

# How to create a $\text{\LaTeX}$ document from a Maxima script

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December 15, 2014

## 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

$\text{\LaTeX}$  is commonly used for writing publishable scientific articles[1]. 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. This article is an example of writing a  $\text{\LaTeX}$  article within Maxima

## 2 Materials and methods

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

The Maxima script consists out of two parts: algebraic manipulations and  $\text{\LaTeX}$  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  $\text{\LaTeX}$  (.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  $\text{\LaTeX}$  code

## 3 Results

Equation  $f(x)$  used:

$$f(x) = 1.0 \times 10^{-4} x^4 - 0.001 x^3 + 0.01 x^2 - 0.1 x + 1$$

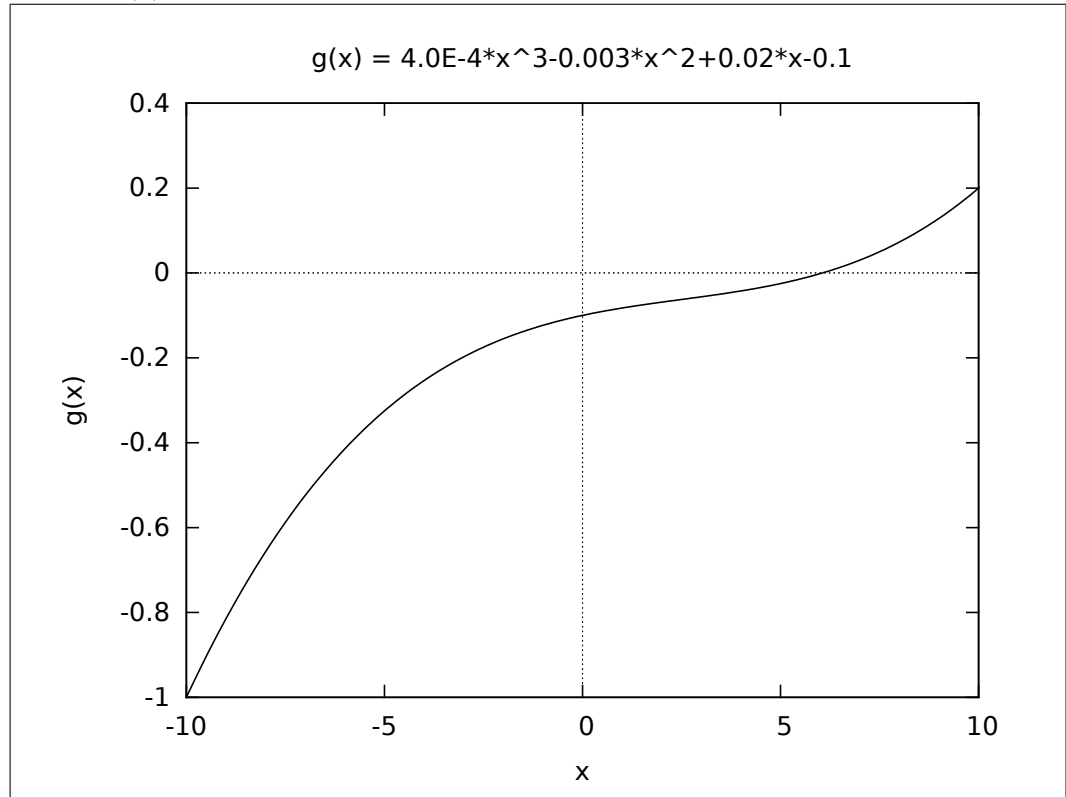
Equation  $g(x)$  is the derivative of  $f(x)$  with respect to  $x$ :

