The CUE assessment system

by

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Introduction

The Scottish Centre for Research into On-Line Learning and Assessment is funded for 3 years through a research and development grant from the Scottish Higher Education Funding Council. Its aim is to develop an infrastructure for interdisciplinary research throughout Higher Education institutions in Scotland. There are three main strands to the Centre's activities:

1. ICT Policy led by the University of Edinburgh
2. Networked Learning led by the University of Glasgow
3. On-Line Assessment led by Heriot-Watt University

At Heriot-Watt, the research activities will be aided by the assessment system called CUE. CUE resulted from collaboration between:

1. **C**ALM (Computer-Aided Learning in Mathematics at Heriot-Watt)
2. **U**CLES (University of Cambridge Local Examination Syndicate)
3. **E**QL Livingston

This system is currently delivering the on-line formative and practice summative assessments within the SCHOLAR programme. The programme covers the Scottish Qualifications Authority (SQA) Advanced Higher and Higher in Biology, Chemistry, Computing, Physics and Maths. Although these are Scottish qualifications, the levels translate roughly to the two years covering AS and A level in England and Wales.

With the focus in SCROLLA on interdisciplinary research, the intention is to make CUE freely available for research purposes to any interested institution within Scotland (and perhaps the rest of Great Britain) in the very near future. In this way, stronger collaboration in projects to advance on-line assessment will be possible without the added difficulties of differences between assessment systems. Naturally institutions will want to consider the features and capabilities of CUE before proceeding. A dedicated server at Heriot-Watt University will be maintained and available to colleagues who use CUE and who wish to test and share their research work with others.

Aspects and features of CUE

There is a demonstration of the features of CUE on the web at:

http://www.calm.hw.ac.uk

References to the demo are given in the form CUEq1 for question 1 in the demo.

Systems information

CUE is an on-line assessment system but can be run through a local Intranet using a Windows 2000 server. It will also run as a stand-alone assessment system on a local server. This is extremely useful for presentations and demonstrations when installed on a laptop.

On the programming side, CUE is written in Delphi (Borland). The system, however, includes question and test editors providing interfaces that are easy to use by the subject authors, lecturers and academics.

General features

CUE tests can be set to run in a variety of ways.
Although commonly described as help, practice and exam modes, there are multiple options for feedback and navigation. (Fig1)

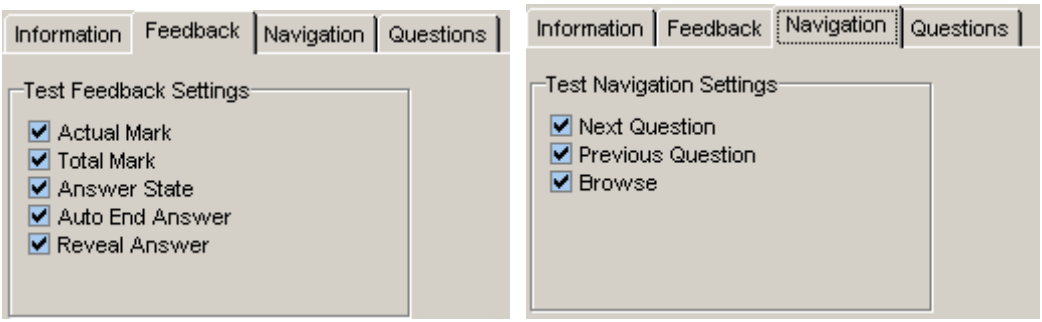

Fig 1 – CUE has multiple options for feedback and navigation

Whilst the reveal button is useful for the student, CUE also provides the options for multiple key parts and steps to these key parts. The key parts allow a complicated question to be broken down into several tasks and help to guide the student through the techniques required. All key parts need to be answered to gain full marks. (CUEq2)

Steps are used to offer similar but lower level help. The student decides whether to take the steps or not. If the steps are chosen the student must answer each question but is given simpler smaller tasks to do that lead to the answer required in the key part. This gives weaker students additional help yet still allows them to progress and gain marks. (CUEq2)

Any question type can be used for each key part and step. The test size is flexible, allowing the author to decide on the number of questions within each test.

