Artificial Intelligence

Case Based Reasoning

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Chapter Description

- Expected Outcomes
  - Student able to review the case based reasoning concept
  - Student able to analyse and apply solution to a given cased based reasoning problem

- References
  - ……..

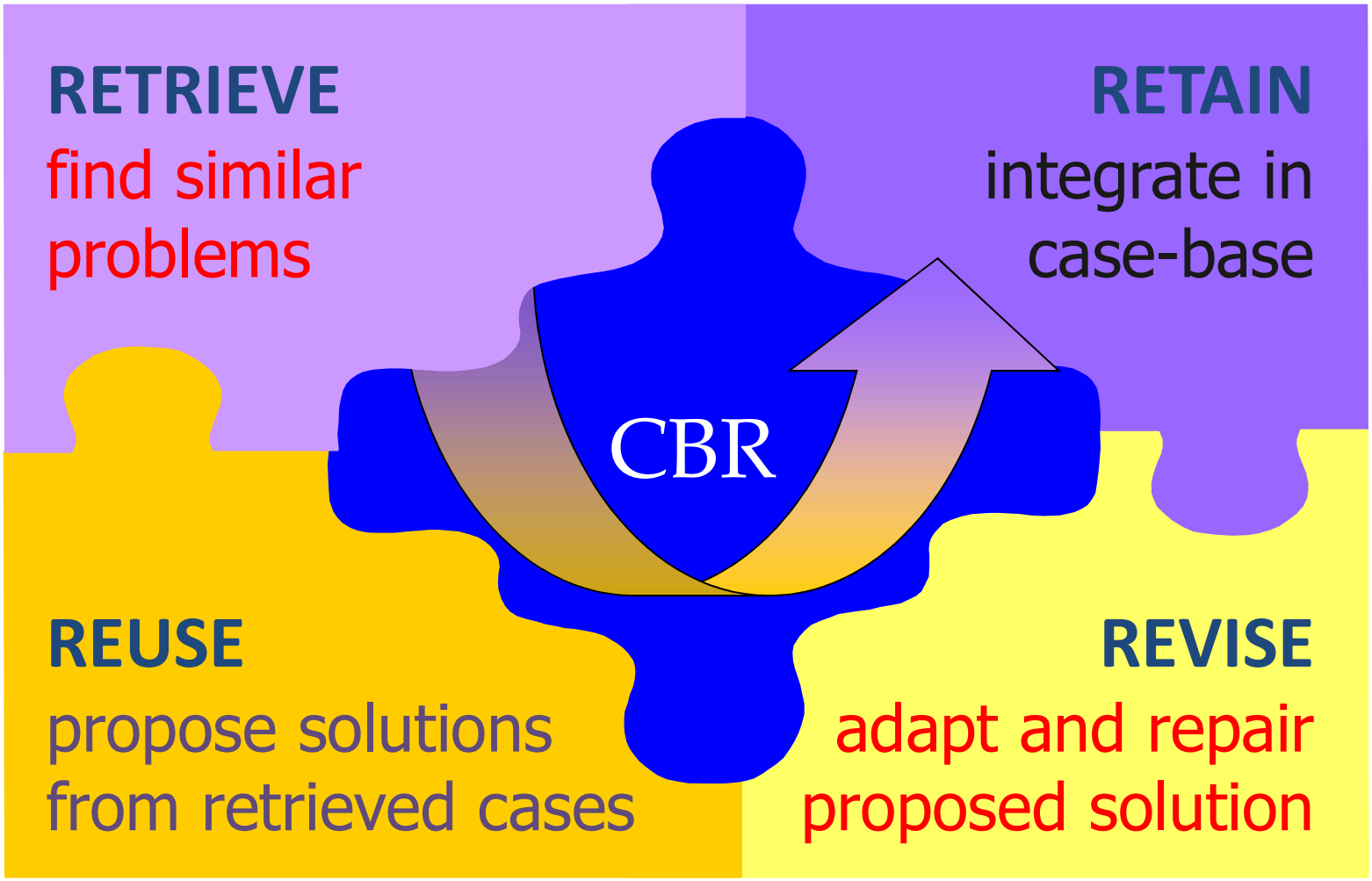
Content #1

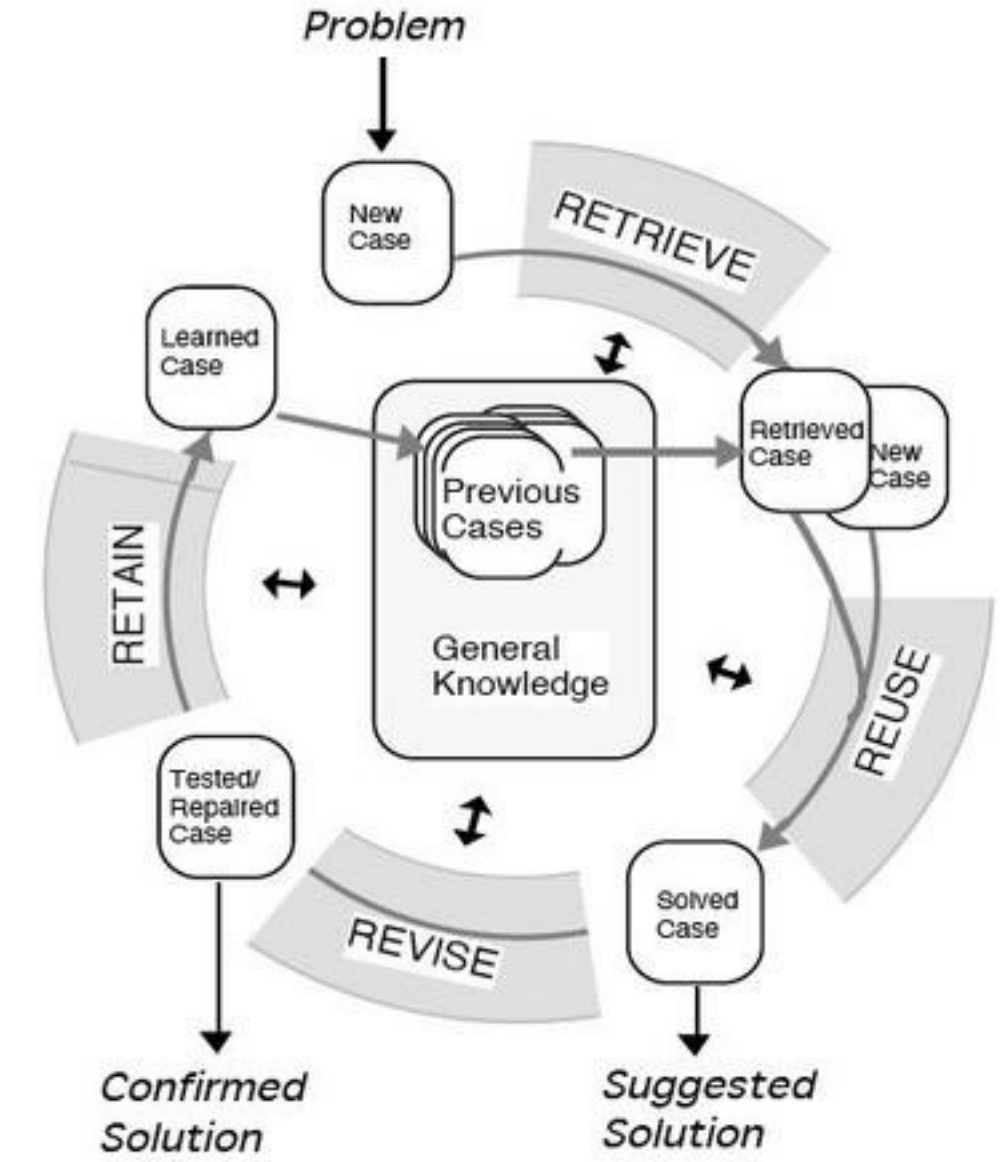
- Case based reasoning cycle
- Retrieval
- Reuse
- Revise
- Retain

