

What is Soft Computing

What is Soft Computing ?

(Ref: L.A. Zadeh- Coined in early 90's)

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.

It is the use of approximate calculations to provide imprecise but usable solutions to complex computational problems.

What is Hard Computing ?

- Hard computing, i.e., conventional computing, requires a precisely stated analytical model and often a lot of computation time.
- Many analytical models are valid for ideal cases.
- Real world problems exist in a non-ideal environment.

What is Soft Computing ? (continued)

The principal constituents, i.e., tools, techniques, of Soft Computing (SC) are

- Fuzzy Logic (FL),
- Artificial Neural Networks (ANN),
- Evolutionary Computation (EC),
- Swarm Intelligence (i.e. Ant colony optimization and Particle swarm optimization,)
- Additionally Some Machine Learning (ML)

Premises of Soft Computing

- The real world problems are pervasively imprecise and uncertain
- Precision and certainty carry a cost
- Some problems may not even have any precise solutions

Guiding Principle of Soft Computing

The guiding principle of soft computing is:

- Exploit the tolerance for imprecision, uncertainty, partial truth, and approximation to achieve non-conventional solutions, tractability (easily handled, managed, or controlled), robustness and low costs.

Hard Computing

- Premises and guiding principles of Hard Computing are
 - Precision, Certainty, and Rigor.
- Many contemporary problems do not lend themselves to precise solutions such as
 - Recognition problems (handwriting, speech, objects, images, texts)
 - Mobile robot coordination, forecasting, combinatorial problems etc.
 - Reasoning on natural languages

Implications of Soft Computing

- Soft computing employs ANN, EC, FL etc, in a complementary rather than a competitive way.
- One example of a particularly effective combination is "neurofuzzy systems."
- Such systems are becoming increasingly visible as consumer products ranging from air conditioners and washing machines to photocopiers

Unique Property of Soft computing

- Learning from experimental data → generalization.
- Soft computing techniques derive their power of generalization from approximating or interpolating to produce outputs from previously unseen inputs by using outputs from previous learned inputs.
- Generalization is usually done in a high dimensional space.



Hard Computing versus Soft Computing

1. Best to solve mathematical problems.
 2. Hard computing relies on binary logic & predefined instructions like numerical analysis & brisk software.
 3. Needs exact input of data and is sequential.
 4. Takes a lot of time to complete tasks & is costly.
 5. Needs accuracy.
 6. Known as conventional intelligence.
 7. Ex: merge sort, quick sort, binary search, etc.
1. Used to solve real world problems as it is stochastic in nature.
 2. Based on the model of human mind having probabilistic reasoning, fuzzy logic & multi valued logic.
 3. Handles abundant data & multiple computations which may happen in a parallel fashion.
 4. Tolerance of uncertainty & imprecision is estimated to achieve machine intelligence quotient & lower the cost.
 5. Needs robustness.
 6. Known as computation intelligence.
 7. Ex :Image processing, handwriting recognition, heater, refrigerator, AC, data compression, etc.

Why Soft Computing?

- Analytical models are valid for ideal cases whereas real world problems exist in non-ideal environment. Soft computing provides insights into real world problems.
- Certain fields like Biology, medicine & humanities etc. Are still intractable using conventional mathematical / analytical models.
- It is possible to map human mind with soft computing but not possible with conventional mathematical/ analytical models.

Major goals of Soft Computing

Soft computing is a multidisciplinary field, to construct a new generation of AI, known as Computational Intelligence.

- Main goal is to develop intelligent machines to provide solutions to real world problems, which are not modeled or too difficult to model mathematically.
- Its aim is to exploit the tolerance for approximation, uncertainty, imprecision & partial truth in order to achieve close resemblance with human like decision making.

