How to create a LaTeX document from a Maxima script

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Abstract

This article is created within the CAS program Maxima and shows (1) algebraic differentiation (2) plotting, and (3) listings. This article is self-containing: it can be recreated from the listings it contains. The article itself is intended to be of publishable quality, having (1) an abstract (2) a bibliography.

1 Introduction

LaTeX is commonly used for writing publishable scientific articles[1]. Algebraic manipulations can be done by a CAS, for example Maxima, Maple or Mathematica. Maxima is the only free and open-source program, and it is the oldest free and open-source computer algebra system, with development started in 1967 (as Macsyma) or 1982 (as MAXIMA). This article is an example of writing a LaTeX article within Maxima

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 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

3 Results

Equation $f(x)$ used:

$$f(x) = 1.0 \times 10^{-4} x^4 - 0.002 x^3 + 0.03 x^2 - 0.4 x + 1$$

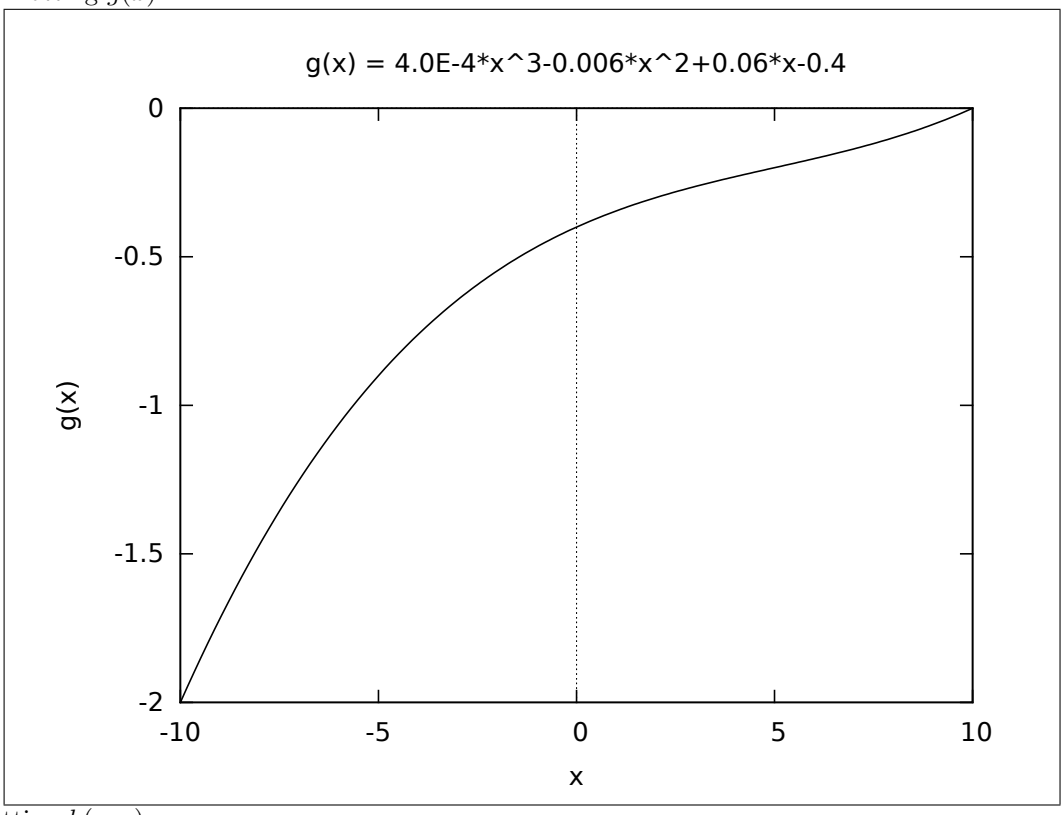
Equation $g(x)$ is the derivative of $f(x)$ with respect to x:

$$g(x) = 4.0 \times 10^{-4} x^3 - 0.006 x^2 + 0.06 x - 0.4$$

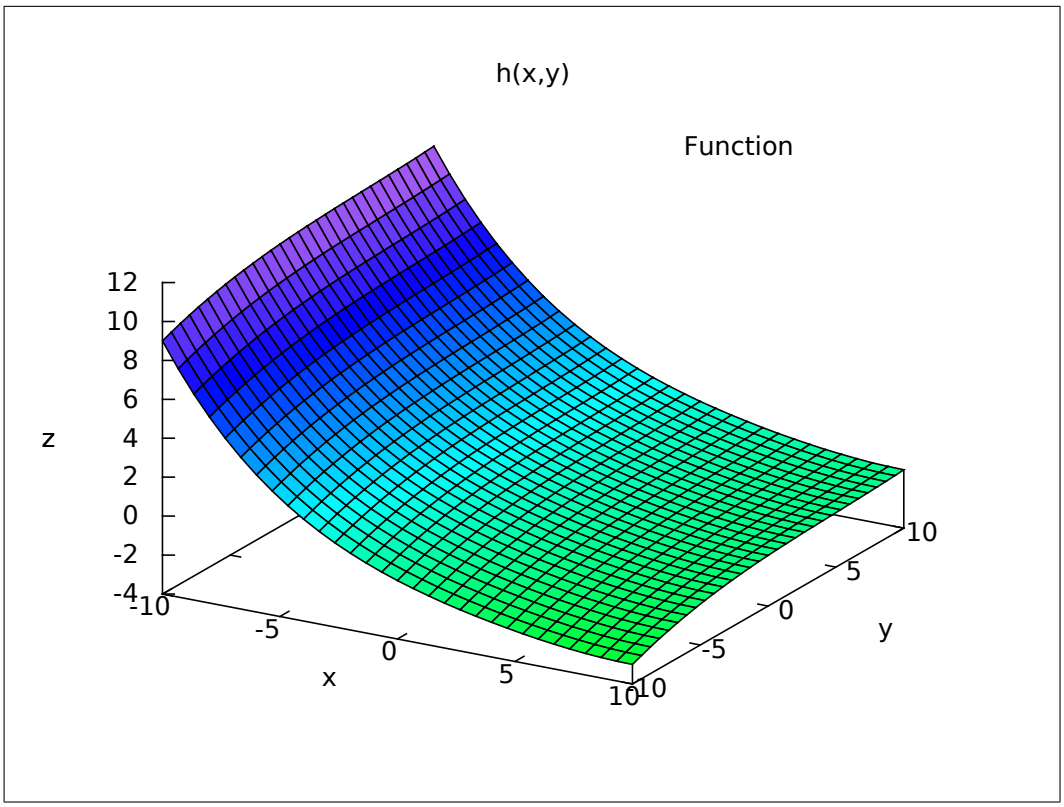
Equation $h(x, y) = f(x) + g(y)$, which equates to:

$$h(x, y) = 4.0 \times 10^{-4} y^3 - 0.006 y^2 + 0.06 y + 1.0 \times 10^{-4} x^4 - 0.002 x^3 + 0.03 x^2 - 0.4 x + 0.6$$

Plotting $g(x)$:



Plotting $h(x, y)$:



4 Discussion

Writing LaTeX within Maxima can be done, but it is a bit cumbersome: Maxima does not know LaTeX syntax and just creates contextless strings, which might not be compilable by LaTeX. However, because the script does create a .tex file, this file can be inspected easily with a LaTeX tool like texmaker.

