🔳 Chapter 1(Intro)

➤ **Intelligence system:** adapts itself to deal with changes in problems (automatic learning)(▪ Reasoning ▪ Learning ▪ Adaptivity)

➤ **Intelligent systems in business** :utilize one or more intelligence tools, usually to aid decision making, Increase productivity and Gain competitive advantage

- Examples of successful intelligent systems applications in business:
    - Customer service (Customer Relations Modelling)
    - Scheduling (eg. Mine Operations)
    - Data mining
    - Financial market prediction
    - Quality control

➤ **Characteristics of intelligent systems:**

- **Possess one or more of these:**
    - Capability to extract and store knowledge
    - Human like reasoning process
    - Learning from experience (or training)
    - Dealing with imprecise expressions of facts
    - Finding solutions through processes similar to natural evolution(soft computing)

- **Recent trend**
    - More sophisticated Interaction with the user through :natural language understanding ,speech recognition and synthesis ,image analysis

- **Most current intelligent systems are** based on :rule based expert systems ,one or more of the methodologies belonging to soft computing

➤ **The field of AI:**

- Development of software aimed at enabling machines to solve problems through human-like reasoning
- Attempts to build systems based on a model of knowledge representation and processing in the human mind
- Encompasses study of the brain to understand its structure and functions

❖ Failed to live up to initial expectations due to : inadequate understanding of intelligence, brain function and complexity of problems to be solved
❖ AI systems: Expert systems, Case Based Reasoning systems

➢ **The Soft Computing (SC) methodologies:**
- Artificial Neural Networks (ANN)
- Fuzzy Systems
- Genetic Algorithms (GA)

➢ **Artificial Neural Networks (ANN):**
- Human brain consists of 100 billion densely interconnected simple processing elements known as neurons
- ANNs are based on a simplified model of the neurons and their operation
- ANNs usually learn from experience – repeated presentation of example problems with their corresponding solutions
- The learning phase may or may not involve human intervention (supervized vs unsupervized learning)
- Particularly suitable for problems not prone to algorithmic solutions
- Different models of ANNs depending on : Architecture , learning method , other operational characteristics (eg. type of activation function)
- Good at pattern recognition and classification problems
- Major strength - ability to handle previously unseen, incomplete or corrupted data
- Some application examples: explosive detection at airports , face recognition , financial risk assessment -,optimisation and scheduling

➢ **Genetic Algorithms (GA):**
- Belongs to a broader field known as evolutionary computation
- Solution obtained by evolving solutions through a process consisting of :
  - **survival of the fittest**

- **crossbreeding**
- **mutation**
- New generations of solutions are produced beginning with the initial population, using specific genetic operations: selection, crossover and mutation
    - crossover (splicing and joining peices of the solution from parents)
    - mutation (random change in the parameters defining the solution
- The fitness of newly evolved solution evaluated using a fitness function
- GAs have been used in :portfolio optimisation ,bankruptcy prediction ,financial forecasting , design of jet engines ,scheduling

> **Fuzzy Systems:**
- **Traditional logic** is two-valued – any proposition is either true or false
- Imposing precision may be difficult and lead to less than optimal solutions
- Fuzzy systems handle imprecise information by assigning degrees of truth - using fuzzy logic
- FL allow us to express knowledge in vague linguistic terms
- Flexibility and power of fuzzy systems now well recognized (eg. simplification of rules in control systems where imprecision is found)
- **Some applications of fuzzy systems**: Control of manufacturing processes ,appliances such as air conditioners, washing machines and video cameras ,Used in combination with other intelligent system methodologies to develop hybrid fuzzy-expert, neuro-fuzzy, or fuzzy-GA systems

> **Knowledge-Based & Rule-Based Expert Systems(ES):**
- Designed to solve problems in a specific domain
- Built by : interrogating domain experts , storing acquired knowledge in a form suitable for solving problems, using simple reasoning
- Used by :
    - Querying the user for problem-specific information

- Using the information to draw inferences from the knowledge base
- Supplies answers or suggested ways to collect further inputs
- Usual form of the expert system knowledge base is a collection of :IF … THEN … rules(like fizzy) not IF statements in procedural code
- Some areas of ES application: banking and finance (credit assessment, project viability) , maintenance (diagnosis of machine faults) , retail (suggest optimal purchasing pattern) ,emergency services (equipment configuration) , law (application of law in complex scenarios)