Current Applications using Soft Computing

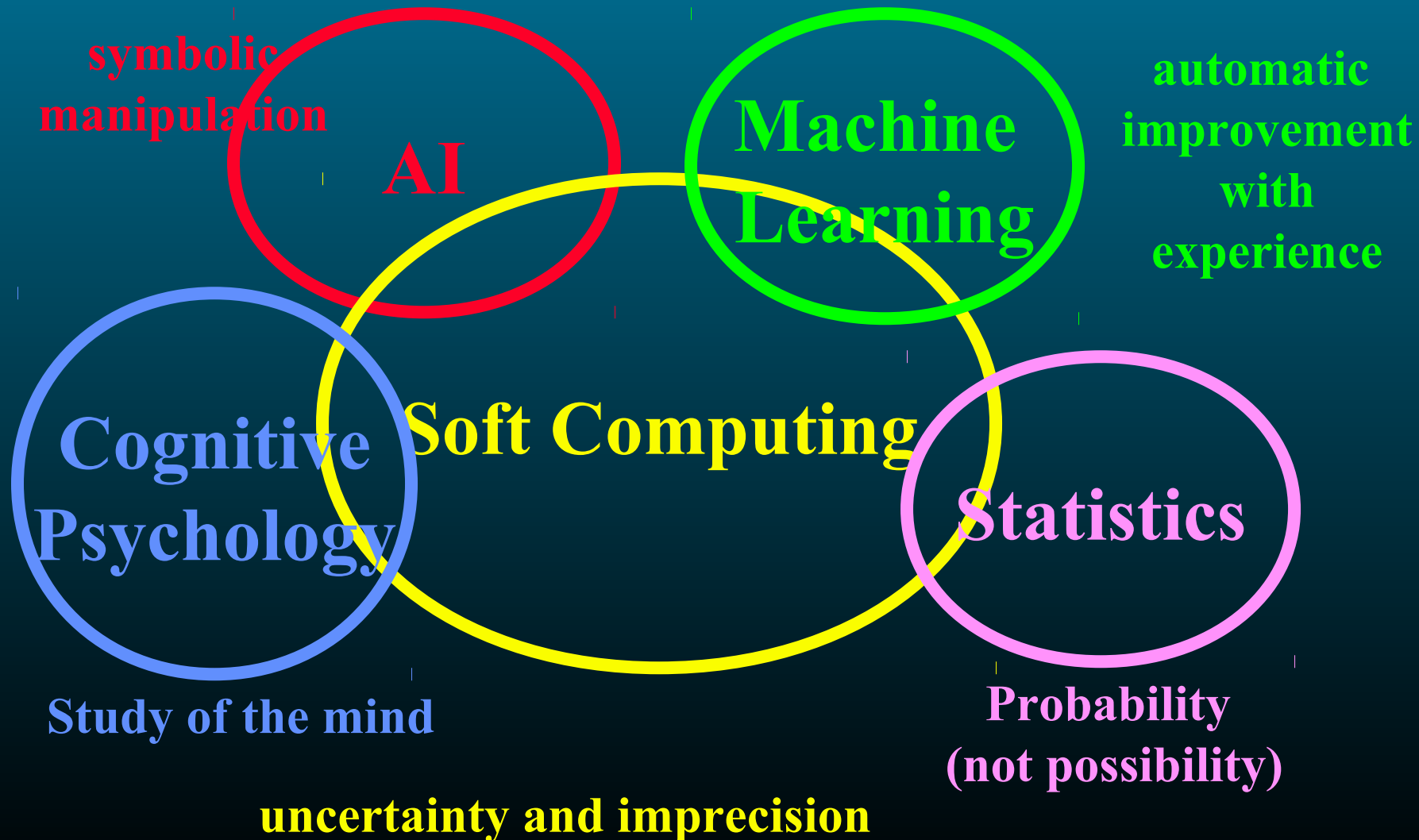
- Handwriting recognition
- Automotive systems and manufacturing
- Image processing and data compression
- Decision-support systems
- Data Mining
- Power systems
- Control Systems

Future of Soft Computing

(Ref: L.A. Zadeh)

- Soft computing is likely to play an especially important role in science and engineering, but eventually its influence may extend much farther.
- 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.

How does SC relate to other fields?



AI and Soft Computing

