



# Scan Grile

Multiple Choice Test Scan Software Application

## General Presentation of the ScanGrile (Multiple Choice Test Scan/ MCTS) Application

The **ScanGrile (MCTS) Application** is a software product suitable for any educational institution which organises contests or competitive examinations based on multiple choice tests. Meaning to automate the marking/grading process, a compact and user friendly software application has been created in order to make the marking/grading work of multiple test examination sheets much easier. The application is based on forms specially devised to be automatically recognised and interpreted.

**ScanGrile** “breaks” the connection between the scanner and the application to be marked/graded. Scanning is performed separately from the application as the scanner type does not have to be specially designed for interpretation and marking/grading. The scanner only has to have an automatic feeder for the examination sheets so that the scanning process should not be too long, but this is not compulsory. To further increase the scanning process, it is recommended that the examination sheets should be scanned at a monochrome, 150 dpi resolution, BMP type images. Thus small size images will result (276 KB) which will be subsequently analysed by the application. The images of the multiple choice tests can be saved in more types beside BMP, the application being able to interpret other image types such as TIFF, JPEG, PCX, and PNG.

One of the advantages of the application is speed. Once the scanning process has been finished (variable time according to the scanner type), **ScanGrile** can mark/grade up to 180 multiple choice tests per minute or 10.800 per hour, using just one licence and one regularly equipped computer (Intel Core 2 Duo and 1 GB RAM). This has been calculated for a multiple choice test made up of 100 questions, 5 variants for each question.

In order to carry out the automated marking/grading of the multiple choice tests scanned, the application uses the latest technologies, such as **OMR (Optical Mark Recognition)**, **OCR (Optical Character Recognition)**, and last but not least, **ICR (Intelligent Character Recognition)**.

The OMR is intensely used all over the world for the analysis of data from forms used in carrying out opinion polls, multiple choice tests, assessments, registrations, voting polls, bank applications. Based on this technology, the **ScanGrile** application is able to identify the candidates' answers with 100% accuracy. The OCR technology is used for the recognition of the candidates' identification data written on the examination sheets when the candidates' identification details are not secret. For the examinations where these details are secret (the corner of the examination sheet on which the candidate's identification details are written is turned down and sealed) ICR is used, a technology which is able to recognise handwriting with precision (used to identify multiple choice test sheets numbered in handwriting).

The first step in marking/grading the multiple choice answer test sheets is to define the examination and its data, viz. number of questions and correct variants. Thus the user can define an exam of up to 100 multiple choice examination questions (on request made by the user we can increase the number of questions), each question with up to 5 correct answer variants. Several multiple choice examination variants can be defined, for instance if the examination is organised on several numbers (e.g. four numbers). The examination organisers are not required to use all 100

questions in 5 variants. Fewer questions can be defined, or fewer variants, according to the type of examination. This makes marking/grading even faster.

For examinations with more than 100 questions, the ScanGrile application offers the organizers the possibility to divide the exam into two sessions. This is useful because it offers the candidates a break between sessions when working time is very long. By this, the number of exam questions is doubled, getting to 200 questions with up to 5 variants each.

According to the exam model chosen, the ScanGrile application has an **exam sheets generation module** for the candidates to fill in the answers – the dot multiple choice test. This is automatically generated by calculating the number of questions, the number of answer variants, the number of multiple choice test sheets, and the number of sessions. Thus the user may devise any type of examination without the need for a pre-established template or one created by a separate application.

The multiple choice test templates will include fields for the candidate's identification details, the multiple choice test sheet identifier (filled in by the examination board), the number of the multiple choice test, the session number, the candidate's mark before the appeals phase, the candidate's mark after the appeals phase, exam title and date as well as the institution's initials (acronym).

The application is **fully automated**: hence, the user is not required to fill in the name of each candidate while marking/grading. This is identified by means of the candidate's ID which is filled in on the examination sheet either by the candidate or by the board when the candidates' identification details are secret.

The **ScanGrile** application has a data base which allows it to store up information. This can be installed locally or on a dedicated server. The advantage of installing on a dedicated server lies in the fact that several licences can be purchased and this leads to the acceleration of the marking/grading process for exams with a large number of candidates. For instance, for an exam with 1000 candidates and three licences purchased (installed on three separate computers) the marking/grading time needed is roughly one hour.

