Uncertainty and vagueness in knowledge based systems

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1 General Considerations of uncertainty and vagueness

1.1 Modeling ignorance

Ignorance arises from a restricted reliability of technical devices, from partial knowledge, from insufficiencies of observations or from other causes.

In the sequel we distinguish between two different types of ignorance: **uncertainty** and **vagueness**.

Vagueness arises whenever a datum, although its meaning is not in doubt, lacks the desired precision.

Uncertainty, on the other hand, corresponds to a human being's valuation of some datum, reflecting his or her faith or doubt in its source. This concept covers those cases in which the actual state of affairs or process is not completely determined but where we have to rely on some human expert's subjective preferences among the different possibilities.

the basic intention of any model is to reflect properties of the real world, i.e. to enable the prediction of a system's behavior in the real world.

a model can never be verified, and the only reasonable argument for its validity is that all efforts to falsify it have failed.

2 Introduction

2.1 Basic notations

Ω *universe of discourse* or *frame of discernment*. $\widehat{\emptyset}$

Definition 2.1. A set Ω' is called a *refinement* of Ω if there is a mapping $\widehat{\Pi} : 2^{\Omega} \to 2^{\Omega'}$ s.t.

1. $\widehat{\Pi}(\{\omega\}) \neq \emptyset$ for all $\omega \in \Omega$
2. $\widehat{\Pi}(\{\omega\}) \cap \widehat{\Pi}(\{\omega'\}) = \emptyset$, if $\omega \neq \omega'$
3. $\bigcup \left\{ \widehat{\Pi}(\{\omega\}) | \omega \in \Omega \right\} = \Omega'$
4. $\widehat{\Pi}(A) = \bigcup \left\{ \widehat{\Pi}(\{\omega\}) | \omega \in A \right\}$

$\widehat{\Pi}$ is called a *refinement mapping*. If such a mapping exists, then the sets Ω and Ω' are compatible, and the refined space Ω' is able to carry more information than Ω. Ω is a *coarsening* of Ω'

Definition 2.2. Let