

Automated Function Analysis for Calculus

A. Naiman¹

¹ Jerusalem College of Technology, Jerusalem, Israel, naiman@jct.ac.il

When teaching basic mathematics courses, at all levels, there are *many* opportunities to include CAS packages like *Mathematica* [2], Maple [1], REDUCE [3], Sage [4], amongst many others. Computer algebra packages assist with the preparation of:

- classroom slides/notes,
- individualized homework assignments,
- in-class, randomized quizzes,
- class projects,
- extra-credit, further reading,
- final examinations,
- etc.

In this paper we discuss only the first area, i.e., that of the preparation of lecture notes, and particularly, for the teaching of basic, first-semester calculus.

About midway through the semester, one teaches the analysis of various functions: domains, ranges, symmetries, periodicity, monotonicity, extreme values, zeros, (one-sided) continuity, (one-sided) derivatives, etc. Furthermore, one needs to properly plot these functions for the added visual effect. As the analysis paves the way for very basic understanding of functions, we present many examples of these analyses during our lectures.

We have set about achieving effective, pedagogic, step-by-step methods for teaching this material. In order to convey the recipe for these analyses, we have also delved into *Mathematica* to find the most relevant functions. These in turn have myriads of options, and those we present as well, in order to best take advantage of the functions and their pedagogic capabilities. Finally, we include some of the pitfalls (learned the hard way!) of this approach, and how to circumvent them.

The most important aspect of the work, is that the process is *automated*, to be able to handle most/all of the basic types of functions learned during this part of Calculus I. We will present many examples of what does, and does not work, for these analyses, in the *Mathematica* environment.

References

- [1] *Maple* at <http://www.maplesoft.com/products/Maple/>
- [2] *Mathematica* at <http://www.wolfram.com/mathematica/>
- [3] *REDUCE* at <http://reduce-algebra.com/>
- [4] *Sage* at <http://www.sagemath.org/>