Web Adaptation Using Fuzzy Logic: Integrating Services, User Reviews and Business Processes

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Structure of presentation…

- Aims of our research
- Background
  - Introduction to Web Adaptation Related work
  - Using Fuzzy Logic in Web Adaptation
  - Modelling Services, User Reviews and Processes for Web Adaptation
- Prototype Example
- Conclusions

Aims of presentation

- To discuss how fuzzy logic can be used in web adaptation.
- To present how to integrate service, user reviews and business processes modelling.

Background …

Main objectives of web personalisation

- To provide personalised information content in personalised format
- To personalise web interface and navigation
- To suggest special offers to selected online users-customers
- To collect and analyse data and to investigate user behaviour.
- To develop a ‘human face’ for the web.

Main objectives of web personalisation For example, they provide…

- Customised local weather reports, favourite links and special offers, introduce new pages (content),
- Insert, delete or even highlight hyperlinks (navigation), change the format of specific points in a page (presentation).
- Create a different version of the site for each user or for different user groups

Web personalisation involves three main steps

1) User behaviour data collection regarding their **services** consumption, **UGC** (TF-IDF, etc.) i.e. reviews and **business processes** and tasks that generate services and the content that falls within users' interests
2) **Analysis** of user data.
3) **Recommendation** of personalised content and personalised presentation.

Web Personalisation and Adaptation

The adaptation of web systems includes:

- **Content Personalisation**: WHAT TO SHOW, i.e. adaptive content configuration and recommendation.
- **Presentation Personalisation**: HOW TO SHOW, i.e. adaptive navigation, search, and adaptive presentation.

Presentation personalisation

Attempts to solve the problem of **how to present** selected content based on its relevance, so that the user's attention is drawn to the most relevant information and **how to select the most appropriate type of media** to deliver the content.

Presentation personalisation

- Priority on focus, i.e. the techniques **emphasise** the content that is considered as the most relevant to the needs of the current user.
- Priorities on context, i.e. the techniques **allow or restrict user access** to information based on the content relevance to current user priorities.

Presentation personalisation techniques

Customise media types, e.g. (text, icon, photo, and video) according to user profile, content, etc

- Make use of
  - strechtext,
  - dimming,
  - thumbnail summaries.
- Hyperlinks dynamic structures
- Augmented Reality and Virtual Reality

There are five groups of factors that can influence the choice media and they may be considered during presentation media adaptation

factors that can influence the choice media I

- **User-specific features**, which refer to users representation preferences, abilities and accessibility matters. For example, a user may prefer graphical to text presentations.
- **Information features**, which imply that not necessarily all media are equally appropriate for presenting a piece of information. For example expressing a price tag with text is preferred to the use of sound.

factors that can influence the choice media II

- **Contextual information** pertaining to user environmental conditions, such as noise, light, weather, speed, etc that may affect presentation quality to the user.
- **Media constraints**, referring to the need to effectively combine media to increase the quality of presentation.
- **Limitations of technical resources**, that relate to device limitations such as screen size, bandwidth, etc.

Web Personalisation Technologies

Software Technologies for Web Adaptation and Service Customization

- Check-Box Personalization
- Tracking Services and Clickstream Analysis
- Content-Based Filtering
- Collaborative-Based Filtering

Using Fuzzy Logic in Web Adaptation

Fuzzy Concepts in Web Adaptation

The content, media, window size, location, colours, etc. parameters that define web interface are subjective and of fuzzy nature. For example,

The **degree to which a users prefers a service** (e.g. highly, medium, etc),

The **appropriateness of each media** in displaying a piece of information (high, medium, etc)…

Assume the 5 areas on a web page


Area 2
Area 5
Area 1
Area 3
Area 4

Each Web page area may be associated with a customisable window size

- Area 1 Very large
- Area 2 Large
- Area 3 Medium
- Area 4 Small
- Area 5 Very small

A fuzzy algorithm for presentation personalisation and media adaptation

Steps of the Algorithm I

- **Step 1:** Collect User Data
  - **Step 1.1**: Input individual users' services priorities from e.g. a **CRM system**. Preferences are represented with TFNs as a vector.
  - **Step 1.2:** Analyse **User Reviews** and calculate-refine users' preferences.

