Maciej Matuszewski (2021)
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In: Contributions to the International Meeting of the STACK Community 2021. TTK University of Applied Sciences: Tallinn, Estonia.
DOI:10.5281/zenodo.4916047

Partial Credit For Complicated Algebraic Expressions

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Abstract: STACK provides powerful tools to allow for giving partial credit and tailored feedback based on students' answers. This paper will demonstrate an example of how to achieve this, with a particular focus on how we can assess answers with multiple terms in a single answer box and how STACK can be made to recognise cases where only some terms are correct.

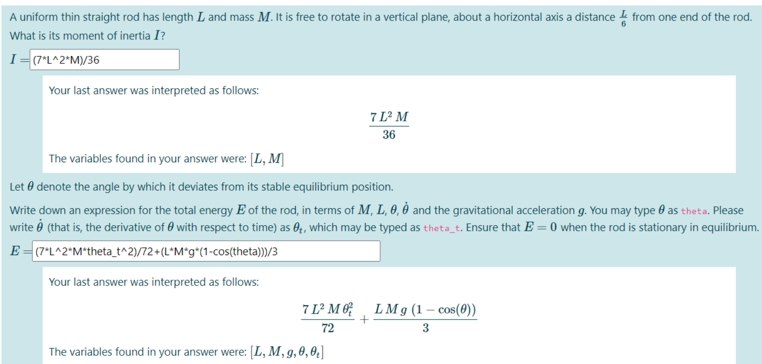
Keywords: STACK; marking; feedback; feedback tree strategies; compound expressions

Introduction

Automated assessment of student work has many advantages [Sa13], among these an ability to provide immediate feedback to students, tailored directly to their answer. This includes the case where a student's answer is only partially correct. We can use the powerful Maxima syntax to subject an answer to multiple tests, such as whether it includes the correct variables, or whether it is consistent with previous incorrect answers. STACK's potential response trees can then be used to allocate appropriate partial credit and feedback based on this.

Case Study

The text of the following first year undergraduate question was provided by the course lecturer [Wa] and converted into automated assessment by the author of this paper.



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For the first part of the question, we can give students half a mark if their answer is just a constant numerical multiple away from the correct answer, and, if the answer is completely wrong, let them know if they at least used the correct variables.

In the second part of the question, we want to give students partial credit if they only managed to get one of the kinetic energy (KE) or potential energy (PE) correct. This is made more difficult by students being able to write the PE as one term, or as two terms. The KE can be calculated from the answer to the first question, so we also want to give partial credit for follow-through errors. We can achieve this using the following potential response tree, scanning through all the terms in the students' solutions:

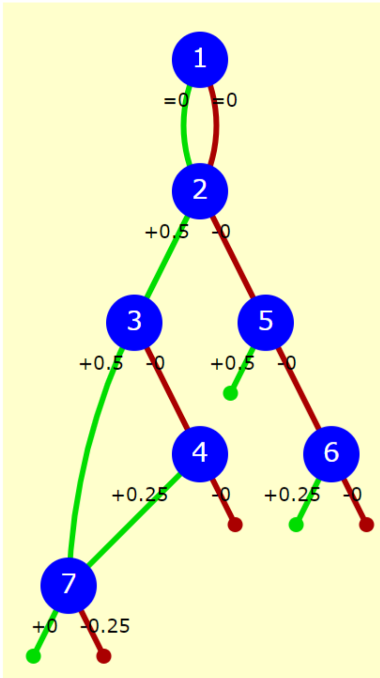
1. Count the number of terms and if there are more than three terms tell the student that we may not be able to detect correct terms. We do this as it is difficult to generalise the process in step 2 to an arbitrary number of terms.

2. Check each term, and each pair of terms, in the solution and award 0.5 points if one of them corresponds to the correct PE.

3. and 5. Check each term and award 0.5 points if one of them corresponds to the correct KE.

4. and 6. If the correct KE is not found, check if any term corresponds to what we expect the student should have found for their KE based on their answer to the first question, and award 0.25 points if that is the case.

7. If neither the KE nor PE are completely wrong, we penalise the student 0.25 points if they have any additional terms (in all other cases if students have additional terms, they have already been penalised for them).



At each node, an appropriate comment is added to the students' feedback, so that they can understand where they went wrong, and how their marks were allocated. This system replicates the level of detail of feedback that can be provided to students by hand marking, while allowing for greater consistency and speed of marking and feedback.

References

[Sa13] Sangwin, Chris: Computer Aided Assessment of Mathematics. Oxford University Press, 2013.

[Wa] Ward, Richard: First Year Dynamics Problem Sheets. Durham University Mathematical Sciences.