Formalization of Expert Knowledge About the Usability of Web Pages Based on User Criteria Aggregation

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ABSTRACT

The Choquet integral based on fuzzy measure is a generalization of the weighted average operator. Due to flexibility in the aggregation of information and ability to take into account possible uncertainties in data the integral has been gaining popularity in the application of multicriteria decision making. In this paper an application of fuzzy integral is considered in the method of expert knowledge formalization about the usability of web pages. Also the problem of identification of fuzzy measures for aggregating user criteria is presented. Examples of assessments for 9 main usability criteria of web pages and results of web pages evaluation of 25 sites of leading universities in the world according QS ranking are provided.

KEYWORDS

Aggregation Operators, Choquet Integral, Expert Knowledge, Formalization, Fuzzy Measure, Human-Computer Interaction, University Rankings, Usability, Usability Ranking, User Interface

INTRODUCTION

Only fifteen years ago for making a decision (in any field: choice of a vacation, shopping, cures for diseases, etc.) an individual usually relied on personal experience and information taken from various print sources as well as the experience of parents and friends. But at the beginning of new century, the main source of such information “de facto” became the Internet (Barber & Paul, 2013).

In the global network can be found web pages containing expert information varying degrees of competence and a large number of electronic versions of printed sources of varying quality. Therefore more acute become a question of professional assessment of usability and reliability of such sources of information in a global network. On the other hand, the user can formulate semantic criteria and their method of aggregation to create a generalized criterion for evaluating the properties of a source of information to select the source on the basis of their preferences and intuitive senses (Fischer et al., 2015; Horiuchi et al., 2015).

Thus, to evaluate the usability of information sources is an actual question related to the formalization of this assessment expertise. In this paper the question of formalization of expertise in assessing the usability of web pages by aggregating user criteria using fuzzy aggregation operator Choquet (Choquet integral) is being reviewed. And by using this method the Universities’ Usability Ranking of 25 best universities in the world is created.

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USABILITY EVALUATION CRITERIA

User evaluation criteria of the usability of web pages can be formulated in different ways, depending on the purpose of the assessment and the particular expert (Fernandez et al., 2011). Usually these criteria are divided into several groups (Dubey et al., 2012). From these criteria groups, in turn, in accordance with the logic of the expert a hierarchy can be constructed. Consider such a hierarchy and each of the criteria-user based on (Chiou et al., 2010).

In order to achieve a simple and easy viewing a web page, it must meet several criteria: first, it is clear visual hierarchy of the page for the user, which denoted by $G_1$. It includes the following several components (input criteria): $g_{11}^1$ - the degree of “isolated” or “underline” the most important elements on the page; $g_{12}^1$ - assessment of the condition “if the items are part of each other logically, they should be submitted as an attachment”; $g_{13}^1$ - degree of relatedness visual elements that are linked logically.

Second, utilization per page established conventions, general rules will be called $G_2$. A criterion consists of two input criteria: $g_{21}^2$ - a clear indication of the active elements; $g_{22}^2$ - application of the standard notation and conventions (understandable in any language).

Third, the measure of separation of the web page to crisp the field for the user to comfortably navigate in these areas will be denoted $G_3$. The criteria include the following components: $g_{31}^3$ - application of template “search, categories, content”; $g_{32}^3$ - the use of reticulated layout.

Fourth, the presence of image noise level, will be denoted $G_4$. This criterion includes the following components: $g_{41}^4$ - measure “congestion” page elements; $g_{42}^4$ – the degree of presence of background noise. Figure 1 examples of known web pages are illustrated each of these criteria. Consider the example of qualitative reasoning of the expert concerning the aggregation in given criteria. Obvious that some of these criteria are correlated, in particular $G_1$ and $G_2$. Intuitively, if the web page has the property of clear visual hierarchy, then most likely, the designer has taken care of a good division of its contents on the crisp areas. Similarly, criteria $g_{21}^2$ and $g_{22}^2$ correlated, since it is clear that if the web page is created with the use of the standard notation and conventions, it is likely that there are clearly marked on the active element.

In accordance with the qualitative reasoning expert, if the web page is sufficiently possesses the property $G_1$, i.e., the most important elements are well marked and highlighted, in such circumstances, the criterion $g_{31}^3$ becomes more important to assess the clarity of visual hierarchy $G_1$, than the criterion $G_2$, since in this case the hyperlink “the most important element - its component parts” will be more user-friendly than visually unrelated, but adjacent to the selected element of its most important constituent parts. This phenomenon is known as the preferred dependence criteria. It is known (Grabisch & Rusinowska, 2013) that no additive aggregation operators, including average, does not allow to formalize such expert arguments. In addition, the expert notes that in determining the presence of image noise a measure of “congestion” page elements is more important than the degree of background noise presence.

Arguments of experts of such kind can be quite complex and ambiguous, depending on the particular expert opinion. For this reason, the formalization of expertise should allow experts to understand and correct the arguments of each other to end up with a coherent formal model. For this it is necessary to model allows one expert trace the chain of reasoning another expert and adjust it in...
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