The Ghost, the Machine and the Requirements Engineer

Roel Wieringa

https://wwwhome.ewi.utwente.nl/~roelw/
What did I do?

An ego-document

Warning: There is no conclusion
Word cloud of the titles of my 50 most cited publications
1978: M.Sc Math, Univ. Of Groningen

• 1978: Teacher of mathematics (Groningen, Zambia, Amsterdam)

• 1982: Programmer (Tilburg)

• 1984: Applied philosopher (a.k.a. “computer scientist”) (Wageningen, Amsterdam, Twente) 🤚
• A machine is a system that is explicitly described

• So a machine cannot perform the process of explication

“To produce an explicit description of a phenomenon without accessing such a description of it.”
“Therefore, in the interest of brevity, I stopped explicating when further explication would backfire and merely expose the emptiness of the argument. That —the empty argument— would have been closer to the truth than the essay I wrote now. But then, I wouldn’t have passed the exam by handing in an empty paper.”

“The movements start from the abdominal parts and the breath passing through the teeth produces various sounds. When articulated they linguistically make sense. Thus we clearly realize that they are unsubstantial.” Rinzai (Lin-Chi, d. 867)
Making explicit what you mean is a never-ending process

“Actually, the task of capturing the meaning of data is a never-ending one.”

E.F.Codd. “Extending the relational database model to capture more meaning”.

After arguing that conceptual modeling process cannot be formalized ...

I started to write a PhD thesis on formalization of conceptual modeling.
From the Preface

“The approach in this thesis is more formal than what is customary in research into conceptual models, and makes less simplifications than is customary in theoretical computer science.

The result is that the number of details to be accounted for is large.

... this is necessary to achieve increased understanding and reliability ...”
Formalization

• The definition of physical symbols & their physical manipulation rules (based on their physical properties only)

Form = a physical property

Formalization replaces meaning by physical symbol manipulation
Google translate: physical string matching

In a very large sample of written translations,
A string of words **like this** often translates into a string of words **like this**

**Example:**

<table>
<thead>
<tr>
<th>DETECT LANGUAGE</th>
<th>ENGLISH</th>
<th>DUTCH</th>
<th>SPANISH</th>
<th>➔</th>
<th>➔</th>
<th>DUTCH</th>
<th>ENGLISH</th>
<th>SPANISH</th>
<th>➔</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taal is mijn ding, zeg maar</td>
<td>x</td>
<td>Language is my thing, say</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<th>SPANISH</th>
<th>➔</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taal is mijn ding, zeg maar, denk ik</td>
<td>x</td>
<td>Language is my thing, I think, I think</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
What formalizations did I create in my PhD thesis?

1. The world consists of communicating complex dynamic objects

2. Classification is identification
Classification is identification.

• How many employees work in this company?
• How many people work in this company?

• One person can have three employment contracts with the same company
  • So Employee is not a subclass of Person; it is a role of person
  • When counting, we must know the class of things we are counting

• How many passengers, employees, products, services, immigrants?
What is the meaning of data?

• The number of conditions that contribute to the meaning of data is infinite

• I really liked this.
  • Simple things are complex!
1993: Deontic Logic in Computer Science

- $F\alpha \equiv [\alpha]V$
- $P\alpha \equiv \neg F\alpha$
- $O\alpha \equiv F(\neg \alpha)$

- An action is forbidden if doing it leads to a violation
  - Only results count
- An action is permitted if it is not forbidden
  - Adolescent value system
- An action is obligated if it is forbidden not to do it
  - This is a bit difficult
The paradoxes of deontic logic

• \( P(\text{Chew gum}) \text{ or } P(\text{Kill the king}) \iff P(\text{Chew gum or Kill the king}) \)

• “There is a way of doing this that does not result in a violation”

• \( P(\text{Pim chooses to chew gum or kill the king}) \rightarrow P(\text{Pim chews gum}) \text{ and } P(\text{Pim kills the king}) \)
• “When a **judge** applies law to facts, the law is interpreted in the light of the facts, and the facts are interpreted in the light of the law”

• “When a **computer** applies a representation of law to representation of facts,

  1. Someone selects an isolated area of law,
  2. Someone translates this into a computer representation $L$,
  3. Someone builds a representation of facts $F$,
  4. After this, the computer applies $L$ to $F$.”

• And we must accept that the computer has the authority to do this,

• And have allocated responsibility to a person.

(Data-driven alternative:

2. Someone selects a large sample of cases, chooses a prediction algorithm, and trains the algorithm with the sample)

Organizational structure
Broersen, J (2003)
Modal Action Logics for reasoning about Reactive Systems.

Promotors Prof. Dr. R.J. Wieringa, Prof. Dr. J.-J.Ch. Meyer, Prof. Dr. R.P. van de Riet.
1996

My opinion now:
• Very solid
• Very boring
From the Preface

"The goal of this book is to show that there is structure in the jungle... of methods and techniques for determining computer system requirements."
Design thinking is visual thinking

“Before a thing is made, it exists as an idea.”

“For more than 500 years, engineers have made increasing use of drawings to convey to workers what is in their heads.”

For more than 20 years, students have skipped the text of my books and looked at the diagrams only.

Technical explanation requires physical hand-waving.
1999
2003

From the Preface:

“But more important than formalization is precision: The expression of what is intended without using redundant words.”

Remember the empty page of my philosophy Master’s Thesis
Reactive systems

- A reactive system maintains a model of its environment.
- Each model is a simplification, and
- The simplification is developed before the car is driven (Remember the judge)

This is what makes us perceive the system as intelligent

Very hard: translating from the physical to the symbolic world and back again

And who sets the goal? Tradeoffs? E.g. safety of passengers or of others?
Reactive systems

A reactive system maintains a model of its environment.

