Lecture 0

What is Soft Computing

What is Soft Computing ? (Ref: L.A. Zadeh)

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.

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) and Probabilistic Reasoning (PR) areas.

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, camcorders and many industrial applications.

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.

Current Applications using Soft Computing

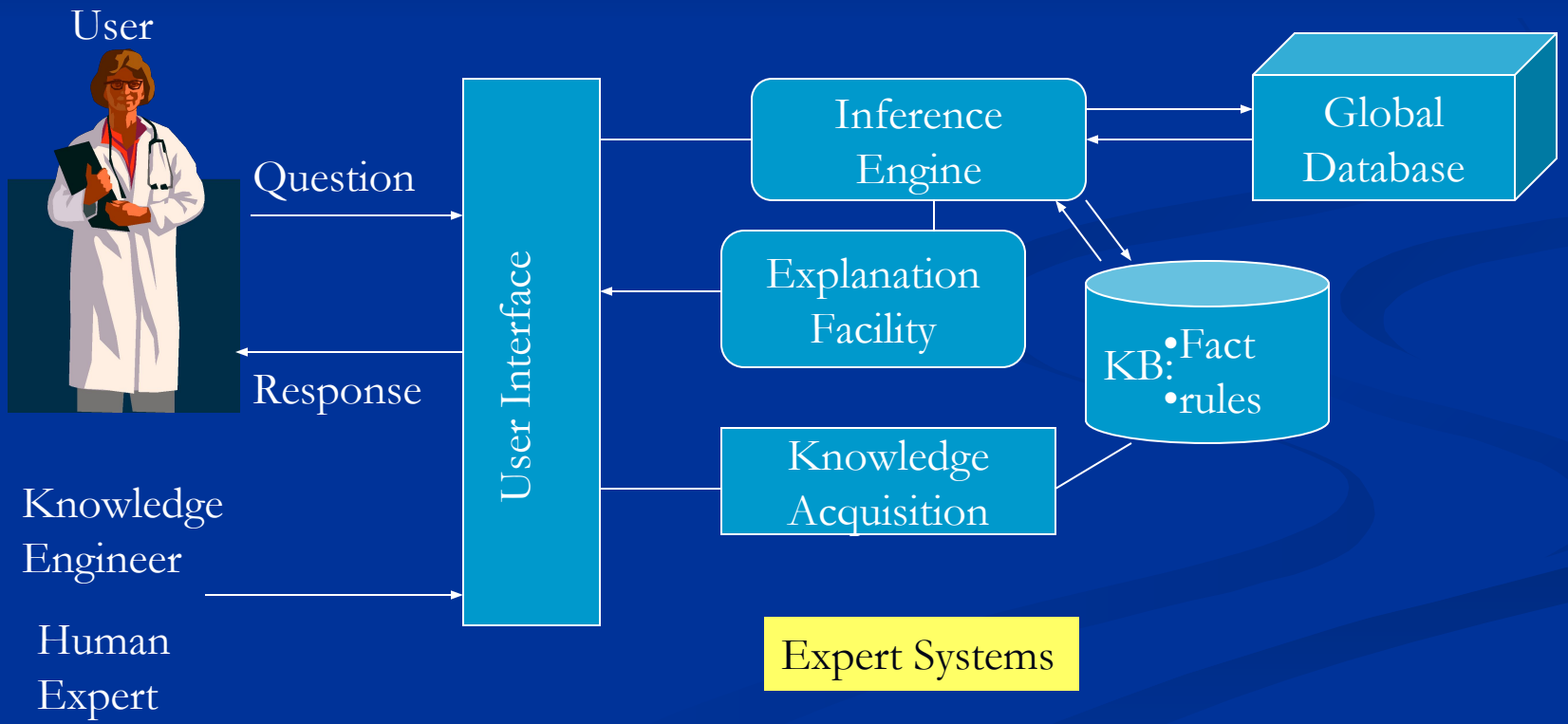
- Handwriting recognition
  - Automotive systems and manufacturing
  - Image processing and data compression
  - Architecture
  - Decision-support systems
- Data Mining
  - Power systems
  - Control Systems

Future of Soft Computing (Ref: L.A. Zadeh)

