

## Unit - 1

Q1 What is Soft Computing? What are its characteristics? Explain in detail.

A1 → Soft Computing encompasses a set of computational techniques and algorithms that are used to solve complex real world problems and deal with complex systems.

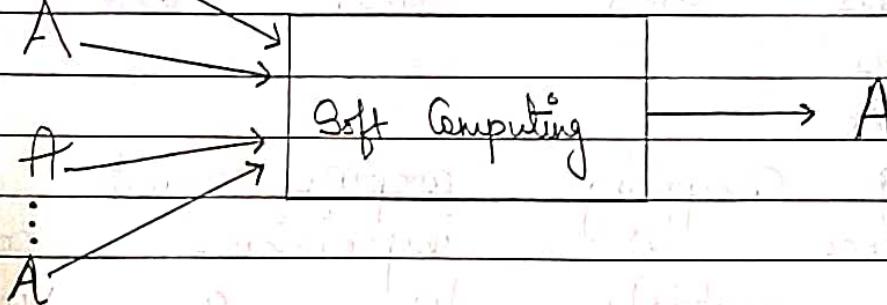
→ Soft Computing explores exploits the given tolerance for imprecision, partial truth and uncertainty for a particular problem.

→ Soft Computing is the reverse of conventional hard Computing.

→ It is the combination of algorithms that were designed to model and enable solutions to real world problems without using mathematical solutions.

→ Zadeh coined the term of soft computing in 1992. The objective of soft computing is to provide precise approximation and quick solutions for complex real-life problems.

- The objective of applying Soft Computing is to obtain robust solutions at reasonable costs.
- The role model of Soft Computing is the human brain.
- Example of Soft Computing:-



- Characteristics of Soft Computing :-
- It may not yield precise solution, that is, it gives approximate solution for real-life problems.
- The algorithms of Soft Computing are adaptive, so the current process is not affected by any kind of change in the environment.
- The concept of soft computing is based on learning from experimental data. It means that soft computing does not require any mathematical model to solve the problem.

- Soft Computing help were to solve real-world problems by providing approximate results that conventional and analytical models cannot solve.
- It is based on Fuzzy logic, genetic algorithm, ANN and expert systems.
- Soft Computing uses some biological inspired methodologies and algorithms such as soft genetics, evolution, etc.,

→ The principle components of Soft Computing are :-

- 1) Neural Network
- 2) Genetic Algorithm
- 3) Fuzzy logic.

→ It has numerous applications in areas such as medical diagnosis, computer vision, handwritten character recognition, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.,

19BECE30025

Q2 Discuss difference between Soft and Hard Computing.

A2 Conventional Hard Computing

Soft Computing

- | Hard Computing  | Soft Computing  |
|---|---|
| → Hard computing uses existing mathematical algorithms to solve certain problems. | → Soft Computing encompasses a set of algorithms used to solve complex real world problems. |
| → It provides a precise and exact solution of the problem.                        | → It provides imprecise and approximate solutions and they are fuzzy in nature.             |
| → It represents simple mathematical model.  | → It represents complex mathematical model.   |
| → It uses existing algorithms.  | → It creates hybridization of existing algorithms giving new algorithms all together.       |
| → The analytical model required by hard computing must be precisely represented.  | → It is based on uncertainty, partial truth, imprecision and approximation.                 |
| → Computation time is more.   | → Computation time is less.   |
| → less efficient  | → More efficient  |

→ It depends on binary logic, numerical systems, and software.

It depends on approximation and disposition, formal logic and probabilistic reasoning.

→ Sequential Computation

→ Parallel Computation

→ Gives exact output

→ Gives approximate output

→ Does not tolerate inexactness, uncertainty, partial truth and approximation.

Tolerates inexactness, uncertainty, partial truth and approximation.

→ Has the features of exactitude (precision) and categoricity.

→ Has the features of approximation and dispositionality.

→ Deterministic in nature.

Stochastic in nature.

→ Works on exact data.

→ Works on ambiguous and noisy data.

→ Requires programs to be written.

→ It will create its own programs.

→ Hard Computing is settled.

→ Soft Computing incorporates randomness.

→ It uses two-valued logic.

→ It uses multi-valued logic.

→ Eg:- Traditional method of computing using our personal computer.

→ Eg:- NNs like ADALINE, MADALINE, ART networks, etc.

19BEC30025

Q3 Discuss in detail applications of soft computing.

