

Module 7

Expert system

- computer program designed to solve complex problems & to provide decision-making ability like a human-expert
- It performs this by extracting knowledge from its knowledge base using the reasoning & inference rules according to user queries, facts + heuristics
- (contains expert knowledge of a specific domain & can solve any complex problem of that particular domain)
- performance of an expert system is based on expert's knowledge stored in knowledge base.

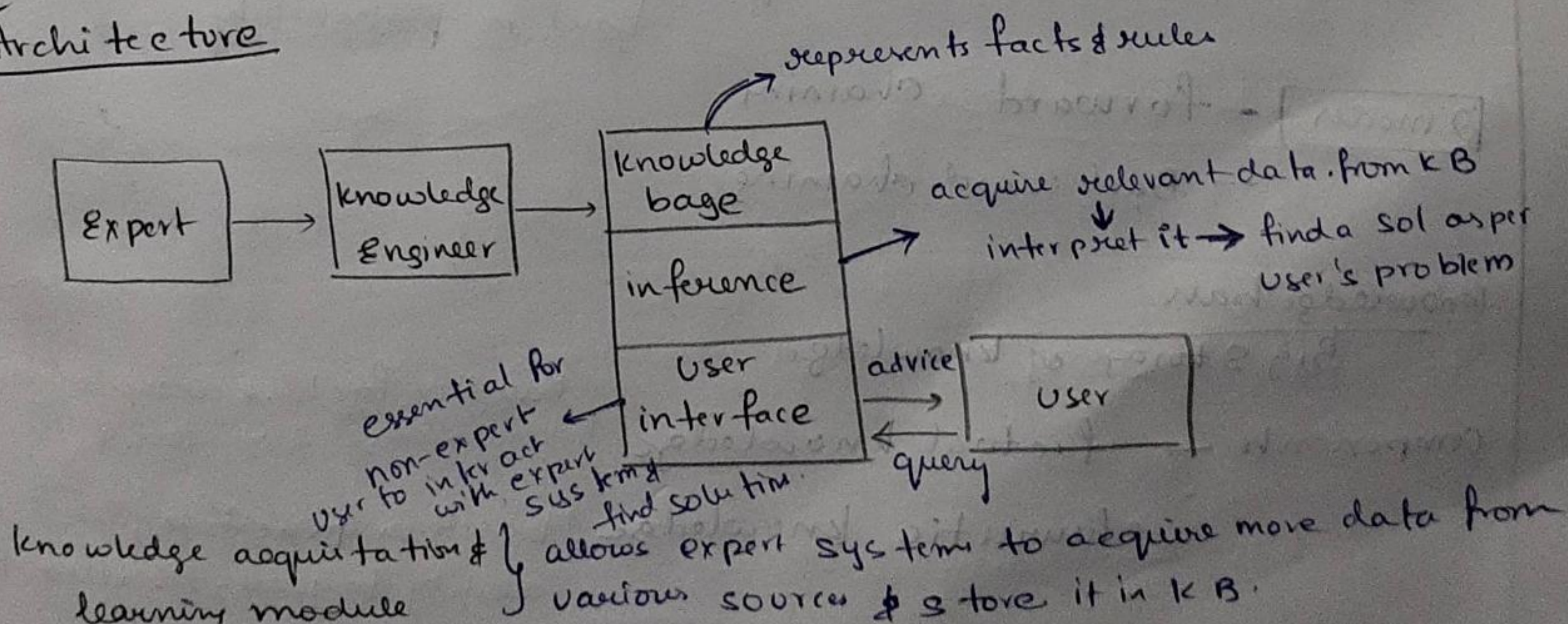
eg: suggestion of spelling errors while typing in google search box

