

Review of Maple T.A.

David Fisher
University of Surrey

d.j.fisher@surrey.ac.uk



Computer-aided assessment (CAA) has been extensively discussed in these columns. At the University of Surrey, the Department of Mathematics and Statistics has been using the web-based system Maple T.A. over the past year. (T.A. stands for 'Testing and Assessment'.) In February 2003 we linked up with Maplesoft's Canadian headquarters for an online seminar and were impressed by this new product's ability to accept alternative forms of an answer, using the power of the computer algebra software Maple to compare a student's response with the correct one. As stated on Maplesoft's website [1], "Maple T.A. supports complex, free-form entry and intelligent evaluation of responses". We felt that this product from an established name in academic computing was more likely to be successful in the long term than a locally-developed system. Previously we had used the Question Mark Designer and Presenter software, which was effective and easy to use but which, for non-numeric answers, is based on string matching so that only the precise specified form of each answer will be accepted.

Maple T.A. has proved most useful in 'gateway testing', ie. initial assessment of new students, but has also been used for part of the assessment in a number of our Level 1 modules and service teaching. Some questions which we compiled in the summer of 2003 are now available to download from the Maple Applications Centre [2], along with other question banks contributed by those who were involved during the trial period. The initial release of Maple T.A. had a number of shortcomings, but improvements have been made and the current version, Release 1.5.2, contains some helpful innovations.

To use Maple T.A., an institution must buy the software and install it on a server. The cost varies according to the number of students; details can be obtained from the U.K. supplier Adept Scientific [3]. At Surrey we have a licence to use it with students taught by our Department. A lecturer or tutor ('Instructor' in Maple T.A. terminology) can then set up a Class within Maple T.A., with its own home page. Both the instructor and the students access the system from this page, which will look something like this:

Supplier's contact details

Adept Scientific plc
Amor Way
Letchworth
Herts SG6 1ZA

T: 01462 480055
F: 01462 480213
W: www.adeptscience.co.uk

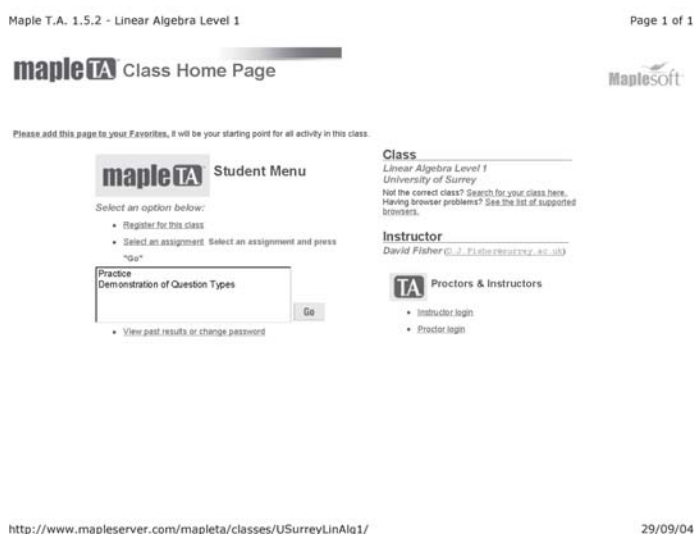


Fig 1 System access via Class Home Page

The options available to the Instructor appear on the following screen:



Fig 2 Options available to instructor

Assignments

Students must first register for the Class, choosing a user name and password. They can then access any assignments that the instructor has made available. The instructor can choose various options for each assignment, so that it can be set as a timed test, homework or quiz, anonymous practice, etc. Other options that the instructor can choose if desired include a pass mark, a fixed start and finish time, feedback to students during or at the end of the assignment, and the permitted number of attempts. A printable version can be offered. A 'proctored exam' is also available, so that the students cannot start, or get their work graded, until an authorised person has signed them in.