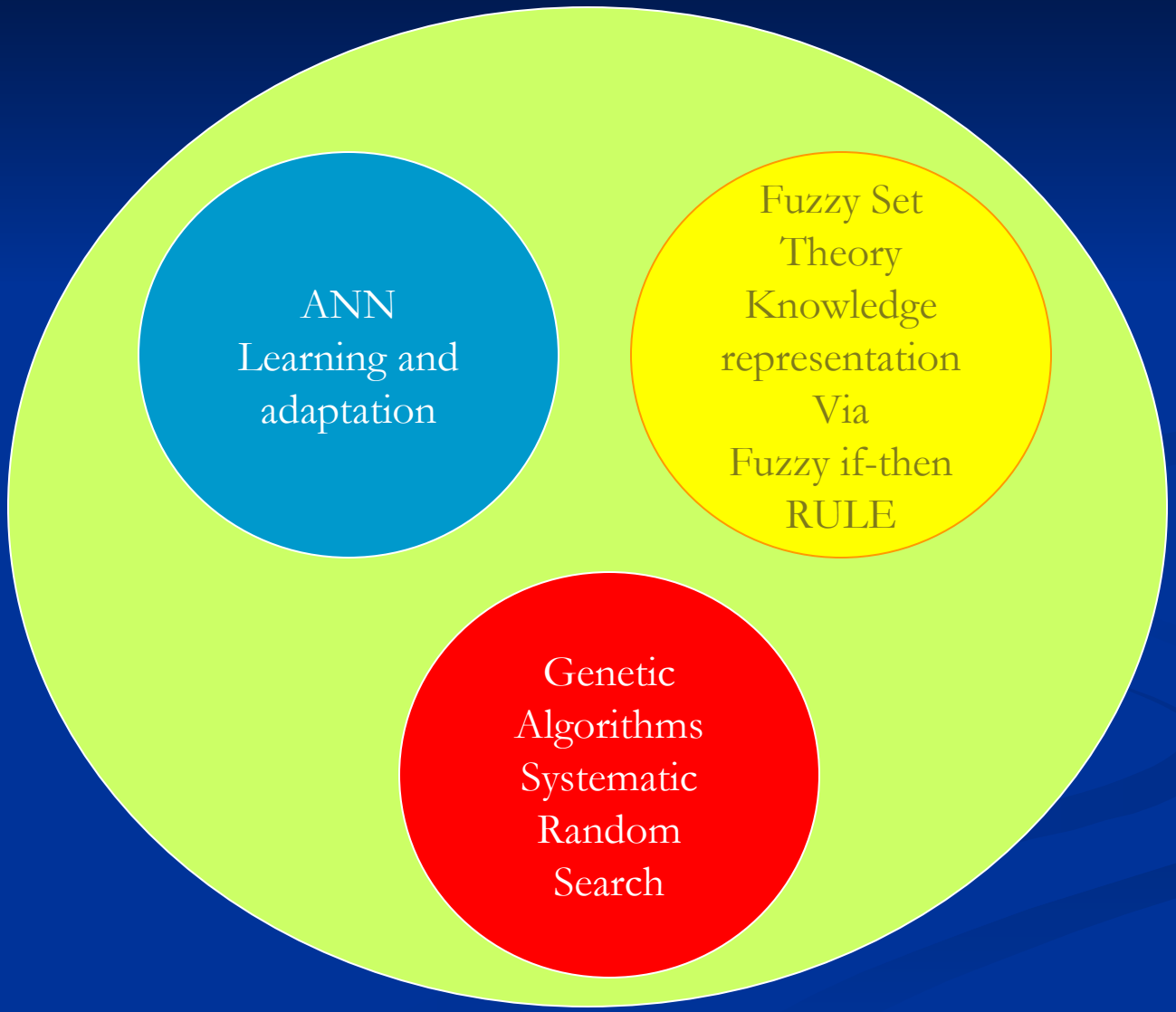
- Soft computing is likely to play an especially important role in science and engineering, but eventually its influence may extend much farther.
- Soft computing represents a significant paradigm shift in the aims of computing
  - A shift which reflects the fact that the human mind, unlike present day computers, possesses a remarkable ability to store and process information which is pervasively imprecise, uncertain and lacking in categoricity.