Modelling User-Customer Services Preferences; The CR Vector

$$C_z R^{S_j}_{SA_{jk_j}} = \left\{ \begin{array}{l} C_z R^{S_j}_{SA_{j1}} \left(e_{j1z}\right), \\ C_z R^{S_j}_{SA_{j2}} \left(e_{j2z}\right), \\ \cdots, \\ C_z R^{S_j}_{SA_{jk_j}} \left(e_{jk_jz}\right), \end{array} \right\}$$

Steps of the Algorithm II

- **Step 2**: Calculate (e.g. with Fuzzy Delphi), the appropriateness degrees of all media types for representing user services, taking into account user preferences.

Using TFNs to

represent the appropriateness of media types for presenting hotel services

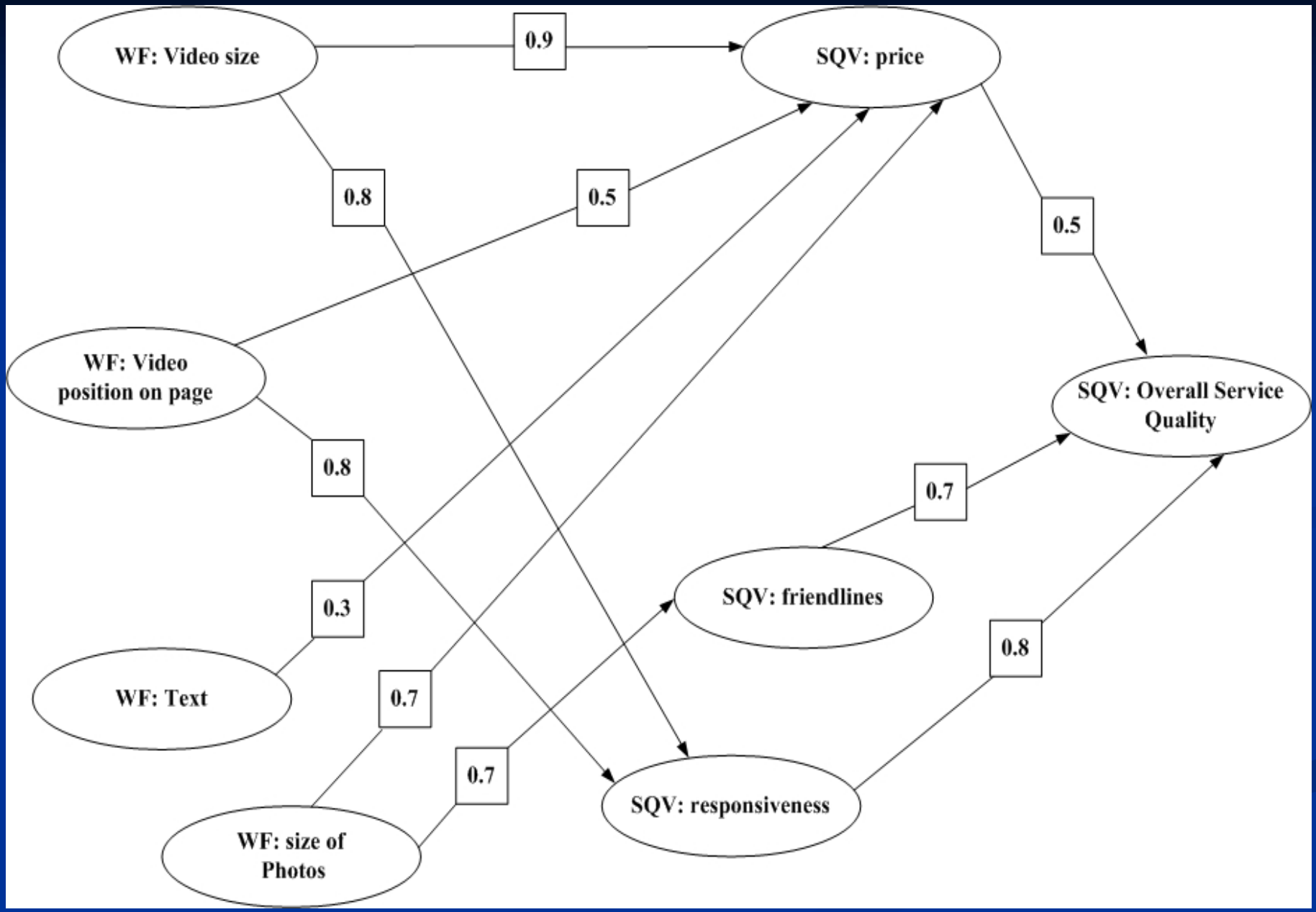
Price-text (0.8, 1, 1)
Price-icon (1, 0, 0.8)
Price-photo (1,0.6,1)
Price-video (1,1,0)

