Intelligent System Facilitating Service Selection

SYLVIA ENCHEVA
Stord/Haugesund University College
Department Haugesund
Bjørnsonsg. 45, 5528 Haugesund
NORWAY

SHARIL TUMIN
University of Bergen
IT-Dept.
P. O. Box 7800, 5020 Bergen
NORWAY

Abstract: Decision making rules an intelligent agent is applying for deriving suppliers' service quality dimensions are investigated in this paper.

Key–Words: Decision support system, intelligent agents

1 Introduction

In order to further improve the efficiency of a ship-building process we propose use of an automated decision support system. Most automated decision support systems are based on binary logic, i.e. a responce is either positive or negative. One of their disadvantages is that they do not treat incomplete or inconsistent information. Application of many-valued logic allows the system to handle situations with inconsistent and/or incomplete input. In this paper we present decision making rules an intelligent agent is applying for evaluating a ship designer's reliability.

The rest of the paper is organized as follows. Related work and statements from many-valued logic may be found in Section 2 and Section 3 respectively. The main results of the paper are placed in Section 4. The system architecture is described in Section 5. The conclusion is placed in Section 6.

2 Background

Lukasiewicz has devised a three-valued calculus whose third value, $\frac{1}{2}$, is attached to propositions referring to future contingencies [12]. The third truth value can be construed as 'intermediate' or 'neutral' or 'indeterminate' [15], [13], and [14].

The semantic characterization of a four-valued logic for expressing practical deductive processes is presented in [2]. In most information systems the management of databases is not considered to include neither explicit nor hidden inconsistencies. In real life situation information often come from different contradicting sources. Thus different sources can provide inconsistent data while deductive reasoning may result in hidden inconsistencies. The idea in Belnap's approach is to develop a logic that is not that dependable of inconsistencies. The Belnap's logic has four truth values 'T, F, Both, None'. The meaning of these values can be described as follows:

- an atomic sentence is stated to be true only (T),
- an atomic sentence is stated to be false only (F),
- an atomic sentence is stated to be both true and false, for instance, by different sources, or in different points of time (Both), and
- an atomic sentences status is unknown. That is, neither true, nor false (None).

The four truth values are arranged in a logical lattice [2] in Fig. 1. A logical conjunction and logical disjunction are related to the meet operation and to the join operation respectively.

Extensions of Belnap's logic are discussed in [5] and [11].

Logic in preference modeling is discussed in [3], [10], and [13]. In [6] it is shown that additional reasoning power can be obtained without sacrificing performance, by building a prototype software model-checker using Belnap logic.

Python applications are known for increasing overall efficiency in the maritime industry [8].

3 Preliminaries

A lattice is a partially ordered set, closed under least upper and greatest lower bounds:

- the least upper bound of α and β is called the join of α and β, and is sometimes written as $\alpha + \beta$,

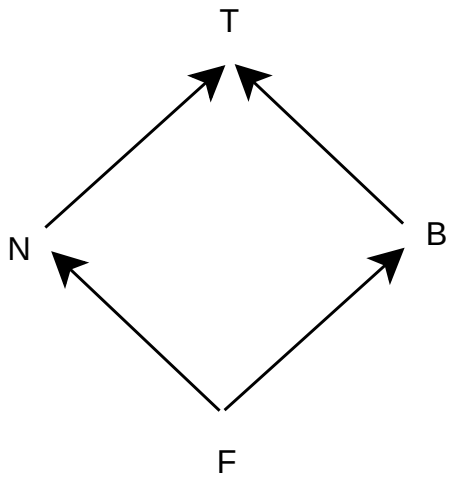

Figure 1: Logical lattice

- the greatest lower bound is called the meet and is sometimes written as $\alpha\dot{\beta}$.

A billatice is a set equipped with two partial orderings $\leq_t$ and $\leq_k$.

- The t partial ordering $\leq_t$ means that if two truth values ϕ, ψ are related as $\phi \leq_t \psi$ then ψ is at least as true ϕ.
- The k partial ordering $\leq_k$ means that if two truth values ϕ, ψ are related as $\phi \leq_k \psi$ then ψ labels a sentence about which we have more knowledge than a sentence labeled with ϕ.

4 Application

Quarries via Web services are sent to two independent databases about a ship designer reliability. What an agent should recommend if the responses are like *'reliable (r), unreliable (ur)'* or *'reliable, no answer (na)'* ?

Our proposal:

- – Input responses $\rightarrow \{r, r\}$.
  – Agent's output $\rightarrow$ recommended.
- – Input responses $\rightarrow \{r, na\}$.
  – Agent's output $\rightarrow$ consult a third database.
- – Input responses $\rightarrow \{r, ur\}$.
  – Agent's output $\rightarrow$ inquire about the reasons in the database with a negative response and consult a third database.
- – Input responses $\rightarrow \{na, na\}$.
  – Agent's output $\rightarrow$ consult new databases.
- – Input responses $\rightarrow \{ur, na\}$.
  – Agent's output $\rightarrow$ consult a third database and then conclude.
- – Input responses $\rightarrow \{ur, ur\}$.
  – Agent's output $\rightarrow$ find another ship designer.

5 System Architecture

A communication framework based on JSON remote procedure call (JSON-RPC) written in Python is used to connect the Web server middleware and the Web application server together. JSON stands for JavaScript Object Notation and it is a lightweight data-interchange format. It is more compact then XML without sacrificing expressiveness. JSON structure is perfect for packaging and sending data in RPC request and reply messages.

The application server provides search and intelligent evaluation services to the Web server. The separation of these two units made it possible to modularly design and implement the system as loosely coupled independent sub-systems. The purpose of the search agent is to search for different reviews from independent reviewers about a particular ship designer. This process will eventually build a database of ship designers' capabilities and reliability reviewed by different reviewers.

By providing a client Web interface, the system invites reviewers to submit their reviews of ship designers they have had experience working with. The user authenticator and user profiler modules play an important role in controlling every particular user, client or administrator authenticity. Only valid reviewers can submit reviews. The administrator can approve the results of a search agent before the data is submitted to the database.

The purpose of the intelligent evaluator is to rank the ship designers' capability and reliability at any one time in response to users' queries.

6 Conclusion

Many-valued logic has been used to support a decision making process. Such systems can evaluate the key points in the process of shipbuilding - dimensions, hydrodynamic performance, speed, stability, seakeeping, cargo carrying capacity, propulsion systems, passengers and environment safety standards, and fuel consumption.

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