Separately from the ScanGrile application, a **web module** has been developed **for storing up questions and generating multiple choice examination tests**. This module is devised as a web application which offers the means to manage a questions and answers data base for future exams.

The advantage lies in the fact that each member of the board in charge of the examination questions can have access to this module regardless of the number of licences purchased for the main application. Being fully secure for users and their passwords, as well as for the information stored up, this module manages the questions at user level, or in this case, at the level of a member of the board in charge of the examination questions. The information encrypting mechanism in the data base uses the 1024 bit AES technology.

The web module can manage the questions on several sets, each set having several types. A history of the questions is kept in order to track the changes that took place. Each question may have attached a set of indicators in order to classify its level of difficulty. According to these indicators, the questions are classified as operative, to be reviewed and rejected.

This web module also generates the examination subject sheets and the marking/grading scheme. For this purpose, a selection filter is used to sort the questions on categories, sets and types, but also according to the level of difficulty resulted from the indicators' analysis.

**ScanGrile** has a benchmarking module which compares the exam results from the data base. For example: to be certain of the results of the marking/grading process two identical exams (in the number of questions, variants and types) may be defined. Then, two independent scanning operations are performed with two different scanners. Further to the scanning, two sets of results appear. The aim of the benchmarking module is to check the results and identify the possible

interpretation differences. If there are such differences, they will be identified and subsequently corrected automatically, (one more scanning operation) or manually.

The benchmarking module which compares the exam results identifies problems such as: papers which have not been scanned or computed, candidates who have given different answers between the two scanning operations, or candidates who answered questions with more or fewer variants than those required. Further to this comparison, we can intervene manually and set the correct score for the questions or introduce the unscanned papers in the final computation.

The **ScanGrile reports module** includes all the types of reports required for the marking/grading of the multiple choice tests and for results displaying. Hence this module helps obtain the candidates' exam results for each question, for each multiple choice test or session and also LERTAP model specific results implemented by the Assessment Systems Corporation.

The ScanGrile application can be integrated with the LERTAP application to generate complex statistics concerning both the performance of the candidates participating in the examination and the difficulty of the exam questions. The ensuing advantage is huge because the application makes the most of the LERTAP statistics generating complex mathematical calculations. The results obtained from these statistics can be included, with the help of the web module, in the questions and answers data base for future exams. Any report or statistics can be exported to Excel, Word, PDF, RTF or TXT formats.

### ScanGrile application advantages

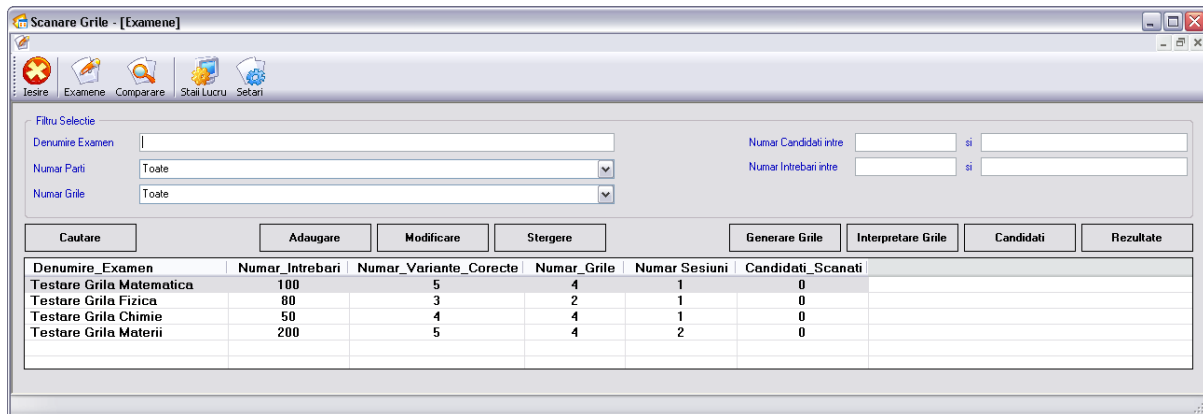
- **Client – server application.** The application has been designed to be used in the computer network of the client. The data base is separate from the application, which can be installed on a dedicated server
- The automated marking/grading of multiple choice exams from image files (**BMP, TIFF, JPEG, PCX, PNG**)
- The application does not require a certain type of scanner or driver. The scanning process is carried out separately from the marking/grading process
- **The scanned images high processing speed** – the speed is different according to the number of questions and variants
- Use of the latest technologies: **OMR** (for answer recognition), **OCR** (for typewriting recognition) and **ICR** (for handwriting recognition)
- **Defining own types of examination** by establishing the number of questions, variants, sets or sessions. Defining score according to each question
- **Printing of exam papers** can be done directly from the application by means of a specialised module using any type of printer: laser, inkjet, Xerox, etc.
- **High tolerance** for errors in exam sheet positioning in the scanner.
- **High tolerance** for the way the candidates fill in the answers
- **Web module** for the collection and storing up of exam questions. To this module, the statistics generated question indicators are attached
- Integration with the **LERTAP** system implemented by the Assessment Systems Corporation
- The score is automatically calculated and assigned to the candidates
- In order to remove any scanning error, the application has a **benchmarking module**. This module enables the manual correction of possible errors
- The marked tests can be displayed and printed on request
- The application has a **reports module** which enables exportation of results to **Excel, Word, PDF, RTF** or **TXT** formats for further processing