What You'll Learn

- Case-Based Reasoning (CBR)
  - Overview of CBR
  - CBR Cycle & System
  - Similarity in CBR
  - Case-based vs. Rule Base Expert System: Knowledge Representation
  - Type of Applications

CBR Cycle


RETRIEVE
find similar problems
RETAIN
integrate in case-base
CBR
REUSE
propose solutions from retrieved cases
REVISE
adapt and repair proposed solution



The CBR Cycle - by Agnar Aamodt and Enric Plaza

Retrieval

- Similarity measure are used in the CBR retrieval process

What is Similarity measure?

- Similarity measure is used in problem solving and reasoning to match a previous experience/case (case-base) with the new unseen problem to find solution.
- Purpose of similarity:
  - Select cases that can be adapted easily to the current problem
  - Select cases that have (nearly) the same solution than the current problem

What is Similarity measure?

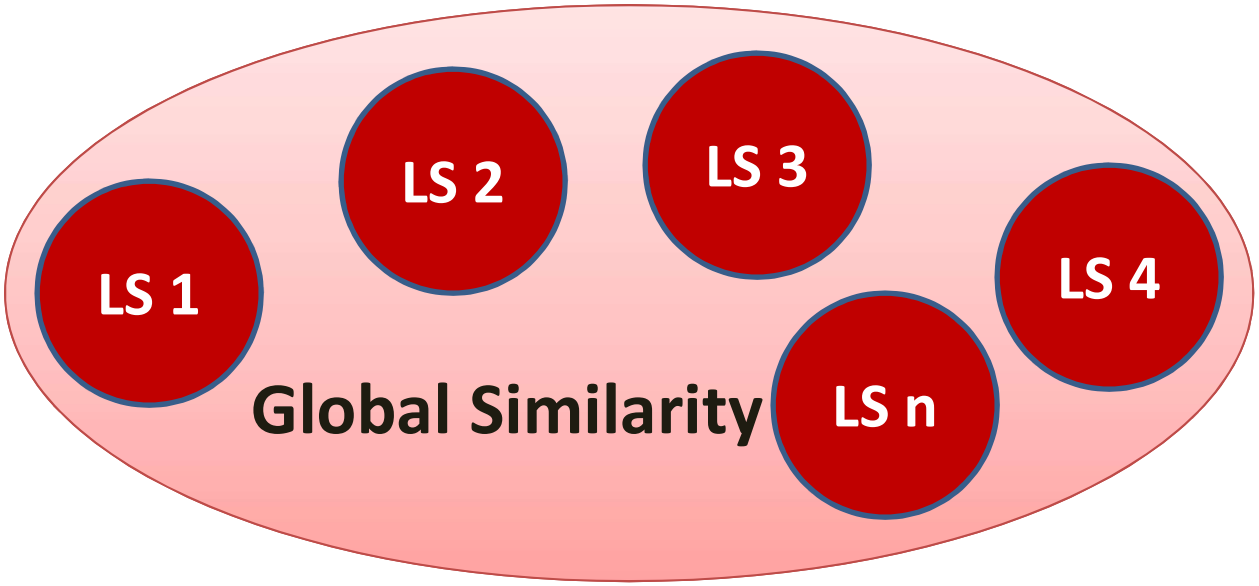
- Basic assumption: **similar problems have similar solutions**

Similarity

- There are two type of similarity:-
  - Local Similarity
    - Used to compute the similarity between query (new problem) and case attributes values – **feature level**
  - Global Similarity
    - Global similarity is a build up from number of local similarity function. It is a weight sum of the local similarity – **case/object level**

Similarity

The similarity measurement for local similarity is calculate between each attributes values, while Global Similarities is calculated between each cases.



Relationship between Local (SL) & Global Similarities

Local Similarity – Discrete

- The formula is:-

$$sim\,(a,b) = \begin{cases} 1 & if\ a = b \\ 0 & if\ a \neq b \end{cases}$$

Where,

a is new feature, and
b is previous features.

