

Expert System for Planning Web Site Promotion Campaigns

Irina Krasteleva
Department of Numerical
Mathematics and Programming,
Moscow Aviation Institute
(Technical University)
Moscow, Russia
irina@krasteleva.com

Dmitri Soshnikov
Department of Numerical
Mathematics and Programming,
Moscow Aviation Institute
(Technical University)
Moscow, Russia
dmitri@soshnikov.com

Abstract

The paper describes an approach of using an expert system for planning promotion campaigns for web sites and optimizing them for promotion. This expert system would to a certain degree substitute human-being expert in the area of web promotion. It would contain knowledge of such an expert in a certain formalized form (a knowledgebase), and a specific reasoning engine to apply that knowledge for planning web promotion campaign for a certain site. Web promotion expert system can be published on a web resource to provide remote consultation for clients through the Internet. This system also contains a plug-in to get additional real-time information from remote web resources on the Internet during the consultation, for example keywords typical to a certain problem domain.

The paper presents some technical aspects of expert system implementation using JULIA toolkit with production-frame knowledge representation, including overall system architecture, structure of the knowledgebase, and different approaches to organizing remote consultation. The paper contains link to working prototype of developed expert system. Some examples demonstrating real-life usages of described expert system in web promotion are given.

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1. Introduction

Internet nowadays is becoming a big advertising market where everybody tries to provide and sell information in the optimal way. In order to maximize profits from any public web resource, it is essential to ensure the popularity of the resource among general Internet users. To enhance public awareness of the resource different promotion methods can be utilized. Web site manager has to spend some amount of time and financial resources to make the web site searchable in search engines and popular among Internet visitors. In most of the cases it is economically beneficial to use services of specialized advertising companies specializing in web promotion. However, for many users price of using web promotion experts is too high, and results of promotion campaign are not guaranteed.

To minimize costs of web promotion it is suggested to involve an automatic system instead of human experts. The main part of this system is the knowledgebase containing knowledge of web promotion experts in some knowledge representation.

What really makes this idea distinct from most of the existing resources in web promotion, is the use of expert system technology, which, instead of following simple pre-determined algorithm, uses the knowledge of the human expert and behaves much in the same way as human expert would in planning the promotion campaign. Expert systems, being one of the most successful areas of Artificial Intelligence, have been applied in many areas of human activities, but it seems that this is the first attempt to use them in web promotion.

Such kind of expert system would benefit from being published on the Internet. It will provide easy and convenient access to this knowledge in the form of remote consultation available to wide audience. Another important advantage of publishing this system on-line is possibility of expert system getting some specific

knowledge or data from remote web resources. The expert system has to contain *internal knowledge*, which is stored in knowledge base, as well as dynamic knowledge, which can be found during the work of the system in the Internet. Using this kind of *external knowledge* helps knowledgebase always provide the newest and actual information.

Such expert system being made publicly available on the web may serve as a preliminary means for the clients to plan their promotion campaign before going to the agency, thus being a very powerful mean of self-advertising and showing the professionalism of web promotion agency.

2. Remote consultation with expert system

Expert systems provide means of knowledge sharing over the Internet. Instead of simple exchange of *static information* typical for most web sites, a web site containing an expert system can provide to visitors interactive consultations, thus applying knowledge contained in the knowledgebase to solving their specific problems. Furthermore, *knowledge sharing* can be used between several expert systems to create a distributed network of interoperating knowledgebases. [7]

The simplest form of knowledge sharing is remote consultation. There are two major types of remote consultations depending on where the inference process takes place: client side inference (thick -client model) and server side inference (thin-client model). [2]

In thick-client model domain knowledge is transferred from the server to the client machine, which then uses its local copy of a knowledgebase to perform inference locally. Thin-client model utilized an opposite approach, which is to transfer not the domain knowledge, but the problem state. In this case the initial information about the problem is represented in some way, and then transferred to the server, which performs the inference, and returns the new problem state to the caller.

In both cases knowledge is concentrated in one knowledgebase, which is either used locally or remotely. The advantage of both of these methods is that updating the knowledgebase has to take place only on the server-side, and there is no need to send new versions of knowledge base to all clients. This is a very important aspect because all commercial knowledgebases have to be updated regularly, thus the remote consultation is the best solution for web promotion systems.

