

Note on Friedman's 'what informatics is and isn't'

Friedman's article 'What informatics is and isn't',¹ presents a necessary and timely analysis of the field of informatics. After defining some of its characteristics, training needs and also examples of what it isn't, the author re-introduces what he has called 'the fundamental theorem of informatics'¹—originally formulated for biomedical informatics—that persons supported by information technology will be better than the same persons performing the same task unassisted'. Figure 1 shows it graphically.

Both the theorem and the picture have become well known in the biomedical informatics field. However, while an interesting, thought-provoking exercise, this proposal about 'what informatics is and isn't' faces several scientific vulnerabilities, as noted below.

THE TERM 'INFORMATICS'

The term 'informatics' derives from the German 'Informatik', the Russian 'Informatika' and the French 'informatique', which combines 'information' with 'automatique'. One concept lies at its core: information. While it is clear how 'informatics' is semantically linked to 'information', what is meant by information is not so obvious: it can convey a wide range of meanings:

- ▶ The concept of information as originally proposed by Szilard to provide an answer to the famous 'Maxwell's demon' thought experiment in physics.
- ▶ The engineering or communication and coding theory sense that Shannon used to define the term, in which 'information' is associated with the concept of entropy—also from physics.
- ▶ Other meanings of scientific information, such as, for instance, the information that is associated with

molecules, for example, binding, with particles and sub-particles—quantum information—or with other biological entities such as cells, tissues, organs, etc. This can refer to how DNA codes biological information, which is basically known, or how this information is translated and transmitted to higher levels of biological aggregation and function through living cells such as human neurons, which is as yet unknown. As Shannon himself realized and stated, his (syntactical) theory was not relevant to capture the characteristics of biological information.²

- ▶ Broad societal and colloquial uses of the concept information, such as referring to the news, signals, stimuli, data plus meaning, etc, seen from different social, economic, historical, or political or technological perspectives, defined, usually, quite vaguely.

Without a standard meaning of information, it is difficult—or impossible—to establish a definition of informatics that can cover the scope of its uses from such an informational perspective.

VULNERABILITIES OF THE 'FUNDAMENTAL THEOREM OF INFORMATICS'

The fundamental theorem faces a number of vulnerabilities:

- ▶ It is not really about a fundamental scientific issue, nor does it provide a formal foundation for scientific inquiry. This contrasts with examples such as Shannon's information theory—including its theorems—which, using entropy to quantify channel capacity, provided the formal foundations for signal coding and communication.
- ▶ It is not a theorem, as in mathematics or logic, which Merriam-Webster online defines as: '(a) a formula, proposition, or statement in mathematics or logic deduced or to be deduced from other formulas or propositions, (b) an idea accepted or proposed as a demonstrable truth, often as a part of

a general theory.' Friedman's is a challenging, intuitive hypothesis, but not really a theorem, as it can be neither deduced nor demonstrated —nor falsified.

- ▶ It is not about informatics itself. If it were, it would address and explain an intrinsic concept related to informatics, such as logic, processing, communication, storage, etc, which could help develop new theories, methods or products specific to informatics, but is here instead focused on the operational use of informatics by people.
- ▶ The proposed 'fundamental theorem' implies some kind of Turing-like test, including conditions for its applicability, and experimentally measurable outcomes to demonstrate its validity. It can be considered too general, and subject to refutation in practice.
- ▶ Computer interaction is hardly as unambiguous as the 'fundamental theorem' suggests. Harvard's Shoshana Zuboff,³ presciently described how computers introduced by organizations lacking good information models, and socially well-adapted management structures (often by persons lacking adequate skills or understanding of information processes) can hurt, rather than improve work process efficiency and effectiveness.
- ▶ Computers relying on imprecise or inappropriate models of economic, technological and sociological conditions frequently detract from intelligent human performance. For creative artistic endeavors, such as writing, the value added by computers can be questionable, as per Nobelist Vargas Llosa: 'the more intelligent our computer is, the dumber we will be'.⁴

THE 'FUNDAMENTAL THEOREM' PICTURE

Figure 1, obviously metaphorical in 'adding together' very different entities like a human brain and a computer, brings to mind the strictures from John Von Neumann himself,⁵ on the fundamental



Figure 1 Friedman's 'fundamental theorem of informatics'.¹

differences between artificial computers and brains in terms of logic, memory, storage, architecture, use of energy, processing, information coding and management, fault-tolerance, number of components, size, speed, access time, organization, etc. Subsequent scientific research and experience supports these reservations, despite the hopes expressed for artificial intelligence by Simon and Newell in their 1975 Turing Award description of physical symbol systems and their hypothesis about them in human and machine symbolic reasoning. The reliance on a similar kind of hypothesis and much more is implicit in the imagery and statement of Friedman's fundamental theorem, which is certainly challenging, but remains too generic to be evaluated—or falsified. More importantly, it does not address a key objective of a scientific discipline: to propose central hypotheses and theories that become exemplars in guiding and articulating

current and future research. Without new theories of information, at multiple biological and social levels, informatics can be defined only from an operational perspective. Friedman's proposal can be seen as a relevant reminder about the need to define biomedical informatics scientifically. However, a 'fundamental theorem' of informatics—if such a theorem were possible—is still pending, as also 'what informatics is and isn't' from an informational perspective, especially for biomedical informatics, given its biological and evolutionary scientific foundations.

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