

Central Registry for Results of Maturity Examinations for Student Admission Systems in Poland

Janina Mincer-Daszekiewicz

Faculty of Mathematics, Computer Science, and Mechanics

Warsaw University, Poland

jmd@mimuw.edu.pl

Abstract

Year 2006 will bring important changes to the student admission at higher education institutions in Poland. Admission will almost entirely depend on the results of the new maturity examinations, for the first time carried out in 2005. At many institutions admission procedures will be supported by web-based software systems for remote handling of all aspects of registration and qualification. The crucial task for the coming year is to organize a process of passing the maturity results in an automatic way from the authorized source to the systems handling qualification procedures. KReM is a nation-wide software registry for results of maturity examinations serving as a proxy for transferring them between databases of regional examination commissions and admission systems at higher education institutions. It will support 2006 admission. Organizational and technical aspects of KReM are the main subject of this paper.

Keywords: maturity examinations, student admission, web-based remote admission system.

1. Introduction

Year 2005 was a turning point for student admissions for higher education institutions in Poland. First, it was the year when maturity examinations, organized centrally under the supervision of the ministry of education and graded by external examiners according to standardized, clearly-defined criteria, by law became a basis for the admission procedures. Second, web-based student admission system called IRK¹ ([4, 6]), developed at Warsaw University, was officially taken over by MUCI ([5]) – consortium of about 20 higher education institutions in Poland – with the aim to integrate it with the student management information system, being designed and developed under MUCI supervision. The new project popularized the idea and delivered the tool for web-based, electronic, remote registration and qualification procedures for student admission.

In year 2006 this trend will deepen. The maturity examination will become almost the only basis for admission to any type of higher education institution, for two reasons:

- a. the minister of education by official regulation discouraged higher education institutions from

organizing extra entrance tests and exams, which would duplicate maturity exams (what was very common a year before),

- b. the percentage of candidates who graduated under the „old system” and need to be examined at the university will be substantially lower.

The number of higher education institutions using web-based systems like IRK for handling admission in an electronic way will increase significantly.

It thus becomes obvious that the crucial task for the coming year is to organize a process of passing the maturity results in an automatic way from the authorized source to the databases of student admission systems to enable remote qualification of candidates. Although the idea seems straightforward and all parties (candidates, admission committees at higher education institutions) would benefit from such solution, we did not manage to implement it in 2005. The obstacles were more of legal – than technical – character. The success seems almost sure during the coming 2006 admission.

The new system of maturity examinations in Poland and the underlying process of student admission is explained in section 2. In section 3 the idea of a web-based student admission system is outlined. In the main section 4 technical and organizational aspects of a new system for passing maturity results from regional examination commissions to admission systems of higher education institutions is described in detail. Some conclusions are drawn in the last section.

2. Maturity examinations and student admission in Poland

2.1. New Maturity Examination, Central Examination Commission and Regional Examination Commissions

In Poland the credential that gives right for entry to higher education is the **maturity certificate**, issued after completion of education in a secondary school and success in the **maturity examination**. The maturity examination is not compulsory in Poland, although it is necessary for all these pupils who wish to apply for admission to any type of higher education institution.

¹ Pronounced *Irka* which is a popular female name in Poland.

In 2001 the minister of education made a decision to introduce in Poland, starting from 2005, a new system of maturity examinations. This new system relies on external grading of written exams, based on clearly-defined criteria and must by law be used as a basis for the admission procedure by higher education institutions. The maturity examination is carried out twice a year, in winter and summer sessions, by an external body – the **Regional Examination Commission (REC)** – in school which the examinee attended. There are 8 such commissions, with the range covering the whole territory of Poland (located in Warszawa, Jaworzno, Gdańsk, Poznań, Łódź, Łomża, Wrocław, Kraków). The examination consists of 2 parts: oral and written. The tasks for the written part are the same in the whole Poland and they are prepared by the **Central Examination Commission (CEC)**. RECs and CEC are supervised by the minister of education. The tasks for the oral part of the examination in Polish language are prepared by the teachers from the given school and the tasks for the examination in modern language are prepared by the REC, which also appoints and authorizes teams of external examiners, who correct and mark written tests. The internal character of the examination consists in the fact that the oral part is held within the school and the final marks are awarded by a jury made up of the teachers from this school. Positive results obtained in oral examinations allow admission to external written examinations. The final marks are placed on the certificate separately for oral and written parts. The maturity certificate lists the courses and the marks obtained on completion of the school, as well as the marks from the examination subjects.

