Software

DSS Site Tools Version 1.0
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News

We are pleased to announce a new web site dedicated to on-line decision support systems. This web site was supported by the Institute for Information Technology at the National Research Council of Canada (NRC).

DSS Site

The Decision Support System Site (DSS Site version 1.0) **www.dss-belacel.net** is a web site consisting of a series of data mining tools designed to explore data in search of consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to new subsets of data.

There are varieties of techniques for data mining such as Cluster Analysis, Neural Network and Decision Trees. Here, we introduce new data mining methodology tools, developed recently by Dr Nabil Belacel, for Decision Support Systems.

Among the tools that have already been implemented in DSS version 1.0, we have:

***Fuzzy J-Means*:** Fuzzy Clustering with Fuzzy J-Means method provides a solution for the fuzzy clustering problem with a new local search heuristic, in which the neighborhood is defined by all possible centroid-to-pattern relocation [1].

Fuzzy classification method PROAFTN*: PROAFTN* is a fuzzy classification method for assigning objects to predefined classes. This method belongs to the class of supervised learning algorithms and based on fuzzy outranking approach [2].

In order to use the web based algorithms found on the site, a user must create an account by registering with the site. The registration process is fully automated and follows a process typically found in self registration web applications.

Figure 1 illustrates the site registration form. The user's input is validated using JavaServer Faces' validation mechanisms [3, 4]. The site's architecture and JavaServer Faces are discussed further in this article.

Figure 1- Registration Form

If the registration data is valid, the user is sent an e-mail with a unique link to confirm the account creation (see Figure 2).
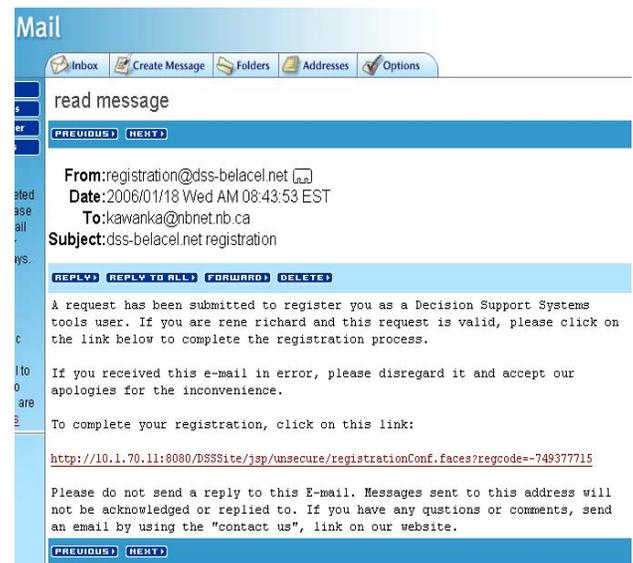
Figure 2 - Account creation (confirmation)

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When the account creation process is complete, the user can then login and use the classification algorithms on a limited set of data. Figure 3 illustrates the interface for applying the fuzzy *J-Means* algorithm, to a dataset which is uploaded using the web interface.
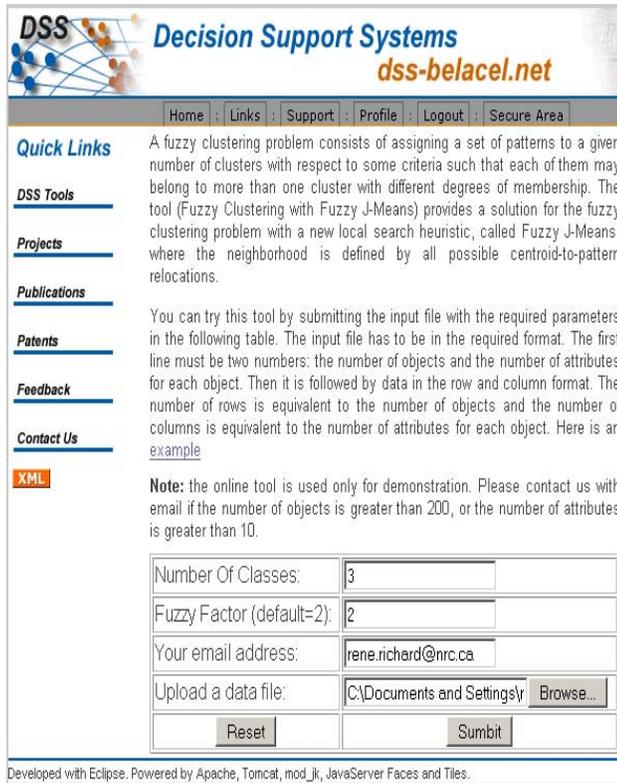
Figure 3 - Fuzzy J-Mean Algorithm Interface

