

**Online examination registration service at the Faculty of  
philosophy in Zagreb – issues and experiences**

Dr. Vladimir Mateljan  
Damir Pavušin  
Krešimir Pavlina

## ***1. Abstract***

This paper introduces experiences gained during the phases of development, implementation and use of the online examination registration service (OERS) at the Faculty of philosophy in Zagreb. The OERS is a software application with primary function to facilitate the communication between students and the Faculty administration. It has been developed by active participation of students as an example of a web service project. By participating in this project, students have gained the first hand experience in development of a web service. The OERS is now operational and can be accessed by use of a Web browser or a mobile phone by WAP and SMS. The paper will also explain how the developers of this project resolved some of the problems related to the process of development of OERS and especially how they tested the components of the service. During the beta testing period, the authors got first positive feedback from the users, which will help them to plan future service expansion. Some of the future service expansion will include connecting with the Faculty's student administration, broadening the services tailored to specific user needs and additional content enhancements.

## **2. Introduction**

Broad usage of information technology made publication of large amounts of information possible. Information is now available to majority of population. Internet enabled relatively cheap and simple way of connecting computers and distribution of data. Web pages and http protocol are important milestones in the process.

The current trend is transition to an even higher degree of communication between information creator and information user. Information users are at the same time information creators and data processing is performed in real time. Users input data directly into database and access relevant (and processed) information at the time of creation. System does not serve for data mediation only; it supports organization and management. Digital signature laws enabled new initiatives and transfer of business and management systems to the Internet. Initiatives in business environment include banking, network management, direct interaction of different business systems, as well as direct access of customers to the business system (B2B and B2C). On-line cooperation and document processing, document share and document flow systems are present in e-government initiatives, but also serve as an initiative for direct involvement of people into decision-making system. *Studomat* system, developed at the Department of Information Science, Faculty of Philosophy in Zagreb was developed to display possibilities of this approach.

High quality network infrastructure and server technology is required for successful interactive Web page and system implementation. Recent developments in server technology and active server pages (ASP) enabled creation of dynamic systems (changes depending on the available information).

Server technology is accessible with price and simplicity of implementation and usage. We can expect a large number of mutually interrelated services (Web services, email, schedule, B2B and B2C system, file sharing, interactive work, idea development and presentation system, resource management and distribution, work organization, management, decision-making, e shopping and data exchange/distribution).

Relevant information must be accessible or delivered to a user at the moment of creation, even if user does not have instant access to the computer and the net. Further development could be summarized: Information always and at every place.

### 3. Methods

#### 3.1 Studomat

*Studomat* has initially started as an on-line registration service. It enabled students to register for an exam via internet and enabled teachers to input grades gained at exams. The main goal was to move from paper-based registration to electronic. We opted for the Web as the most useful media for distribution. Active server pages technology appeared to be the logical solution. During the development of *studomat*, we have decided to implement several new ideas as well.

Studomat has three major modules:

- Students module
- Teaching staff module
- Administration module (department administrators, students office and system administrator)

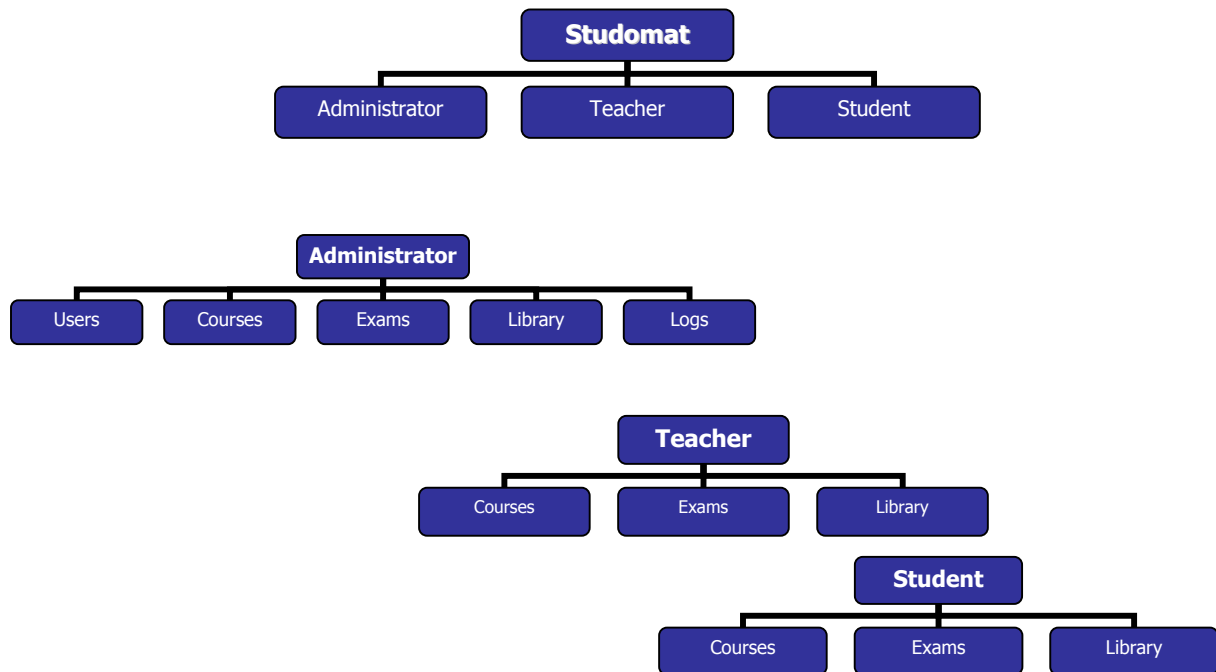


Figure 1. *Studomat* structure

The studomat system is a 0-level administration system with most of the functions automated. It includes process of information input, storage, and organization in the database, as well as processing on request. System is based on the principle of actions. All procedures and data processing is defined or programmed. Actions (preprogrammed procedures) are triggered by input or request for specific information.