2.2. Admission to higher education institutions

Admission to higher education is based on the new maturity certificate. According to law on higher education, the senate of each higher education institution establishes the rules and procedures for admission to studies in this institution. The resolution of the senate is announced publicly not later than till 31st May of the year preceding the year which the resolution concerns. If the requirements concerning admission envisage passing the exam in a subject which was taken by the candidate during the maturity examinations, the obtained results are the basis for admission for studies to this institution. In such case, the senate establishes what percentage of the points obtained from maturity examination will be required for the admission to this institution.

In the year 2004, maturity certificates were awarded for the last time on the basis of the system functioning prior to the reform. Year 2005 was the first when maturity results were taken into account in the admission procedures. Many institutions, especially these which traditionally organized competitive entrance examinations because capacity was lower than the number of candidates, worried that the unfortunate distribution of maturity results would make it difficult to recognize and pick up the best candidates. They took a chance given by the new law, which allows for assessing candidates' predispositions required for a given branch of study, and

organized additional entrance exams. This however complicated already complex rules of recruitment implied from the necessity to reconcile, during the transitional period, both the old and the new systems. In particular, universities had to decide how to split the admission limits between various groups of candidates (those who graduated from secondary schools under the "old system" and those who graduated or will graduate under the "new system").

Maturity examination in 2005 was – generally speaking – a success. Despite a few cases maturity examinations proved to be proper tools for assessment of the preparation of candidates in school disciplines. In most cases extra entrance exams didn't turn out to be necessary. Another impulse for changes came from the minister of education, who issued a new regulation, according to which senates of higher education institutions have to apply for a special permission for each exam they want to incorporate into the admission procedure. In consequence many of them decided to abandon exams organized a year before. The remaining exams are generally interviews checking the applicants' dispositions to a given specialization (sport, art, architecture etc.). Most institutions will apply ranking procedures based on the final grades listed in the maturity certificate, making it the only requirement for the admission. It is expected that in the reformed system of education in Poland the maturity examination, being external and standardized, will gradually replace all entrance examinations to higher education establishments.

More about higher education in Poland can be found at [1, 2].

3. Web based student admission systems

Warsaw University was the first higher education institution in Poland to centralize admission procedure (registration and assessment) and to implement and deploy remote web-based student admission system (see [6]). In 1996 the first central exams were offered for the most popular exam subjects: mathematics, Polish language, and foreign languages. In 1997 for the first time candidates were registered centrally for all studies at Warsaw University. Prototype web-based student admission system – called IRK – was implemented in 2002 and gradually improved since then. New admission system – IRK2005 – which moved away from the sole reliance on the entrance exams to basing the decision on the results of the new maturity examinations, was implemented and used for the first time in 2005.

IRK2005 solves most of the problems of remote registration and admission. Prospective students can handle all registration activities on-line. They use web forms to enter personal data and to register for as many fields of study as they wish. They get from the system their 'personal account numbers' to which they transfer required registration fee, and also from the system get the confirmation that the money has been received. Of course they had to personally take part in additional tests or

interviews required by the admission procedure, but the results can be scanned and entered to the system in an electronic way.

IRK is not the only system of that type in Poland. There are others used either at university or faculty level. To our knowledge it is the only one and the first system (with the underlying organizational procedure) in which paper documents are gathered from candidates not BEFORE but AFTER the official admission. It is also the only one used by more than one institution. IRK2005 has become officially a part of the integrated software package for handling student affairs, developed and financed by the consortium of Polish higher education institutions called MUCI ([5]). This gives it a chance to become the basis for a national standard. This year's version – IRK2006 – will be used by most of the members of the consortium.

