# CBR and CADET SYSTEM

# Case-based reasoning

- Instance-based methods
  - lazy
  - classification based on classifications of near (similar) instances
  - data: points in n-dim. space
- Case-based reasoning
  - as above, but data representted in symbolic form
- New distance metrics required
- In **case-based reasoning**, the training examples, the **cases**, are stored and accessed to solve a new problem. To get a prediction for a new example, those cases that are similar, or close to, the new example are used to predict the value of the target features of the new example

# CADET SYSTEM: Example of CBR

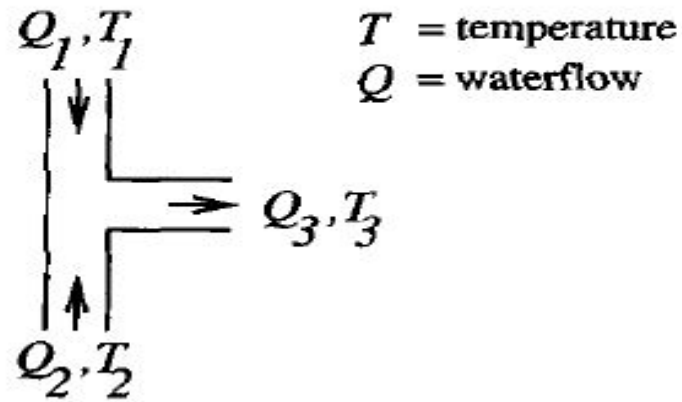
- The CADET system employs casebased reasoning to assist in the conceptual design of simple mechanical devices such as water faucets. It uses a library containing approximately 75 previous designs and design fragments to suggest conceptual designs to meet the specifications of new design problems. Each instance stored in memory (e.g., a water pipe) is represented by describing both its structure and its qualitative function.

- New design problems are then presented by specifying the desired function and requesting the corresponding structure. The top half of the figure shows the description of a typical stored case called a T-junction pipe. Its function is represented in terms of the qualitative relationships among the waterflow levels and temperatures at its inputs and outputs.

- In the functional description at its right, an arrow with a "+" label indicates that the variable at the arrowhead increases with the variable at its tail. For example, the output waterflow Q3 increases with increasing input waterflow Ql.

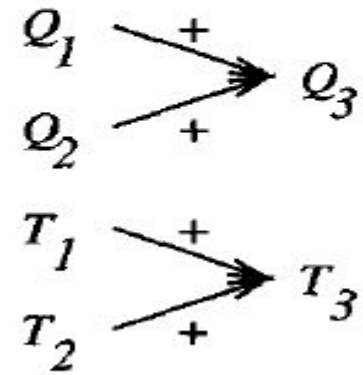
**A stored case:** T–junction pipe

Structure:




$T$ = temperature
$Q$ = waterflow

Function:

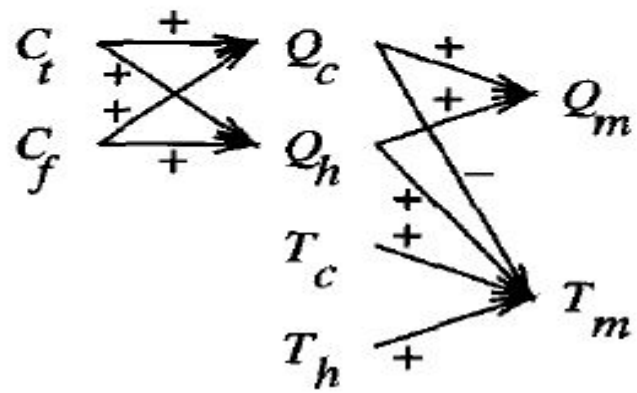



**A problem specification:** Water faucet

Structure:

?

Function:



- The bottom half of this figure depicts a new design problem described by its desired function. This particular function describes the required behavior of one type of water faucet.

- Here Q, refers to the flow of cold water into the faucet, Qh to the input flow of hot water, and Q, to the single mixed flow out of the faucet. Similarly, T,, Th, and T, refer to the temperatures of the cold water, hot water, and mixed water respectively. The variable C, denotes the control signal for temperature that is input to the faucet, and Cf denotes the control signal for waterflow. Note the description of the desired function specifies that these controls C, and Cf are to influence the water flows Q, and Qh, thereby indirectly influencing the faucet output flow Q, and temperature T,.

- Given this functional specification for the new design problem, CADET searches its library for stored cases whose functional descriptions match the design problem. If an exact match is found, indicating that some stored case implements exactly the desired function, then this case can be returned as a suggested solution to the design problem. If no exact match occurs, CADET may find cases that match various subgraphs of the desired functional specification.

# Case Based Learning (CBR)

1. Retrieve- Gathering from memory an experience closest to the current problem.
2. Reuse- Suggesting a solution based on the experience and adapting it to meet the demands of the new situation.
3. Revise- Evaluating the use of the solution in the new context.
4. Retain- Storing this new problem-solving method in the memory system.

# Lazy & eager learning

- Lazy: generalize at query time
  - kNN, CBR
- Eager: generalize before seeing query
  - Radial basis, ID3, …
- Difference
  - eager *must* create global approximation
  - lazy *can* create many local approximation
  - lazy can represent more complex functions using same H (H = linear functions)