

¿Czy ~~informatyka~~ automatykom potrzebne są zasady?

— Wezwanie do intelektualnego buntu —

— Przemysław Śliwiński —

□ CYBER-PHYSICAL SYSTEMS GROUP ■



Bunt intelektualny I

– Super! A...tak konkretnie, to... osochosi?!

Propozycja — Manifest konserwatywno[†]-konstruktywnego buntu (sic!)

Dopuszczamy – jako **jedną** z dróg[‡] prowadzących do zrozumienia świata –
gotowość zakwestionowania wszystkiego, wszędzie i... wszystkich.[‡]

[†]**Konserwatysta** ^{def} = osoba, która m.in. wie że: „not «all the glitters is gold»”.

[‡]“Yes, there are two paths you can go by, but in the long run
There’s still time to change the road you’re on”.

[‡]“Seeking a **better explanation** of the phenomena – that’s the **scientific frame of mind**”.



Bunt intelektualny II

– Super! A...tak konkretnie, to... osochosi?!

- „Tak, ale po co?!”/„Na co? dla jakiej przyczyny?”

- „Przecież kwestionujemy! I buntujemy się!! **I-to-ot-pszcz-kola!!!**”
- „I nic!”
- „To co jest nie tak?”
- ...
- I dlaczego? Dlaczego? Dlaczego!? — Richard **Feynman**

- „Tyrania **status quo**” — Milton **Friedman**

- **Jak?** [*„L’art?...c’est l’art — et puis, voila tout!”*]
- **Kto?** [*„Fredo, you’re my older brother and I love you, but...”*]
- **Co?** [*„Amicus **Plato**, sed magis amica veritas!”*]

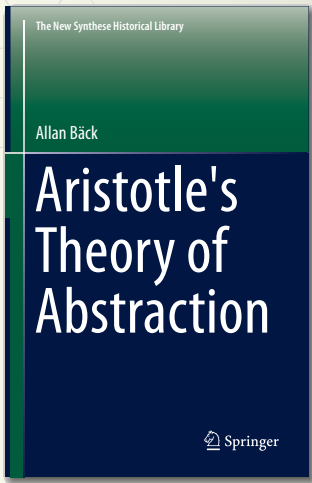


- 1 "Math, Matter and Mind"
— Sir Roger **Penrose**
- 2 "The Unreasonable Effectiveness of Mathematics in the Natural Sciences"
— Eugene **Wigner**
- 3 "Surely this is not coincidence:
it is a regularity in nature.
So it must have an **explanation**"
— David **Deutsch**



Abstrakcja? [subtrakcja??] [ekstrakcja??]

Emil du Bois-Reymond: „Ignoramus et ignorabimus?”



- "The idea is that abstract space ("αφαίρεσις") **ignores irrelevant details** — **Arystoteles**
 - Selective attention
 - Real aspects isolation
 - Concepts, symbols & attributes
 - Whole-part & hierarchies
 - **Invent** ≠ **imagine** ≠ **fabricate**
- „Arystoteles **wrócił** do uprawiania filozofii **po tym jak zakończył badania** w innych dziedzinach nauki."

Abstrakcja!

„Piotr malował podobne, Jan piękniejsze twarze.” — Ignacy **Krasicki**



- “The reliance on the abstract is [...] an insight into the **limited powers**^{†‡} of our reason.” — **Frederick Hayek**

- “I learned that one has to adapt **abstractions to reality**, not the other way around.” — **Alex Stepanov**

[†] “Do not **judge** a neighbor until you walk **two moons** in his moccasins.” — **Cheyenne’s proverb**

[‡] „Nawet największy **abstrakcjonista** staje się **realistą** podpisując swój obraz.” — **Salvatore Dali**

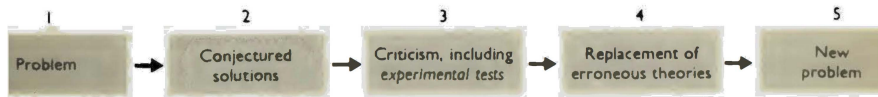


FIGURE 3.3 *The course of scientific discovery.*

❶ Kreatywność — ale nie tylko

- ❶ "Standing on the shoulders of giants" — Sir Issac Newton
- ❷ "Analogies between analogies" — Stanisław Marcin Ulam

❷ Testowanie hipotezy — wielokrotnie i na różne sposoby

- ❶ Spójność i poprawność formalna
- ❷ Tautologiczny vs. empiryczny charakter
- ❸ Porównanie z innymi hipotezami: predykcja vs. wyjaśnialność
- ❹ Weryfikacja empiryczna (indukcja vs. dedukcja)

[†] Ale też każdego innego typu wynalazku.