In 2005 the admission was mostly based on results of maturity examinations carried out at schools and marked by RECs. 2006 admission will almost entirely depend on maturity results. This opens new possibilities. Let us assume that maturity results are delivered electronically, from the authorized source. The admission system thus gathers all the data necessary for making final assessment decisions. Candidates point out fields of study of their choice, rating them according to their preferences, the system takes into account maturity results (and results of additional entrance exams, if necessary) and composes ranking lists. The final decisions are made without anybody having to travel or deliver any documents. This could also work for more than one institution, if they would decide to carry common admission procedure. The candidates would definitely welcome such a solution since now quite often they are expected to make a final decision at one university before knowing their ranking position at the other.

An automatic and remote qualification will be possible if one more problem is solved – passing the maturity results from the authorized source to the databases of student admission systems. Although the idea seems to be straightforward and all parties (candidates, admission committees at higher education institutions) would benefit from such solution, we did not manage to implement it in 2005. The obstacles were more of legal – than technical – character. The success, however, is almost guaranteed during the coming 2006 admission.

4. Central registry of results of maturity examinations

4.1. Organizational aspects

The only authorized source of maturity results are eight RECs, which store in their databases results of all pupils examined at schools from the districts covered by these RECs. In particular, maturity certificates are printed at RECs and from there delivered to schools. It might be expected that these results are then transferred to the database of CEC, but this is not the case. CEC gathers only aggregated data for preparing global statistics for the

minister of education. Only RECs are by law allowed to gather and process maturity results at the level of individuals. This is the first obstacle, the other one being the fact that higher education institutions in Poland use – as described in p. 3 – different admission systems and procedures. Passing the same data from each REC to each university admission system in Poland in a distributed way would be unacceptable, since RECs are busy performing their legal duties and wouldn't agree to get involved in any process which would put their main obligations under risk. The same may be said about CEC. The only reasonable solution is to build the system serving as a proxy between all RECs on the one hand, and all higher education institutions in Poland, on the other.

KReM (the name comes from *Krajowy Rejestr Matur*, in Polish, or *Country Registry of Maturity Results*, in English²) is a web-based system serving as such a proxy. The first version was built in April 2005. The reason it wasn't used last year was strictly legal. According to Polish law, any person has the right to have his/her personal data protected, so it is not allowed to gather and process personal data without written permission of the owner. In April it was too late to get such permissions from all candidates, especially remotely and without any additional manual activities involving extra time and money. The procedure applied during 2005 admission at Warsaw University was the following: candidates were asked to enter the maturity results by themselves to IRK. These results were used to make qualification decisions. Every qualified candidate was then asked to deliver official documents, together with the maturity certificate. At that moment the results in the system were manually verified with the certificate. In only rare cases the discrepancies were found which needed correction of earlier qualification decisions.

As it turned out, the legal aspect of the process was crucial for the final success. The preparations for 2006 admission started in September 2005. There is one moment in the whole procedure when each pupil in Poland is individually asked about the maturity exam and delivers some feedback: whether he/she is willing to take it, what examination subjects he/she chooses and at which level (basic or extended). The pupils get special forms to fill. The data from these forms are then entered to the electronic system of RECs by school administration officers.

This year pupils were asked one extra question: whether they give their permission for passing the maturity results to the admission systems of higher education institutions. This answer, together with other data, was delivered electronically to RECs' databases. The main condition is met: there are written permissions and they are also available in an electronic form and can be processed remotely. The important aspect is that this was achieved without any special extra activities carried by schools, higher education institutions or RECs. The percentage of obtained permissions is quite high – on the average about

² *Krem* is a Polish word for *cream*.

90%, although surprisingly results vary quite substantially between RECs, from 75% to 95%. We are quite sure that these results will be higher next year.