The following functions are implemented:

- Registration (review of passed exams, review of exam dynamics and admission requirements)

- Elective courses
- Timetable
- Latest information on class/exam cancellation (available or delivered to the user at the moment they are inputted in the system)
- Completion of course obligations (course status, exam results, marks, etc.)
- Exam registration and withdrawal
- Review of exams registered
- Examination results (if exams consist of written and oral part)
- Access and retrieval of library catalogues for all Departmental libraries at the Faculty of Philosophy (in cooperation with the project "Scientific Information System" – access to library catalogues in the Republic of Croatia)
- Course literature
- Course information (links to course Web sites)
- System settings (user email address, mobile phone number (SMS), settings for email or SMS notification)
- Course details (for teaching staff)
- Class cancellation
- Exam candidate lists
- Administration (student data, department data, courses, timetable, etc)
- Logs: all changes in the system are tracked and recorded in logs:
  - Inputted, changed or deleted data
  - Date and time
  - User identifier
  - Type of change
  - IP address of the computer from which the system was accessed

Web interface (Internet browser – all functions implemented) enables easy access from anywhere in the world. Wap mobile phone (only exam registration/withdrawal, important notes and exam results) and sms messages (exam registration/withdrawal, exam results, help system) are alternative and convenient ways of accessing information on the system.

## ***3.2 Server technology***

### **3.2.1 Server**

Majority of computers at the Faculty of Philosophy have Windows operative system pre-installed. We wanted to see how Windows Server performs as a Web server and tried to determine further application possibilities. System security has been given special attention.

Windows 2000 Server runs on Pentium 650 MHz with 256 MB RAM, 30 GB hard disc and 100 MBps network card connected to the University network and the Internet.

The computer has a fixed IP address and a DNS name: infoz.ffzg.hr

Virtual server has been established for studomat web service at the same physical machine (IIS option). *Studomat* Web pages are accessible at the following web address: <http://studomat.ffzg.hr>

Web forum (type of a bulletin board system) runs at the same machine. Communication between students and teaching staff is forum primary function. It is

installed as virtual Web server at the address <http://forum.ffzg.hr>. Interface and most of the functions are familiar to the most of the users (90% of all forums on the Web are UBB forums). Majority of users will need minimal training in order to use web forum.

Same server is main Department teaching resource web server and project web pages at the Department of Information Science.

FTP server enables users to access private and public files stored at the server. Personal web pages have following form:

[http://infoz.ffzg.hr/prezime\\_profesora](http://infoz.ffzg.hr/prezime_profesora) or [http://infoz.ffzg.hr/naziv\\_projekta](http://infoz.ffzg.hr/naziv_projekta).

Alternatively, all files are accessible through Windows Networking (file sharing option).

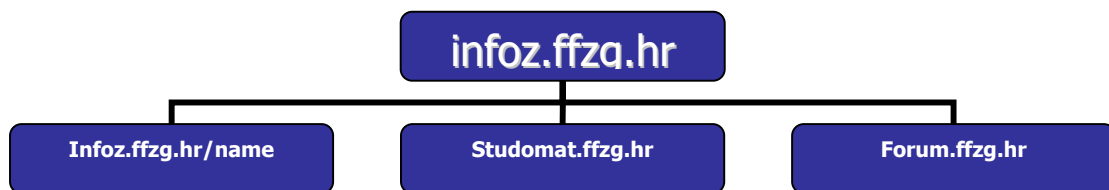


Figure 2. Server and virtual hosts

### 3.2.2 Web server

IIS is included in Windows 2000 Server. It consists of (and not limited to):

- FTP Server
- Web server (support for ASP and WAP included)
- SMTP (Mail server)
- NNTP (News server)

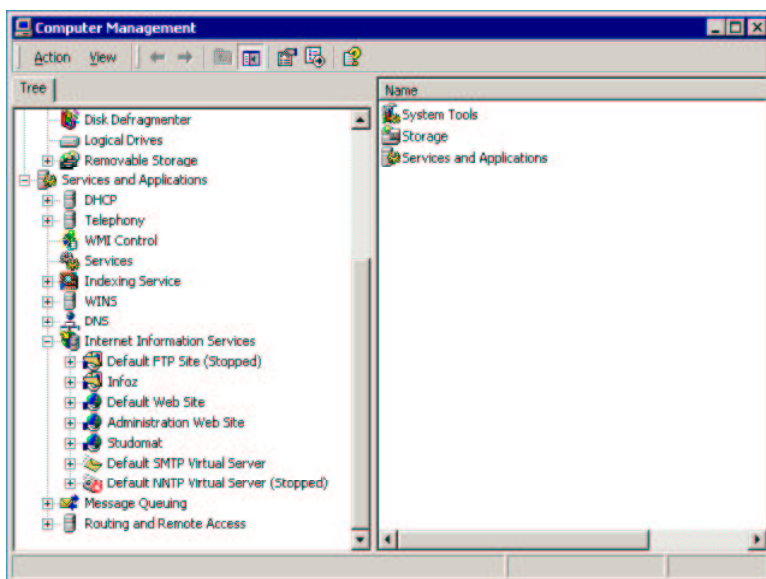


Figure 3. Computer Management console inn Windows 2000 Server

We have used Web server (WAP server), FTP server and SMTP Server in our project.