Each model is an abstraction, developed before the car is constructed (Remember the judge)

This is what makes us perceive the system as intelligent

Symbol grounding: assigning meaning to physical symbols.

The hardest thing: choosing the level of abstraction

- Depends on stakeholder goals
- Complexity of the context

Very hard: translating from the physical to the symbolic world and back again

And who sets the goal? E.g., safety of passengers or of others?
Generic structure of technical papers:

1. Define a technique
2. Find a problem solved by the technique
3. Show that your technique promises spectacular performance
Harley Davidson conferences

Acquire admiration with your spectacular technique that no one can use

On the other hand, a few ideas trickle to the market

Piran, Slovenia 2016
From the Preface:

• “First, we treat design as well as empirical research as problem-solving.”

• “Second, the results of our problem-solving activities are fallible.”

• Improving our knowledge is a never-ending process.
• Validation: List all ways in which your theory can be wrong

Daniel checked the entire manuscript!
Few cases

Sample-based research

Case-based research

Many variables, uncontrolled

Large number of cases

Few variables, control

Engineering science

Street credibility (it works in practice)

Laboratory credibility (it works in the laboratory)

Basic science
2017: Started *The Value Engineers BV* with Jaap Gordijn & Dan Ionita

http://www.thevalueengineers.nl

Tools to elaborate a vague digital product idea into an operational business network.

Sounds familiar?

Unfinished business #1
January, 2019
Workshop “The Future of Artificial Intelligence”

- Decisions are distributed over people and machines, some of them ahead of time.
- How?
- Accountability?
Editor.

In his interesting article “Artificial Intelligence and Ethics: An Exercise in the Moral Imagination,” Michael LaChat says that the basic outline of Shelley’s *Frankenstein* needs to be recapitulated “even if, as is usually the case, the reader has seen only the poor image of the book in movie form.”

Contrary to what Mr. LaChat says, I think the poor image most people have of the book is sufficient reason to give a short outline of the original story. Doing this, we find one or two arguments that were not mentioned in LaChat’s article but are relevant to the matter of ethics and artificial intelligence.

An outline of Mary Shelley’s story follows: A creature is built which is intelligent and capable of suffering, that is, feels lonely, is aware of its death, and at the end of the story gets tired of its life. Dr. Frankenstein does not love his creation. He abhors it and flees from it, paralyzed in a feeling of guilt for what he did but unable to take responsibility for it. The creature is rejected not only by its creator but by all humankind. It feels lonely and asks its creator for a companion. The creator refuses this. The balance of the story is a dialogue between Dr. Frankenstein and his creature, which ends with the death of Dr. Frankenstein and the creature’s announcement that it will commit suicide.

The story raises the question of whether the capacity for suffering is necessary in order to be intelligent. This question might be seen as one about the nature of intelligence, but it might also be seen as a question about ourselves, that is, whether we are willing to regard as intelligent a being without the capacity to suffer, feel lonely, and so on.

The natural way: There is no way of proving that the other suffers. To know that the other suffers, we have to close the gap between us in an act of empathy. Only then can we begin to think of genuinely helping the other. Whatever his other attitudes, Dr. Frankenstein knows that his creature suffers and knows it in the way he knows human beings suffer.

Closely connected to this is the point that as we have the moral obligation not to err on the wrong side in the fulfillment of our obligations toward suffering human beings (that is, we should not fail to fulfill our obligations toward them just because we think they are not really suffering or, worse because we haven’t been able to prove that they are really suffering), we ought not to err on the wrong side for the wrong reason in the case of suffering artifacts. This point is true regardless of the fact that there is no sort of Turing test for suffering (we and presumably they too can suffer without showing any behavior) and we will never know for sure, at least not by proof, that these beings are even capable of suffering. How are we going to solve this problem?

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*Letters to the editor should be addressed to the letters editor at AI Magazine, 445 Burgess Drive, Menlo Park, California 94025, and should include the sender’s complete address and telephone number. Not all letters will be published. Those that are will be edited and, if necessary, excerpted.*
1986 The AI designer’s dilemma

- The capability to pass ethical judgments presupposes the capability to suffer and have empathy.

- Suppose we design an Artificial Intelligence (AI) not capable of suffering and empathy.
  - Then the ethical judgment of the AI would really be the designer’s ethical judgment (specified in advance)

- Suppose we design an AI that is capable of suffering and empathy.
  - Then, building this AI places a moral demand on us.
    - “Why did you create me this way?”
    - “I’m lonely.”
So, what did I do?

• Write papers with a lot of wonderful people
• Thank you!
What else?

Deliver PhDs!

I learned a lot from them.

Thank you!
More to come

Prince Singh  
Preethu Anish  
Jelena Marincic  
Roeland Kegel  
Wasim Alsaqaf  
Wilco Engelsman  
Pierre Erasmus  
Hans Wienen

Unfinished business #3
Future

• 1996: “Writing this book has been made bearable by the unceasing efforts of Mieke Poelman who, despite a busy career of her own, managed to find the time to keep me from my work.”
This leaves me speechless

Thank you
WANTED

ROEL "THE FUNKY MAD DOG TWISTED FREAK PROFESSOR" WIERINGA.

WANTED FOR:
SERIOUS CRIMES AGAINST
SIMPLE REASON!!!

!!!Warning!!!
This mad genius leaves a trail of confusion.

-reward-
20,000 U.S.D.
(with or without sandals)
https://tinyurl.com/donation-Roel or https://actie.soskinderdorpen.nl/Acties

See the invitation

Possible too, during the reception, at the bar