Local Similarity – Continuous

- The formula is:-

$$sim(a,b) = 1 - \frac{|a-b|}{range}$$

Where,

a	is new feature,
b	is previous features, and
$range$	is the value of difference between the upper and lower boundary of the set.

Global Similarity

$$sim(A,B) = \frac{1}{\sum w_i} \cdot \sum_{i=1}^{p} w_i \cdot sim_i(a,b)$$

Where,

A	is new case,
B	is previous cases,
a	is new feature from local similarity,
b	is previous features from local similarity,
p	is the number of attributes,
i	is the iteration
w_i	is weight of attributes i $\sum_{i=1}^{p} w_i = 1$, and
sim_i	is local similarity calculate for attribute i.

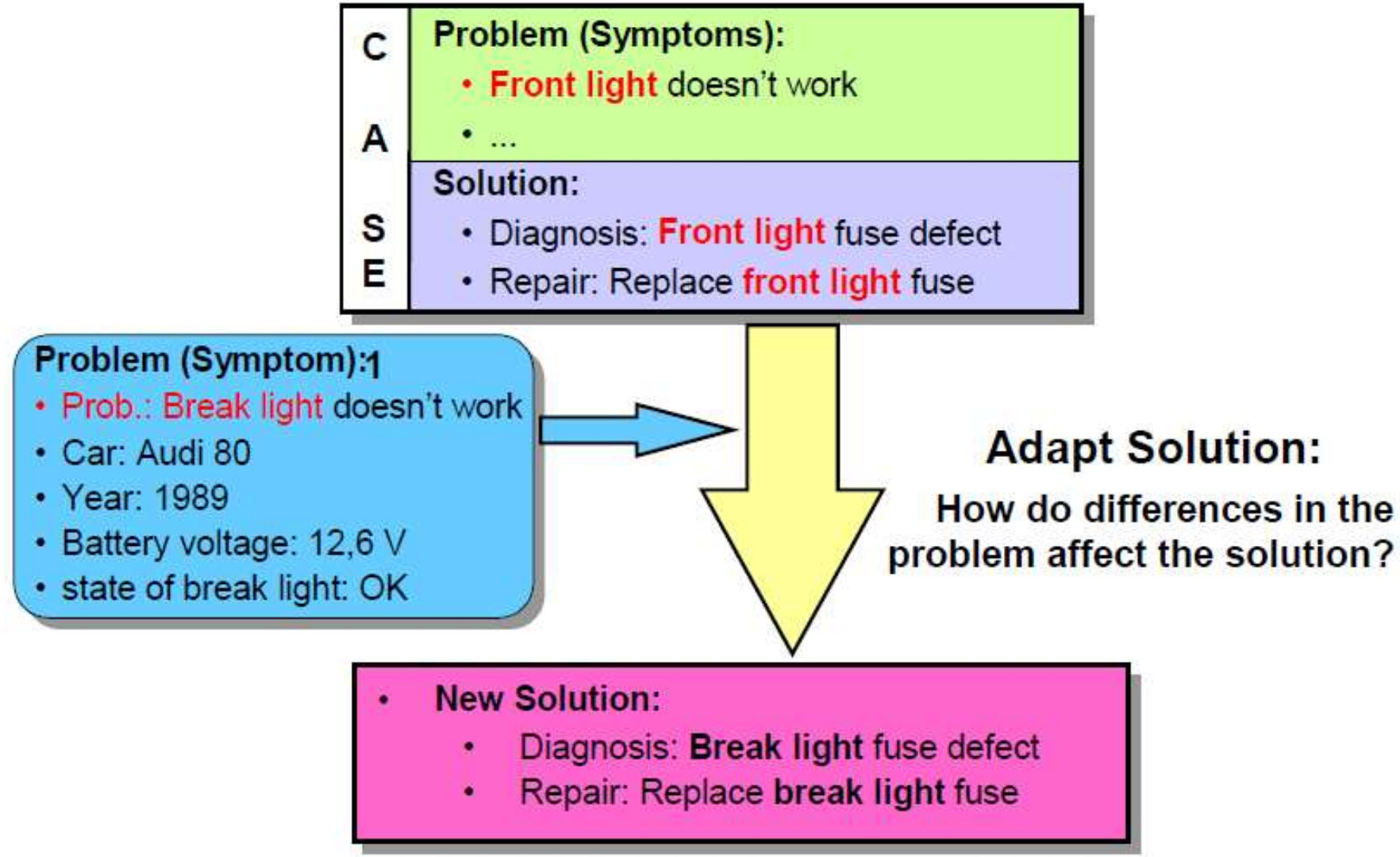
Reuse

- Different option available:-
  - **No modification** of the solution: ***just copy***
  - **Manual/interactive** solution adaptation by the user
  - **Automatic** solution adaptation
    - **Transformational Analogy:** transformation of the solution
    - **Derivational Analogy:** replay of the problem solving trace