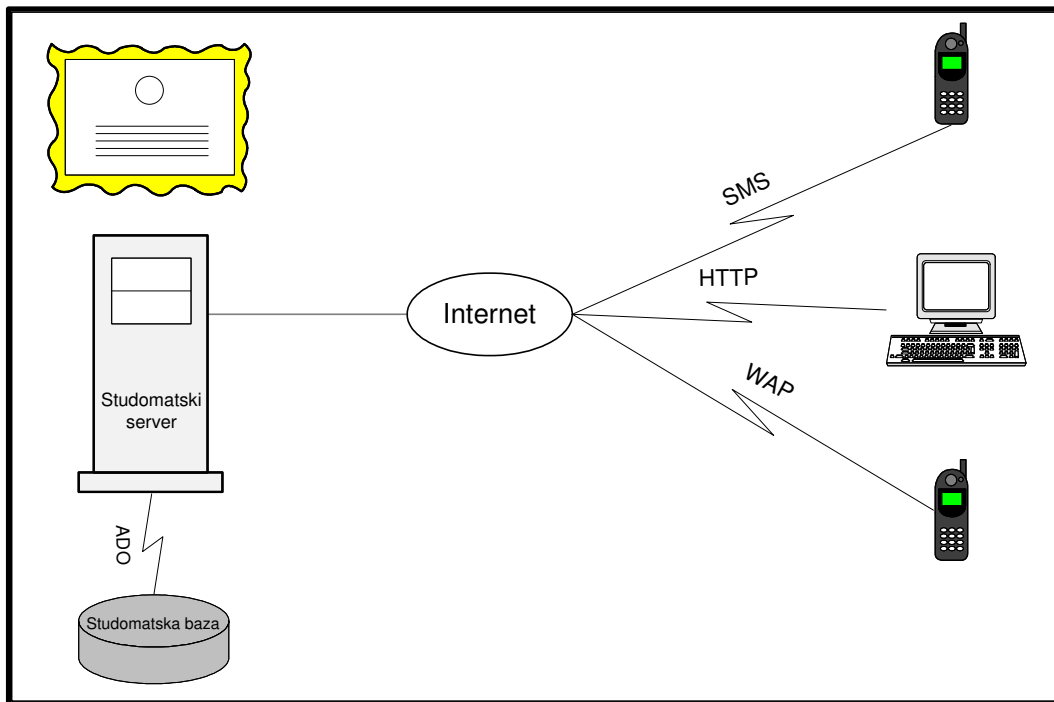


Figure 4. Flow chart

Active Server Pages technology has been chosen for this task. This technology enables dynamic Web page creation. Visual Basic Script was used for software programming. Programmed scripts are executed server side and pure HTML code is sent to the user (this prevents potential problems in compatibility and makes system maintenance significantly easier).

We have not noticed considerable server overload during the testing period. Larger load is expected when the forum use increases.

SSL certificate implementation and HTTPS protocol will be set for protection of communication between user and server.

Server is protected by rigid access policy. All unused services are turned off and several key services can be accessed only from certain IP addresses. It is extremely important to regularly update server using automatic update system. Regular updates largely reflect on the system's security and stability. Checking the logs at regular basis gives insight on the most frequently attacked services. It is easy to detect how intrusion happened and prevent it in the future. We believe that the testing period went well despite frequent attacks and several computer virus outbreaks on the Faculty intranet. High security level has been maintained during the testing period.

### 3.2.3 WAP

WAP pages (Wireless Application Protocol) are used for displaying simple web pages on mobile GSM devices equipped with wml browser. Minor changes in IIS configuration are needed to set up WAP service.

Advantage of WAP pages is accessibility. WAP pages are simplified HTML pages adopted for small GSM phone display. However, WAP is relatively cumbersome because of difficult data input, low speed and high access cost.

### 3.2.4 SMS

Access and modification of most important data has been made possible by SMS messages in order to achieve maximum user mobility at low cost. This approach is very useful; it enables cheap access to information at any time and from any location covered by GSM network. User is given an option to receive relevant information on GSM mobile phone few minutes after information entered the system. For example: If a professor cancels an exam via SMS, system processes the cancellation and immediately sends notice via SMS to all relevant students (students registered for this exam on this particular date). It usually takes less than a minute for system to receive, process and send notice to users. Entire process is completely automated.

SMS notice system is based on SMS to email option offered by both Croatian mobile operators. User must request activation of this service from the operator. The service is free of charge for subscribers while pre-paid users have to pay 20 kuna for activation. This service enables sending SMS messages to email and receiving email messages on the mobile phone.

Sample SMS:

*[studomat@ffzg.hr](mailto:studomat@ffzg.hr) user password ACTION SUBJECT DATE*

Eg. if user iivic with password ivan01 wants to register for an exam on Databases for 25-06-2002, he will send an SMS of the following content to the number 101 (Cronet users) or 0917101 (VIP users):

*[studomat@ffzg.hr](mailto:studomat@ffzg.hr) iivic ivan01 PR BAZ 25062002*

For cancellation of registration for the same exam, he should send this message:

*[studomat@ffzg.hr](mailto:studomat@ffzg.hr) iivic ivan01 OD BAZ 25062002*

Each change is confirmed by SMS message from the system. All changes are instantly visible over the Web or WAP interface.

Teaching staff can announce, cancel or change dates of examinations with SMS messages.

