EXPERT SYSTEMS

HABIB ULLAH QAMAR
MSCS(SE)

LET ME INTRODUCE MYSELF

- Habib Ullah Qamar
- 20 years of CS Expeience
- Lecturer (M.Phil CS) in a Govt. P/G College of Commerce
- Senior Programmer @ Smartesol.com
- YouTuber (theITeducation.com , Knowledge info center)
- Blogger (theITeducation.com, learnhowtoinstall.com, theweeklysports.com, moringainpakistan.com)
- Freelancer, SEO Projects, (DigiSkills.pk)

WHAT IS AN EXPERT?

- A person who is very knowledgeable about or skilful in a particular area.
- Having or involving a great deal of knowledge or skill in a particular area.

Synonyms for *expert*

adept	skillful	professional	able	facile
adroit	trained	savvy	apt	practiced
deft	crack	sharp	big league	qualified
experienced	crackerjack	slick	clever	schooled
skilled	handy	virtuoso	dexterous	

EXPERT SYSTEM?

- A piece of software which uses **databases** of **expert knowledge** to offer **advice or make decisions** in such areas as medical diagnosis.
- In artificial intelligence, an **expert system** is a computer system that emulates the decision-making ability of a human expert.
- Expert systems (ES) are one of the **prominent** research domains of AI. It is introduced by the researchers at **Stanford University**, Computer Science Department.

LETS FIND SOME EXAMPLES..

- Chess Game
- Installation of Windows
- Configuration of a Server
- Monitoring a load balance in networking traffic
- Assemblers in productions
- Patient attendant in ICUs

EXPERT SYSTEM?

- Expert systems are designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as if–then rules rather than through conventional procedural code.

Example: loan officer in a bank

"Decide whether or not to grant a personal loan to an individual."

OK (The loan should be approved.)
COLLAT (The collateral for the loan is satisfactory.)
PYMT (The applicant is able to the loan payments.)
REP (The applicant has a good financial reputation.)
APP (The appraisal on the collateral is sufficiently grater than the loan amount.)
RATING (The applicant has a good credit rating.)
INC (The applicant's income exceeds his/her expenses.)
BAL (The applicant has an excellent balance sheet.)