$$g(x) = 4.0 \times 10^{-4} x^3 - 0.003 x^2 + 0.02 x - 0.1$$

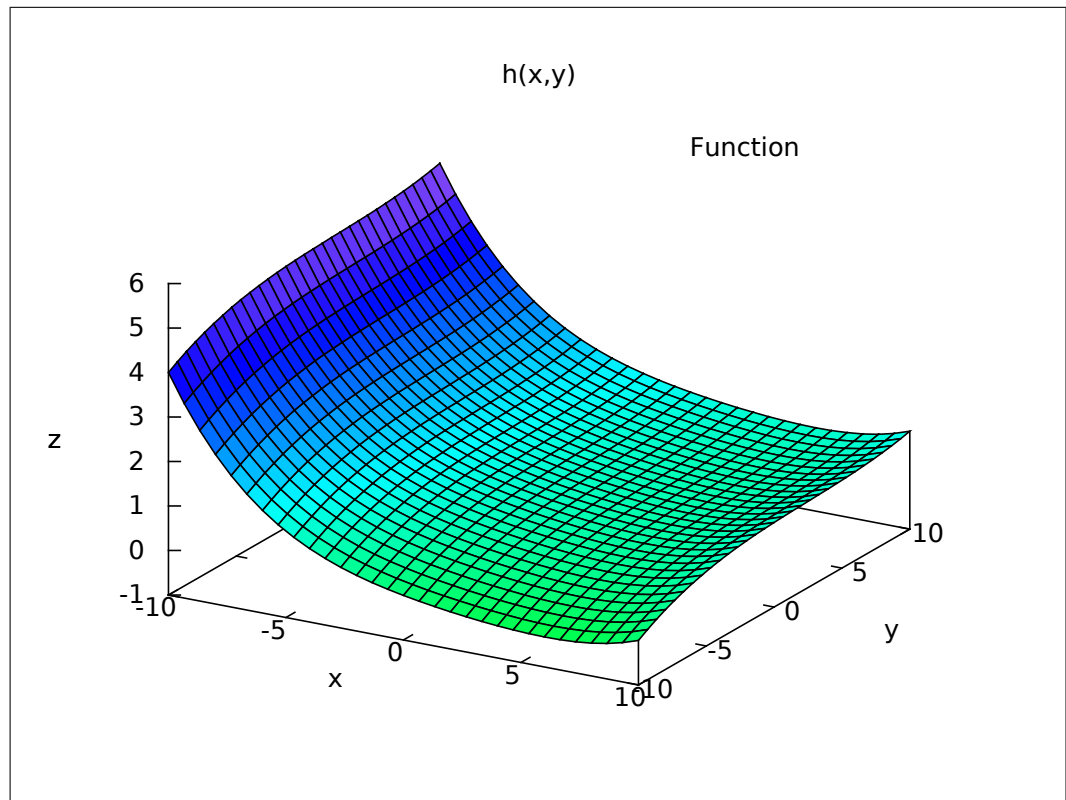
Equation  $h(x, y) = f(x) + g(y)$ , which equates to:

$$h(x, y) = 4.0 \times 10^{-4} y^3 - 0.003 y^2 + 0.02 y + 1.0 \times 10^{-4} x^4 - 0.001 x^3 + 0.01 x^2 - 0.1 x + 0.9$$

Plotting  $g(x)$ :



Plotting  $h(x, y)$ :



## 4 Discussion

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

```

## 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)) - (0.001*(x^3)) + (0.01*(x
^2)) - (0.1*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" ] ,
    [ xlabel , "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, "Of these examples, Maxima is the only free
    and open-source program.~%")$

```

```

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}

```



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This article is self-containing: it can be recreated from the listings it contains.

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`\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.

Of these examples, Maxima is the only free and open-source program.

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:


$$f(x) = 1.0 \times 10^{-4} x^4 - 0.001 x^3 + 0.01 x^2 - 0.1 x + 1$$


Equation  $g(x)$  is the derivative of  $f(x)$  with respect
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Equation  $h(x,y) = f(x) + g(y)$ , which equates to:


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Plotting  $g(x)$ :

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

\fbbox{\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}

```