This system is based on SMTP server at infoz.ffzg.hr, which receives all SMS-email messages sent to [studomat@ffzg.hr](mailto:studomat@ffzg.hr). Received email messages are parsed and processed by software resident on the server. All email messages are redirected and processed at infoz.ffzg.hr thus minimizing load on faculty mail servers. Cost of the service is entirely insignificant (it is not necessary to rent expensive SMS gateways and servers from GSM operators).



### 3.2.5 Forum

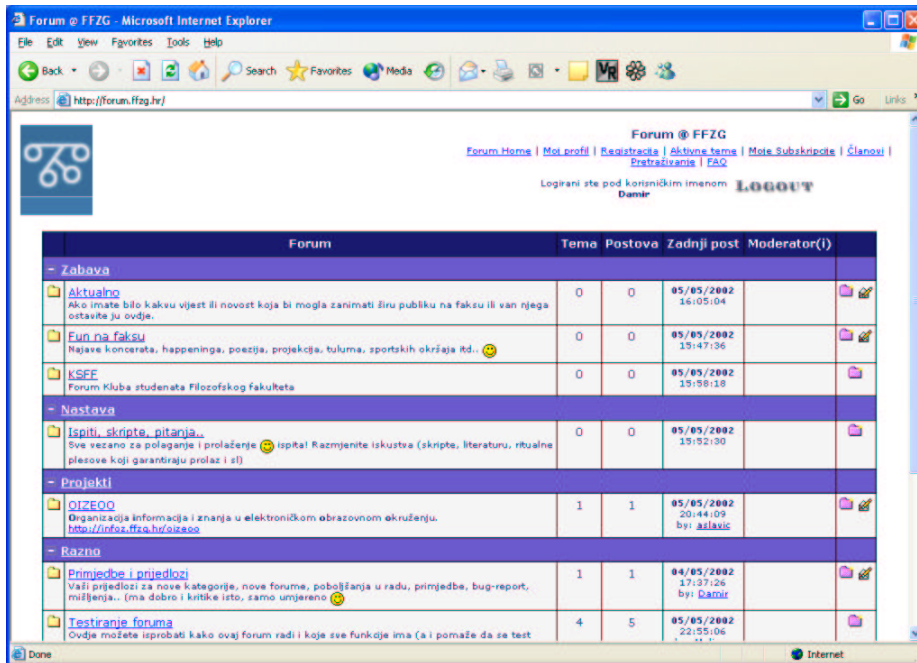


Figure 5. Forum Web interface

Forum is free open source ASP application developed by a group of enthusiasts (forum.snitz.com).

All data on the forum is entered in MS Access or SQL database. Ms.Jet or SQL is used for accessing the database. ASP technology offers ease of work, possibility for a large number of simultaneous users and low use of resources on the system. ASP has been a logical solution (an alternative to Perl/CGI script) on Windows platform. Forum functions separately from other web services and has separate administration system. Application has been largely modified (GNU license) and translated into Croatian.

The forum is structured by categories, with separate forums (division according to subject, work area, student or teaching staff's etc., defined by the administrator). There are discussions or posts in each forum. Administrator and forum moderators help users, organize discussions, create new forums, etc.

Different levels of access rights and private forums are possible. Subscribing to the forum has a function of a mailing list, i.e. the user is notified by email of any change on the forum or discussion list that he/she is subscribed. Forum is great environment for exchange of knowledge and a must for any project.

It is easy to achieve open communication and exchange of ideas on forum. Combined with FTP, forum is a powerful developmental tool that supports collaboration, exchange of ideas, application exchange, etc. We believe that it will be largely combined with the *studomat* system.

### 3.2.6 File server/FTP server

File server ensures 24/7/365 availability of files and data stored on it. It is rudimentary Windows 2000 server function. Infoz server consists of personal folders and public folders. A personal folder is private, only a user with a password can access it. There are few public folders (e.g. \_Public). Several project folders are restricted to project members only. Folders are easily accessed via Windows Explorer

(or Networking) and it is possible to map them as local drives. Alternatively, an FTP access is possible. It is necessary to have information sharing and development infrastructure for a project or teamwork.

Future plans include more powerful server, assigning Dial Up access passwords, web space on network disk and FTP access to all students at the signup. Windows 2000 server has terminal access option (graphical interface). It is now used only for system administration but in the future we plan to offer this option to users as well.

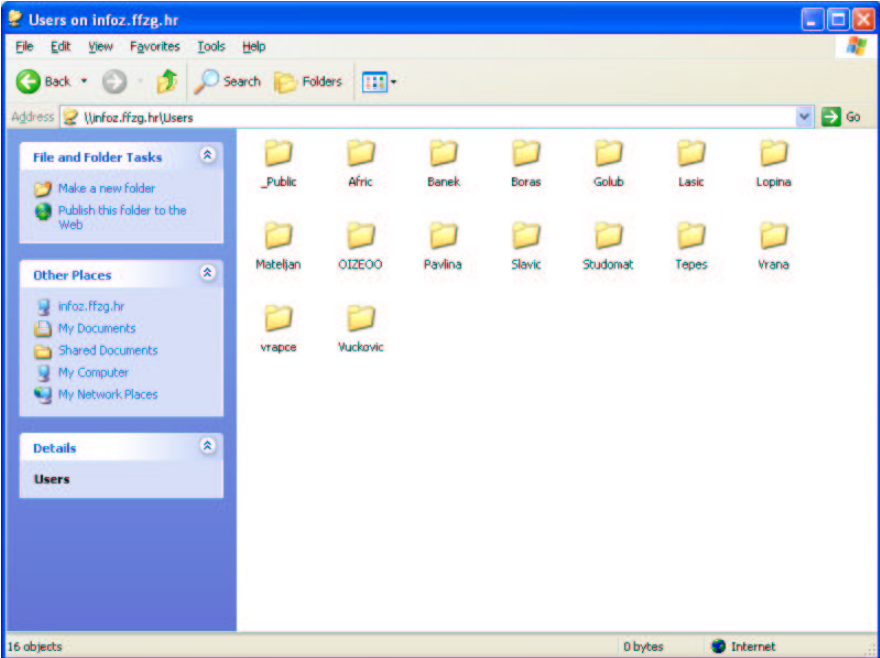


Figure 6. Simplicity of access to data (via Windows Explorer)

