

Formal Statements of Pedagogic Correctness (Possible PhD Project)

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It is possible to use the techniques of computer algebra, or of rewrite rules, to say whether or not two expressions A and B are mathematically equivalent. This, however, is a long way from saying whether, if A is the answer to a question posed in a textbook or an examination, B is also a correct answer. This question has bedevilled much computer testing, but is, we believe, capable of algorithmic answers.

1 The problem

Table 1 shows that the marks to many questions will vary depending on the pedagogic context. This points also comes up well in [San13], where the writing of an individual exercise (template, i.e. allowing for different instantiations) for computer-marking is likened to writing a computer program.

Table 1: Context-Dependence

'Right' answer	student answer	Reaction
$x + 2y$	$2y + x$	Correct
$x + 2y$	$y + x + y$	$\left\{ \begin{array}{l} \text{Wrong} \quad (\text{Teaching collection}) \\ 8/10 \quad (\text{Teaching a course after collection}) \\ \text{Right} \quad (\text{Collection irrelevant}) \end{array} \right.$
$\cos(x) + c$	$\cos(x)$	Depends on teacher's view of constants in integration

2 A Solution

[BDS09, BDS10] propose regarding this as a rewrite rule problem, where, for example, commutativity would (almost) always be legal, but the penalties on, say, collection would be variable. This has yet to be implemented, or tested. JHD is pretty sure of cooperation from Chris Sangwin with this project.

References

- [BDS09] R.J. Bradford, J.H. Davenport, and C.J. Sangwin. A Comparison of Equality in Computer Algebra and Correctness in Mathematical Pedagogy. In J. Carette *et al.*, editor, *Proceedings Intelligent Computer Mathematics*, pages 75–89, 2009.
- [BDS10] R.J. Bradford, J.H. Davenport, and C.J. Sangwin. A Comparison of Equality in Computer Algebra and Correctness in Mathematical Pedagogy (II). *International Journal of Technology in Mathematical Education 2*, 17:93–98, 2010.
- [San13] C.J. Sangwin. *Computer-Aided Assessment of Mathematics*. Oxford University Press, 2013.