WEB - Based Optimization System Applied to High School Schedule Building

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1. WEB-Based Optimization

Building a Web-based optimization application requires the development of a framework capable of employing a variety of solvers from optimization packages regardless of the model to be generated. Currently available internet services help access optimization software for this purpose. According to [2], the dynamic and changeable nature of optimization software and algorithms helps access updated contents on the internet.

[3] distinguishes three categories of clients using optimization software:

1) Modelers working directly with solvers and modeling systems capable of building optimization models and presenting feasible solutions;

2) Application developers using solvers, as part of large packages, dealing with anything from general functions, such as data management, to graphical presentation interfaces;

3) Users of application packages requiring optimization at some point.

The needs of these three types of users should be taken into account when developing an optimization framework.

[1] proposes to explore the potential of the internet by splitting up processing tasks between multiple servers and thereby solving the problem of optimization. The applications should be arranged according to the design shown in Figure 1.

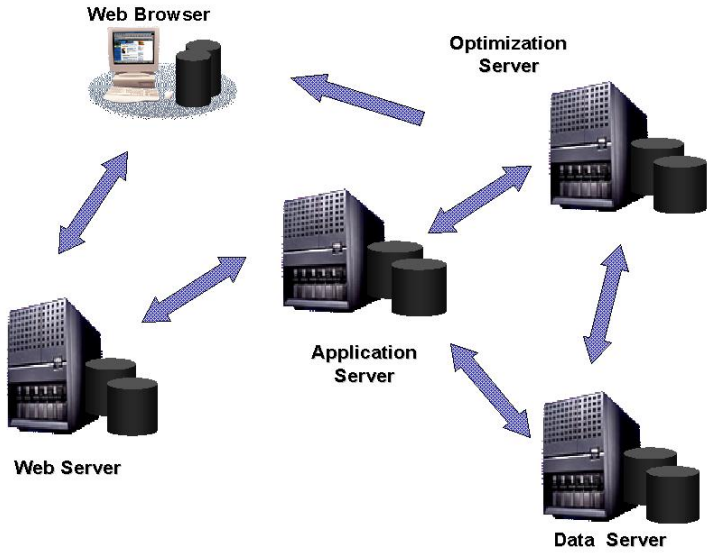

Figure 1: Multi-layer design for solving optimization problems. [1]

Through a browser the user submits a program to the application server, which will load the data required for building a model, such as an integer linear model. Some of the information required for building the model may be available from a database accessible by a database server. The user may also request the model to be optimized. To obtain a solution the application server will then start the process in an optimization server by transferring the model. When the process is complete, the optimization server will send the user an e-mail containing a uniform resource locator (URL) presenting the solution or may send a report with the solution using different internet port channels.

2. The Schedule Building Framework

The schedule building framework described in [4] is composed of a set of components interacting to solve a problem. The components are: access control, model configurator, model generator, model editor, model solver and a consultation-and-report interface. Figure 2 shows how these components are organized within the framework design.

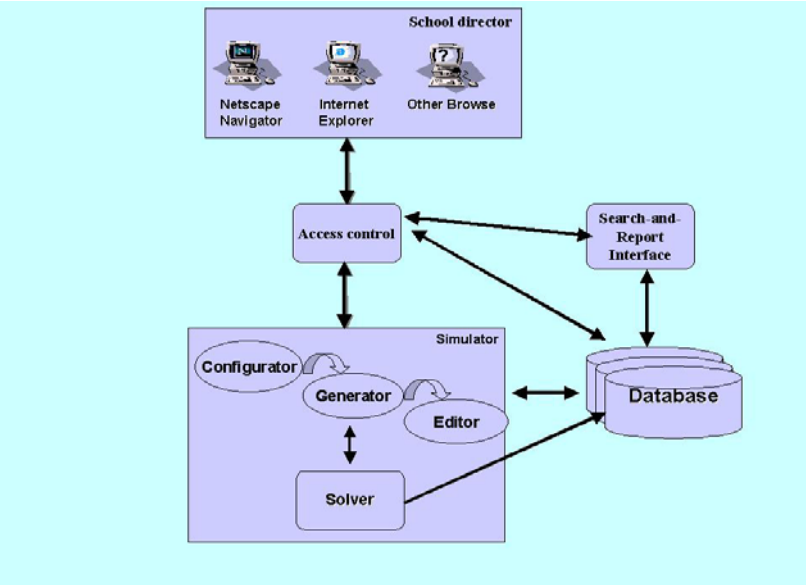

Figure 2: Organization of components of framework.

As components of the framework, the model configurator, model generator and model editor make up the simulation center and may be used to simulate a number of situations. Once the simulation is completed the model may be forwarded for solution. The solution is subsequently stored in the database.

Each component may be regarded as a computational module. All the modules are interconnected through an interface, but differ as to their implementation form, as described in the previous section.

Access control - the access control module manages the users' access to the internet-based framework. A validated user may access all the options in the framework allowed for his or her level.

Model configurator - This module allows the director to access and enable or disable the restriction options of the model. Other available options concern the number of groups in each term and changes in teacher availability.

Model generator - The user submits a requisition to the model generator which then executes a database reading routine, since new data may have been entered by the model configurator. Subsequently a text file containing the generated model is created. The text file may be viewed through the editor or used by the model's solving module to build a schedule.

Model editor - the model editor complements the conceptual model of the simulation center. This module allows users to edit the model generated by the generating module and verify all the variables and restrictions generated.

Model solver - the model's solver module requires a set of informed options to be executed. It can partially solve the schedule building problem, while leaving it to the user to decide how to solve the model. An example of resolution could be the generation of a schedule for a specific term only, with the inclusion of some specific teacher restriction.

Search-and-Report Interface – this interface is responsible for making a graphical interface available to the user by which requisitions may be submitted to the schedule building framework and results may be viewed via the internet. This module allows the user to perform a number of searches and reports.

3. Conclusions

We have presented a web-based optimization framework applied to the problem of allocating time and teachers in public high schools in the state of Ceará. Apart from the functionality of each component the tests have allowed to verify the performance of the framework. The capacity to view the generated model before the resolution has made it easier to make the corrections required by the

framework, thus proving the efficiency of the simulation design. We also describe the design of an internet-based optimization framework [1] which offers considerable flexibility in correcting faults in specific components of the framework. The problems being more easily detected and corrected in separate. Although the system has been implanted and tested already we recommend that more rigorous tests be performed during the allocation process. The system is currently being evaluated by the State Department of Education with a view to implanting it in all schools in the coming term.

References

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