### 3.2.7 Database server

Data is saved in MS Access databases. Students' office database is used for retrieval of basic student data (name, address, programme, etc). All the databases are created in MS Access, and they are accessed via ADO control and MS Jet engine. Due to the infrastructure, the database does not need to be on the local server. Databases cannot be accessed directly from the Internet and are password protected. All transactions with the databases are recorded in the log file. Our primary task is to set up and test SQL server and upsize all databases to SQL.

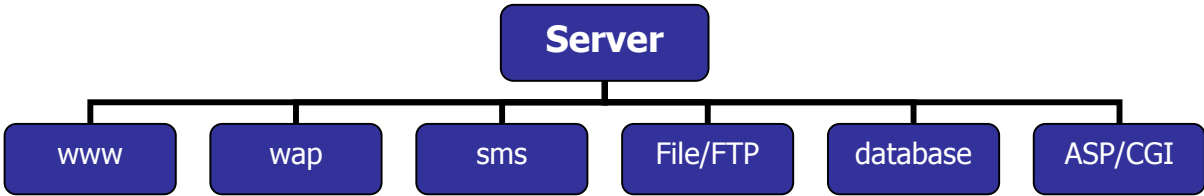


Figure 7. Server structure and subsystems

## 4. Experiences and discussion

Server performance has been monitored between May and July. Analysis has been made for 70 days of server uptime. During that period server was shut down for a day due to the UPS system malfunction. Besides that off-line period, server had 99.7% uptime.

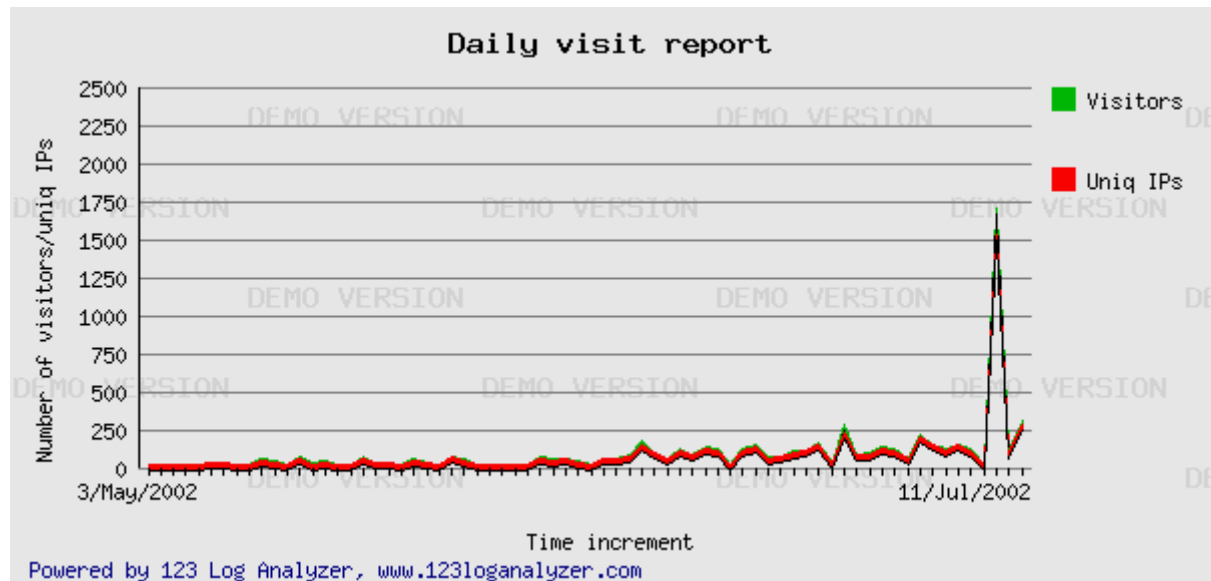
Results show windows 2000 log file analysis made with 123logalyzer, application made by ZY Computing, Inc. (<http://www.123logalyzer.com>). We have analyzed only one of the web servers, forum.ffzg.hr and one ftp server (there are three web services running at the same machine).

Charts show access stats, increase in the number of visitors and amount of transferred data. Log analysis confirmed our hypothesis - server was stable and running under real work conditions and even survived short periods of extreme conditions.

