural” (physical) science

(b) The intentional sciences

Brian Smith’s ideas...
intentionality ≈ “aboutness”, directionality, pointing to something beyond itself—it has to do with meaning, interpretation, semantics, etc.

symbols and representations and computations are inherently intentional devices

intentional sciences: mathematics, computing science, cognitive science...
Age of science

Age of significance

alchemists

C++ programmers

from B C Smith
“Hawking is wrong. It is we, not the natural scientists, who must develop a theory of everything.”

(Brian Cantwell Smith)