Facts

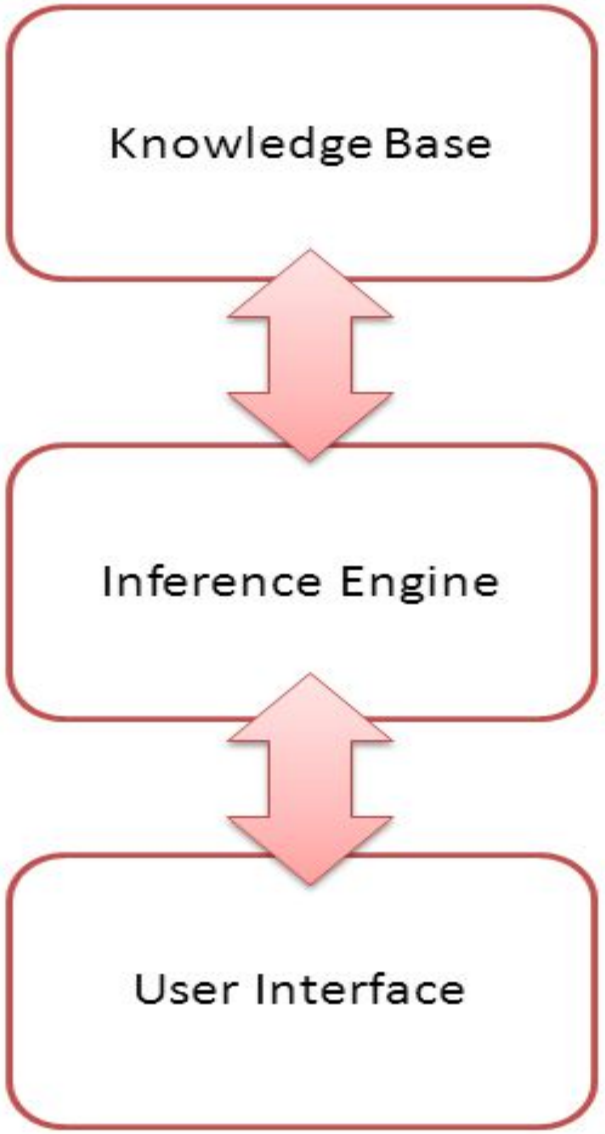
Rules

1. COLLAT ∧ PYMT ∧ REP ⊃ OK
2. APP ⊃ COLLAT
3. RATING ⊃ REP
4. INC ⊃ PYMT
5. BAL ∧ REP ⊃ OK

HISTORY

- The first expert systems were created in the 1970s and then proliferated in the 1980s. Expert systems were among the first truly successful forms of artificial intelligence (AI) software.
- An expert system is divided into two subsystems: the inference engine and the knowledge base.
- The knowledge base represents facts and rules. The inference engine applies the rules to the known facts to deduce new facts.

An Expert System



- A huge organised set of knowledge about a particular subject. It contains facts and judgemental knowledge which gives it the ability to guess like a human
- A set of rules on which to make decisions (using the if-then structure). The Inference engine does reasoning by manipulating the knowledge base
- The user interface presents questions and information to the operator and also receives answers from the operator

ARCHITECTURE

- The knowledge base represents facts about the world.
- In later expert systems developed with commercial shells, the knowledge base took on more structure and used concepts from object-oriented programming.
- The world was represented as classes, subclasses, and instances and assertions were replaced by values of object instances.
- The rules worked by querying and asserting values of the objects.

ARCHITECTURE

- The inference engine is an automated reasoning system that evaluates the current state of the knowledge-base, applies relevant rules, and then asserts new knowledge into the knowledge base.
- The inference engine may also include abilities for explanation, so that it can explain to a user the chain of reasoning used to arrive at a particular conclusion by tracing back over the firing of rules that resulted in the assertion.
- There are mainly two modes for an inference engine: forward chaining and backward chaining.

ARCHITECTURE

- The knowledge base represents facts about the world.
- In later expert systems developed with commercial shells, the knowledge base took on more structure and used concepts from object-oriented programming.
- The world was represented as classes, subclasses, and instances and assertions were replaced by values of object instances.
- The rules worked by querying and asserting values of the objects.

CHARACTERISTICS OF EXPERT SYSTEMS

- High performance
  - Like an expert
- Understandable
  - Rules and answers
- Reliable
- Highly responsive
  - Real time

CAPABILITIES OF EXPERT SYSTEMS

- Advising
- Instructing and assisting human in decision making
- Deriving a solution
- Diagnosing
- Explaining
- Predicting results
- Justifying the conclusion
- Suggesting alternative options to a problem