**System requirements:**

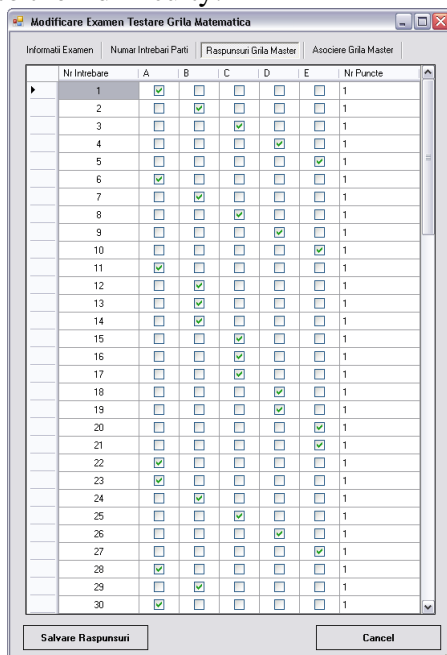
- Recommended: CPU Intel Core 2 Duo Computer, a minimum of 1GB RAM
- Minimum 100 MB free space on HDD to which scanned images are added (268 KB per candidate – for example: 262 MB for 1000 candidates)
- Operation System: Windows XP (SP2 at the very least), Windows Vista, Windows 7, Windows 2003 Server or Windows 2008 Server
- Optional: MS SQL Server 2005 Express Edition or MS SQL Server 2008 Express Edition
- Optional: Net Framework 3.5
- Optional: a printer for multiple choice test sheets and an automatic feeder scanner for multiple choice test sheets scanning

## Detailed presentation of the ScanGrile application

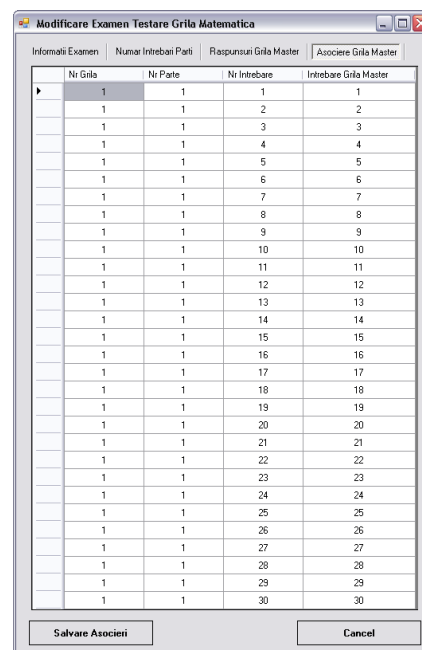
The first step in using ScanGrile is to define the exam or test which the candidates are to take. There are just a few essential issues which have to be defined: the number of test questions, the number of correct variants, how many types of multiple choice tests will be provided, and for long exams, and how many sessions.



