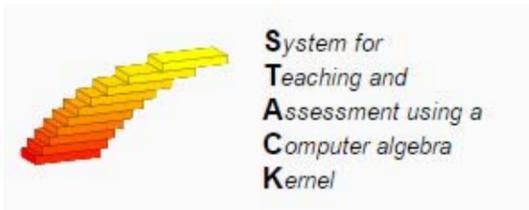


Use of STACK to generate formative assessment for level 3 Pure mathematics

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Background



STACK is a question type for Moodle quizzes that uses a computer algebra system and that has been used successfully at levels one and two to produce randomly generated mathematical questions for formative and summative assessment in mathematics.

Because of the difficulty in producing error free solutions there is very little material available for students who want to practise long level 3 questions and check their solutions (most pure mathematics textbooks at this level do not have solutions).

"I had planned to take M303 but for revision I rely very heavily on past papers"

In particular, on fairly new modules such as M303, there is a lack of exam or TMA type long practice questions. Anecdotal evidence (from student forum posts) strongly suggests that this prevents students from taking modules and that those who do take the modules feel less confident when completing TMAs and taking the exam. It also limits their ability to practise the techniques involved with longer questions

"I'm thinking about doing M303 next, however I am worried about exam preparation. So far my revision has always been based on doing past exam questions"

What we want to do

Use the rational root test to answer the following question. Select the correct answer from the drop down list.

It is that the polynomial $f(x) = x^3 + 4x^2 + 2x - 3$ is reducible over $\mathbb{Q}[x]$.

Incorrect answer.

Since $f(x)$ has degree 3, if $f(x)$ has any factors then one of these must be a linear factor. We use the rational root test (see page 51), to determine whether $f(x)$ has any linear factors.

The polynomial $f(x)$ is a polynomial in $\mathbb{Z}[x]$ so the rational root test tells us that any rational root $\frac{p}{q} \in \mathbb{Q}$ of $f(x)$ must have p an integer factor of -3 and q an integer factor of 1. This means that p must be ± 3 or ± 1 , and q must be ± 1 . We can check each of these by substituting these four values into the polynomial in turn.

We have:

- $f(3) = 66$ and so 3 is not a root (Definition 4.1 of Chapter 11, HB page 50). Therefore by the Factor Theorem we see that $(x - 3)$ is not a factor.
- $f(-3) = 0$ and so -3 is a root (Definition 4.1 of Chapter 11, HB page 50). Therefore by the Factor Theorem we see that $(x + 3)$ is a factor.
- $f(1) = 4$ and so 1 is not a root (Definition 4.1 of Chapter 11, HB page 50). Therefore by the Factor Theorem we see that $(x - 1)$ is not a factor.
- $f(-1) = -2$ and so -1 is not a root (Definition 4.1 of Chapter 11, HB page 50). Therefore by the Factor Theorem (11) we see that $(x + 1)$ is not a factor.

Therefore $f(x)$ is reducible.

This project is primarily focussed on M303 students and looks to further develop the existing set of STACK exam practice questions, adding TMA practice questions and more exam practice questions. We want to develop ways of using logical tests and text strings as variables to generate these questions and specimen solutions, enabling students to develop confidence in answering and to develop understanding of the logical structure underlying the application of the methods. This idea could possibly be extended to generate individual (or tutor group specific) TMAs with associated tutor notes.

This project would also allow us to see which questions and concepts the students are finding difficult and enable us to adjust our tuition to take this into account (and evaluate our efforts). Patterns in the incorrect solutions can help us to identify hidden dependencies of concepts. It would allow us to generate many questions and solutions (and so improve productivity) and writing questions in this way facilitates the identification of any question parts that use intuition rather than taught material and so should improve assessment and retention.

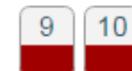
Question C (Book C)



Question 4 (Books D and F)



Question 5 (Book E)



Question 6 (Books F and D)