The next step was made on March 15, 2006, when the vice-rector of Warsaw University responsible for student affairs and all eight directors of RECs gathered at the Ministry of Higher Education to sign the agreement on transfer of maturity results to KReM. According to this agreement:

1. Warsaw University implements KReM, provides necessary hardware and system resources for its functioning, and administers it.
2. REC passes maturity results of its pupils and possible updates, according to an agreed schedule and procedure.
3. Warsaw University makes maturity results available to authorized higher education institutions, according to an agreed schedule and procedure.
4. Warsaw University assures that the maturity results will not be exposed to unauthorized subjects.
5. Warsaw University assures that the data will be stored in the system for 5 years and then removed.

The following step – Warsaw University signs an agreement with each higher education institution interested in getting data from KReM – is under way. Since these institutions are spread all over territory of Poland and there are many, the process is organized in such a way to ruled out as much manual activities on both sides as possible. The source of all necessary information is a web page ([3]), where prospective users of KReM can found electronic version of the agreement to print, sign and send to Warsaw, at the address given on the same page. There is also a registration card for reporting administrators authorized to get accounts in KReM (the same registration cards have to be filled in and delivered by RECs – they also need accounts in KReM for their administrators).

According to an agreement between Warsaw University and a higher education institution:

1. Warsaw University implements KReM, provides necessary hardware and system resources for its functioning, and administers it.
2. Warsaw University makes maturity results available to a higher education institution, according to an agreed schedule and procedure.
3. A higher education institution agrees to get from KReM only results of its candidates, not to expose them to unauthorized subjects and to use them only for the admission.

What is a surprise to many, Warsaw University does not charge any of the parties for KReM services. The software has been designed and implemented by students and faculty members of the Department of Mathematics,

Computer Science, and Mechanics of Warsaw University, is located on the departmental server and administered by the departmental staff.

One problem still remains for the coming years. There will be candidates who graduated under the „old system” and also those who graduated under the new one but in 2005. These candidates will have to be processed as before, partly manually. This also means that the admission systems have to recognize pupils who graduated in 2006, those who graduated in 2005 (and also those graduating in 2005 and passing backup exams in 2006), and those who graduated in 2004 or earlier. Each group needs different treatment. The positive aspect is that all groups but the first one will be diminishing over time.

4.2. Technical aspects

4.2.1. Introduction

From the technical point of view the following activities need to be carried out:

1. Adopting software used by RECs. Fortunately most RECs use the same software product build according to the specification prepared by CEC. CEC is responsible for adopting the specification to the new needs (as for April 2006 these changes are under way).
2. Adopting admission systems at higher education institutions. Every institution will have to take care of its software. These using IRK developed under supervision of MUCI will get the upgraded version (as for April 2006 these changes are under way). In particular every institution can decide by itself to what extent the upgraded software will support candidates, e.g. whether will allow them to view, print, or even verify results obtained from KReM.
3. Developing and implementing KReM. This is responsibility of Warsaw University.

KReM is built using the following technologies:

- Apache web server with SSL,
- PHP for system logic,
- HTML and Javascript for system presentation layer,
- Smarty for separation of presentation layer from system logic,
- MySQL for database layer.

The most fundamental system requirements are the following:

1. to accept files from RECs in an agreed format;
2. to accept files from higher education institutions and to prepare files for them in an agreed format;

3. to allow for updates of previously transferred results;
4. to fully protect the system data from possible frauds.

The remaining requirements are the following:

1. to support a simple, flexible interface for data transfers;
5. to inform users in their interfaces about important events occurring in the system;
2. to report about discovered inconsistencies in transferred data;
3. to support both massive data transfers as well as individual data updates;
4. to support effective data transfers (massive data transferred in short time).

The only data concerning maturity results collected in the system have the form: (Personal number, exam code, grade). No other data is transferred or collected, in particular no other personal data concerning candidates.