As soon as the test is added to the data base, we can enter the correct variants for each question. For exams with several types of multiple choice tests (on several numbers), it is not necessary to enter the correct answer and the score for each question, but only for the so-called "Master multiple choice test". Based on the "Master multiple choice test" we can easily associate the other questions. According to the number of correct variants we can tick them, and particularly the score for each question as the application allows us to have questions with different scores according to their difficulty.

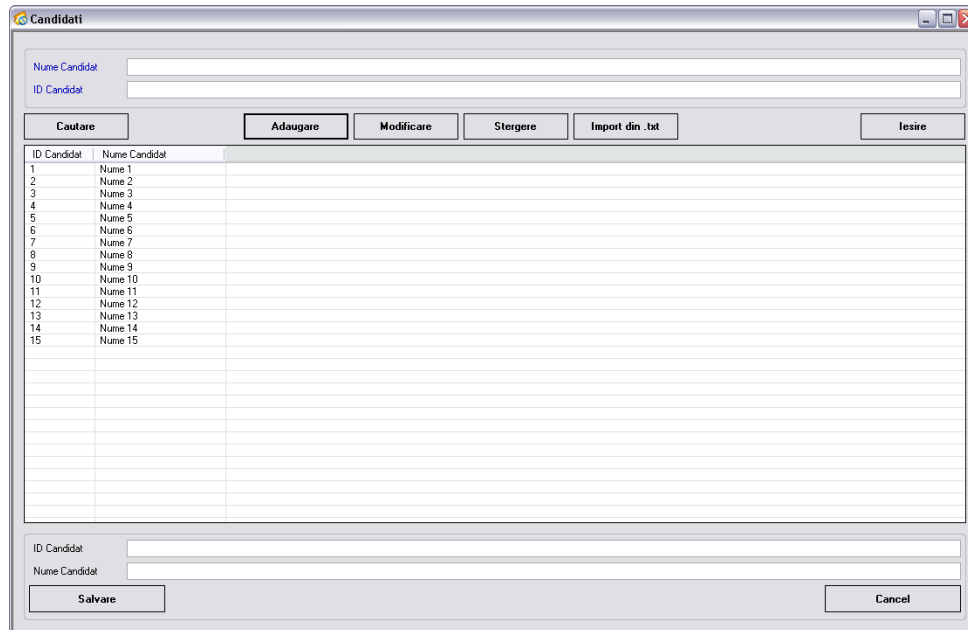


*Master*



*Master Association*

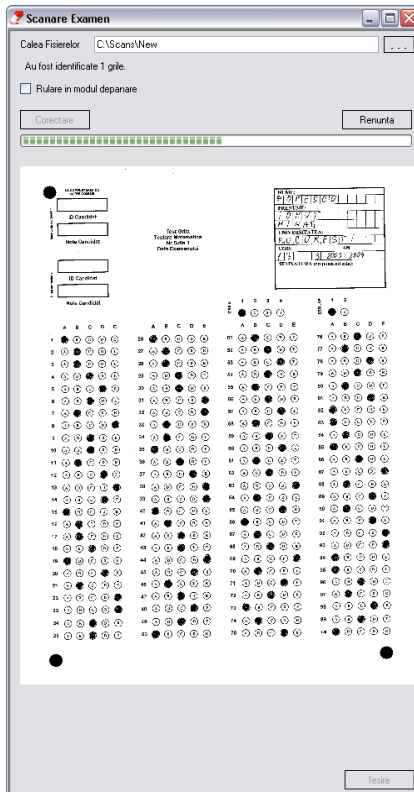
If the candidates' identification details are not secret, we can associate the candidate's number with his/her ID. At the end of the automatic marking/grading, we will be able to generate a report or Excel table with each candidate's score next to his/her name. There are two methods to enter the candidates in the data base: manually, filling in the ID and name of each candidate, or taking them over directly from a text file which can be generated from an Excel file, for example. This is easily and quickly done, making the exam results reporting less difficult.