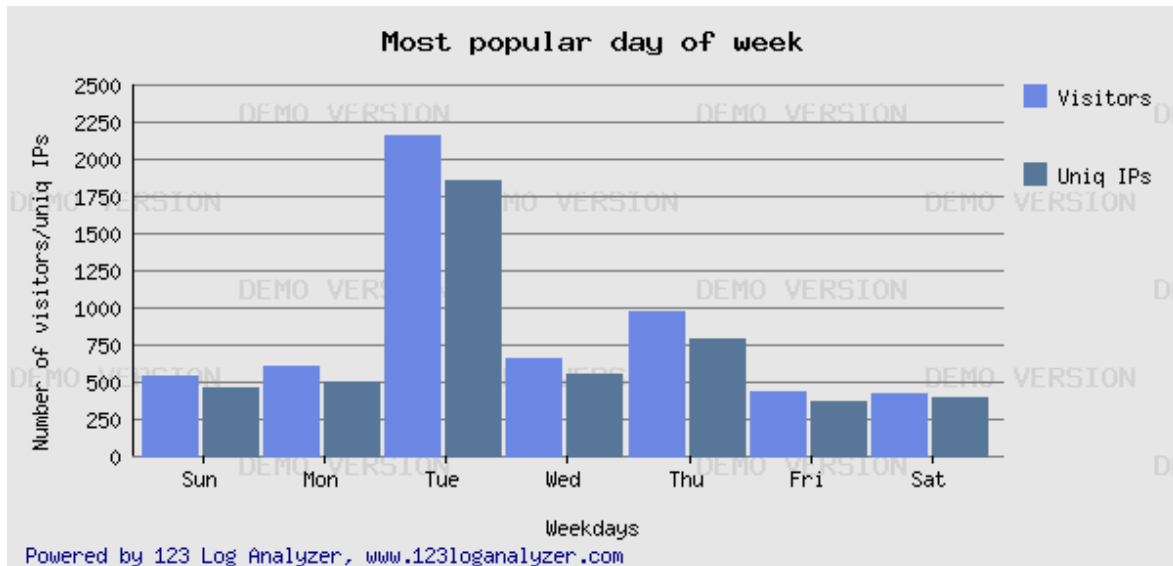
**Domain Name: forum.ffzg.hr**

Time Period:03/May/2002:14:43:29 - 12/Jul/2002:00:59:28 total 70 day(s)

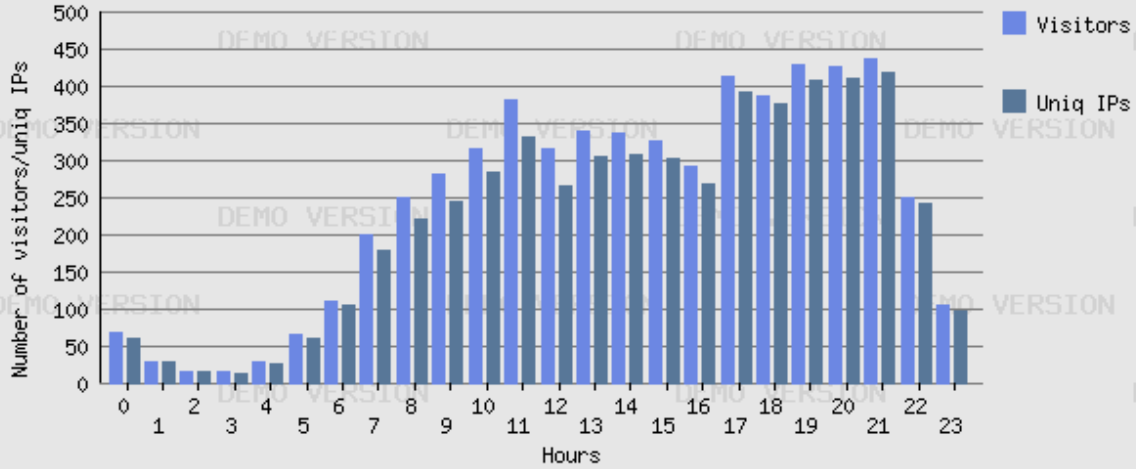
### General Statistics



Statistics		
<b>Hits</b>	Total Hits	232810
	Total Cached Hits	232810
	Average Hits Per Day	3325
	Average Hits Per Hour	139
	Average Hits Per Visitor	39.8
	Average Data Transferred per Hit	0.0 KB
	<b>Visitors</b>	Total Visitors
Average Visitors Per Day		83
Average Time Spent		369 Seconds
Average PageViews per visitor		7.73
Average Downloads per visitor		0.00
Average Data Transferred per Visitor		0.0 KB
<b>Uniq IPs</b>		Total Uniq IPs
	Visitors Who Visit Once	3394
	Visitors Who Visit more than Once	794
<b>PageViews and Downloads</b>	Total PageViews	45230
	Average PageViews Per Day	646
	Total File Downloads	0
	Average File Downloads Per Day	0
	Total Images	185803
	Average Images Per Day	2654
	Total failed requests	477
	Total Incomplete File downloads requests	0
	Number of visitors bookmarked your web site	54
	<b>Bandwidth</b>	Total Data Transferred
Average Data Transferred per Day		0.00 KB