➢ **Case-based reasoning (CBR):**
- CBR systems solve problems by making use of knowledge about similar problems encountered in the past
- The knowledge **used in the past** is built up as a case-base
- Difficult to do well in practice, but very powerful if you can do it
- CBR systems can improve over time by learning from mistakes made with past problems
- Application examples: ▪Utilisation of shop floor expertise in aircraft repairs , Legal reasoning , Dispute mediation , Data mining, Fault diagnosis , Scheduling

➢ **Data Mining:** The process of exploring and analysing data for discovering new and useful information
- Techniques such as artificial neural networks and decision trees have made it possible to perform data mining involving large volumes of data (from "data warehouses").
- Applications: direct target marketing campaigns, fraud detection, and development of models to aid in financial predictions, antiterrorism systems

➢ **Intelligent software agents (ISA):** computer programs that provide active assistance to information system users to Help users cope with information overload
- Capable of learning from the user as well as other intelligent software agents

- Application examples: News and Email Collection, Filtering and Management, Online Shopping ,Event Notification, Personal scheduling, Online help desks, interactive characters , Rapid Response Implementation

➤ **Language Technology (LT):** application of knowledge about human language in computer based solutions
- Communication between people and computers is an important aspect of any intelligent information system
- A LT-based system can be the front-end of information systems themselves based on other intelligence tools
- Applications of LT: Natural Language Processing (NLP) , Knowledge Representation ,Speech recognition , Optical character recognition (OCR) , Handwriting recognition , Machine translation , Text summarisation , Speech synthesis

Chapter 2(ES)

➤ **Expertise**: is the knowledge that is necessary to efficiently perform a task or solve a problem.
- Expertise can be gained from training, reading and experience.

➤ **Expert System Components:**
- A knowledge base: which is the most important element of an expert system,This is where knowledge concepts and relationships related to a problem are stored.
- An inference engine : that provides problem-solving skills to a system by determining how and when to apply appropriate knowledge.
- A user interface :to communicate with the user.
- Explanation systems :that justify the reasoning of the expert system and refining systems that evolve the knowledge representations encoded in the expert system.

- **An expert system**: is an interactive computer-based decision tool that uses both facts and heuristics to solve difficult decision problems based on knowledge acquired from an expert
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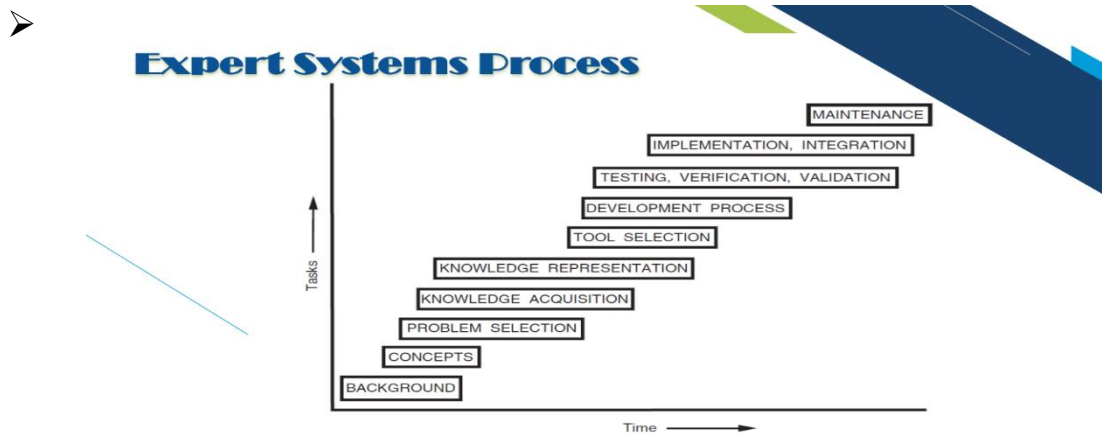
- **Expert Systems Applications:** Interpreting and identifying ,Predicting , Diagnosing ,Designing ,Planning , Monitoring, Debugging and testing ,Instructing and training , Controlling

