Abstract

This article is created within the CAS program Maxima. and shows (1) algebraic differentiation (2) plotting, and (3) listings. Additional functionality is added in elaboration of this 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

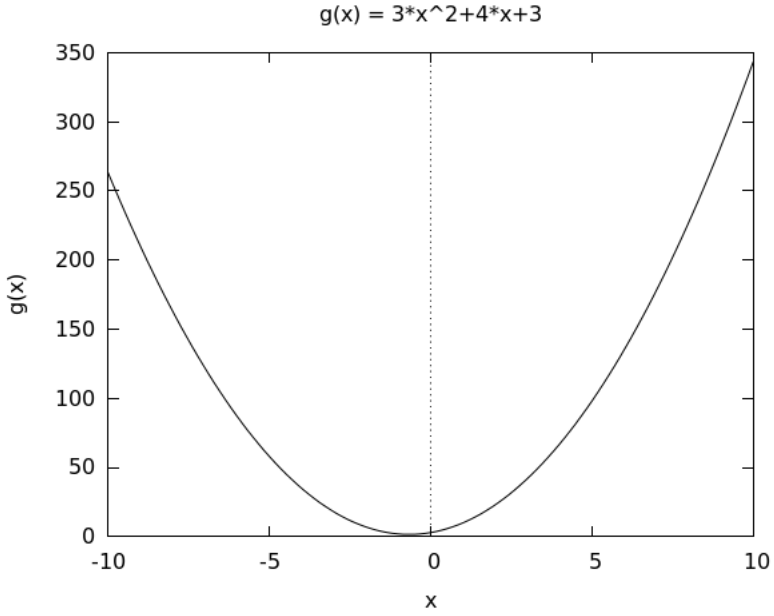
This is the formula for f:

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

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,"Additional functionality is added in
    elaboration of this 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.
Additional functionality is added in elaboration of this
   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}
```