3. Expert system for planning web site promotion campaigns

A prototype of web promotion expert system has been developed by the authors and published online at

<http://www.krasteleva.com/promo>. This web site also contains static content (in Russian) describing different promotion methods of Internet resources that have been considered in the knowledgebase. Web resource provides the expert system, through which visitors can get a remote consultation on-line. The system works by asking questions to the user about his/her site, and then, based on the answers, makes recommendations on page optimization and specific steps to promote the site within the Russian segment of the Internet.

One of the main determinants of advertising campaign is the financial budget. Depending on the amount of money user going to spend for the promotion campaign different strategies may be applied. The sum is being split in the optimal way between several methods of web promotion (banners, mailing lists, etc.). For dividing money the weight coefficients are used. To each promotion method corresponds its own weight coefficient calculated in the process of logical inference. Using this coefficient the expert system is able to determine the part of budget, which goes to this particular method. In addition each promotion method has its own minimum and maximum financial limits. For example: if promotion budget is less than \$500, the expert system does not recommend a banner advertising method.

The expert system also recommends specific web resources that can be used to promote the site in the best way (e.g., for banner exchange), and also specific web promotion agencies if there is enough money for a full-scale campaign. Expert system prototype contains about 300 rules related with all main methods of Internet promotion:

- **Web page optimization:** System contains rules about optimizing HTML code, generate META tags. Web page optimization is necessary for the successful registration in search engines and catalogues.
- **Search engines and catalogues registration:** System gives targeted information about the best automatic registration systems as well as some tips and hints about main search engines and catalogues (e.g. Yahoo, AltaVista, Lycos etc.) The expert system also contains knowledge about some specific thematically organized directories. For example, directory of all auto resources in Moscow is www.auto.ru
- **Statistic systems:** System advises using different statistic systems to track visitors of a web resource. Depending on promotion budget the expert system may recommend free counters as well as advanced e-commerce statistic systems (e.g. Webtrends).
- **Banner advertising:** System recommends how to install banner exchange systems as well as

provides information about main advertising resources. Prices ranges for banner advertising are included in the knowledgebase, and in the commercial version would be gathered from the agencies on the fly.

- **E-mail advertising:** System contains rules and tips on how to use e-mail advertising. Places where user may buy mailing lists advertising according to site theme and prices are contained in the knowledgebase.
- **BBS and conferences:** System may recommend using discussion boards and conferences for a purpose of promoting a web site.
- **Site features:** System provides some web resource improvements for the purpose of getting more visitors coming back to a web resource. For example, creating own mailing list and conference, on-line voting and games, etc.
- **Off-line promotion:** System suggests how to promote web site in traditional mass media.

In addition, the system contains a specific plug-in written in Java, which gathers keywords from different web sites in a specified category, and optimizes them to create a unique set of keywords for the given resource, which can significantly improve the position of the resource in search engines listing.

Area of web promotion contains a lot of rapidly changing knowledge. For example, prices for banner advertising are subject to change every day; web resources appear and stop working every hour. Sometimes it is very hard to provide actual information in this area of knowledge. To provide the newest and actual knowledge special plug-ins can be integrated in the expert system. All commercial expert systems have to be well maintained and have to contain latest information. This data gathering will help expert systems to update most sensitive information for the purpose of accurate and up-to-date consultation.

4. Implementation of web promotion expert system

The system is implemented in the form of a Java applet, which operates in the user's browser. It requires either standard Netscape 6.0, or Internet Explorer 4.x or higher with installed Java plug-in from Sun Microsystems (Java Virtual Machine version 1.3 or higher is required). The user interface is primary intended for asking questions to the user and showing the results of the reasoning for a particular case. (See fig. 1).

The expert system is based on JULIA toolkit (Java Universal Library for Intelligent Applications) [5,7]. All additional functions, such as keyword generation are implemented in Java as JULIA function libraries or Java Class Frames. JULIA provides a solution to building

knowledge-based application using frame knowledge representation and productions rules. It is also presents the basis for creating distributed reasoning systems, where parts of the frame hierarchy are located on different network hosts.