4.2.2. Data transfer

In compliance with the requirement of a simple and flexible interface, the data from the RECs' databases to the KReM database and from the KReM database to the admission systems databases will be transferred as text files having the very simple format, being produced by one system and read into the other.

All files delivered by RECs are text files having the following format:

(Personal number (;exam code; grade))*

Files delivered by higher education institutions are even simpler text files:

(Personal number)*

Transferring the files from one system to the other may be done manually or by a system cron daemon.

Various scenarios of data transfer were considered and finally the following one was implemented.

1. Each REC enters into KReM maturity results of those of all its pupils, who gave the permission for transfer of data to the admission systems of higher education institutions.
2. Each higher education institution enters into KReM personal numbers of its candidates.
3. Each higher education institution obtains from KReM maturity results of the candidates identified in p. 2, whose results have been introduced by RECs as described in p. 1.

In this scenario KReM may gather more data than necessary, since RECs deliver results of all pupils who gave the permission without checking first whether these data are needed by any of the institutions, but that makes

the process simpler for RECs which have to upload the files once (if there are not any changes in data after the upload).

Maturity results once entered into KReM may be subject to changes due to either manual or technical errors in data processing in RECs (which may always happen when massive data are handled) or correction of grades by examiners. In such cases the order of data updates is the following:

1. Each REC gradually uploads into KReM updated maturity results, which have earlier been entered into KReM.
2. Each higher education institution gradually downloads from KReM updated maturity results from p. 1, which have earlier been obtained from KReM.

(Comment: Higher education institutions need not again deliver personal numbers of their candidates, since KReM remembers, which institutions have earlier collected data of concern. Special warning message is displayed in personal interfaces of these institutions informing about the necessity to update previously collected data).

KReM should also support possible withdrawals of permissions by candidates. The withdrawal should be reported by the candidate to the respective REC. The file with personal numbers of such candidates is then uploaded to KReM, data concerning these candidates are removed and the requests to remove the data from their repositories are displayed in interfaces of these institutions which earlier collected these data.

Interface for RECs is presented in fig. 1 and interface for higher education institutions in fig. 2. The main web page of KReM with links to both demo and production versions of the system, documentation, sample data files etc. is available at [3].