AI and Soft Computing: A Different Perspective

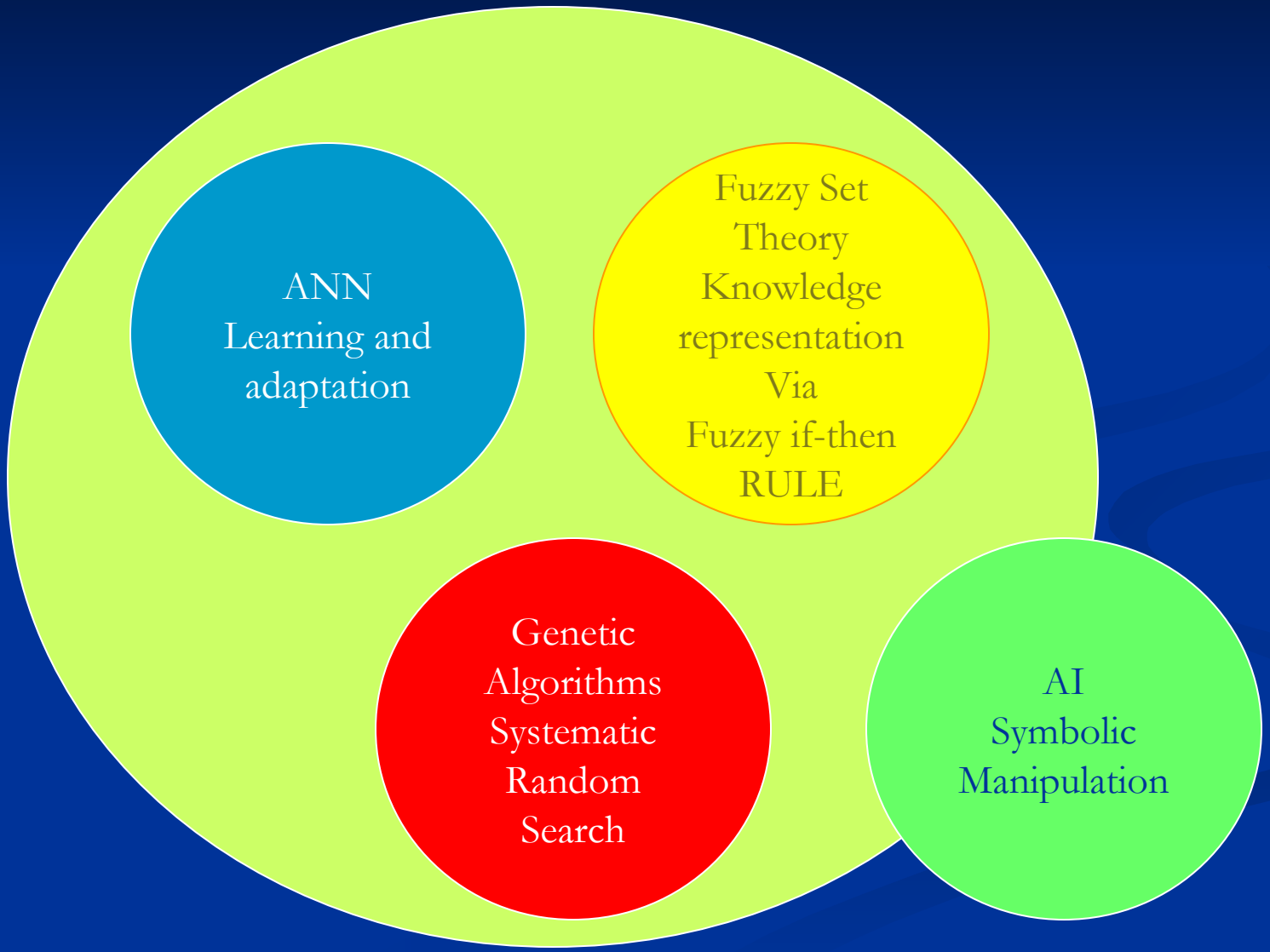
- AI: predicate logic and symbol manipulation techniques



AI and Soft Computing



AI and Soft Computing



AI and Soft Computing