Web-based repository for pre-calculated mathematical equations

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***Abstract**: The computer applications somehow recreate the real world. This causes some of the applications to use the same equation and requires the equations' constant recalculation. This leads to loss of time and computer resources. This paper proposes a solution of this problem and represents a repository which stores pre-calculated mathematical expressions.*

***Key words:** repository, prior-calculated, mathematical equations, irrational use of computing power*

INTRODUCTION

Nowadays, computers accompany people in almost all areas of their lives. Without computers and computer programs, people would not be able to perform most of the activities in their lives or at least their lives would much more different.

It is known that the computers perform various calculations. And since the applications somehow recreate the real world, the computers would have to calculate some of the equations again. This means loss of computer time and resources for calculating the same equations over and over again. The longer the humanity uses computers, the more likely is the same equations with the same input parameters to be calculated in different applications. On the other hand, it is very likely during the execution of a single application, specific conditions to be repeated again. This also leads to recalculating the same equations with same input parameters and loss of resources for obtaining results already obtained. If we take into consideration and the increasing complexity of the equations - the calculation time will increase significantly. This would lead to irrational use of computing power, computer's resources and to ineffective work of the computers in general.

The current report gives a solution to this problem by presenting global repository, which stores pre-calculated mathematical equations. The current report is a continuation of the system architecture for pre-calculated mathematical equations, presented in [3] and represents a realization of only one part of this architecture, namely the global web based repository for pre-calculated mathematical equations.

THE WEB-BASED REPOSITORY

The repository represents a register of all estimated equations by the system so far. As noted in [3], the repository does not keep the answers of specific equations, but rather it keeps the relationship between a specific equation and the computer who made the calculations and stores the result of that equation. However the repository can have its own servers, as shown on figure 2 and although the repository do not keep the equations' answers it can use these servers and estimate and return the equation answer to the user.

If an application needs to estimate an equation, before it starts the calculations, it can check if another computer has already made these calculations. If the global repository holds information about the answer of the equation, then the application can take that answer and there would no need of calculation. If the repository does not have information for the answer then the application calculates and registers it on the global server (repository), so no other application needs to calculate the equation again.

Figure 1 shows discussed in [3] architecture of a system for pre-calculation of mathematical equations. In gray color, the repository, presented in the current report, is shown. As the figure shows, the repository is only a small part of the overall system.

Figure 2 shows the architecture of currently presented web repository. It contains the following blocks:

1) Users' connection block- the module handles the communication between the repository and local servers. Connection is established via http protocol and follows the