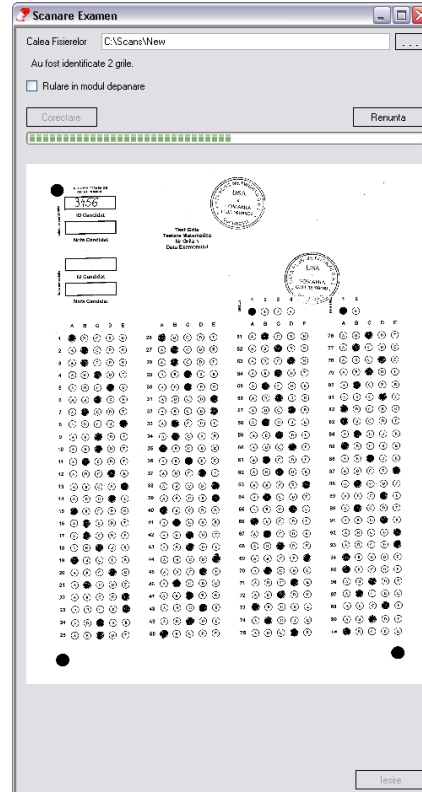
The examination sheets can be scanned with any type of scanner. The brand or drivers installed on the computer (to which the scanner is attached) are not important. This is because the ScanGrile application does not work with the scanner itself. It only uses the images resulted from scanning. This application uses BMP, TIFF, JPEG, PCX, and PNG images with a monochrome (black/white) resolution starting from 150 Dpi,. This provides speed and requires little storing space on the Hard Disk.

The exam sheets processing can be performed in two ways: with or without debugging. The debugging process displays the steps of the scanning algorithm in the automatic marking/grading process and does not save the results in the data base. This method takes too long and is used only to ensure that all parameters are observed and no calculation error will occur. The regular processing mode does not display the calculation steps and is very fast (about 6 tests per minute in the application's simple variant, and for the maximum workload: 100 questions with 5 variants).

In the case of the exams in which the candidates' identification details are secret, (the corner of the sheet with the identification information is turned down and sealed) after being handed in, the exam sheets have to be randomly assigned an arbitrary ID. This is the identification of the test sheet until the identities of the candidates are disclosed. This ID can be filled in by the board either by hand or by a stamp with numbers used to make marking/grading easier. The application distinguishes either solution. For such exams, the application reads the multiple choice test IDs and the results will be generated for these IDs.



*Readable Identification*



*Hidden Identification*

After finishing the calculation of each candidate's score, the results can be displayed. ScanGrile can display the results in three modes: simple, detailed or explicit (results are displayed according to the LERTAP model). The first variant – the simple variant – is used to display the results of each candidate for the whole exam, regardless of the type of the multiple choice test, number of questions or any other parameters. The second variant – the detailed one - highlights the candidates' scores for every type of multiple choice tests. This is useful when the candidates are given two or more types of multiple choice tests. The third variant displays each answer given by the candidate next to the score obtained. This variant is useful when statistics are carried out concerning the candidates and their answers (e.g.: LERTAP).

Rezultatele Examenului 17

ID Candidat:  Fișier:

Numar Grila:  Punctaj in tre:  si

Numar Intrebare:

ID Candidat	Nume si Prenume	Nr. Grila	Nr. Intrebare	A	B	C	D	E	Rezultat	Fișier
3456	Candidat 3	3	38		Da				1	150 Dan.bmp
3456	Candidat 3	3	39		Da				1	150 Dan.bmp
3456	Candidat 3	3	40		Da				1	150 Dan.bmp
3456	Candidat 3	3	41			Da			0	150 Dan.bmp
3456	Candidat 3	3	42			Da			1	150 Dan.bmp
3456	Candidat 3	3	43			Da			1	150 Dan.bmp
3456	Candidat 3	3	44			Da			1	150 Dan.bmp
3456	Candidat 3	3	45			Da			1	150 Dan.bmp
3456	Candidat 3	3	46			Da			1	150 Dan.bmp
3456	Candidat 3	3	47			Da			1	150 Dan.bmp
3456	Candidat 3	3	48			Da			1	150 Dan.bmp
3456	Candidat 3	3	49			Da			1	150 Dan.bmp
3456	Candidat 3	3	50			Da			1	150 Dan.bmp
3456	Candidat 3	3	51			Da			1	150 Dan.bmp
3456	Candidat 3	3	52			Da			1	150 Dan.bmp
3456	Candidat 3	3	53			Da			1	150 Dan.bmp
3456	Candidat 3	3	54			Da			1	150 Dan.bmp
3456	Candidat 3	3	55			Da			1	150 Dan.bmp
3456	Candidat 3	3	56			Da			1	150 Dan.bmp
3456	Candidat 3	3	57			Da			1	150 Dan.bmp
3456	Candidat 3	3	58			Da			0	150 Dan.bmp
3456	Candidat 3	3	59			Da			0	150 Dan.bmp
3456	Candidat 3	3	60			Da			0	150 Dan.bmp
3456	Candidat 3	3	61				Da		1	150 Dan.bmp
3456	Candidat 3	3	62				Da		1	150 Dan.bmp
3456	Candidat 3	3	63				Da		1	150 Dan.bmp
3456	Candidat 3	3	64				Da		1	150 Dan.bmp
3456	Candidat 3	3	65				Da		1	150 Dan.bmp
3456	Candidat 3	3	66				Da		1	150 Dan.bmp
3456	Candidat 3	3	67				Da		1	150 Dan.bmp
3456	Candidat 3	3	68				Da		1	150 Dan.bmp
3456	Candidat 3	3	69				Da		1	150 Dan.bmp
3456	Candidat 3	3	70				Da		1	150 Dan.bmp
3456	Candidat 3	3	71				Da		1	150 Dan.bmp
3456	Candidat 3	3	72				Da		1	150 Dan.bmp
3456	Candidat 3	3	73				Da		1	150 Dan.bmp
3456	Candidat 3	3	74				Da		0	150 Dan.bmp



Each of the three variants can generate a report or Excel file for further processing. The reports can be exported to PDF, Word or RTF.

ID Candidat	Nume Candidat	Numar Grila	Numar Intrebare	Punctaj	Fisier
1234	Candidat 1	1	1	1	150 Mircea1.bmp
1234	Candidat 1	1	2	0	150 Mircea1.bmp
1234	Candidat 1	1	3	0	150 Mircea1.bmp
1234	Candidat 1	1	4	0	150 Mircea1.bmp
1234	Candidat 1	1	5	0	150 Mircea1.bmp
1234	Candidat 1	1	6	1	150 Mircea1.bmp
1234	Candidat 1	1	7	0	150 Mircea1.bmp
1234	Candidat 1	1	8	0	150 Mircea1.bmp
1234	Candidat 1	1	9	0	150 Mircea1.bmp
1234	Candidat 1	1	10	0	150 Mircea1.bmp
1234	Candidat 1	1	11	1	150 Mircea1.bmp
1234	Candidat 1	1	12	0	150 Mircea1.bmp
1234	Candidat 1	1	13	0	150 Mircea1.bmp
1234	Candidat 1	1	14	0	150 Mircea1.bmp
1234	Candidat 1	1	15	0	150 Mircea1.bmp
1234	Candidat 1	1	16	0	150 Mircea1.bmp
1234	Candidat 1	1	17	0	150 Mircea1.bmp
1234	Candidat 1	1	18	0	150 Mircea1.bmp
1234	Candidat 1	1	19	0	150 Mircea1.bmp
1234	Candidat 1	1	20	0	150 Mircea1.bmp
1234	Candidat 1	1	21	0	150 Mircea1.bmp
1234	Candidat 1	1	22	1	150 Mircea1.bmp
1234	Candidat 1	1	23	1	150 Mircea1.bmp
1234	Candidat 1	1	24	0	150 Mircea1.bmp
1234	Candidat 1	1	25	0	150 Mircea1.bmp
1234	Candidat 1	1	26	0	150 Mircea1.bmp
1234	Candidat 1	1	27	0	150 Mircea1.bmp
1234	Candidat 1	1	28	1	150 Mircea1.bmp
1234	Candidat 1	1	29	0	150 Mircea1.bmp
1234	Candidat 1	1	30	1	150 Mircea1.bmp
1234	Candidat 1	1	31	0	150 Mircea1.bmp
1234	Candidat 1	1	32	0	150 Mircea1.bmp
1234	Candidat 1	1	33	0	150 Mircea1.bmp
1234	Candidat 1	1	34	0	150 Mircea1.bmp