DO YOU THINK ANY INCAPABILITY OF ES

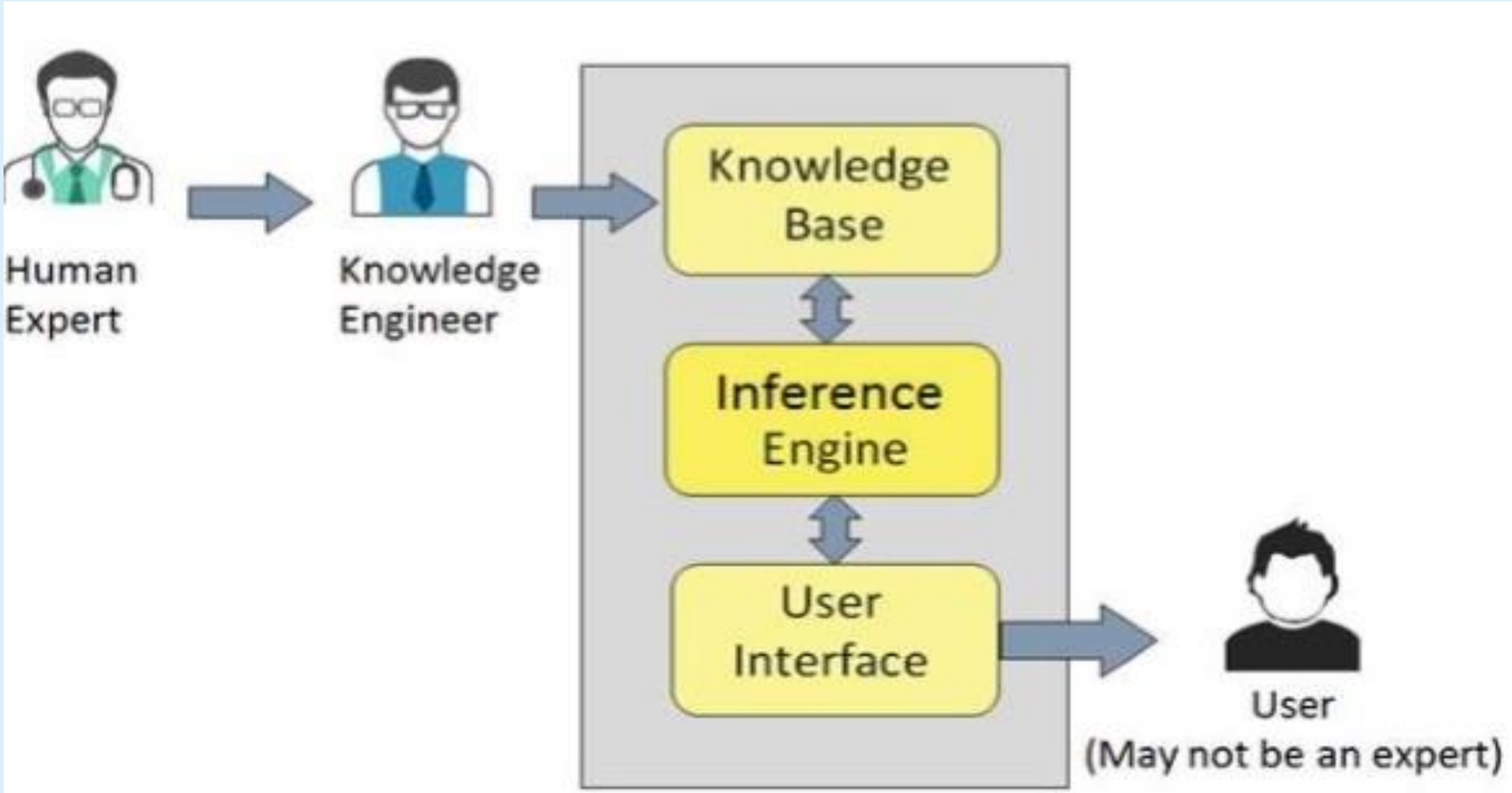
YES ------

NO--------

LIMITATIONS

- Substituting human decision makers
- Possessing human capabilities
- Producing accurate output for inadequate knowledge base
- Refining their own knowledge

COMPONENTS OF ES



KNOWLEDGE ENGINEERING

- Transformation of a human expert knowledge into expert system knowledge base
- **What is Knowledge?**
- **Data, information,** and **past experience** combined together are termed as knowledge.
- The knowledge base of an ES is a store of **both, factual and heuristic knowledge.**
- **Factual Knowledge** − It is the information widely accepted by the Knowledge Engineers for a specific domain.
- **Heuristic Knowledge** − It is about practice, accurate judgment, one's ability of evaluation, and guessing.