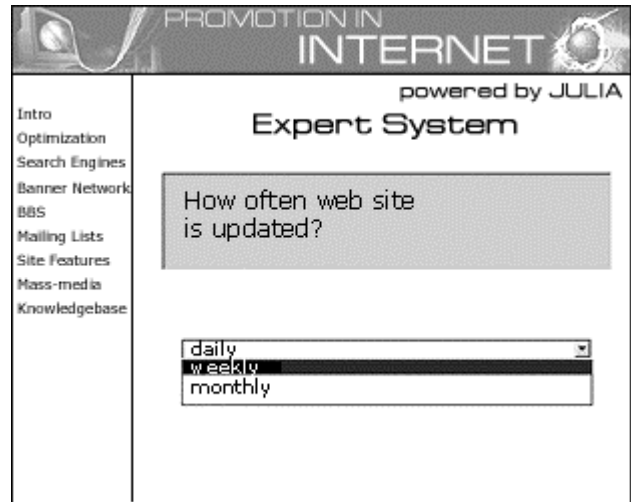


Figure 1 Client interface www.krasteleva.com/promo

Original knowledge is formulated by using specific knowledge representation language JFMDL. Source file containing frame definitions and productions rules is then serialized and stored in self-contained file, which is transferred through the network upon the consultation and instantiated to perform logical inference. Thus, client-side inference / thick client implementation is used, in order to take an extra load off the web server. The expert system uses backward inference, and is capable of optimizing different promotion steps under given financial constrains based on user's answers to a large set of questions. Backward inference is a very common solution for all planning and consultation expert systems.

As it was mentioned before the expert system contains plug-ins for data gathering from remote Internet resources. Since this process requires downloading and analyzing a number of third-party web pages, it has been decided to implement the system on the client side, so that all traffic goes through the client directly. To minimize network traffic between client and server rule-on-demand and frame-on-demand loading is used where possible. [7]

5. Structure of the knowledgebase

Knowledgebase utilizes frame knowledge representation with production rules that are used in the process of backward inference. Frame structure is implemented for capturing the conceptualization of problem domain, and also provides logical organization of production rules and knowledge reuse through inheritance. [6]

JULIA library provides a number of methods to create production rules as well as frame structures. Example of production rule which is created using JULIA knowledge representation language JFMDL:

```
IF BannerExchange.MoneyLeft > 500
AND SiteTheme.Main == 'Programming'
THEN
BannerExchange.Recommendations+='You
may buy banner advertising on
http://citforum.ru';
```

Each method of Internet promotion is represented by a frame in the knowledgebase:

```
FRAME Optimization
FRAME SearchEngines
FRAME Statistic
FRAME Banners
FRAME MailingLists
FRAME BBS
FRAME SiteFeatures
FRAME OfflinePromotion
```

Each method contains number of slots describing its main properties. All promotion methods have a parent frame *PROMOTYPE*. (Refer to Fig.2).

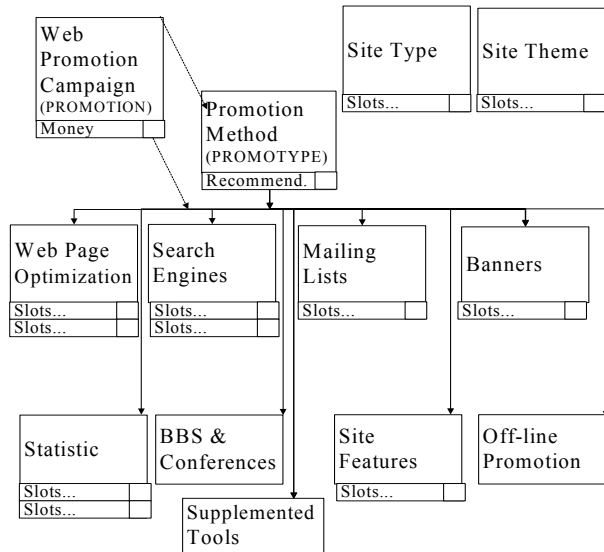


Figure 2 Frame structure

This frame defines several slots, which are the same to all promotion methods:

```
FRAME PROMOTYPE
{
SCALAR MaxMoney INT;
SCALAR MoneyLeft INT;
SCALAR Money INT;
LIST Recommendations DEF [ ];
};
```