There is a comprehensive results database where data from tests is gathered and stored. This is done incrementally to safeguard against network failure during a test. Information from the database can be made available to the student and the registered tutor.

Marking within CUE gives ticks and crosses, feedback in a separate window for most question types and the option of partial credit. Every CUE question has the same basic structure in the question editor (Fig 2) although this example includes two key parts and one step in each.

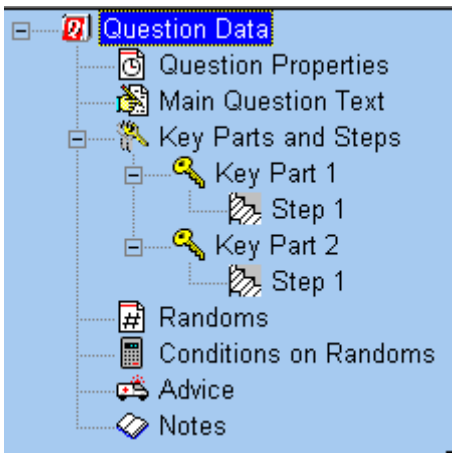

Fig 2 – Question editor showing standard basic structure of CUE question

Question types

These are best described in detail from the authoring viewpoint as there is a growing trend for types to differ according to the maker or developer.

Judged mathematical expression: CUEq1 and CUEq2

This is one of the most powerful types available and perhaps could be better described as Numerical, Algebraic and Mathematical Expression. A detailed description is given as this question type is rarely available. This type will automatically mark mathematical equivalent expressions in addition to numerical and algebraic answers. Random parameters can be used adding a greater flexibility to the questions.

In Fig 3 there are 2 key parts, one with a step.