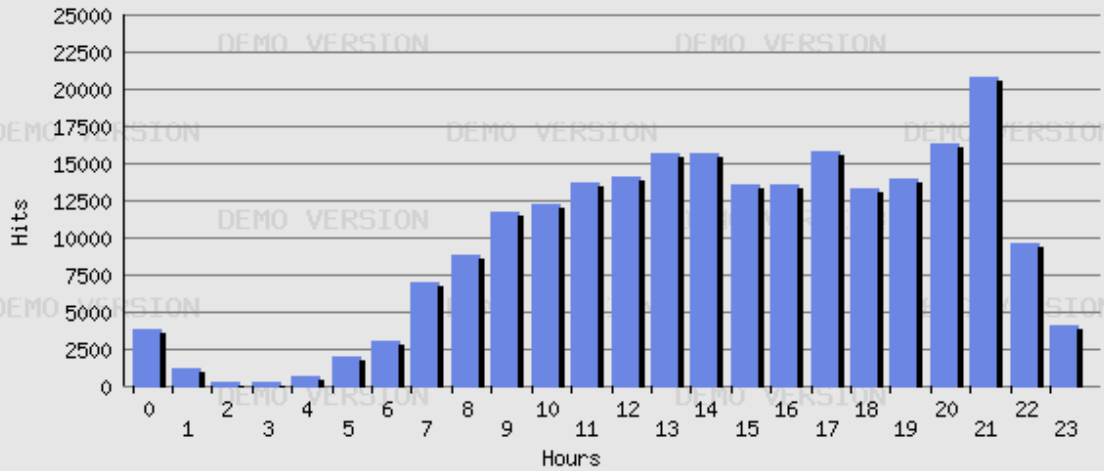


### Most popular hour of day



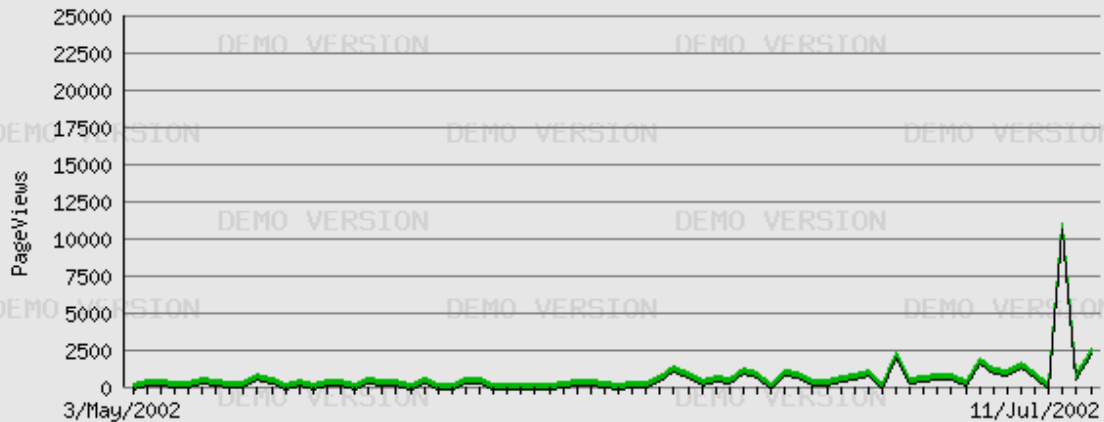
Powered by 123 Log Analyzer, [www.123logalyzer.com](http://www.123logalyzer.com)

### Hits in hour of day



Powered by 123 Log Analyzer, [www.123logalyzer.com](http://www.123logalyzer.com)











### Daily PageViews report



Time increment

Powered by 123 Log Analyzer, [www.123logalyzer.com](http://www.123logalyzer.com)

### Top 10 Referring Domains

1		forum.ffzg.hr (212098)
2		No Referrer (14893)
3		ffzg.hr (5142)
4		infoz.ffzg.hr (176)
5		iskon.hr (93)
6		buras.iskon.hr (87)
7		pauk.ffzg.hr (84)
8		search.iskon.hr (69)
9		216.32.180.250 (28)
10		altavista.hinet.hr (22)

Powered by 123 Log Analyzer, [www.123logalyzer.com](http://www.123logalyzer.com)

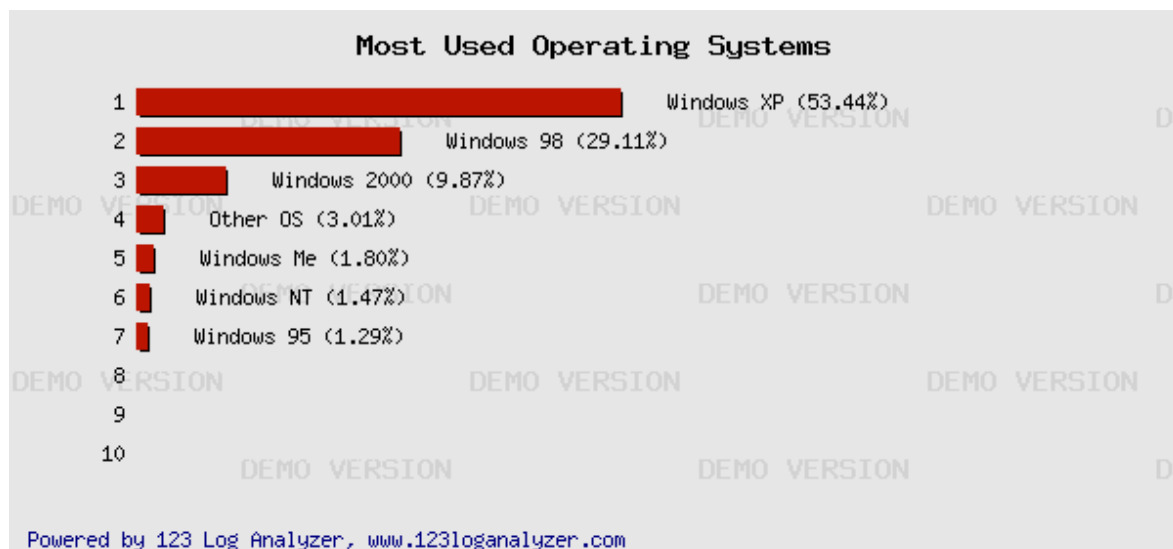
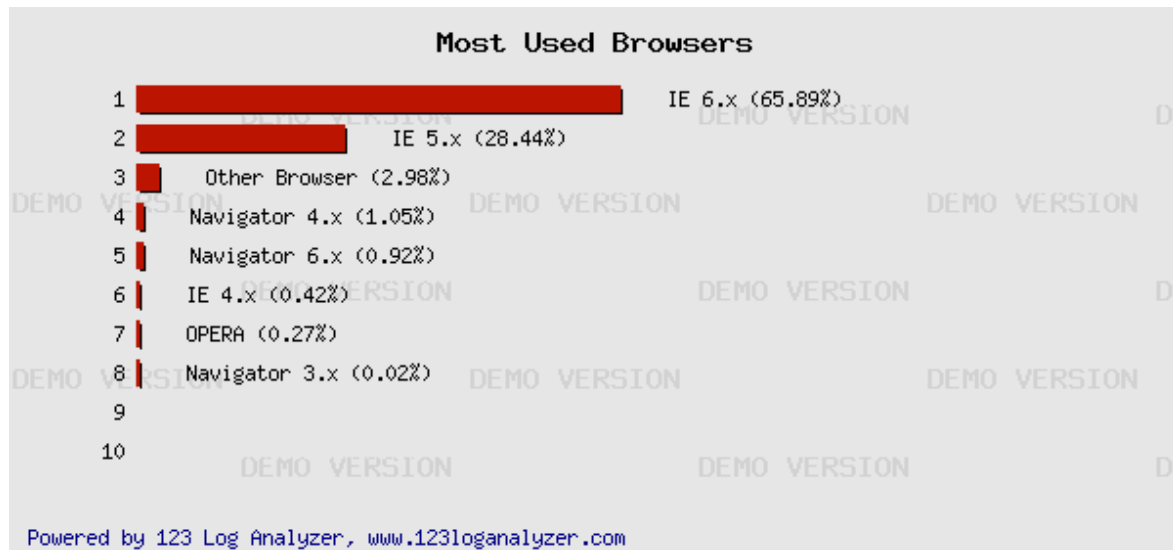
### Most Active Countries