References

[1] Gaudeul, A. 2006 Do Open Source Developers Respond to Competition?: The (La)TeX Case Study. Available at SSRN: http://ssrn.com/abstract=908946 or http://dx.doi.org/10.2139/ssrn.908946

A Script file

```
#!/bin/bash
maxima_input_file="create_tex_article.txt"
```

```
tex_output_file="create_tex_article_output.tex"

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

maxima -b $maxima_input_file
pdflatex $tex_output_file
pdflatex $tex_output_file
```

B Maxima file

```
/* Maxima batch file */

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

/* Input filename */
bash_filename:"create_tex_article.sh"$
maxima_filename:"create_tex_article.txt"$ /* this file */

/* Output filenames */
tex_filename:"create_tex_article_output.tex"$
plot2d_filename:"/home/richel/GitHubs/Maxima/
    create_tex_article_output_plot2d.pdf"$
plot3d_filename:"/home/richel/GitHubs/Maxima/
    create_tex_article_output_plot3d.pdf"$

/* Do the calculations */
F(x):= f(x) = (0.0001*(x^4)) - (0.002*(x^3)) + (0.03*(x
    ^2)) - (0.4*x) + 1;
G(x):= g(x) = ''(diff(rhs(F(x)),x));
H(x,y):= h(x,y) = ''(rhs(F(x)) + rhs(G(y)) );

plot2d(
  rhs(G(x)),[x,-10,10],
  [title,string(G(x))],
  [xlabel,"x"],
  [ylabel,"g(x)"],
  [color,black],
  [pdf_file,plot2d_filename]
);
```

```
plot3d(
  rhs(H(x,y)),[x,-10,10],[y,-10,10],
  [title,"h(x,y)"],
  [xlabel,"x"],
  [ylabel,"y"],
  [zlabel,"z"],
  [pdf_file,plot3d_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,"\\title{How to create a \\LaTeX~~document
   from a Maxima script}~%")$
printf(stream,"\\author{Richel Bilderbeek}~%")$
printf(stream,"\\date{\\today}~%")$
printf(stream,"~%")$
printf(stream,"\\begin{document}~%")$
printf(stream,"~%")$
printf(stream,"\\maketitle~%")$
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,"This article is self-containing: it can be
    recreated from the listings it contains.~%")$
printf(stream,"The article itself is intended to be of~%"
   )$
printf(stream,"publishable quality, having (1) an
   abstract (2) a bibliography.~%")$
printf(stream,"\\end{abstract}~%")$
printf(stream,"~%")$
printf(stream,"\\section{Introduction}~%")$
printf(stream,"~%")$
printf(stream,"\\LaTeX~~is commonly used for writing
   publishable scientific articles\\cite{gaudeul2006}.~%"
   )$
printf(stream,"Algebraic manipulations can be done by a
   CAS, for example Maxima, Maple or Mathematica.~%")$
```

```
printf(stream,"Maxima is the only free and open-source
    program, and it is the oldest free and open-source
    computer algebra system, with development started in
    1967 (as Macsyma) or 1982 (as MAXIMA).~%")$
printf(stream,"This article is an example of writing a \\
    LaTeX~~ article within Maxima~%")$
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,"Equation $f(x)$ used:~%")$
printf(stream,"~%")$
printf(stream,tex(F(x),false))$
printf(stream,"~%")$
```

```
printf(stream,"Equation $g(x)$ is the derivative of $f(x)
    $ with respect to $x$:~%")$
printf(stream,"~%")$
printf(stream,tex(G(x),false))$
printf(stream,"~%")$

printf(stream,"Equation $h(x,y) = f(x) + g(y)$, which
    equates to:~%")$
printf(stream,"~%")$
printf(stream,tex(H(x,y),false))$
printf(stream,"~%")$

printf(stream,"Plotting $g(x)$:~%")$
printf(stream,"~%")$
printf(stream,"\\fbox{\\includegraphics[scale=0.8]{")$
printf(stream,plot2d_filename)$
printf(stream,"}}~%")$
printf(stream,"Plotting $h(x,y)$:~%")$
printf(stream,"~%")$
printf(stream,"\\fbox{\\includegraphics[scale=0.8]{")$
printf(stream,plot3d_filename)$
printf(stream,"}}~%")$
printf(stream,"~%")$
printf(stream,"\\section{Discussion}~%")$
printf(stream,"~%")$
printf(stream,"Writing \\LaTeX~~within Maxima can be done
    , but it is a bit cumbersome:~%")$
printf(stream,"Maxima does not know \\LaTeX~~syntax and
    just creates contextless strings,~%")$
printf(stream,"which might not be compilable by \\LaTeX
    .~%")$
printf(stream,"However, because the script does create a
    .tex file,~%")$
printf(stream,"this file can be inspected easily with a
    \\LaTeX~~tool like texmaker.~%")$
printf(stream,"~%")$
printf(stream,"\\begin{thebibliography}{9}~%")$
printf(stream,"~%")$
printf(stream,"\\bibitem{gaudeul2006}~%")$
printf(stream,"  Gaudeul, A.~%")$
printf(stream,"  2006~%")$
printf(stream,"  Do Open Source Developers Respond to
    Competition?: The (La)TeX Case Study.~%")$
printf(stream,"  Available at SSRN: http://ssrn.com/
    abstract=908946 or http://dx.doi.org/10.2139/ssrn
    .908946~%")$
```

```
printf(stream,"\\end{thebibliography}~%")$
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 LaTeX file