    - **Compositional adaptation:** combine several cases to a single solution

Revise

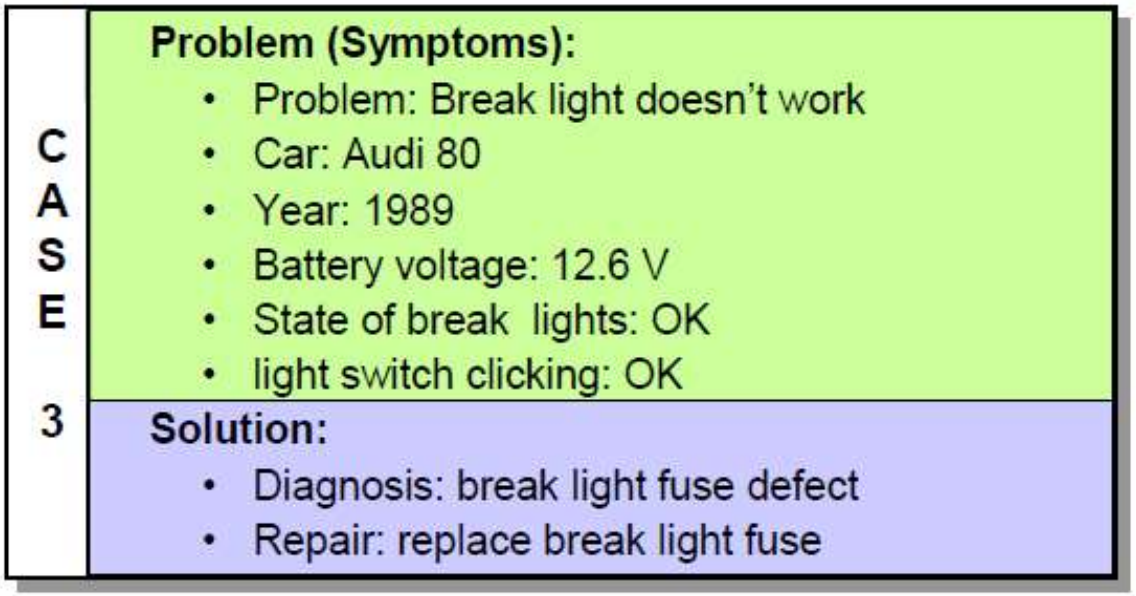
- **Revise phase:**
  - No revise phase
  - Verification of the solution by computer simulation
  - Verification / evaluation of the solution in the real world
- **Criteria for revision**
  - Correctness of the solution
  - Quality of the solution
  - Other, e.g., user preferences

Revise the Solution of Case 1



Retain

- If the diagnosis is correct: Store it to the **case-base**



Conclusion of The Chapter

- Conclusion #1
  - CBR cycle consist of four phase :- retrieval, reuse, revise and retain
- Conclusion #2
  - Retrieval used local and global similarity to find similar problem
- Conclusion #3
  - Reuse used the solution from the similar problem case
- Conclusion #4
  - Revise process modify the solution to suit the solution
- Conclusion #5
  - Retain phase stored the new case and solution to the knowledge storage