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The ScanGrile application includes an extremely useful module used to compare the results of two exams. **It is a module meant to increase the security in processing the exam sheets and to eliminate any scanning or calculation error.**

Denumire_Examen	Numar_Intreb...	Numar_Variante_Corecte	Numar_Grile	Candidati_Scanati
<input checked="" type="checkbox"/> Testare Grila Matematica	100	5	4	
<input type="checkbox"/> Testare Grila Fizica	80	3	2	
<input type="checkbox"/> Testare Grila Chimie	50	4	4	
<input type="checkbox"/> Testare Grila Materii	200	5	4	
<input checked="" type="checkbox"/> Testare Grila Matematica 2	100	5	4	

ID Candidat	Nume si Prenume	Examen	Nr. Grila	Nr. Intrebare	A	B	C	D	E	Rezultat
4567	Candidat 4	Testare Grila Matematica	4	1	True	True	False	False	False	0
4567	Candidat 4	Testare Grila Matematica	4	100	False	False	False	False	False	0
4567	Candidat 4	Testare Grila Matematica 2	4	1	False	True	False	False	False	0
4567	Candidat 4	Testare Grila Matematica 2	4	100	True	False	False	False	False	0

ID Candidat	Nume si Prenume	Examen	Nr. Grila	Nr. Intrebare	A	B	C	D	E	Rezultat
4567	Candidat 4	Testare Grila Matematica 2	4	2	False	False	True	False	False	0

ID Candidat	Nume si Prenume	Examen	Nr. Grila	Nr. Intrebare	A	B	C	D	E	Rezultat
4567	Candidat 4	Testare Grila Matematica	4	100	False	False	False	False	False	0

Let us suppose that we have an examination of 1000 candidates who will fill in an exam sheet with 100 single answer questions, each having 5 answer variants. We will use two ScanGrile application licences on two fairly strong PCs. The scanning time is arbitrary, depending on the scanner/scanners used. But the processing time is easy to know: about 1 hour and 20 minutes. The most widely used method in such cases is scanning twice the exam sheets and interpreting them independently. We will subsequently compare results in order to ensure they are accurate. **The ScanGrile application can perform this comparison automatically.** All we have to do is select the two exams and push the button “Compare”. That is all. The results of the comparison are in three categories: candidates with different answers, candidates who have not been included in both processing operations and candidates who filled in wrong answers. This information allows us to go further and interpret only the different ones.

For the exam sheets which have not been processed, all we have to do is look for those files overlooked in the marking/grading operation and process them separately following the same procedure. The application will help us by identifying the file number overlooked in marking/grading.

When we have two multiple choice tests of the same candidate scanned in the two phases and whose results do not coincide, the application can display the test or tests in question, manually indicating the correct one. The application removes the test indicated by the user to be wrong.

For the test sheets in which no answer or too many answers are filled in, the application can identify these anomalies. The user can delete the incorrect multiple choice tests and mark/grade only the sheets containing mistakes.

The last module we would like to present is the **web module for the collection of questions for future exams**. This module is very important because it provides a data base of questions and answers for the current exam and for future ones. This module is fully secure at data base level, where the questions and answers are encrypted, and at application level, where authentication is made on the basis of user name and password. The module uses advanced encrypting algorithms to avoid any attempt at unauthorised access: AES technology with a public key for questions and answers, and HASH technology for users’ passwords.

The web module can be accessed using any type of Internet browser. It can store up the exams’ questions and answers as well as the history of changes. The questions are organised in sets. Each set is assigned a code made up of the question’s author name, the type of question and its order number. The authors of the question sets are the persons who conceive the questions, enter them in the data base using this module and modify the questions if necessary.

Each question set is organised in set types and each question in the set can be assigned to a category of questions. All the questions will include information regarding the level of difficulty, examination date, system validation date, indicators taken over from LERTAP as well as its system status. This information will help us in the creation of multiple choice tests

The selection of the questions for the multiple choice tests is enabled by a selection filter for the sets and questions respectively in the data base. The questions may also be selected according to the set types, question types, LERTAP indicators or question status.

Once the multiple choice test is created, the web module allows us to print the examination sheets including the questions and marking/grading scheme.

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