KNOWLEDGE REPRESENTATION

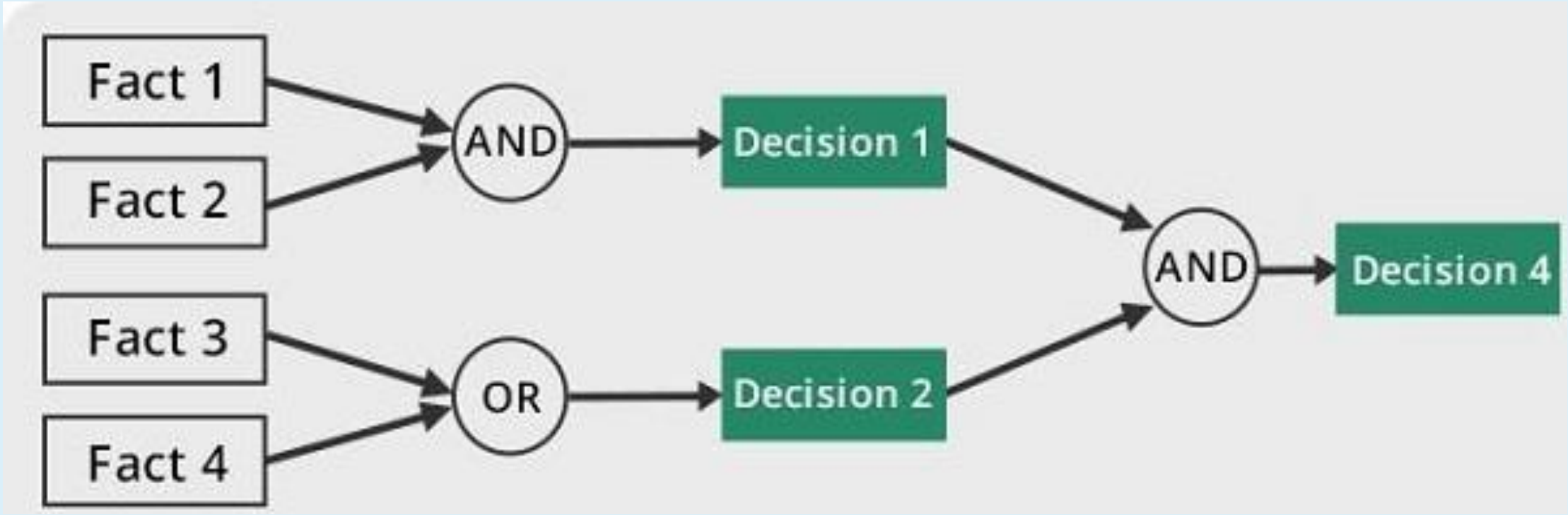
- It is the method used to organize and formalize the knowledge in the knowledge base. It is in the form of **IF-THEN-ELSE** rules.
- **Knowledge Acquisition**
- The success of any expert system majorly depends on the **quality, completeness, and accuracy of the information** stored in the knowledge base.
- The knowledge base is formed by readings from various experts, scholars, and the **Knowledge Engineers**.
- He acquires information from subject expert by recording, interviewing, and observing him at work, etc. He then categorizes and organizes the information in a meaningful way, in the form of IF-THEN-ELSE rules, to be used by interference machine.

INFERENCE ENGINE

- Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct, flawless solution.
- In case of knowledge-based ES, the Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution.
- **In case of rule based ES, it –**
- **Applies** rules repeatedly to the facts, which are obtained from earlier rule application.
- **Adds** new knowledge into the knowledge base if required.

