Abstract

This article is created within the CAS program Maxima. and shows (1) algebraic differentiation (2) plotting, and (3) listings, which are believed to be the most commonly used aspects of an article.

1 Introduction

Writing scientific articles is commonly done with LaTeX. Algebraic manipulations can be done by a CAS, for example Maxima, Maple or Mathematica. Of these examples, Maxima is the only free and open-source program. Would it be possible to write a LaTeXarticle within Maxima? If yes, would it be elegant enough?

2 Materials and methods

A script executes the process from Maxima file to LaTeX-formatted document in two steps. The first step executes the Maxima script to create a LaTeX(.tex) file. The second step converts the LaTeXfile to Portable Document Format (.pdf). The script does not require user intervention.

The Maxima script consists out of two parts: algebraic manipulations and LaTeXoutput

The algebraic manipulations demonstrated are: (1) defining a function (2) calculate its derivative and, (3) plot this derivative.

The second part uses these algebraic results to create a LaTeX(.tex) file. It creates an article displaying the formula's, the single plot in the Results section. In the Appendix, it shows: (1) the bash script to create a PDF from the Maxima script (2) the Maxima script (3) the generated LaTeXcode

3 Results

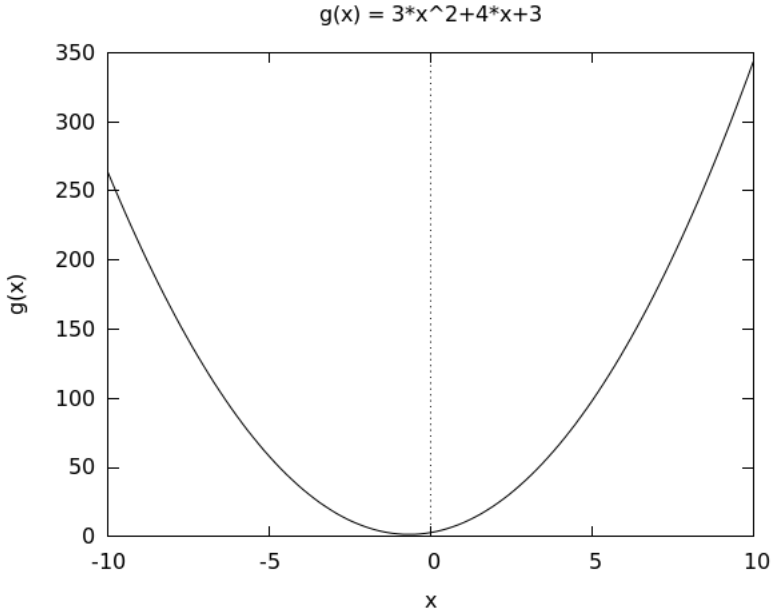
This is the formula for f:

$$f(x) = x^3 + 2\,x^2 + 3\,x + 4$$

This is the formula for g, the derivative of f to x:

$$g(x) = 3\,x^2 + 4\,x + 3$$

Which looks plotted as such:



A Script file

```
tex_output_file="create_tex_article_simple_output.tex"

if [ -e $tex_output_file ]
then
  rm $tex_output_file
fi

maxima -b create_tex_article_simple.txt
pdflatex create_tex_article_simple_output.tex
```