A3 → Controls motor like induction motor, DC servo motor

→ Power plants can be controlled using an intelligent control system

→ In image processing, the given output input can be of any form, either image or video which can be manipulated using soft computing to get an exact duplicate of the original image or video

→ In biomedical applications where it is closely related to biology and medicine, soft computing techniques can be used to solve biomedical problems like diagnosis, monitoring, treatment and therapy

→ Smart instrumentation is trendy nowadays, where intelligent devices automatically communicate with other devices using a certain set of communication protocols to perform certain tasks, but the problem here is that, there is no ~~better~~ proper standard protocol to communicate. This can be overcome by using soft computing techniques, where

29BEC30025

the smart devices are communicated over multiple protocols with high privacy and robustness.

- widely used in gaming and checker
- used in kitchen appliances like microwave and Rice Cooker
- Used in home appliances like washing machine, heater, refrigerator, and Ac as well.
- widely used in robotics
- Used for handwriting recognition
- Used in image processing and data compression.
- Used in power plants for distribution purposes mainly.
- Used in pattern recognition, signal processing, mathematics, time forecasting, data mining, civil engg., mechanical engg., artificial intelligence, agriculture, environment conservation and analysis, number plate recognition, etc..

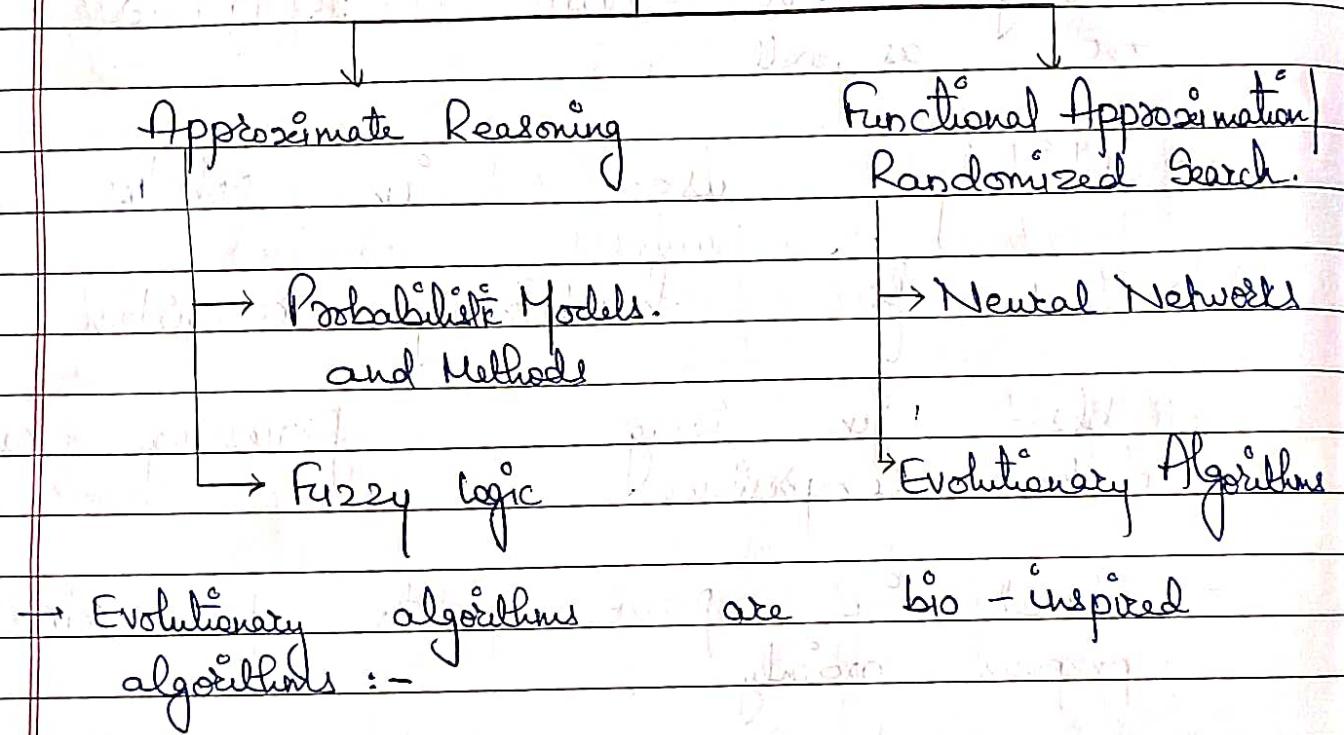
19 BE CE 30025

Q4. Explain in detail various areas of soft computing.

