Context Dependence and Value Systems in Science: Computing Paradigm Shift.

From Turing Model to Natural Computing

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Abstract

The widespread idea of science as objective knowledge would be justified only in a static world where context of knowledge, even if not explicated in a given theory, could be reconstructed and taken into account when theory is used in practice. Ours is however an age of intense development and static view of science is problematic.

Together with the difficulty of anchoring of knowledge in an unpredictable context, one of the aspects of the problem concerns knowledge user's attitudes. In a world undergoing radical change in the production of knowledge and its ways of use, priorities and attitudes of knowledge users change so fast that some old results do not answer their important new needs. That is the development we can observe in Theory of Computing where Turing paradigm is being generalized to Natural Computing. What has happened? In the context of its development Turing model of computing answered the relevant questions of its own time and helped to automatize mathematics. The focus was on the exact solution of the problem and the question of halting of the procedure was central in that context. Today, computing is much more than solving mathematical problem. Computing is what is done in global computational networks connected with sensors and actuators controlling real physical processes. What is important is not for a computational process to halt. Not even to provide an exact solution. It is to give a good enough solution for a given context in interplay with the physical world. Here again context (including attitudes such as value system) increases in importance, and as Nancy Cartwright rightly points out, not only the solution of the problem and tests of the solution in a given context are relevant but equally so the awareness of the limits of applicability of the solution which will show up in a different context of use. In my analysis I focus on the new Natural Computing paradigm which uses computational solutions already existing in nature, and especially in the living world (Organic Computing) to develop new ideas about how to compute in the regime where resources are limited and we are interested in the best achievable solution given resources, instead of a perfect solution. The basic idea is to show how the concept of computing is evolving dependent on what sort of problem we attempt to address by its use, on its context and the value system.