An assignment is compiled by the instructor from items in the class Question Bank, which may be shared with other classes. The following screen shows an assignment being constructed:

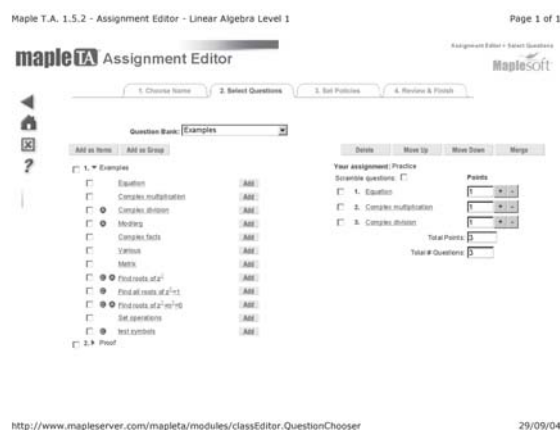


Fig 3 Assignment Editor used to construct assignment

The available types of question are described below. All types of questions can contain randomized ('algorithmic') variables, so students can repeat a practice exercise with numerically different versions of each question. When a whole group is taking a test, each student will get a randomized form of an algorithmic question, thus reducing opportunities for cheating. At the end of an assignment, students can access their grade and the correct answers. The instructor has immediate access to the students' results.

Creating Questions

Initially, it is necessary to create a bank of questions which can be used in assignments. Maple T.A.'s Question Bank Editor enables the instructor to import questions from elsewhere, such as a file downloaded from the Maplesoft site or provided by another instructor, and also to create new questions either directly in Maple T.A. or using LaTeX. MathML expressions can be created using the built-in editor or by exporting from a Maple worksheet. For LaTeX authoring, a copy of the file ed.sty must be downloaded via a link from Maple T.A.'s help pages. Questions created in LaTeX have to be compiled using an online conversion service - this is a convenient authoring method for those familiar with LaTeX, but the questions cannot subsequently be edited within Maple T.A. so the LaTeX file must be amended and re-converted. A question bank can be saved in text format as a .qu file, and can be edited in this form.

Many of the available question types will be familiar to users of other CAA systems: for example, Multiple choice; Multiple selection; True-False; Matching; Fill-in-the-blanks; Numeric; Mathematical Formula. The last-named has an option for disallowing trigonometric and logarithmic functions in the answer, so that 'sin(Pi)' will not be accepted as an answer to 'Give the exact value of $\sin \pi$ '. Ordered and unordered lists of answers can also be handled. Other question types include Essay (the student enters text to be marked manually) and Clickable imagemap (the student clicks on some feature of an image such as a turning point on a graph). Maple plots can be included in any type of question.

Multipart questions can be constructed by first creating each part as a separate question and then combining them into a single question, with different weightings if required. In the latest release there is also the Inline question type, which can be used to construct a multipart question in its entirety. It would be very useful if 'follow-through' credit could be given for answers which are correct based on a wrong answer to an earlier part, but at present this facility is not available.

An important advantage of Maple T.A. over other CAA software is the Maple-graded question. Here, Maple is used to compare a student's response with the correct answer. If the two are regarded as equivalent by Maple, then the answer is graded as correct unless some form of the answer has been specifically excluded. Answers need not be entered using Maple syntax, though there is the option to require this. Generally, 'calculator syntax' and expressions like $3x$ and e^x will be recognised. Thus the response that has been entered in the following will be accepted;



Fig 4 Question Bank Editor

In the Question Bank editor, Maple code must be entered to grade the student response. The last line of this must be a Boolean expression which evaluates to 0 or 1 (false or true). The variable $\$RESPONSE$ is automatically set equal to the student's response.

Thus if the question requires $\cos(X + Y)$ to be expanded, the Maple code for the answer could be

```
evalb($RESPONSE = expand(cos(X + Y)) );
```

This evaluates to 1 or 0, according to whether or not the response is equal to the expansion of $\cos(X + Y)$. The answer ' $\cos(X+Y)$ ' will not be accepted, as Maple does not treat this as being equivalent to the expanded form.