eg: DENDRAL, MYCIN, PODES, CADeT

Typical tasks for expert system

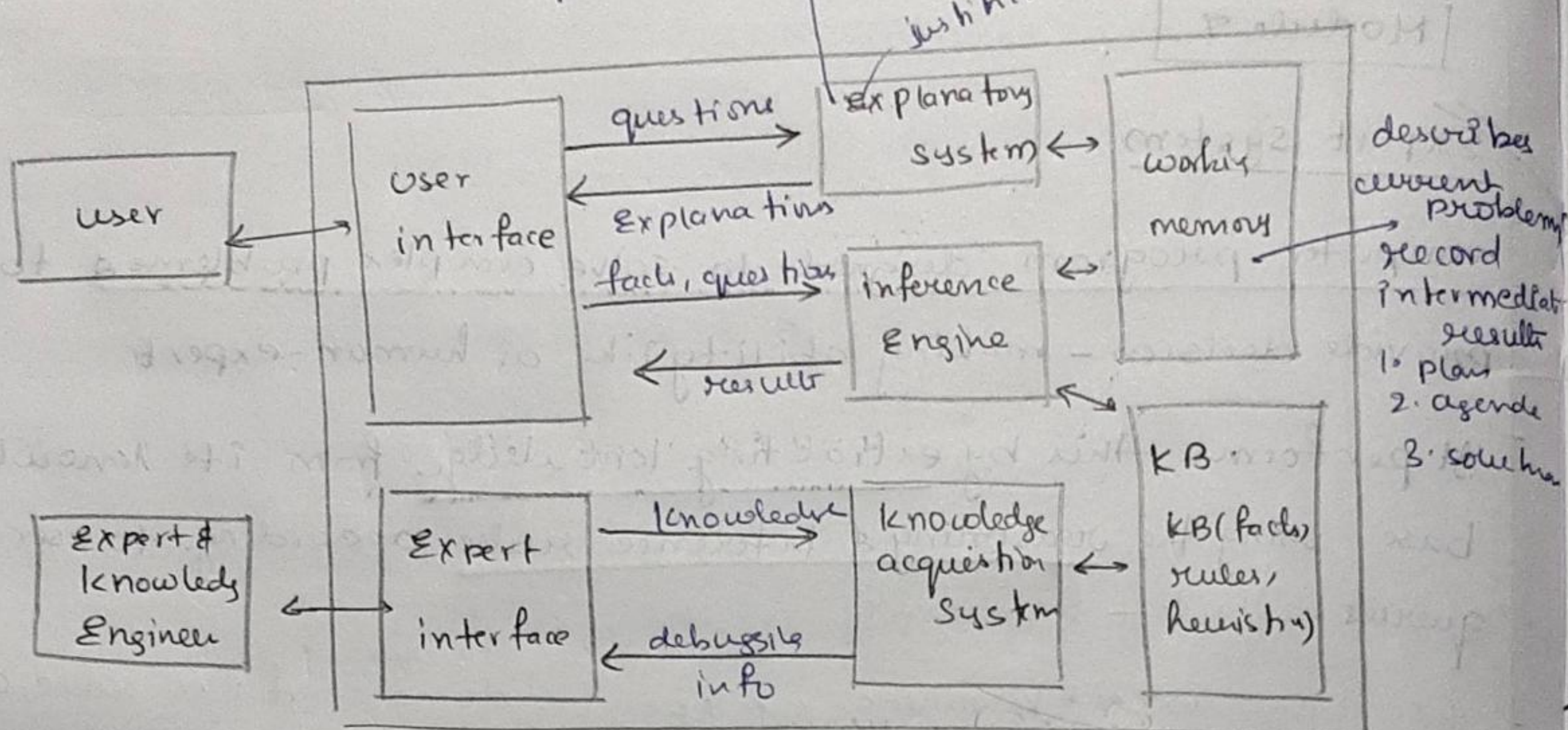
- ① interpretation of data
- ② diagnosis of malfunctions
- ③ structural analysis or configuration of complex objects
- ④ planning sequences of actions
- ⑤ predicting future

Architecture



(12)

explain ES behaviour by interactively answering questions → why? how? what? where? when?



Components

User interface

queries in readable format → inference engine → o/p to user is displayed.

Inference engine

brain / main processing unit of system.

helps in deriving error-free solution of queries asked by user.

applies inference rules to KB to derive conclusion / deduce new info

2 types → deterministic { conclusions drawn are true by facts & rules }

→ probabilistic { contain uncertainty in conclusions based on probability }

2 modes → forward chaining

→ Backward chaining

Knowledge base

Big storage of knowledge

Components → factual knowledge { based on facts & accepted by knowledge engineers }

heuristic knowledge { based on practice, ability to guess, evaluation & experience }

Characteristics

- ① high performance (↑ efficiency & accuracy)
- ② understandable (response is understandable to user)
(i/p & o/p are in human language)
- ③ Reliable
- ④ highly responsible & provides result for any complex query within a very short period of time

Capabilities

- ① advising (capable to advise human beings)
- ② provide decision-making capabilities
- ③ demonstrate a device. (demonstrating device's features, specifications how to use, etc)
- ④ problem-solving
- ⑤ Explaining a problem (capable of providing detailed description of an input problem)
- ⑥ Interpreting a problem
- ⑦ predicting results
- ⑧ diagnosis

Advantages

- | | |
|--|---|
| <ol style="list-style-type: none"> ① no memory limitations ② high efficiency ③ Expertise in a domain ④ Not affected by emotions (performance is steady) ⑤ high security ⑥ considers all facts ⑦ regular updates improve performance | <ul style="list-style-type: none"> • highly reproducible • can be used for risky places where human presence is not safe • error possibilities are less if KB contains correct knowledge |
|--|---|

disadvantages

- response might be wrong if KB contain wrong info
- like human, it cannot produce creative output for diff scenarios
- maintenance & development cost \uparrow
- knowledge acquisition for designing is diff.
- for each domain, we require a specific ES.
- ES cannot learn from itself, hence requires manual updates (maintenance cost \uparrow)
- Even in case of emergency, we need to follow all the initial steps to get output/response

Stages of development

{ time consuming, requires team of several people }

① Identification

describe with as much as precision as possible, the problem that system is intended to solve

determine exact nature of problem, ~~st~~ state the precise goals

indicate how we expect system to contribute to solution

② Conceptualization

focused on understanding problem

analyze the problem.

knowledge engineer frequently creates diagram of problem to depict graphically the relationships b/w objects &

processes in problem domain.

Problem $\begin{matrix} \rightleftarrows \\ \rightarrow \end{matrix}$ sub problems

{ find relationships b/w them

③ formalization focused on proposed solution by analysing relationships depicted in prev stage

various technique of knowledge representation, heuristic search, expert tools, Should be known to Knowledge Engineer.

④ implementation

formalized concepts are programmed onto computer.

using pre determined techniques & tools to implement a "first pass" proto type of expert system.

first prototype: "throw-away" system { useful for evaluation program but hardly usable expert system }

⑤ Testing

provides opportunities to identify weakness in structured implementation of system & to make appropriate correction.

Roles of Expert systems (or) applications

- In designing & manufacturing domain

broadly used for designing & manufacturing physical devices such as cameras lenses & automobiles

- Knowledge domain

used for publishing relevant knowledge to users

two popular ES used for this domain → advisor.
tax advisor

- Finance domain

used to detect type of possible fraud, suspicious activity
advice bankers that if they should provide loans for
business or not

- In diagnosis & troubleshooting of devices

- Planning & Scheduling of some particular task for achieving goal of that task