Distant location-text (0.2, 0.8,1)
Distant location-icon (1, 0, 0.7)
Distant location-photo (1, 0.55,1)
Distant location-video (1, 0.1, 0.9)

Swimming pool-text (0, 0.8, 1)
Swimming pool-icon (0, 0.4, 1)
Swimming pool-photo (0, 0.99, 1)
Swimming pool-video (0, 0.9, 1)

Understanding clients' needs-text (0.3, 0.95,1)
Understanding clients' needs-icon (1, 0, 0.5)
Understanding clients' needs-photo (1, 0, 0.8)
Understanding clients' needs-video (1,0.4, 0.5)

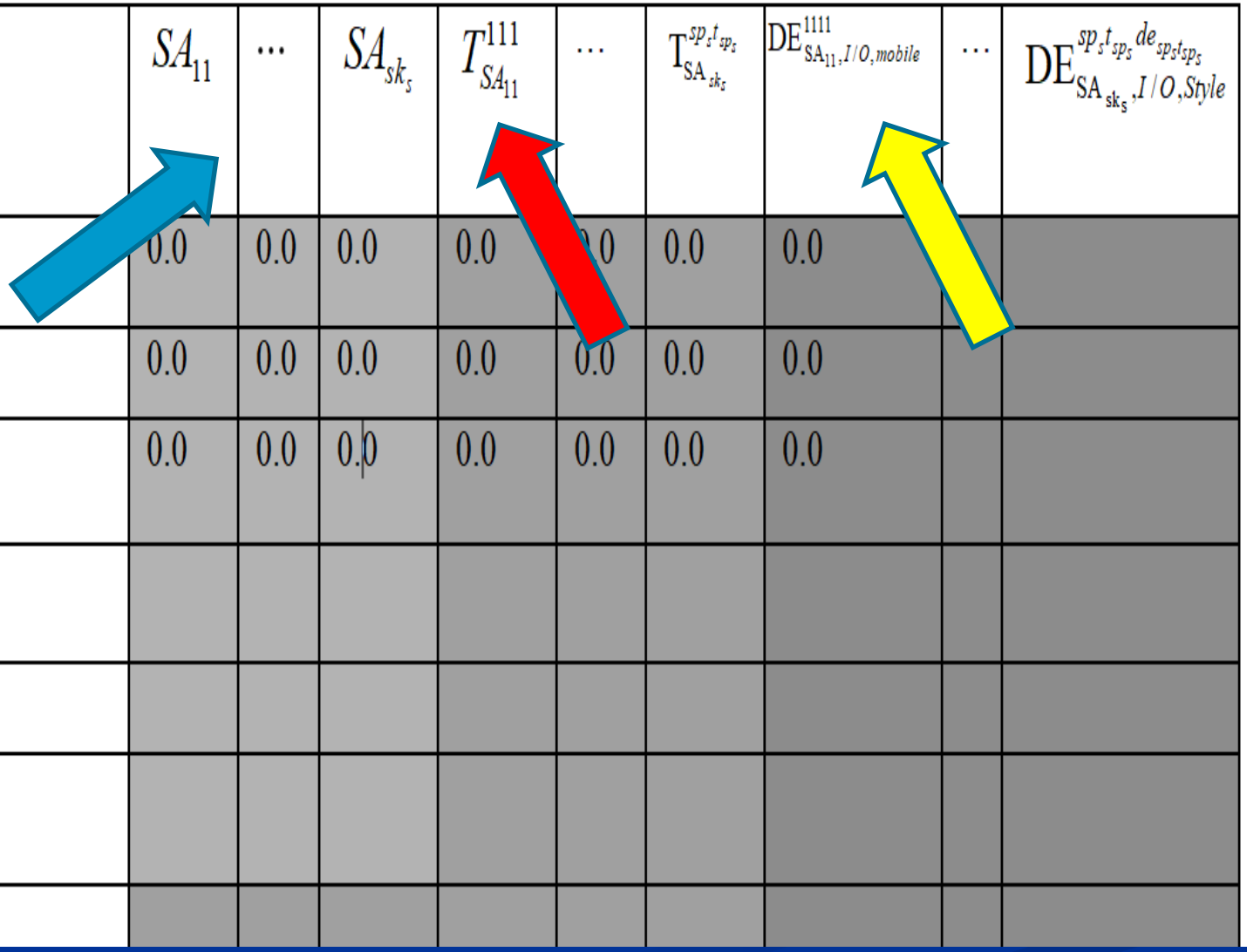
Using FCMs **conceptually link media and services** with their associated degrees of appropriateness


