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AUTOMATED EMAIL SYSTEMS FOR SUBMISSION AND MARKING OF COURSE WORK

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Automated email systems for submission and marking of course work

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The Learning Scenario

Many science subjects have the need for students to learn laboratory skills, such techniques as titrations, extractions, digestions, gravimetric determinations, to name but a few. Within my own discipline of food science it is desirable that the students are aware of the techniques required to determine the basic composition of foods through chemical analysis. The term Proximate Composition refers to the percentage of the five macronutrient components present in our foods, namely: protein, fat, carbohydrate, moisture and total minerals.

The analytical procedures which are used to determine these proteins, fat, moisture and minerals can be carried out in a three hour practical session (carbohydrates can be determined by difference from 100%). Working with about 20 students in a laboratory session, I run a demonstration/practical in which we carry out the analysis of peanuts. I start the session with a preamble along the lines:

“There are two reasons that students undertake practical work, the first is to gain marks which help them to get a degree and the second is learn laboratory techniques. In this session I am only interested in the second.”

We then get started on the fat extraction, the protein digestion, the moisture and ash determinations. There is then a ½ hour gap during which they go for a coffee break. After this we carry out titrations on the protein digest and distil off the solvent which has been used to extract the fat. All this fits into a 2½ hour period. I tell the students that to complete the procedures they will need to return the next morning to obtain their moisture and mineral results (these take about 12 hours in an oven or furnace).

Towards the end of the practical session I inform the students that they are required to complete a report. For their report, I tell them that they each have a unique set of data which is within the expected variation for analysis of peanuts, but includes a random element to ensure that each student has a unique set of figures. I go on to tell them how to access the data using the program which I developed.

Despite the students not actually working with the laboratory data, I suggest that they return the following day for the final moisture, ash and fat results, if only to see the analytical part of the practical to completion.

The Problem

Two problems arise from this practical session:

1. The students are relatively inexperienced in general laboratory work and this is probably the first time they have ever carried out these particular analytical techniques – consequently their results may be suspect.
2. Since the session is run as a group demonstration, all the students will have the same results. Consequently when the students come to manipulate the data to determine the proximate composition, they might work with each other as a syndicate producing a group result and plagiarising from each other.

A Possible solution

One possible solution is to provide each student with their own unique data. Accepting that peanuts (as with all other foods) are biological materials and as such prone to natural variation in composition, I generate unique data for each student which is based on a typical peanut composition, but into which small random elements have been added. For example to determine the fat content we weigh a sample into a porous container and then extract the fat with a solvent into a flask. The student is told the weights of the thimble, the thimble plus the food, the empty extraction flask and the final weight of the extraction flask containing the extract (not too difficult – I hope).

The actual fat content of peanuts is in the region of 49%, the following table shows the algorithm which varies the student data.

Item	Description of item	Algorithm to provide data
"A"	Weight of porous thimble (cup) (g)	7 + a random number less than 1
"B"	Weight of porous thimble + peanuts (g)	"A" + 7.1 + a random number less than 1
"C"	Weight of empty round bottomed flask (g)	53.3 + a random number less than 1
"D"	Weight of round bottomed flask after extraction (g)	"C" + ("B" – "A") \times 0.47 + a random number less than 1

The student data was generated using Excel and stored as a data file, one set of unique data per student.

Design & Implementation Options

The task clearly has several elements:

- Students must have unique data, thereby preventing plagiarism and syndication
- The student must be able to return their calculated answer.
- I must be able to access the students' answer and mark it.
- I must be able to provide feedback to the student.
- Once the student has submitted and received feedback they must be barred from resubmission

At the outset of this project I approached computer services at my institution explaining what I wanted to do and asking them how I should best go about the task. The individuals I spoke to pondered the question for some time and suggested that it might be possible with one of the automated email systems, but they thought that public domain software such as *Majordomo* would not be able to cope with the demands which I was asking it to do. They went on to say that they were currently reviewing alternative software for such purposes (which can be fairly costly) and they suggested that I waited a few months till it was sorted. I did not have a few months and undeterred I considered some of the possible alternatives.