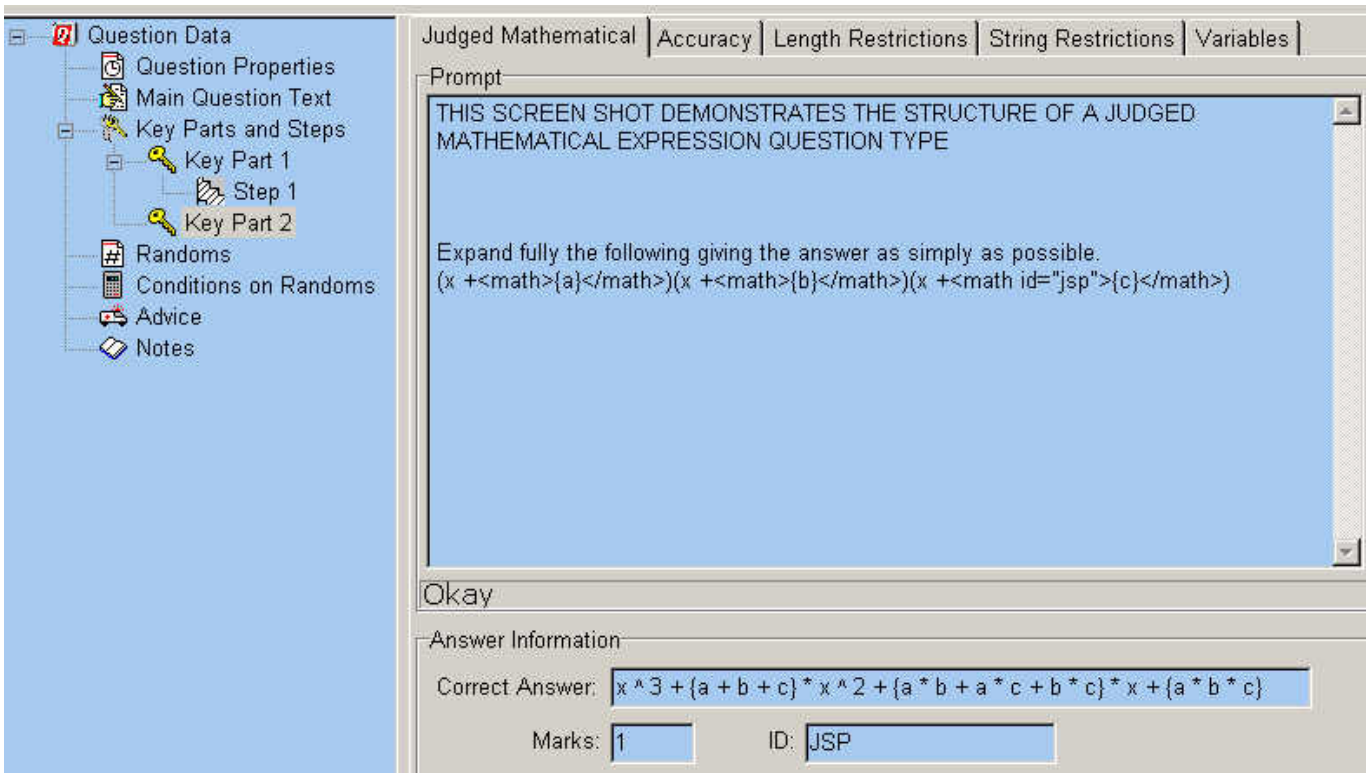

Fig 3 – Question with 2 key parts, one with a step

The question shows the use of random parameters (within curly brackets). For clarity the question is shown as Fig 4.

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Expand fully the following giving the answer as simply as possible.
(x +<math>{a}</math>)(x +<math>{b}</math>)(x +<math id="jsp">{c}</math>)
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Fig 4 – Example of random parameters in question

The parameters ‘a’ and ‘b’ show normal tags with parameter ‘c’ displaying a math tag with an id attribute. This id attribute allows the choice of options at Fig 5:

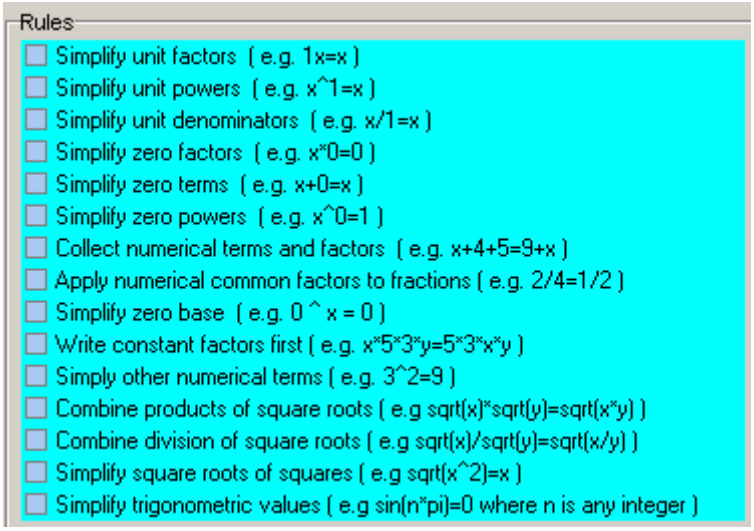

Fig 5 – Choice of options available

There are tabs above the prompt in the example question. (Fig 6).