WF: Video size
0.9
SQV: price
0.8
0.5
0.5
WF: Video position on page
SQV: Overall Service Quality
0.8
0.7
0.3
SQV: friendlines
0.8
WF: Text
0.7
0.7
SQV: responsiveness
WF: size of Photos

Price	Balcony View	Room Space	…	Text	Photo	Audio	Video
Price				(0.8, 1, 1)	(1,0.6,1)	(1,0.6,1)	(1,1,0)
Balcony View				(0, 0.6,1)	(0.5, 0.15, 0.8)	(0.7, 1, 1)	(1, 0.9,1)
Room Space							
…							
Text							
Photo							
Audio							
Video							

(the SPDM matrix)

Expand the FCMs to model services, processes(tasks), Media and Data with their associated degrees of appropriateness



SPDM matrix: Integrating Services, Processes, Data, Media

The data entities…

- Are *input data (I)* or *output data (O).*
- The are associated with a *Delivery style* either an *input or an output style*

Delivery styles can be **text, audio, video**, **e-mail, fax, web, mobile, person-to-person**, **Augmented Reality**, etc. They are used to define the communication channel(s) that are used to engage a service with another service or the user.

Steps of the Algorithm III

- **Step 3**: Select media type or a combination of media types for presenting service feature (i), i.e.

- **Based on the FCM theory, Multiply User Preference vector (CR), with the SPDM matrix**.

Modelling User-Customer Services Preferences; The CR Vector

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The CR Vector expands to become identical to a SPDM matrix row, but values are allocated only to cells representing services

A combination of media types

- e.g. a service feature to be presented with text and photo together. So, all media types(j) should be used to present service feature (i), provided that their appropriateness degree $Z_{i,j} > \text{median}(Z_{i,j})$.

Steps of the Algorithm IV

- **Step 4**: Specify the location area and window size on the web page within which, selected service feature Si should be shown.

- Then the most important service features are positioned within area (1), which covers the centre area of a web page. Then the second most important is placed across the top…with least important to be placed in area (5).

Results example:

Service responsiveness is suggested to be shown with a video of large size, located within medium distance from the centre, etc…

Size of Video	Location of Video	Size of Text	Size of Image	Responsiveness
0.72	0.40	0.24	0.56	0.0

Prototype…

http://bilab.aueb.gr/Hotel_Webservice/index.html

Conclusions

- Fuzzy Logic allows for modelling **subjective user preferences**.
- It allows for **representing content with a combination of interface components** (media type, size, location on screen, etc.) that best suit individual user's requirements.
- With FCMs it is possible to **conceptually integrate services and UGC with processes and media** and to investigate their interactions.

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Thank you for your attention