Jak tedy pogodzić naukę z rzeczywistością? I

Asymetria zależności...

- Czy w sukurs może przyjść nam **sama nauka**?

Propozycja — a.k.a. reguła Bayesa:

W teorii jest **prosto, pięknie i przejrzyste** (M - model, R - rzeczywistość)

$$\underbrace{P(R|M)}_{\text{a posteriori}} = \underbrace{P(R)}_{\text{a priori}} \cdot \underbrace{\frac{P(M|R)}{P(M)^\dagger}}_{\text{true \& false positives}}$$

Labels above the equation: "true positives" above $P(M|R)$, "true & false positives" below the fraction.

... a w życiu (na *manowcach* „**kto?**” i wśród *meandrów* „**jak?**” ;) bywa **różnie!**

$$^\dagger P(M) = P(M|R) \cdot P(R) + P(M|\bar{R}) \cdot P(\bar{R})$$

- “Extraordinary claims require extraordinary evidence!” — Carl Sagan



Jak tedy pogodzić naukę z rzeczywistością? II

Asymetria zależności...

- ❶ **Skipper:** *Kowalski, what's our trajectory?*
- ❷ **Kowalski:** *Ninety-five percent certain we're still doomed.*
- ❸ **Skipper:** *And the, uh...other five percent?*



- ❹ **Kowalski:** *Adventure & glory like no penguins have ever seen before!*

Jak tedy pogodzić naukę z rzeczywistością? III

Asymetria zależności...

- Lord Farquaad: *"Should the winner fail to return, the runner up shall take his place, and so on and so forth. Some of you may die..."*



- Lord Farquaad: *"...but it's a sacrifice I am willing to make."*



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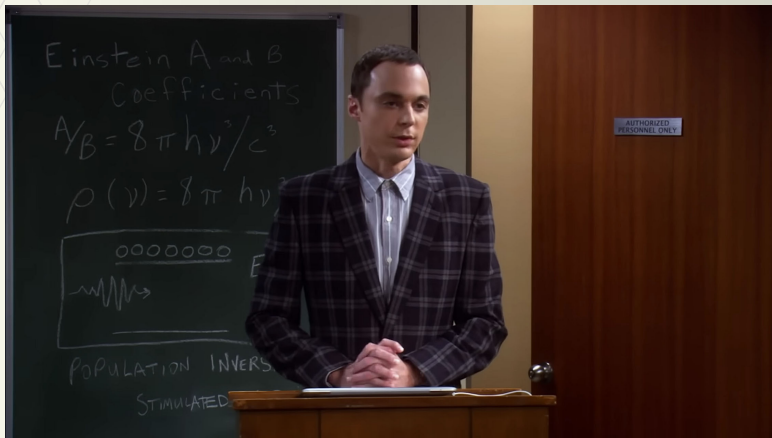


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Jak tedy pogodzić naukę z rzeczywistością? IV

Asymetria zależności...

The Bing Bang Theory: „A cruel trick!”



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Jak tedy pogodzić naukę z rzeczywistością? V

Asymetria zależności...

Wielki **Szu**: „Sztafeta!”



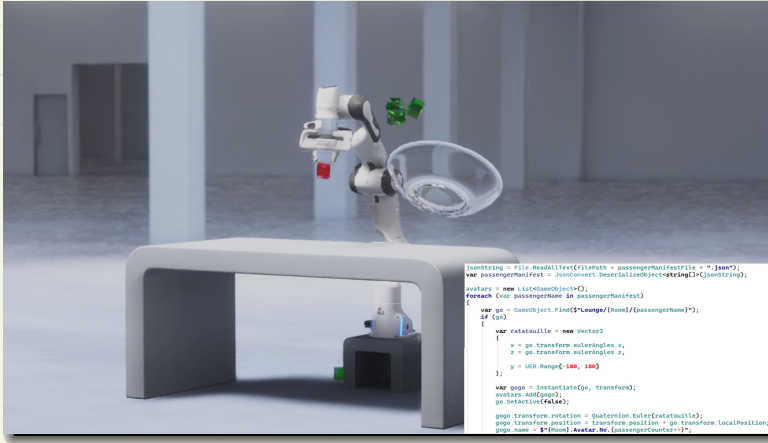
"I need to digress for a moment here"...

- 1 "The **equations** have this marvelous way of giving you back **more** than you put in." — Frank **Wilczek**
- 2 "When you write down the **theory**, the theory then becomes your **teacher**." — Donald **Hoffman**
- 3 "Shut up and **calculate!**" — David **Jamieson**
- 4 "«If we know our theory is right from mathematical reasons, we don't really need to pay attention to observations» – and **I am very critical of such point of view.**" — Neil **Turok**
- 5 "I want to emphasize **most of what theorists do is wrong**. And one of the main, the most important thing, is **they should be willing to recognize when they have gone wrong.**" — Neil **Turok**



Omniverse - a cyber-physical simulator

Zasady zachowania **robotów**, **ich programów** i **ich programistów...**



For the record: How many Smiths have you counted?



