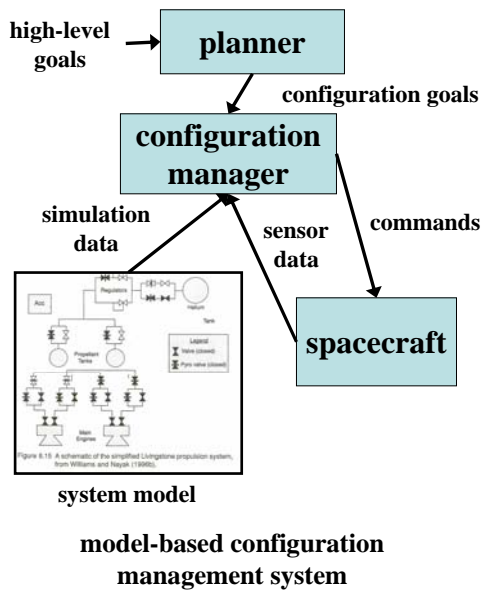




## NASA deep space probes



Cassini spacecraft

- must continue to function for many years in harsh conditions
- inevitably, system parts will fail, and design cannot consider all contingencies
- communication lag may prevent earth-based solution
- dynamically reconfigure parts to respond to failures – understand ability of parts to play different roles

## Model-Based Reasoning

### Advantages:

- Use of functional/structural knowledge of the domain
- Tend to be robust and flexible, due in part to ability to handle unanticipated problems
- Basic scientific/theoretical knowledge sometimes transferable to other tasks
- Can provide causal explanations that convey deep understanding of problem

### Disadvantages:

- Lack of experiential, descriptive knowledge of the domain
- Requires explicit domain model of normal functioning as well as behavior in the presence of faults
- High complexity, in part due to detailed modeling process
- Vulnerable to exceptional situations, such as unexpected fault behavior that cannot be predicted

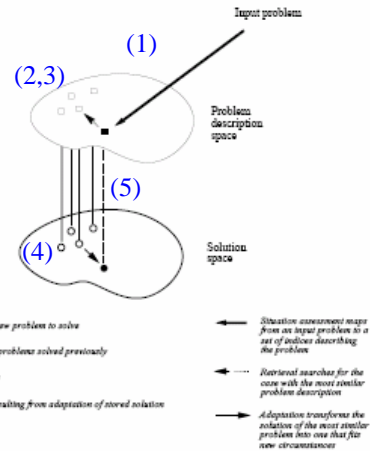
## Case-based reasoning systems

**Primary knowledge source:** stored cases (e.g. past problems & solutions)

**To find solution to new problem:** retrieve most relevant cases from memory and adapt solutions to fit new situation

### case-based problem-solving

- (1) situation assessment
- (2) retrieve most relevant case(s)
- (3) assess similarities/differences between old and new problems
- (4) adapt old solution to fit new problem
- (5) save new problem and solution



**case-based interpretation: (1)-(3)**

## Case-based legal expert systems



*AI am the law*  
The Economist

### Principle of Precedent

“Then there is the doctrine of precedent, one of my favourite doctrines. I have managed to apply it at least once a year since I’ve been on the Bench. The doctrine is that whenever you are faced with a decision, you always follow what the last person who was faced with the same decision did. *It is a doctrine eminently suitable for a nation overwhelmingly populated by sheep.* As the distinguished chemist, Cornford, said, “The doctrine is based on the theory that nothing should ever be done for the first time.”

Lionel Murphy (1979)  
*The Responsibility of Judges*

“... the notion that a computer can predict the course of judicial decision rests on assumptions that are demonstrably untenable, does violence to the very nature of law, and is moreover certain to blunt the professional techniques of any lawyer who relies on machines rather than his own powers of reasoning and advocacy”

Frederick Bernays Wiener (1962)  
*Decision Prediction by Computers: Nonsense Cubed – and Worse*

## **Case-Based Reasoning**

### **Advantages:**

- Ability to encode historical knowledge directly, from multiple sources
- Allows shortcut in reasoning if related problem can be found
- Can avoid past errors and exploit past successes
- Extensive analysis of domain knowledge is not required
- Knowledge acquisition and coding are relatively easy
- Appropriate indexing strategies add insight and problem solving power

### **Disadvantages:**

- Cases lack a deep, functional knowledge of the domain
- Explanation facilities are limited
- Large case base adds challenge to storage and search processes
- Difficult to formulate good criteria for indexing and matching of cases