

## A Brief Introduction to Soft Computing

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### Abstract

The aim of this article is to illustrate what soft computing is and how important it is.

Key words : Evolutionary Computation, Fuzzy Systems, Machine Learning, Neural Networks, Probabilistic Reasoning

### 1. What is soft computing?

Soft computing differs from conventional (hard) computing in that, unlike hard computing, it is tolerant of imprecision, uncertainty, partial truth, and approximation. In effect, the role model for soft computing is the human mind. The guiding principle of soft computing is: Exploit the tolerance for imprecision, uncertainty, partial truth, and approximation to achieve tractability, robustness and low solution cost. The basic ideas underlying soft computing in its current incarnation have links to many earlier influences, among them Zadeh's 1965 paper on fuzzy sets; the 1973 paper on the analysis of complex systems and decision processes; and the 1979 report (1981 paper) on possibility theory and soft data analysis. The inclusion of neural computing and genetic computing in soft computing came at a later point.

At this juncture, the principal constituents of Soft Computing (SC) are Fuzzy Logic (FL), Neural Computing (NC), Evolutionary Computation (EC) Machine Learning (ML) and Probabilistic Reasoning (PR), with the latter subsuming belief networks, chaos theory and parts of learning theory. What is important to note is that soft computing is not a melange. Rather, it is a partnership in which each of the partners contributes a distinct methodology for addressing problems in its domain. In this perspective, the principal constituent methodologies in SC are complementary rather than competitive. Furthermore, soft computing may be viewed as a foundation component for the emerging field of conceptual intelligence.

- Fuzzy Systems
- Neural Networks
- Evolutionary Computation
- Machine Learning
- Probabilistic Reasoning

### 2. Importance of soft computing

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The complementarity of FL, NC, GC, and PR has an important consequence: in many cases a problem can be solved most effectively by using FL, NC, GC and PR in combination rather than exclusively. A striking example of a particularly effective combination is what has come to be known as "neurofuzzy systems." Such systems are becoming increasingly visible as consumer products ranging from air conditioners and washing machines to photocopiers and camcorders. Less visible but perhaps even more important are neurofuzzy systems in industrial applications. What is particularly significant is that in both consumer products and industrial systems, the employment of soft computing techniques leads to systems which have high MIQ (Machine Intelligence Quotient). In large measure, it is the high MIQ of SC-based systems that accounts for the rapid growth in the number and variety of applications of soft computing.

The conceptual structure of soft computing suggests that students should be trained not just in fuzzy logic, neurocomputing, genetic programming, or probabilistic reasoning but in all of the associated methodologies, though not necessarily to the same degree.

### 3. A glimpse into the future

The successful applications of soft computing suggest that the impact of soft computing will be felt increasingly in coming years. Soft computing is likely to play an especially important role in science and engineering, but eventually its influence may extend much farther.

In many ways, soft computing represents a significant paradigm shift in the aims of computing – a shift which reflects the fact that the human mind, unlike present day computers, possesses a remarkable ability to store and process information which is pervasively imprecise, uncertain and lacking in categoricity.

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