„Jesteśmy z tej samej gliny...

... i nie mamy innego celu jak ten, który żeśmy zadeklarowali!”



„Pomożecie?!“ — Edward **Gierek**



„W interesie [...] inteligencji

...witać będziemy zawsze każdy przejaw [...] zdrowej krytyki”



*„Każdy prowokator czy szaleniec, który odważy się podnieść rękę przeciw władzy ludowej, niech będzie pewny, że mu tę rękę władza ludowa odrąbie!” — Józef **Cyrankiewicz***



So the professor takes the student's point seriously, and responds with a concise but adequate argument in defence of the disputed equation. The professor tries hard to show no sign of being irritated by criticism from so lowly a source. *Most* of the questions from the floor will have the form of criticisms which, if valid, would diminish or destroy the value of the professor's life's work. But bringing vigorous and diverse criticism to bear on accepted truths is one of the very purposes of the seminar. *Everyone* takes it for granted that the truth is not obvious, and that the obvious need not be true; that ideas are to be accepted or rejected according to their content and not their origin; that the greatest minds can easily make mistakes; and that the most trivial-seeming objection may be the key to a great new discovery.





THE FABRIC OF REALITY

Nor is it valid to rule out any theory solely on the grounds that it is 'absurd': the Inquisition, together with most of the human race in Galileo's time, thought it the epitome of absurdity to claim that the Earth is moving. After all, we cannot feel it moving, can we? When it does move, as in an earthquake, we feel that unmistakably. It is said that Galileo delayed publicly advocating the heliocentric theory for some years, not for fear of the Inquisition but simply for fear of ridicule.

What if you'd rather not know? You may not like these predictions. Your friends and colleagues may ridicule them. *You may try to modify the explanation* so that it will not make them, without spoiling its agreement with observations and with other ideas for which you have no good alternatives. You will fail. That is what a good explanation will do for you: it makes it harder for you to fool yourself.



One expression of this within mathematics is the principle, first made explicit by the mathematician Georg Cantor in the nineteenth century, that abstract entities may be defined in any desired way out of other entities, so long as the definitions are unambiguous and consistent.

It so happens that my arguments in this book are quite independent of this problem. However, my view of the matter, for what it is worth, is that there is no such thing as a logical method of having new ideas, or a logical reconstruction of this process. My view may be expressed by saying that every discovery contains 'an irrational element', or 'a creative intuition', in Bergson's sense.



Every room is at the beginning of infinity. That is one of the attributes of the unbounded growth of knowledge too: we are only just scratching the surface, and shall never be doing anything else.

The recognition that all moral urgency has its basis in the urgency of suffering or pain. I suggest, for this reason, to replace the utilitarian formula 'Aim at the greatest amount of happiness for the greatest number', or briefly, 'Maximize happiness', by the formula 'The least amount of avoidable suffering for all', or briefly, 'Minimize suffering'. Such a simple formula can, I believe, be made one of the fundamental principles (admittedly not the only one) of public policy.

This argument that abstractions really exist does not tell us what they exist *as* – for instance, which of them are purely emergent aspects of others, and which exist independently of the others. Would the laws of morality still be the same if the laws of physics were different?



THE BEGINNING OF INFINITY

I think that there is only one way to science – or to philosophy, for that matter: to meet a problem, to see its beauty and fall in love with it; to get married to it and to live with it happily, till death do ye part – unless you should meet another and even more fascinating problem or unless, indeed, you should obtain a solution. But even if you do obtain a solution, you may then discover, to your delight, the existence of a whole family of enchanting, though perhaps difficult, problem children ...

Realism and the Aim of Science (1983)

The only uniquely significant thing about humans (whether in the cosmic scheme of things or according to any rational human criterion) is our ability to create new explanations, and we have that in common with all people.



Since theories can contradict each other, but there are no contradictions in reality, every problem signals that our knowledge must be flawed or inadequate.

Explanations often yield predictions, at least in principle. Indeed, if something is, in principle, predictable, then a sufficiently complete explanation must, in principle, make complete predictions (among other things) about it. But many intrinsically unpredictable things can also be explained and understood. For example, you cannot predict what numbers will come up on a fair (i.e. unbiased) roulette wheel. But if you understand what it is in the wheel's design and operation that makes it fair, then you can explain why predicting the numbers is impossible.