- 1) Neural Network (NN)
  - 2) Fuzzy logic (FL)
  - 3) Genetic Algorithms (GA)

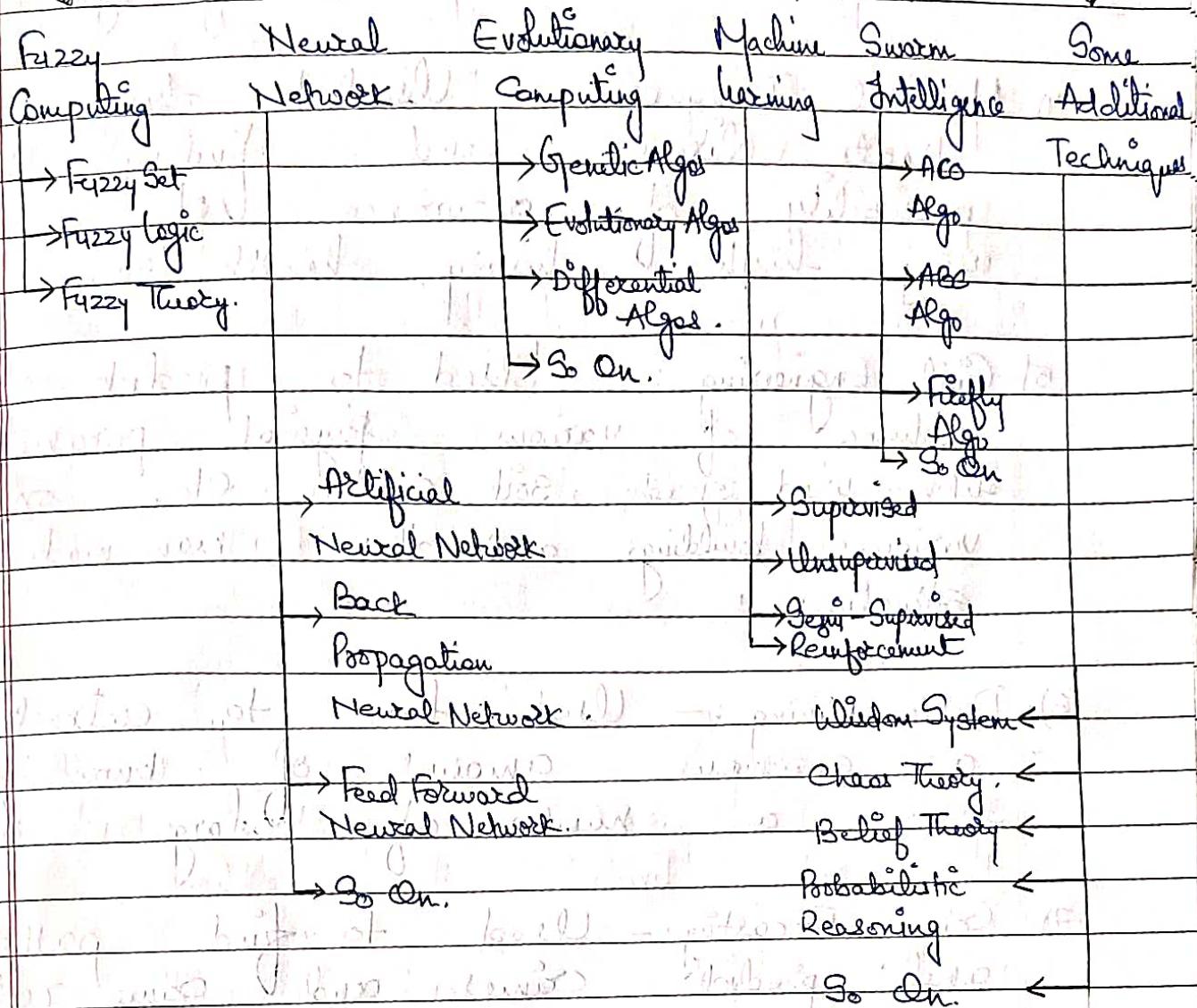
→ These methodologies form the core of Soft Computing:-

# Soft Computing.



- 1) BAT Algo
  - 2) ABC (Artificial Bee Colony) Algo
  - 3) ACO (Ant Colony Optimization) Algo.
  - 4) BFO (Bacteria Foraging Optimization) Algo.

# Soft Computing Techniques



→ Application areas of soft computing:-

- 1) Mathematics:- Used to provide usable solutions to complex mathematical problems and models.
- 2) Mechanical Engineering:- Used in various machines and used to automatically operate them based on physical parameters.