Fig 6 – Tabs above the example question include: Judged Mathematical; Accuracy; Length Restrictions, String Restrictions; and, Variables

They offer comprehensive accuracy settings for decimal places, absolute/relative differences and significant figures. (Fig 7)

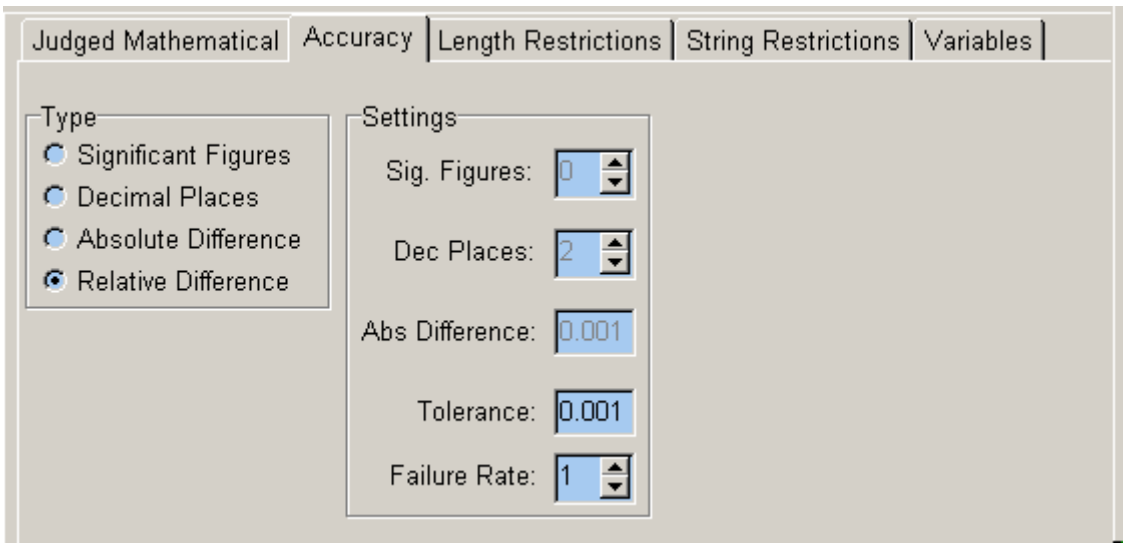

Fig 7 – Accuracy tab settings can be adjusted for the question

Length and String restrictions provide other ways of limiting answers with ‘allowed‘ and ‘not allowed‘ characters and maximum/minimum character length in the answer box. (Fig 8)

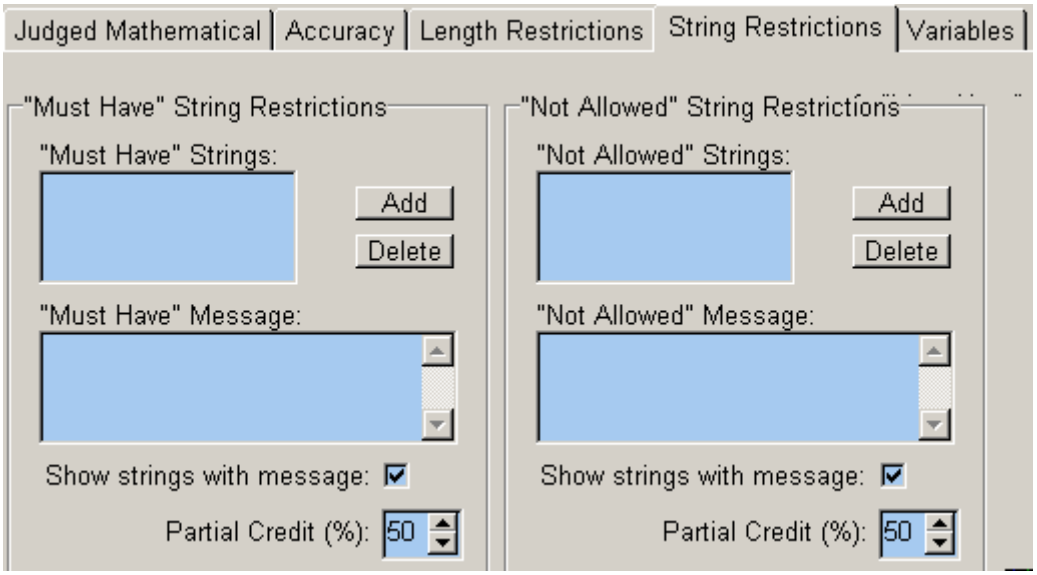

Fig 8 – Length and string restrictions help to limit answers

CUE has options for global and conditional restrictions to be imposed on randoms. In this question type the user inputs the answers in string equivalent form. On revealing any answer both this form and the rendered version of the maths is shown to help the students if they are finding this difficult.