- Expert systems are typically very domain specific.
- The developer of expert system must limit his or her scope of the system to just what is needed to solve the target problem.
- **Special Programming Languages:** Languages like LISP and PROLOG or special tools (CLIPS: C Language Integrated Production System) , CLIPS is a rule-based programming language
   - Why?:Efficient mix of integer and real variables , Good memory-management procedures , Extensive data-manipulation routines , Incremental compilation ,Tagged memory architecture ,Optimization of the systems environment , Efficient search procedures
- **Expert Systems Structure:**
   - Working memory; refers to task-specific data for the problem under consideration.
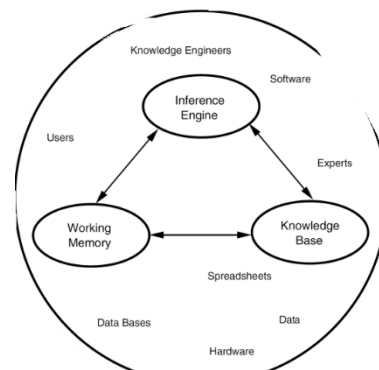
➤ From Data Processing to Knowledge Processing
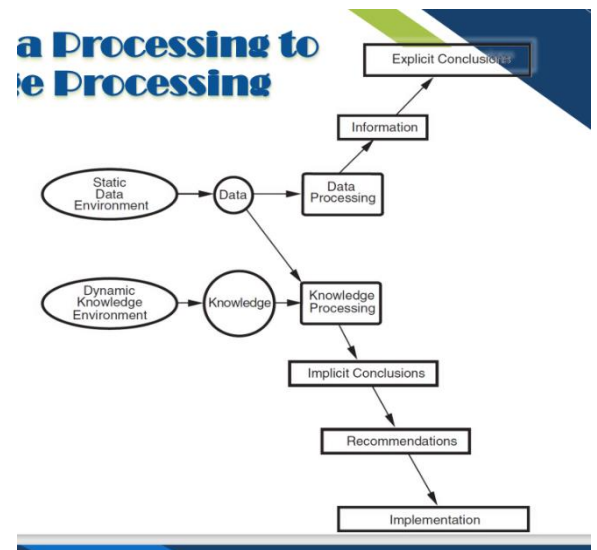
➤ Expert Systems Characteristics:

1. Human expertise is very scarce.
2. Humans get tired from physical or mental workload.
3. Humans forget crucial details of a problem.
4. Humans are inconsistent in their day-to-day decisions.
5. Humans have limited working memory.
6. Humans are unable to comprehend large amounts of data quickly.
7. Humans are unable to retain large amounts of data in memory.
8. Humans are slow in recalling information stored in memory.
9. Humans are subject to deliberate or inadvertent bias in their actions.
10. Humans can deliberately avoid decision responsibilities.
11. Humanes lie, hide, and die.

➤ Traditional Decision-Support Tools: Are algorithmic in nature and depend only on raw machine power, Depend on facts that may be difficult to obtain, Do not make use of the effective heuristic approaches used by human experts, Are not easily adaptable to changing problem environments, Seek explicit and factual solutions that may not be possible

➤ Benefits of Expert Systems:

1. Increase the probability, frequency, and consistency of making good decisions
2. Help distribute human expertise
3. Facilitate real-time, low-cost expert-level decisions by the nonexpert
4. Enhance the utilization of most of the available data
5. Permit objectivity by weighing evidence without bias and without regard for the user's personal and emotional reactions
6. Permit dynamism through modularity of structure
7. Free up the mind and time of the human expert to enable him or her to concentrate on more creative activities
8. Encourage investigations into the subtle areas of a problem

➢ **Heuristic Reasoning:** The rules of expert heuristics allows the expert to arrive at a good solution quickly and efficiently.
  • Expert systems base (match the human thinking process)
    ▪ **reasoning process**
    ▪ **heuristic inference**

➢ **Search Control Methods:**
  • All expert systems are search intensive.
  • Many techniques have been employed :Branch and bound, pruning, depth-first search, and breadth-first search
➢ **User Interface:** Natural Language ,Explanations Facility in Expert Systems , Data Uncertainties , Application Roadmap ,Symbolic Processing