B Maxima file

```
/* Maxima batch file */

/* Load libraries */
load("stringproc")$

/* Input filename */
bash_filename:"create_tex_article_simple.sh"$
```

```
maxima_filename:"create_tex_article_simple.txt"$ /* this
    file */

/* Output filenames */
tex_filename:"create_tex_article_simple_output.tex"$
png_filename:"/home/richel/GitHubs/Maxima/
    create_tex_article_simple_output.png"$

/* Do the calculations */
F(x):= f(x) = (1*x^3) + (2*x^2) + (3*x) + 4;
G(x):= g(x) = ''(diff(rhs(F(x)),x));
plot2d(
  rhs(G(x)),[x,-10,10],
  [title,string(G(x))],
  [xlabel,"x"],
  [ylabel,"g(x)"],
  [color,black],
  [png_file,png_filename]
);

/* Write results to TeX file */
stream: openw(tex_filename)$
printf(stream,"\\documentclass{article}~%")$
printf(stream,"~%")$
printf(stream,"\\usepackage{listings}~%")$
printf(stream,"\\usepackage{graphicx}~%")$
printf(stream,"~%")$
printf(stream,"\\begin{document}~%")$
printf(stream,"~%")$
printf(stream,"\\begin{abstract}~%")$
printf(stream,"This article is created within the CAS
    program Maxima.~%")$
printf(stream,"and shows (1) algebraic differentiation
    (2) plotting, and (3) listings,~%")$
printf(stream,"which are believed to be the most commonly
    used aspects of an article.~%")$
printf(stream,"\\end{abstract}~%")$
printf(stream,"~%")$
printf(stream,"\\section{Introduction}~%")$
printf(stream,"~%")$
printf(stream,"Writing scientific articles is commonly
    done with \\LaTeX.~%")$
printf(stream,"Algebraic manipulations can be done by a
    CAS, for example Maxima, Maple or Mathematica.~%")$
printf(stream,"Of these examples, Maxima is the only free
    and open-source program.~%")$
```

```
printf(stream,"Would it be possible to write a \\LaTeX
    article within Maxima?~%")$
printf(stream,"If yes, would it be elegant enough?~%")$
printf(stream,"~%")$
printf(stream,"\\section{Materials and methods}~%")$
printf(stream,"~%")$
printf(stream,"A script executes the process from Maxima
    file to \\LaTeX–formatted document in two steps.~%")$
printf(stream,"The first step executes the Maxima script
    to create a \\LaTeX (.tex) file.~%")$
printf(stream,"The second step converts the \\LaTeX file
    to Portable Document Format (.pdf).~%")$
printf(stream,"The script does not require user
    intervention.~%")$
printf(stream,"~%")$
printf(stream,"The Maxima script consists out of two
    parts:~%")$
printf(stream,"algebraic manipulations and \\LaTeX output
    ~%")$
printf(stream,"~%")$
printf(stream,"The algebraic manipulations demonstrated
    are: ~%")$
printf(stream,"(1) defining a function~%")$
printf(stream,"(2) calculate its derivative and,~%")$
printf(stream,"(3) plot this derivative.~%")$
printf(stream,"~%")$
printf(stream,"The second part uses these algebraic
    results to create a \\LaTeX (.tex) file.~%")$
printf(stream,"It creates an article displaying the
    formula's, the single plot in~%")$
printf(stream,"the Results section.~%")$
printf(stream,"In the Appendix, it shows: ~%")$
printf(stream,"(1) the bash script to create a PDF from
    the Maxima script~%")$
printf(stream,"(2) the Maxima script~%")$
printf(stream,"(3) the generated \\LaTeX code~%")$
printf(stream,"~%")$
printf(stream,"\\section{Results}~%")$
printf(stream,"~%")$
printf(stream,"This is the formula for f:~%")$
printf(stream,"~%")$
printf(stream,tex(F(x),false))$
printf(stream,"~%")$
printf(stream,"This is the formula for g, the derivative
    of f to x:~%")$
printf(stream,"~%")$
```

```
printf(stream,tex(G(x),false))$
printf(stream,"~%")$
printf(stream,"Which looks plotted as such:~%")$
printf(stream,"~%")$
printf(stream,"\\includegraphics[scale=0.5]{")$
printf(stream,png_filename)$
printf(stream,"}~%")$
printf(stream,"~%")$
printf(stream,"\\appendix~%")$
printf(stream,"~%")$
printf(stream,"\\section{Script file}~%")$
printf(stream,"~%")$
printf(stream,"\\lstinputlisting[language=C++,
    showstringspaces=false,breaklines=true,frame=single]{"
    )$
printf(stream,bash_filename)$
printf(stream,"}~%")$
printf(stream,"~%")$
printf(stream,"\\section{Maxima file}~%")$
printf(stream,"~%")$
printf(stream,"\\lstinputlisting[language=C++,
    showstringspaces=false,breaklines=true,frame=single]{"
    )$
printf(stream,maxima_filename)$
printf(stream,"}~%")$
printf(stream,"~%")$
printf(stream,"\\section{\\LaTeX file}~%")$
printf(stream,"~%")$
printf(stream,"\\lstinputlisting[language=tex,
    showstringspaces=false,breaklines=true,frame=single]{"
    )$
printf(stream,tex_filename)$
printf(stream,"}~%")$
printf(stream,"~%")$
printf(stream,"\\end{document}~%")$
close(stream)$
```

C LaTeXfile

```
\documentclass{article}

\usepackage{listings}
\usepackage{graphicx}
```

```
\begin{document}

\begin{abstract}
This article is created within the CAS program Maxima.
and shows (1) algebraic differentiation (2) plotting, and
    (3) listings,
which are believed to be the most commonly used aspects
   of an article.
\end{abstract}

\section{Introduction}

Writing scientific articles is commonly done with \LaTeX.
Algebraic manipulations can be done by a CAS, for example
    Maxima, Maple or Mathematica.
Of these examples, Maxima is the only free and open-
   source program.
Would it be possible to write a \LaTeX article within
   Maxima?
If yes, would it be elegant enough?

\section{Materials and methods}

A script executes the process from Maxima file to \LaTeX-
   formatted document in two steps.
The first step executes the Maxima script to create a \
   LaTeX (.tex) file.
The second step converts the \LaTeX file to Portable
   Document Format (.pdf).
The script does not require user intervention.

The Maxima script consists out of two parts:
algebraic manipulations and \LaTeX output

The algebraic manipulations demonstrated are:
(1) defining a function
(2) calculate its derivative and,
(3) plot this derivative.

The second part uses these algebraic results to create a
   \LaTeX (.tex) file.
It creates an article displaying the formula's, the
   single plot in
the Results section.
In the Appendix, it shows:
```

```
(1) the bash script to create a PDF from the Maxima
    script
(2) the Maxima script
(3) the generated \LaTeX code

\section{Results}

This is the formula for f:

$$f\left(x\right)=x^3+2\,x^2+3\,x+4$$

This is the formula for g, the derivative of f to x:

$$g\left(x\right)=3\,x^2+4\,x+3$$

Which looks plotted as such:

\includegraphics[scale=0.5]{/home/richel/GitHubs/Maxima/
    create_tex_article_simple_output.png}

\appendix

\section{Script file}

\lstinputlisting[language=C++,showstringspaces=false,
    breaklines=true,frame=single]{create_tex_article_
    simple.sh}

\section{Maxima file}

\lstinputlisting[language=C++,showstringspaces=false,
    breaklines=true,frame=single]{create_tex_article_
    simple.txt}

\section{\LaTeX file}

\lstinputlisting[language=tex,showstringspaces=false,
    breaklines=true,frame=single]{create_tex_article_
    simple_output.tex}

\end{document}
```