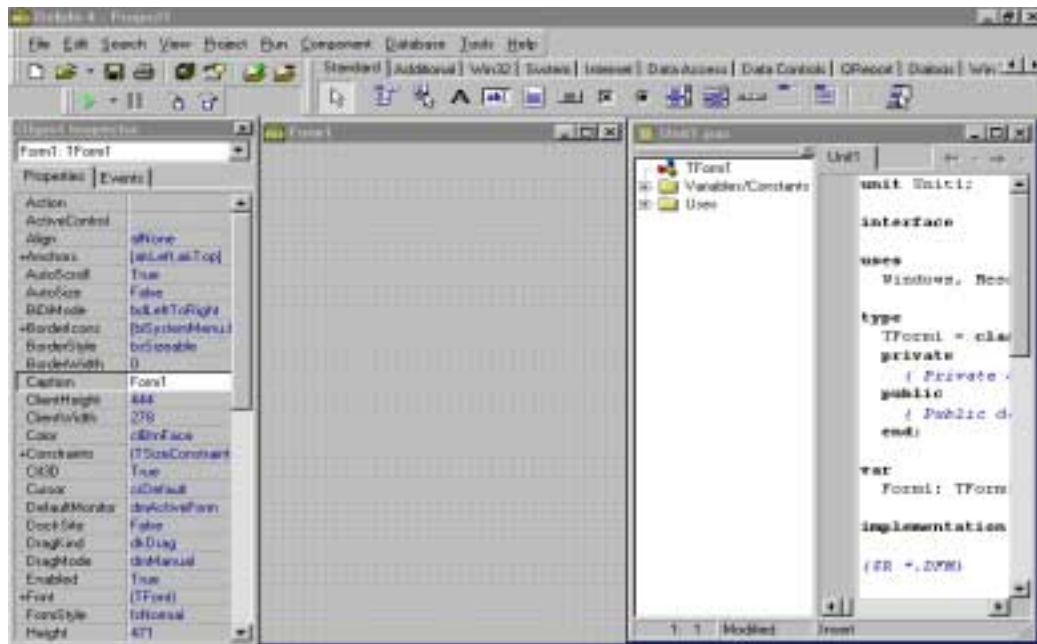
It seemed to me that a number of possible options existed which might allow the tasks outlined above to be performed.

1. Of course I could have given each student a sheet of paper with their personalised data written out. It seemed to me that this was both wasteful of resources and would require me to keep a separate lists of who got what data as well as a separate list of the "right answer" for each student – rather than work it out again. I could then provide them written feedback
2. Another possibility was to have an Excel spreadsheet (see Peter Grebenik's presentation – this conference) which provided the student with their own unique data, allowed them input their answer and stored or calculated the correct answers for me, so that I could check their calculation.
3. Tailor a stand alone program which achieves all the desired requirements using a package such as *Borland Delphi*.

Delphi as a Design Package

Borland Delphi allows a modest programmer to produce windows type applications. Delphi 4 expands the Object Pascal language to include dynamic arrays, method overloading, default parameters, and more. A Project Manager enables the user to combine projects that work together into a single project group. To organise and work on interdependent projects such as separate tiers in a multi-tiered application or DLLs and executables that work together. A *Code Explorer* makes creating classes easy by automating many of the steps. The *interface section* generates skeleton code which can be filled out with a basic understanding of Pascal.

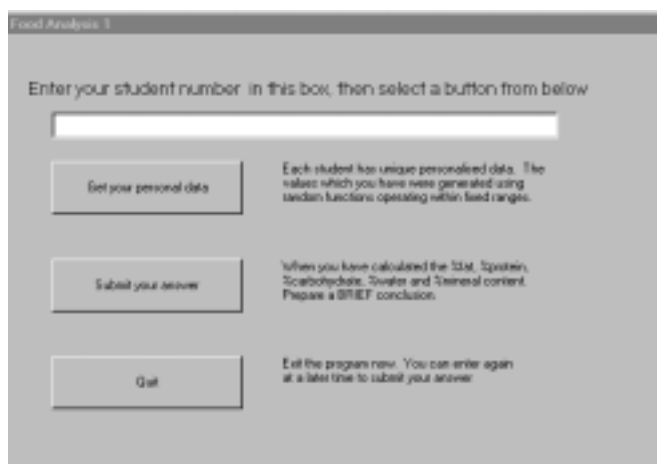
When a new project is started, a form is generated along with a code listing as shown in figure 1.



Pre-formed objects such as menus, popup menus, text boxes, edit boxes, buttons, radio buttons, check boxes, list boxes, *etc....* are available, as are data access objects, internet objects, ActiveX objects, *etc, etc, etc....*

Implementation

When the student enters the program they are presented with the following screen



The student is required to enter their student number. If the student is not registered on the module, they are referred to the module leader, otherwise they are allowed to access their personal data or submit the result of their calculations.

On pressing the button to obtain personal data, the student is presented with a page of data which they may copy down, they also have an option to email that same data to themselves.

It is expected that they will work on the data on their own and at a later time re-enter the program to submit their data. When they choose the submit button they are offered a screen with five textboxes allowing them to enter the moisture, carbohydrate, fat, protein and mineral content of the foods. There is also a scrolling

textbox in which they are able to comment on the data which they obtained as compared to published values in the literature. Once they are happy with their answer they are able to the submit button which does three things:

- It emails me the results which they have submitted along with calculation alongside of what the results of their personalised data should be.
- It emails them a model answer using their own unique data.
- It modifies the data file, preventing them from resubmitting in the future. If they should attempt to resubmit in the future they are only allowed to get a further copy of their model answer.

Outcomes

The objective that students manipulate data independently is achieved.

Students receive personalised data and feedback on their work automatically without any additional effort on my part.

While time is spent in creating a tailored application, I actually quite enjoy *playing* with software such as Delphi and sometimes I find that it is easier to do it your self rather than rely on others.

The payoff to development time comes in the marking of student work which is relatively easy and quick. I found that I could mark practical submissions at a rate of around 30 students per hour.