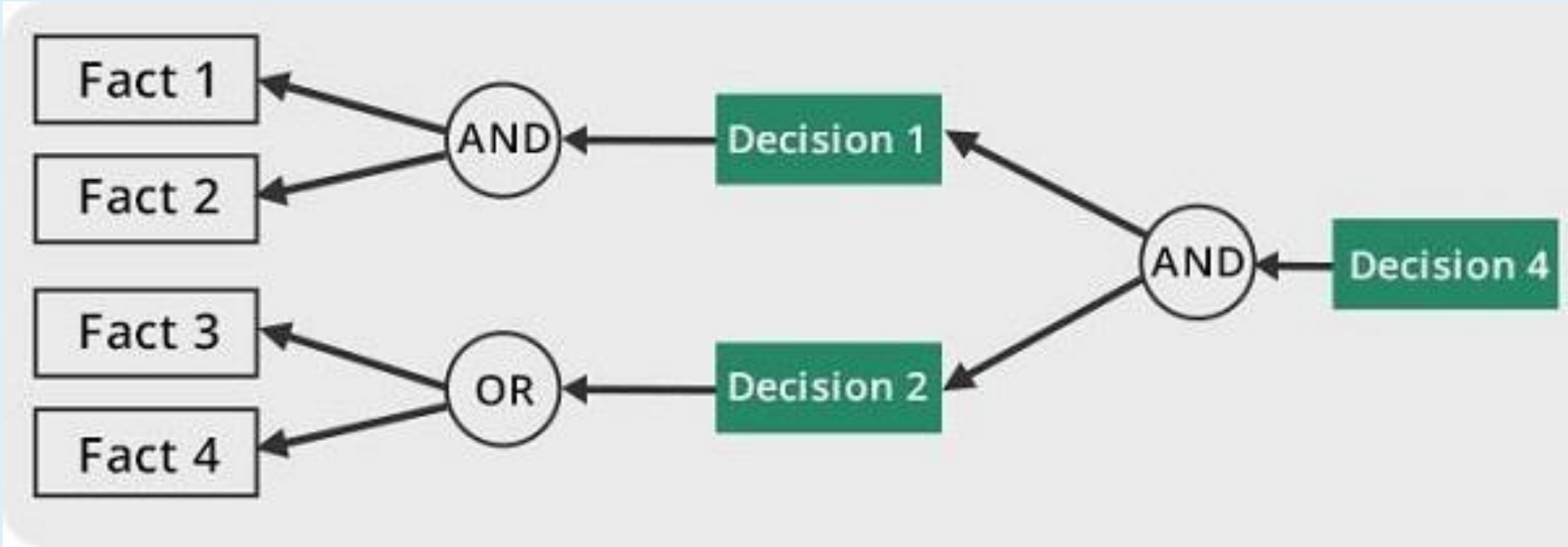
INFERENCE ENGINE STRATEGIES

- Forward Chaining



INFERENCE ENGINE STRATEGIES

- Backward Chaining



EXPERT SYSTEMS LIMITATIONS

- Limitations of the technology
  - –DNA Test Duration
- Difficult knowledge acquisition
  - –Incomplete
- ES are difficult to maintain
  - –Being the complex
- High development costs

EXPERT SYSTEM TECHNOLOGY

- High level Symbolic Programming Languages such as **LIS**t **P**rogramming (LISP) and **PRO**grammation en **LOG**ique (PROLOG).
- Workstation, Mini or mainframe computers
- Java Expert System Shell (JESS)
- *Vidwan*, a shell developed at the National Centre for Software Technology, Mumbai in 1993.

APPLICATIONS OF EXPERT SYSTEM

Application	Description
Design Domain	Camera lens design, automobile design.
Medical Domain	Diagnosis Systems to deduce cause of disease from observed data, conduction medical operations on humans.
Monitoring Systems	Comparing data continuously with observed system or with prescribed behavior such as leakage monitoring in long petroleum pipeline.
Process Control Systems	Controlling a physical process based on monitoring.
Knowledge Domain	Finding out faults in vehicles, computers.
Finance/Commerce	Detection of possible fraud, suspicious transactions, stock market trading, Airline scheduling, cargo scheduling.

STUDY MATERIAL

- https://en.wikipedia.org/wiki/Expert_system
- https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm
- ThelTeducation.com

THANKS .....

HABIB ULLAH QAMAR