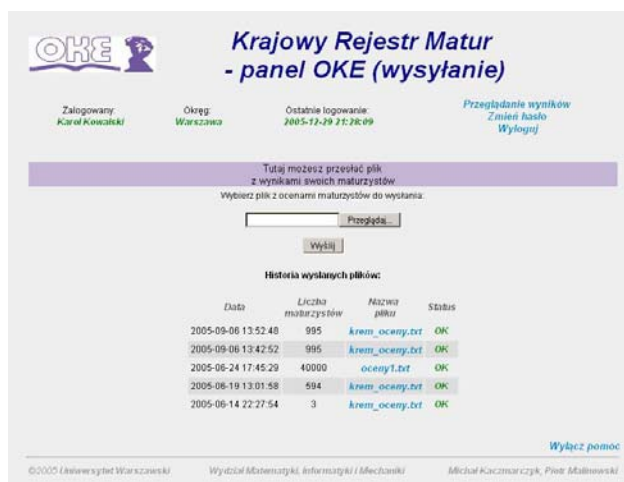


Figure 1. Interface for Regional Examination Commissions

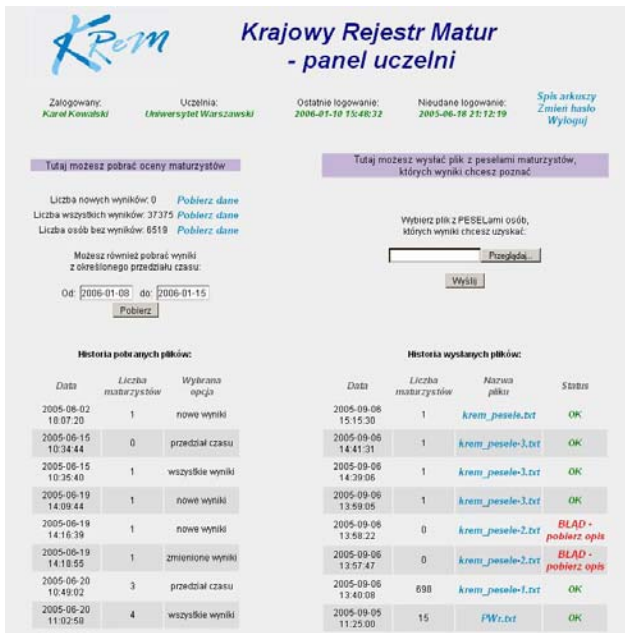


Figure 2. Interface for higher education institutions

4.2.3. Security protection

4.2.3.1. Public Key Infrastructure

Security protection is one of the main system requirements. The following elements of it has been incorporated into KReM:

1. Service is delivered from a dedicated server hidden behind a firewall, which can only be accessed from the previously registered computers identified by their IP numbers.
2. Only authorized users can login to the system. A user's account is blocked for 20 minutes after three unsuccessful login attempts in a row.
3. All transmission to and from the system is carried over the SSL protocol which ensures secure (encrypted) connection between two parties.
4. All transferred files are digitally signed by the senders and stored in the system in the original form.

Server verification

The SSL certificate of KReM – issued by the well known certification agency – should be installed on the client side in the client browser. Fingerprint of the certificate should be verified during the personal phone call.

Creating users accounts

Users from universities and RECs have to be officially authorized by their home institutions on so called registration cards, signed and send to Warsaw University. The card should contain (among others): IP of the client machine, personal data of the user, telephone number, email, and system login. After delivering the card, the

user should himself create an account in the system on a dedicated web page (see fig. 3), where the data from the registration card should be entered. An important extra information is a public key of the keypair, created using e.g. open-source GnuPG software [7]. A private key of the keypair will later be used for signing files delivered into the system by the client. A password is also entered on the web page and thus is known only to the user creating the account and need not be send on the net.

These accounts are later on activated by the system administrator. During activation process data from the registration card are compared with the data delivered on the web page and the personal telephone call is made to verify the fingerprint of the public key of the user

The server publishes its public key on the web page. Its fingerprint should also be verified by the users during the personal phone call.

Such procedure of handling user accounts is secure and convenient for the KReM administrator since the time consuming task of creating accounts is performed by the users. It helps to conduct the process in a distributed environment where on the one hand clients are dispersed over the Poland territory, but on the other security is so crucial.

Signing digitally transmitted data

Files delivered from RECs and universities are digitally signed with the private key of the user preparing the file. When the file is uploaded to KReM, the signature is checked on-the-fly using the corresponding public key of the logged user, stored in the KReM database. If the verification fails, the data from the file are rejected and the file is marked as insecure. In that way it is ensured that only files from verified sources are accepted and that the client can not later deny that the regarded files came from him.

KReM also signs digitally files prepared for the users from the universities.

The data is compressed before being signed and the output is in binary format. Given a signed document, the receiver can check the signature and recover the original data.



Figure 3. Registration form for the new user

4.2.3.2. Logging system events

Detailed logging facilities have been incorporated into KReM to further increase system security and protect it from malicious misuses. Each user is identified in KReM by the unique identifier and all carried operations are stamped with a timestamp and this identifier. The system administrator has access to the system logs and can track actions carried by the users.

The following operations (among others) are logged into the system log files:

1. creating, deleting and changing user accounts,
2. log ins and log outs (user id and computer IP),
3. unsuccessful log ins (computer IP),
4. creating, deleting and changing data about higher education institutions and RECs,
5. uploading into the system a file with maturity results by REC,
6. uploading into the system a file with candidates' personal numbers by a higher education institution,
7. obtaining from the system a file with maturity results by a higher education institution,
8. uploading into the system a file with personal numbers of these candidates who have withdrawn permissions.

All files transferred are stored in an original form and can be reviewed by the system administrator.

