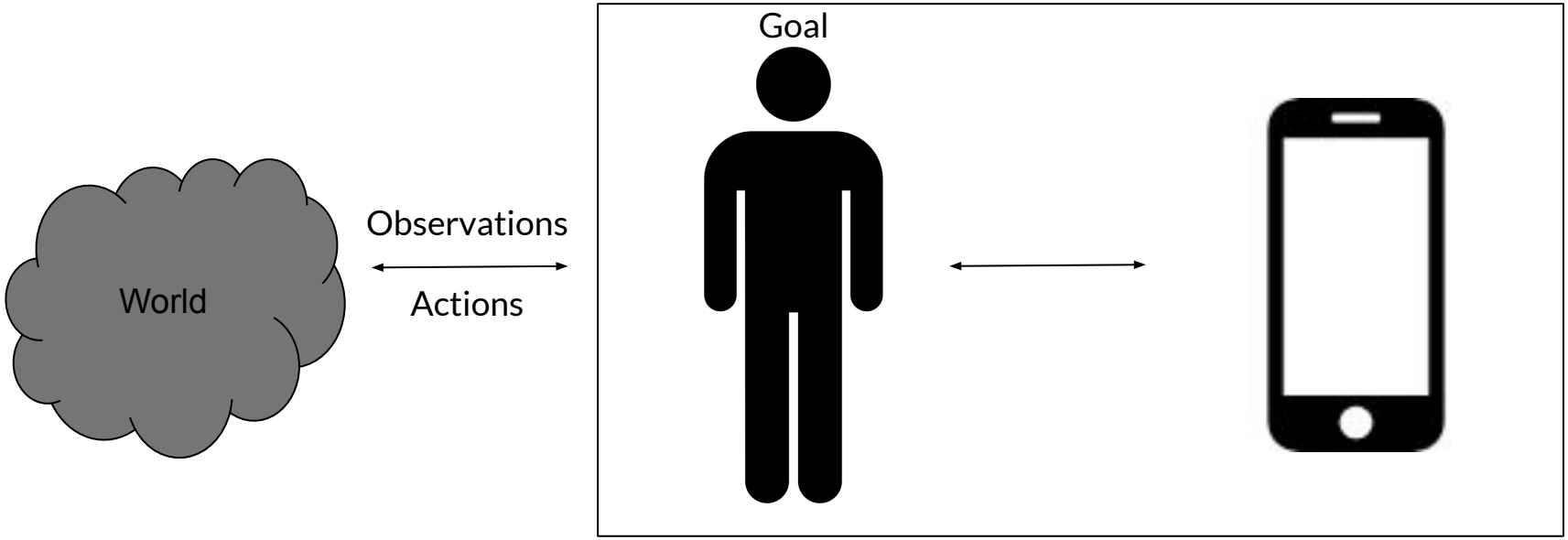
Abstract Model Generation in Interactive Consultant

Pierre Carbonnelle, G. Janssens, M. Denecker
KULeuven

Build a machine to help professionals make better decisions

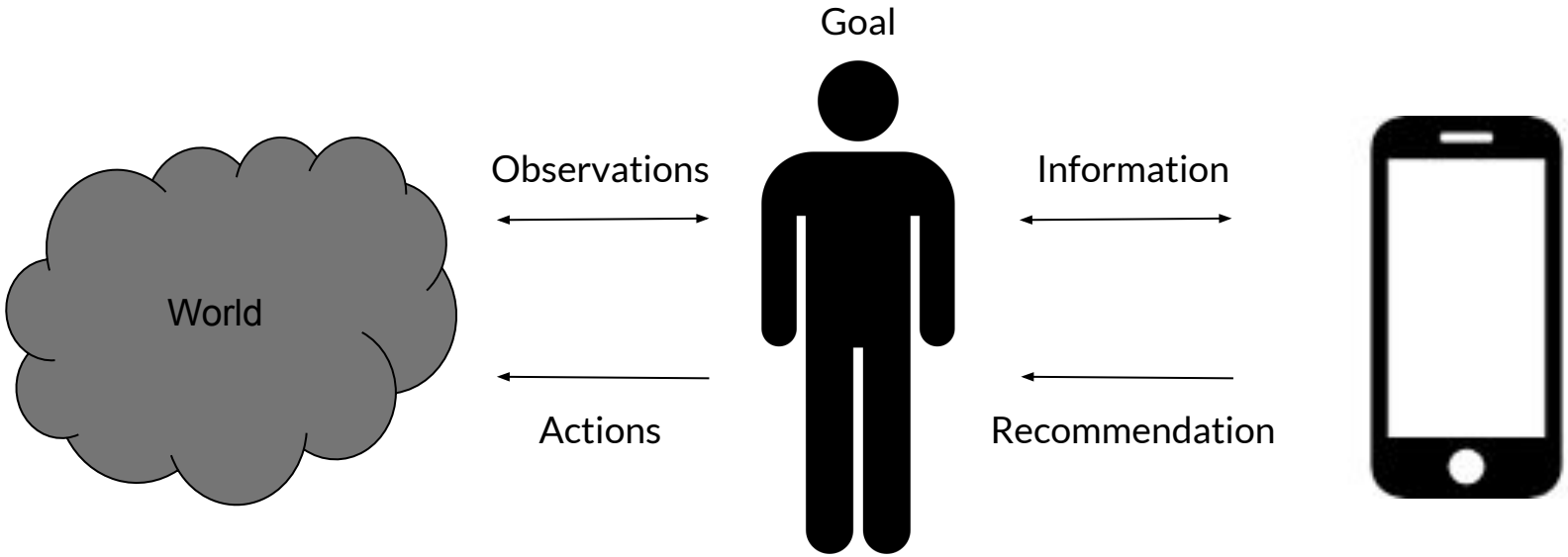
Joint cognitive model for decision making