Multiple Choice: CUEq3,4,5

This system offers various rendering and display styles (button image, radio group, choice content, drop down list) and layout (number of columns). It is possible to randomise the order of the choices, use random parameters in maths expressions and use animation or images in the choices. Feedback can be given for each choice. Some styles offer submit buttons before the selection is logged. From a choice of options the user has to select one correct answer.

Multiple Response: CUEq6

This type allows for more than one correct answer and there are comprehensive marking possibilities allowed that will give partial credit for a lesser number of correct answers than required. The multiple choice template option forms the basis of this type but the style (check box) allows for the alternative answers. The user selects more than one correct answer from a choice in multiple response types.

Word Match: CUEq7and CUEq8

With this question type it is possible to have several correct alternative answers (chosen by the author), case sensitivity and phrase match. Word match will work with any keyboard character and can accept the accented letters in languages such as French. Correct marking of root recognition is also possible. Fig 9 shows the entry in the editor for alternatives as the answer to the question 'Name one primary colour'.

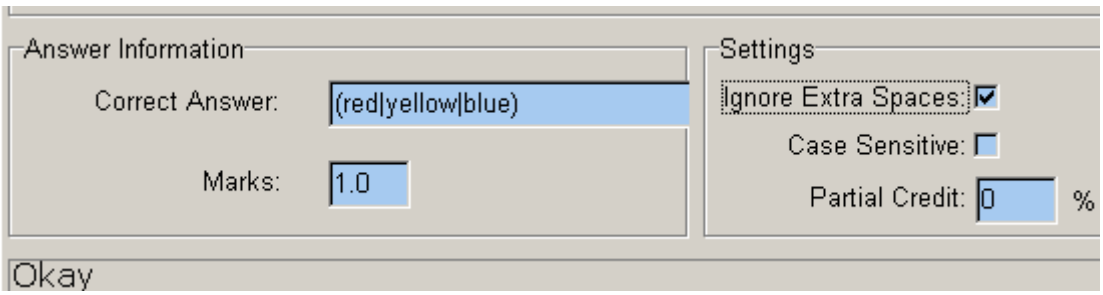

Fig 9 – Alternative answers (red, yellow or blue) set to the question "Name one primary colour" within question editor

The user types in the answer in normal text format.

Hotspot: CUE q9,q10,q15

In CUE this type of question allows the author to dictate the shape of the 'spot' rather than force a rectangle. Multiple hotspots correct or otherwise, are allowed on an image and it is possible to use multiple images as hotspots. The user chooses an answer or answers by clicking on the correct image or part of it.

Essay: CUEq11

The student is able to type in an essay answer but it is not yet possible to automatically mark it. The results service will however record that the question has been accessed. The student can save, copy and print it. In formative mode the author can prepare a model answer that is available to the student under the reveal button. The size of text box available on screen is set by the author.

Hint/Information: CUEq12

This facility allows a hint or information to be given. Marks can be deducted if required when the hint is within a step. There is no user input for this type.

Multimedia: CUEq13,14,16

In general, all question types can accept images and animation using packages such as Flash. Sound files can also be included.

Developments

Although CUE has many strengths there are still areas for development. These include the introduction of new question types, additional features such as hot links to on-line resources and improvement in the general usability and stability of the system.

Contacts

There is a demonstration test on the web showing these features in CUE:

http://www.calm.hw.ac.uk - follow the links to CUE demo.

This demo will also be available shortly through the SCROLLA websites at:
http://www.scrolla.hw.ac.uk and http://www.scrolla.ac.uk .