In addition each method has its own slots, which describe its specific properties:

```
FRAME Banners PARENT PROMOTYPE
{
SCALAR PlaceBanner;
SCALAR NumberOfVisitors;
...
};
```

There are also several additional frames to define characteristics of a web resource:

```
FRAME SiteTheme
FRAME SiteType
```

Each slot in the knowledgebase contains a set of attached production rules using which the expert system can determine the value of the slot. In addition to production rules, slot can have associated actions to query their value from a user, defined by *ASK* statement:

```
ASK Banners.PlaceBanner 'Would you
like to place some banners on your web
site?' ['y', 'n'];
```

It allows getting additional data from the user that is required in the process of logical inference.

Frame *PROMOTION* is the base frame for promotion consultation. This frame contains all slots that describe the promotion campaign. Consultation with the expert system starts from determination of a slot *Recommendations* of frame *PROMOTION*:

```
GET PROMOTION.Recommendations;
```

Slot *Recommendations* collects recommendations from all promotion methods, contained in the slot *PromoTypes*:

```
SET PROMOTION.Recommendations =
&FLATTEN(MAP { %.Recommendations :
PROMOTION.PromoTypes });
```

To determine the value of this slot the expert system has to determine value of *Recommendations* slots of each promotion method, which are used in this particular promotion campaign. Consultation session is finished when all knowledge, which is necessary for *PROMOTION.Recommendation* slot determination, has been applied. After the consultation user will get a list of recommendations, which is a value of *PROMOTION.Recommendations* slot.

6. Keywords generator

The expert system for Internet promotion and optimizing web pages contains the plug-in for keywords generator. Keywords are very important part of a web resource

preparation, and are contained in a META tag of HTML code. This tag helps search engines to determine a web site theme and associate web site with these particular keywords. During indexing process search engines consider explicit keyword listing to be of higher priority with respect to the actual page content. Below is an example of keyword META-tag from <http://www.krasteleva.com/promo:>

```
<META NAME=keywords CONTENT="web
promotion, expert system,
knowledgebase, Internet advertising
...">
```

It is very important to select the appropriate keywords for a web resource. It is beneficial to use keywords that are very often requested in search engines with relation to the site theme. One of the most common solutions to generate the keyword list is analyzing keywords of the most popular resources with the same theme as a promoted web site. The expert system contains a plug-in, which can do it automatically. As soon as theme of the web resource is determined user will be asked:

```
ASK Optimisation.Keywords 'Would you
like to auto-generate keywords to your
web site? ' ['y','n'];
```

All generated keywords fill the slot *Keywords* of *Optimization* frame:

```
IF Optimisation.Keywords == 'y' THEN
Optimisation.Recommendations+ =&KEYWORD
(SiteTheme.Url);
```

Depending on site theme plug-in searches the keywords in particular subdirectory. The expert system contains number of rules determining the location of resources corresponding to different themes:

```
IF SiteTheme.Main == 'Security' THEN
SiteTheme.Url =
'http://top100.rambler.ru/top100/Secur
ity/';
IF SiteTheme.Main == 'Economics' OR
SiteTheme.Main == 'Money' THEN
SiteTheme.Url =
'http://top100.rambler.ru/top100/Busin
ess/';
```

Integration of keyword plug-in is implemented using a function library class. The expert system in the beginning of consultation imports all external library classes:

```
IMPORT LIBRARY
'com.shwars.julia.Keywords.inet';
```

The Java plug-in would automatically go to one of the rating sites (presently top100.rambler.ru), and collect keywords from top 25 web resources (number of web resources is the parameter) with the same theme as the promoted web site. It would then process those keywords, selecting most popular among them, and present the user with an optimized list of recommended keywords for page optimization.