(Woods 1985)



Exploit the complementarity of man and machine

Strengths



+ Observation
+ Abstraction
+ Heuristics

+ Rigorous reasoning
+ Perfect memory

What can human bring ?

+ Observation
+ Abstraction
+ Heuristics

Humans can provide these information to the machine:

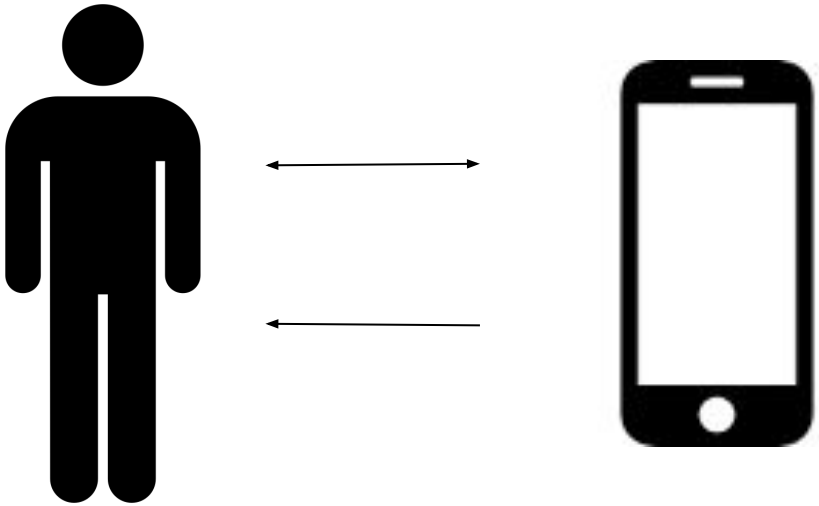
(Abstract)

- What is the vocabulary to describe a situation ?
- What are the laws to be respected ?
- What are the rules of thumb to solve the problem ?

(Concrete)

- What are the particulars of the situation at hand ?
- What are tentative answers or reasonable hypothesis ?

A common language



English ?

Structured English ?

First Order logic with arithmetic

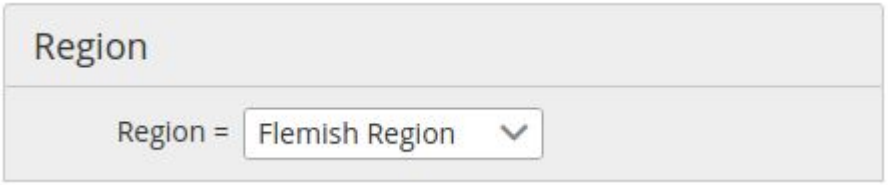
In Abstract mode

"The tax rate is 6 % when registering the sale of a building for social purpose in the Flemish region."

```
Tax_Rate = 6% ⇔
  ( Registration_Type = Social_Purpose
  ∧ Region = Flemish_Region
  ).
```

Each abstract information provided by the user
is a **constraint** on the possible solutions.

In Concrete mode




```
Region = Flemish_Region.
```

Each concrete information provided by the user
is a **constraint** on the possible solutions.

How can the machine help ?

+ Rigorous reasoning
+ Perfect memory

The machine could answer questions such as:

- What can be deduced from what we already know ?
- What are the remaining options ?
- What could / should be investigated next ?
- How can we maximize the “utility” ?
- How do we justify the decision ?

Each of these questions require a different kind of inference on the same set of constraints:

- consequences of what we know → Propagation
- remaining options → Abstract models
- to be investigated → Relevance
- maximize utility → Optimisation
- justify → Explain

SMT solver !

Demo

Abstract Models

The Mental Model Theory

(Johnson-Laird, 1991)

We, human, do not reason by applying the logical laws of inference.

We reason by constructing mental models of the possible worlds.

We can save the user some mental effort
by constructing these models of the possible worlds.

```
Tax_Rate = 6% ⇔
  ( Registration_Type = Social_Purpose
  ∧ Region = Flemish_Region
  ).
```

Registration_type	Region	TaxRate
= Social_Purpose	= Flemish_Region	= 6%
≠ Social_Purpose		≠ 6%
= Social_Purpose	≠ Flemish_Region	≠ 6%

Demo