```
\documentclass{article}

\usepackage{listings}
\usepackage{graphicx}

\title{How to create a \LaTeX~document from a Maxima
    script}
\author{Richel Bilderbeek}
\date{\today}

\begin{document}
```

```
\maketitle

\begin{abstract}
This article is created within the CAS program Maxima
and shows (1) algebraic differentiation (2) plotting, and
    (3) listings.
This article is self-containing: it can be recreated from
    the listings it contains.
The article itself is intended to be of
publishable quality, having (1) an abstract (2) a
   bibliography.
\end{abstract}

\section{Introduction}

\LaTeX~is commonly used for writing publishable
   scientific articles\cite{gaudeul2006}.
Algebraic manipulations can be done by a CAS, for example
    Maxima, Maple or Mathematica.
Maxima is the only free and open-source program, and it
   is the oldest free and open-source computer algebra
   system, with development started in 1967 (as Macsyma)
   or 1982 (as MAXIMA).
This article is an example of writing a \LaTeX~article
   within Maxima

\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}

Equation $f(x)$ used:

$$f\left(x\right)=1.0 \times 10^{-4}\,x^4-0.002\,x
    ^3+0.03\,x^2-0.4\,x
 +1$$

Equation $g(x)$ is the derivative of $f(x)$ with respect
    to $x$:

$$g\left(x\right)=4.0 \times 10^{-4}\,x^3-0.006\,x
    ^2+0.06\,x-0.4$$

Equation $h(x,y) = f(x) + g(y)$, which equates to:

$$h\left(x , y\right)=4.0 \times 10^{-4}\,y^3-0.006\,y
    ^2+0.06\,y+
 1.0 \times 10^{-4}\,x^4-0.002\,x^3+0.03\,x^2-0.4\,x
     +0.6$$

Plotting $g(x)$:

\fbox{\includegraphics[scale=0.8]{/home/richel/GitHubs/
    Maxima/create_tex_article_output_plot2d.pdf}}
Plotting $h(x,y)$:

\fbox{\includegraphics[scale=0.8]{/home/richel/GitHubs/
    Maxima/create_tex_article_output_plot3d.pdf}}

\section{Discussion}

Writing \LaTeX~within Maxima can be done, but it is a bit
     cumbersome:
```

```
Maxima does not know \LaTeX~syntax and just creates
    contextless strings,
which might not be compilable by \LaTeX.
However, because the script does create a .tex file,
this file can be inspected easily with a \LaTeX~tool like
     texmaker.

\begin{thebibliography}{9}

\bibitem{gaudeul2006}
  Gaudeul, A.
  2006
  Do Open Source Developers Respond to Competition?: The
      (La)TeX Case Study.
  Available at SSRN: http://ssrn.com/abstract=908946 or
      http://dx.doi.org/10.2139/ssrn.908946
\end{thebibliography}

\appendix

\section{Script file}

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

\section{Maxima file}

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

\section{\LaTeX~file}

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

\end{document}
```