To gather the best and the most popular keywords the following algorithm is utilized. Plug-in goes to particular thematic subdirectory provided by web promotion expert system and split out of it URLs of top 25 web resources. To achieve the web resource JAVA object *URL* is used:

```
URL U=new URL(url);
Reader is = new
InputStreamReader(U.openConnection().g
etInputStream());
```

Using the generated list of URLs, plug-in chooses keywords META tag from all of these web resource. After that only these keywords, which occur more than in one web resource, are selected. The final list of generated keywords goes back to the expert system. (See Fig.3)

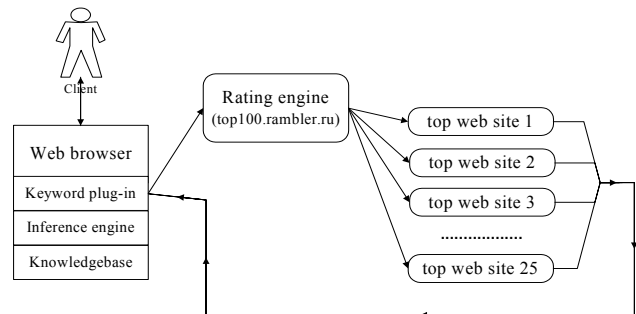


Figure 3 Keywords generation

This expert system can be improved using an integration of different Java plug-ins. Such plug-ins can dynamically get different types of data from the World-Wide Web. For example system can get price ranges for banner advertising on a particular web site. Main advantage of using such an approach is that expert system can get some additional data from the Internet without human support.

7. Examples of usage

There are several main groups of users, which can benefit from using web promotion expert system:

- Site managers
- Beginners in Internet promotion
- Experts in Internet promotion

For each group of visitors a slightly different knowledgebase is provided.

Site managers can utilize this system to get more information about web promotion methods. Version for site owners does not contain technical details of implementing a promotion campaign. For example, keyword generator is not included into this version. On the other hand, this version provides a lot of explanation for each promotion method as well as price range. Manager can chose different financial amounts and draft an approximate budget for promotion campaign by hand.

Beginners can use this system to learn how to plan web promotion campaigns. Using the expert system students are able to learn how to operate with main methods of advertising in Internet.

Experts in Internet promotion are able to use this system to decrease time for planning web promotion campaign. A good way of using this system is to create pilot project (prototype) of advertising campaign. Keyword generator is very helpful tool for web page optimization.

The working system (in Russian) together with some text describing the web promotion terms is available from <http://www.krasteleva.com/promo>.

This system was utilized for planning a promotion campaign of a web resource of the Economics Faculty of Moscow Aviation Institute www.mai.ru/~k502. The knowledgebase was developed and improved during the promotion campaign implementation for this web resource. Several faculty members were interviewed by the expert system on purpose to understand target audience as well as main goals of promoted web resource. As the result the list of follows recommendations was given:

- Possible mailing lists for e-mail advertising with pricing.
- Web catalogues related with economics training where promoted web site has to be added.
- Internet conferences and BBS where this web site can be announced.
- Comments for site improvements and many others.

The result of this promotion campaign is a significant increase of number of students getting information about Economics Faculty trough the World-Wide Web.

The promotion expert system was used for HTML code optimization of the Moscow Expat Site www.expat.ru. Keywords generator was utilized for creating the optimized set of keywords for each thematic part of web site and improving web site Meta Tags. Several employees of the Expat site got remote consultation with the expert system. They described the content of the Expat site on purpose to determine possible competitors in Internet area. Analyzing keywords of web competitors

generated the optimal keywords sets for each thematic part of the site. After resubmitting this web resource in major search engines and catalogues it has been obtaining around 200 new visitors each week.

Nowadays the expert system is put into practice in Russian State University of Innovation Technologies for the purpose of teaching students in the area of Internet promotion. The work on creating the expert system was financed by grant 99720 – 08080 of Russian State University of Innovations Technologies.

8. Conclusion

As it illustrated above, there are many different ways to use expert systems in web promotion. It is beneficial for various groups of users with different knowledge and goals: site managers, beginners and promotion experts.

The main advantage of involving the expert system is the decreasing cost of planning advertising campaign given time constraints. By applying imperative plug-ins in the process of expert system reasoning it is possible to get dynamic data from remote Internet resources. Developed expert system is integrated into a web resource for the purpose of giving remote consultations to site visitors. Knowledgebase is located on the server side, and can be updated easily.

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