1		Croatia (local Name: Hrvatska) (91.28%)
2		United States of America (5.59%)
3		United Kingdom (1.00%)
4		Sweden (0.55%)
5		Bosnia And Herzegovina (0.52%)
6		Germany (0.34%)
7		Slovenia (0.28%)
8		Austria (0.21%)
9		China (0.12%)
10		Canada (0.12%)

Powered by 123 Log Analyzer, [www.123logalyzer.com](http://www.123logalyzer.com)

Rank#	Countries	Visitors	Page Views
1	Croatia (local Name: Hrvatska)	5307	42343 (93.62%)
2	United States of America	325	1448 (3.20%)
3	United Kingdom	58	655 (1.45%)
4	Sweden	32	177 (0.39%)
5	Bosnia And Herzegovina	30	82 (0.18%)
6	Germany	20	110 (0.24%)
7	Slovenia	16	59 (0.13%)
8	Austria	12	54 (0.12%)
9	China	7	92 (0.20%)
10	Canada	7	24 (0.05%)
11	Macedonia	5	13 (0.03%)
12	Yugoslavia	5	11 (0.02%)
13	Singapore	3	73 (0.16%)
14	Switzerland	3	7 (0.02%)
15	Australia	3	33 (0.07%)
16	Denmark	3	23 (0.05%)
17	Italy	2	4 (0.01%)

18	Brazil	2	2 (0.00%)
19	Oman	2	7 (0.02%)
20	Netherlands	2	3 (0.01%)
21	Nigeria	1	1 (0.00%)
22	Luxembourg	1	6 (0.01%)
23	Spain	1	2 (0.00%)
4	France	1	1 (0.00%)



We believe that our initial hypothesis has been proved. Server technology and Web application development tools are advanced enough, cost has been reduced, applications are simple to use and deploy. It is possible to develop and implement a medium-size Web application without huge investments in the infrastructure. Windows 2000 Server is stable and secure for commercial and academic use. Advantages of a windows platform are relatively easy maintenance and familiar interface. Disadvantages are non-open source technology and somewhat expensive software.

Active Server Pages technology has enormous possibilities and we are certain that the most off-line systems will soon be available on the Internet.

Microsoft's .Net initiative points direction of software development in the next few years. We have managed to achieve this type of mobility using restricted resources and without the .Net technology.

Further development will include new options, better communication between different systems within the Faculty (the system for student management ("x-cards") and studomat) and better and faster data flow. This would simplify student data processing and improve overall processing speed.

We are working with *library online project* at Faculty of Philosophy. Our plan is to include their search and retrieval system in the *studomat* and cooperatively develop system for automatic update of exam literature lists.

Application of a similar system is certain in libraries. Users will have direct access to library catalogue, item availability, reservation system, etc. System would send SMS/Email notice when a book becomes available and remind user to return it. It would be possible to organize book delivery, users could write a review included in the book description, it would be easy to make top rented book lists, etc. The possibilities are numerous.

Web services simplify work with distributed or remote databases (e.g. a number of different libraries).

ASP technology enables user to work from any PC connected to the internet. Program deployment is as easy as uploading new version to the server. There is no need for a complex distribution and installation.

Server side scripting means that the processing is executed on the server. After processing, pure HTML code is sent to the Web browser/client. This guarantees wide OS and browser compatibility. Server side access enables higher level of security and low possibility of database attack - only a programme/script executed on the server has access to the database.

ASP technology and stabile Windows 2000 server present an ideal solution to academic and scientific projects as well as for commercial applications. We believe this project proved our hypothesis.



## ***5. References***

1. DOUGLAS J. REILLY: Designing Microsoft® ASP.NET Applications, Microsoft Press, 2002-05-06
2. MICROSOFT CORPORATION: Microsoft® Internet Information Services 5.0 Documentation, 2002-05-06
3. <http://www.microsoft.com/mspress/it/feature/040501.asp>