The DSS version 1.0 web site includes two classification methods Fuzzy J-Means for clustering or unsupervised problems and *PROAFTN* for supervised learning problems. The fuzzy *J-Means* method is a local search method, where moves belong to the neighborhood of the current solution defined by all possible centroid-to-pattern relocations. This crisp solution found is then transformed into a fuzzy one by an alternate step, i.e., by finding centroids and membership degree for all patterns and clusters. The fuzzy *J-Means* heuristic is then embedded in the variable neighborhood search metaheuristic framework. More details are in [1]. The recent application in bioinformatics shows the efficiency of Fuzzy *J-Means* to cluster genes from Microarray data [5]. The second tool that has been implemented in this version is the *PROAFTN* method. The *PROAFTN* method belongs to the class of supervised learning and it is used for solving multiple criteria classification problems. The *PROAFTN*

method has been applied to the resolution of many real-world practical problems including medical diagnosis [6], asthma treatment [7] and crew scheduling problems [8]. In this version, we have implemented the Chebyshev's theorem with variable neighborhood search metaheuristic for determining the parameters of *PROAFTN* method as described in [9]. Two validation techniques were considered to test *PROAFTN* methodology: 10-cross validation and leave-one-out techniques.

For this version, we have implemented fuzzy *J-Means* and *PROAFTN* methods for only small datasets. To use DSS for large datasets, a license will be required.

The next version of the DSS web site (DSS 1.1) will include:

- New classification methods such as Fuzzy choice approach for fuzzy classification problems *PROCFTN* [10] and automatic clustering method known as Inter-cluster.

- On-line clinical decision support system. We will incorporate a web based application, which integrates a fuzzy classification method *PROAFTN* in Acute leukemia Diagnosis. The on-line clinical decision support system has been implemented to be a complete useful reference for clinical practice and an e-learning resource [11].

Site Architecture

This section gives a broad overview of the web site's architecture. Please see Figure 4 for the architecture diagram.
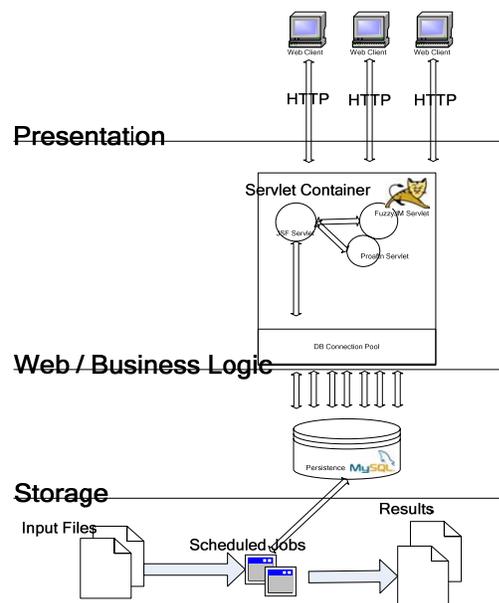
Figure 4- Site architecture

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The user interacts with the application using a web browser. He can select a classification algorithm and submit a dataset for processing. This represents the Presentation tier.

The Web / Business Logic tier is implemented on top of JavaServer Faces and the Tomcat servlet container. The business objects in the servlet container create batch jobs based on user interactions. This represents the Web / Business Logic tier.

The submitted batch jobs are stored on in a relational database. This represents the Storage tier. Batch jobs are processed on a scheduled basis and produce results which are emailed to the user.

JavaServer Faces

JavaServer Faces (JSF) is a web application framework for creating user interfaces. JSF enables the web developer to create and re-use server-side custom components. It also enables the web developer to attach event handling code to these components and manage their state. Events are generated on the client side and handlers are executed on the server side. Additional framework features include: page navigation, input validation and internalization.

JSF is also a technology specification, which is managed by the Java Community Process (JCP) [12]. Because JSF web applications are developed in a standard way, Integrated Development Environment (IDE) vendors can create products, which automate redundant tasks and enhance a developer's productivity.

The JSF specification in combination with other existing server side specifications enables web applications to be deployed in a variety of servlet containers without modifications [12].

The latest version of the JavaServer Faces technology is version 1.2, which is currently being developed through the Java Community Process under JSR-252.

The most recent implementation of the JavaServer Faces technology is version 1.1. The DSS Web Site uses version 1.1.01 of the JavaServer Faces Reference Implementation.

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