Additional rules also apply:

1. A higher education institution cannot remove from the system information about getting the maturity results of a particular candidate.
2. REC cannot remove from the system information about delivering the maturity results of a particular pupil.
3. No user can gain access to the interface of any other user.

Sample log file seen in the interface of the system administrator, is presented in fig. 4.

5. Summary

Whether we fully succeed to make the plans described in this paper a reality will turn out in July 2006. The transfer of the data is planned for July 11th. Most problems have already been solved. The important aspect is that KReM, together with IRK and a student management information system developed under MUCI supervision is another step toward the integrated software package for higher education institutions in Poland.

Data	Nazwa jednostki	Login	Informacja
2006-01-15 11:09:08	KReM - Administracja[1]	jmd	Użytkownik jmd zalogował się do systemu. IP:217.97.60.97
2006-01-14 22:34:54	KReM - Administracja[1]	pkgm	Użytkownik pkgm wylogował się z systemu. IP:10.1.8.250
2006-01-14 21:20:18	KReM - Administracja[1]	pkgm	Użytkownik pkgm zalogował się do systemu. IP:10.1.8.250
2006-01-14 21:27:53	KReM - Administracja[1]	pkgm	Użytkownik pkgm wylogował się z systemu. IP:10.1.8.250
2006-01-14 21:25:57	KReM - Administracja[1]	pkgm	Użytkownik pkgm zalogował się do systemu. IP:10.1.8.250
2006-01-14 21:25:52			Nieprawidłowa nazwa użytkownika (malinew) IP:10.1.8.250
2006-01-12 14:41:44	Szkoła Główna Handlowa[87]	sgb	Użytkownik sgb zalogował się do systemu. IP:194.145.104.191, 194.145.95.51
2006-01-12 11:12:07	Szkoła Główna Handlowa[87]	sgb	Użytkownik sgb zalogował się do systemu. IP:10.1.3.93
2006-01-11 21:49:08	OKE w Jaworznie[4]	jaworzno	Użytkownik jaworzno wylogował się z systemu. IP:92.210.177.71
2006-01-11 21:48:35	OKE w Jaworznie[4]	jaworzno	Użytkownik jaworzno zalogował się do systemu. IP:92.210.177.71
2006-01-11 21:48:27	Szkoła Główna Handlowa[87]	sgb	Użytkownik sgb wylogował się z systemu. IP:92.210.177.71
2006-01-11 21:48:10	Szkoła Główna Handlowa[87]	sgb	Użytkownik sgb zalogował się do systemu. IP:92.210.177.71
2006-01-11 17:16:35	KReM - Administracja[1]	mickac	Użytkownik mickac zalogował się do systemu. IP:83.19.119.245

Figure 4. Interface of the system administrator – a log file

Acknowledgements

Many thanks to Michał Kaczmarczyk and Piotr Malinowski – main developers of KReM.

References

- [1] Examination and certification system at the end of the upper secondary general education, electronic conference, May-December 1999 (report for Poland) <http://www.mszs.si/exam/index.html>
- [2] Home page of Bureau for Academic Recognition and International Exchange, Warsaw, Poland, <http://www.buwiwm.edu.pl/>
- [3] Home page of the country registry for results of maturity examinations, KReM, <https://krem.uw.edu.pl/>
- [4] Home page of the student admission system of Warsaw University, <http://irk.uw.edu.pl/>
- [5] J. Mincer-Daszkiewicz, *Deploying University Study-Oriented System at Polish Universities*, EUNIS'2003, The 9th International Conference of European University Information Systems, Amsterdam, the Netherlands, July 2–4, 2003, pp. 513–517.
- [6] J. Mincer-Daszkiewicz, *Student Admission System for Warsaw University*, EUNIS'2004, The 10th International Conference of European University Information Systems, Bled, Slovenia, June 29–July 4, 2004, pp. 328–336.
- [7] The GNU Privacy Handbook, The Free Software Foundation, <http://www.gnu.org/gph/en/manual.html>.