19 BECE 30025

- 3) Pattern Recognition :- Used to find similarities and patterns such as finding visually similar images using google lens.
- 4) Medical Diagnosis :- Used to diagnose, treat diseases and finding the possibility of occurrence of a disease using either history, health, etc.,
- 5) Civil Engineering :- Used to predict the influence of various physical parameters like wind speed, soil culture, etc., on various buildings and other man-made structures
- 6) Data Mining :- Used here to extract a enormous amount of knowledge from a number of large database
- 7) Crime Forecasting - Used to find patterns and predict crimes and crime rate.
- 8) Agriculture :- Used to help farmers increase growth and output using various techniques
- 9) Environment
- 10) AI
- 11) Signal Processing.

12) Feature Selection

13) Computer Engineering

14) Fault Tolerance

15) Image Processing

16) Industrial

17) Material Engineering

18) Nano Technology

19) Process Control

20) Smart Instrumentation

21) Polymer Extrusion Process

22) Actuators Science

## Q5 Explain the Need / Requirement of Soft Computing.

A5 → Hard Computing is used for solving mathematical problems that need a precise answer. It fails to provide solution for some complex real-world problems. Thereby, for real-world problems whose precise solution does not exist, soft computing helps.

→ Many analytical models are valid for ideal cases. Real-world problems exist in a non-ideal environment.

→ Soft computing provides insights into real-world problems and is just not limited to theory.

→ Hard computing is and only suited for solving mathematical problems which give some precise answers.

→ It is even possible to map the human mind with the help of soft computing, but it is not possible with conventional mathematical and analytical models.

→ Some important fields like Biology, Medicine and Humanities, etc., are still intractable using conventional mathematical and analytical models.

Q6 What are the advantages and disadvantages of Soft Computing.  
 A6 → Advantages of Soft Computing :-

- 1) It has good efficiency
- 2) It is applicable in real-time problems and systems.
- 3) It is based on human reasoning.
- 4) Tolerant of imprecision and uncertainty
- 5) less computation time is required
- 6) It can work on noisy and ambiguous data.
- 7) It can even map the human mind.
- 8) Are capable of improving themselves and are self-evolving
- 9) Closer to human thinking and are biologically inspired
- 10) Can solve non-linear problems.

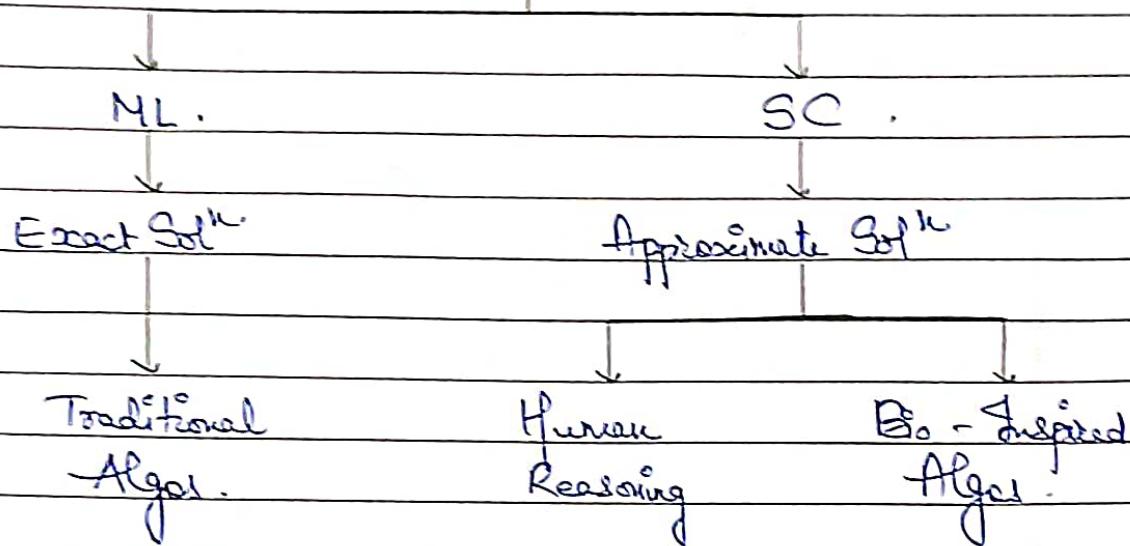
49 BECE 30025

## Disadvantages of Soft Computing:-

- 1) It gives approximate output
- 2) It has imprecision and uncertainty
- 3) If a small error occurs, the entire system stops working. To overcome its entire system must be corrected from the beginning, which takes a lot of time.
- 4) They are not fault-tolerant.

~~Q1~~ Extra.  
~~Q2~~

## Computational Approach



## → Computational Paradigm