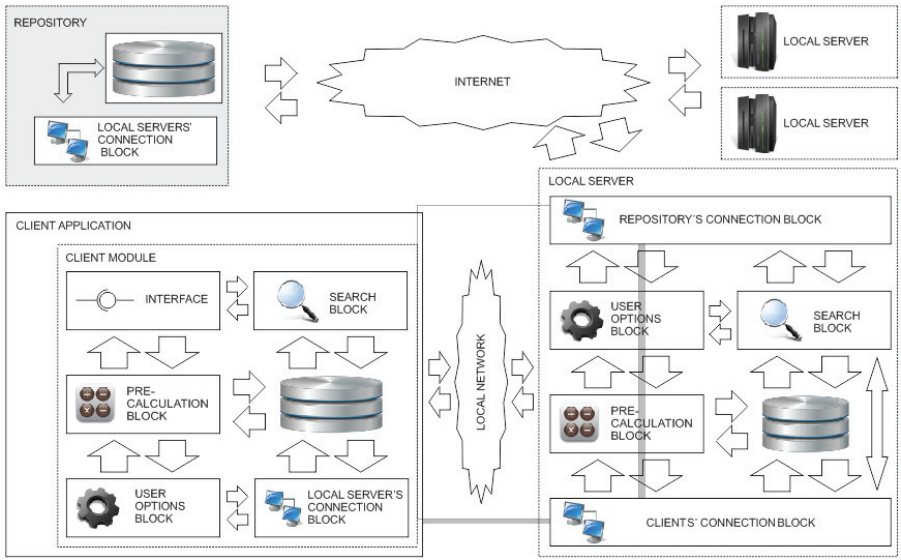

Figure 1. Architecture of system for
pre-calculation of mathematical equation

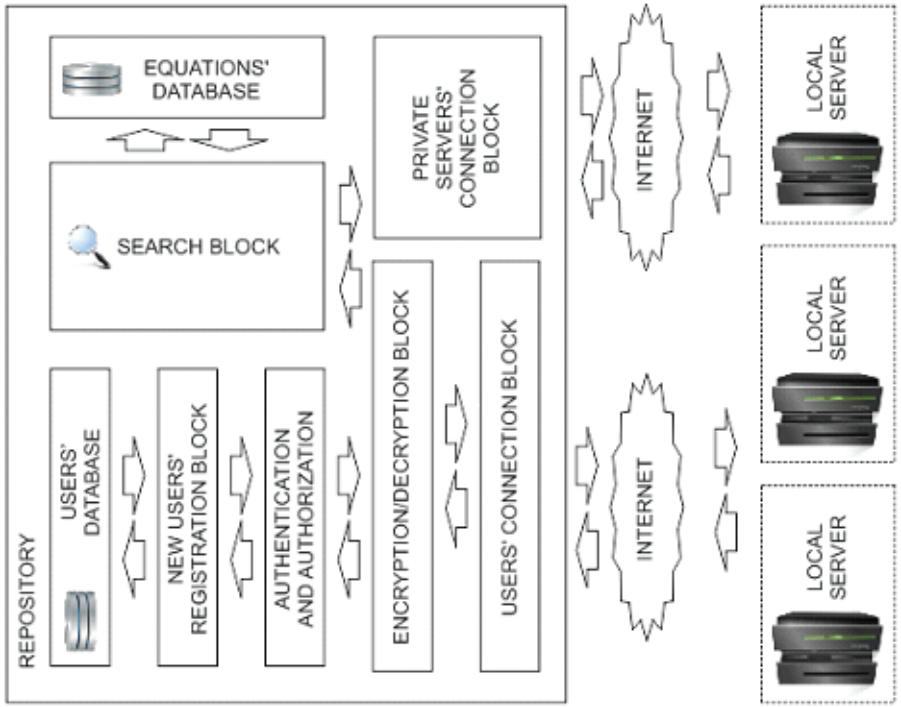

Figure 2. Architecture of the repository which stores the
pre-calculated mathematical equations

request-response model. Local servers can be located on the user's computer or in his local network and stores the answers for various equations;

2) Block for encryption/decryption - if transmitted information need to be protected then the block handles the encryption and decryption of transmitted data. This block allows several basic methods of protection:

- Asymmetric encryption - transmitted data can be encrypted/decrypted with asymmetric algorithms
- Symmetric encryption - transmitted data can be encrypted/decrypted with symmetric algorithms
- Calculating hash values - it is possible only hash values of the transmitted messages to be calculated

The repository allows this block to be turned on or off. For example, if the data does not need to be protected or https protocol is being used - this block can be turned off;

3) Block for authentication and authorization - before the start of communication between the repository and specific user, the user need to confirm his identity to the system. This block support the functionality of checking the identity of a particular user and determining it's level of access to different repository's resources;

4) New users' registration block - the block handles the registration of the new users;

5) Search block - when the user's identity is being confirmed and he request the answer of some equation, this block appears on stage. The first thing that block does is to check the database and sees whether the equation is already calculated or not. If it is calculated then the information about the answer is being sent to the user. The response can be either the answer itself or the URL address of the server containing the answer;

6) Equations' database - a relational database linking the answer of specific equation to the local server;

7) Private servers' connection block - with the help of this block, instead of URL address the repository can return the answer to an equation. These servers represent the repository's private calculation power. After registration, each user can make certain settings of his account. The account can be set that so if the user request the answer of an equation and that answer is not registered on the repository, then the repository can use its private calculation power (private servers) to compute the equation and then to return the answer to the user made the request. Thus, users with fewer resources (computing power) could benefit from the resources of the entire network.

COMMUNICATION PROTOCOLS

Communication between the repository and its users is performed via JSON. When sending a query to the repository, the users can specify:

- Type of the request – the request type can be either for obtaining or for registering the answer of an equation;
- The equation itself - the equation which the user want to register on the repository or to get the answer to;
- Answer - if users will register a new answer for a given equation, then the field contains corresponding answer to the equation;
- Whether equation to be calculated - - if the repository does not contains already calculated answer of the equation, then the user can specify whether he wants or not the repository to calculate the answer for him;

– Application id - a unique identifier to each equation can be assigned. With its help, the request is easily identified.

Figure 3 shows an example of JSON request, sent to the repository.

```
{
    "id": ID,
    "equation": "THE_EQATION",
    "calculate": "TRUE" | “FALSE"
}
```

Fig. 3. An example of JSON request, sent to the repository

```
{
   "id": ID,
   "answer": [
      {
         "answer": "THE_RESULT OR URL
                   OF THE SERVER
                   CONTAINING THE
                   ANSWER",
         "note": "NOTE_TO_THE_RESULT"
      },
      ...
   ]
}
```

Fig. 4. An example of response, sent from the repository to the client

Figure 4 shows an example of response, sent from the repository to the client. The response contains the identifier of the request and the answer of the requested equation.

CONCLUSION

The proposed repository for pre-calculated mathematical equations presents a new strategy for the operation of the computers and of the computer applications. Building a network, based on proposed repository and multiple local servers, which storing the pre-calculated equations, would save resources and execution time and will make the work of the computers more organized.

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Докладът е рецензиран.