It should be noted that this kind of Maple coding is not needed in other question types. For example, in numerical questions it is just necessary to specify the correct answer (or a formula for it), allowing a margin of error if desired.

Randomised variables can be included in any question type, so that each student is presented with a numerically different version of the question. In the question text, a name of the form $\$x$ denotes an algorithmic variable, though when creating a question using LaTeX the

notation $\backslash\text{var}\{x\}$ is used.

There is a template for designing algorithms, but the commands for assigning random variables are quite straightforward and generally it seems easier to type them in directly. For example, $\$a = \text{range}(8)$; assigns to the variable $\$a$ a random integer in the range 1 to 8 (inclusive). Each time $\$a$ occurs, this integer will be substituted in the question as the student sees it. Maple commands can also be included in algorithms.

Comments may be included, to indicate the correct method to students if they answer wrongly. If no comment has been written then, for types other than Maple-graded, the correct answer is automatically shown when the student checks the answers. For a Maple-graded question, code to give the answer must be entered using the Question Bank editor or included in the LaTeX source.

The Gradebook

The marks obtained by students in graded assignments are stored and can be accessed by the instructor from the Gradebook. The list of marks can be sorted by Name or Grade, and can be downloaded in either comma or tab delimited format for importing into a spreadsheet if desired. Marks for several assignments can be viewed together. Statistics on each question are available (success rate, p-value and d-value), but there is no facility for obtaining a list of the responses given for each question, with their frequencies. This can be done in Question Mark, so it should not be beyond the development team at Maplesoft!

Comments

There are some deficiencies in the current version of Maple T.A. which one would hope to see addressed in future releases. As stated above, 'follow-through' grading would be a valuable improvement. It would also be very useful to be able to include a title page at the start of each assignment, containing instructions to the students. At present, any such introduction must be incorporated into Question 1.

The order of questions within a question bank cannot be modified, other than by saving as a text file and editing that. This is not of great importance, as the order of questions within an assignment is easy to manipulate. However, it would be nice to be able to maintain a bank in order and insert new questions at any position.

When testing an assignment one may wish to modify a question, but there is no direct link to the question

source so it is necessary to quit the assignment editor, enter the question bank and edit the question there.

Writing questions, particularly Maple-graded ones, requires a certain ingenuity - both in the use of Maple commands and in testing the question with various acceptable and unacceptable answers to ensure that it behaves as intended. This can be quite daunting, and it would be useful to have a more structured question-designing interface. The Visual Editor for Inline questions, new in Release 1.5.2, goes some way towards achieving this but does not help with creating Maple code.

For those familiar with LaTeX, this method of authoring is a very natural approach. It would be very useful if the conversion program could be made available to institutions, rather than being accessible only via the web.

The online help is comprehensive, but is not very well structured, although the index has been improved in the current release. There is no 'back' button on the help pages, which is annoying as one often has to refer back to a previous section. The logout and help icons are close together, and it is easy to click on the wrong one!

As described in the August issue, some CAA packages can be integrated into VLEs (Virtual Learning Environments). At present Maple T.A. will work with Blackboard, and there are plans to interface it with other VLEs in the near future. It would certainly be useful to be able to generate randomised assignment items with Maple T.A., similar to those which have been produced at York using AiM.

Conclusion

Maple T.A. is a fairly new product. At Surrey we were involved at an early stage and have seen some improvements in the first year of use. With the expertise of Maplesoft behind it, it seems likely that Maple T.A. will be further refined and will become a market leader among CAA systems. We have encountered no serious problems in using it with large groups of students in the computer labs at one time. As a means of providing unlimited revision and practice material on basic mathematical topics it is of great value; we have not yet exploited its full potential in this area but have been developing more question banks for the purpose. I would be glad to hear from other U.K. users, to compare our experience of the system and possibly to instigate further work on question design and implementation.

References

More details of the product can be found on the following websites:

- [1] www.maplesoft.com/mapleta
- [2] www.mapleapps.com (click on 'Maple TA' under the 'Education' heading)
- [3] www.adeptscience.co.uk/products/mathsim/mapleta