

Maxima interface

Maxima 5.28.0 <http://maxima.sourceforge.net>
using Lisp SBCL 1.1.13
Distributed under the GNU Public License. See the file COPYING.
Dedicated to the memory of William Schelter.
The function `bug_report()` provides bug reporting information.

(%i1) `diff(xx, x, 3)`

$$\begin{aligned} & x^{x^x} (x^x \log(x) (\log(x) + 1) + x^{x-1})^3 + x^{x^x} \left(x^{x-1} \left(\log(x) + \frac{x-1}{x} \right)^2 + \right. \\ & x^x \log(x) (\log(x) + 1)^3 + x^{x-1} (\log(x) + 1)^2 + x^{x-1} (\log(x) + 1) \left(\log(x) + \frac{x-1}{x} \right) + \\ & \left. x^{x-1} \log(x) \left(\log(x) + \frac{x-1}{x} \right) + 2 x^{x-1} \log(x) (\log(x) + 1) + \left(\frac{2}{x} - \frac{x-1}{x^2} \right) x^{x-1} + 2 x^{x-2} \right) + \\ & 3 x^{x^x} (x^x \log(x) (\log(x) + 1) + x^{x-1}) \left(x^x \log(x) (\log(x) + 1)^2 + x^{x-1} \left(\log(x) + \frac{x-1}{x} \right) + \right. \\ & \left. x^{x-1} (\log(x) + 1) + x^{x-1} \log(x) \right) \end{aligned}$$

(%i5) $\int \frac{x^5}{x^2 - 2016x + 1} dx$

$$\begin{aligned} & \frac{8325150882179544 \log\left(\frac{2x - 2\sqrt{1016063} - 2016}{2x + 2\sqrt{1016063} - 2016}\right)}{\sqrt{1016063}} + \frac{16518164640769 \log(x^2 - 2016x + 1)}{2} + \\ & \frac{x^4 + 2688x^3 + 8128510x^2 + 32774144256x}{4} \end{aligned}$$

(%i15)

Maple interface

```

cat /Library/Frameworks/Maple.framework/Versions/17/bin/maple | sed
's%${MAPLE}/${MAPLE_SYS_BIN}/cmaple%${HOME}/.TeXmacs/bin/tm_maple_9%' | sed
's%${MAPLE}/${MAPLE_SYS_BIN}/maplew%${HOME}/.TeXmacs/bin/tm_maple_9%' > /Users/
vdhoeven/.TeXmacs/bin/tm_maple_9.sh
chmod a+x /Users/vdhoeven/.TeXmacs/bin/tm_maple_9.sh
gcc -L/Library/Frameworks/Maple.framework/Versions/17/bin.APPLE_UNIVERSAL_OSX -
lmaplec -I/Library/Frameworks/Maple.framework/Versions/17/extern/include src.9/
tm_maple_9.c -o /Users/vdhoeven/.TeXmacs/bin/tm_maple_9
|\~/| Maple
._|_| |/|_ Copyright (c) Maplesoft, a division of Waterloo Maple Inc. 2004
\OPENMAPLE/ All rights reserved. Maple and OpenMaple are trademarks of
<----> Waterloo Maple Inc.
| Type ? for help.

```

TeXmacs interface by Joris van der Hoeven

Maple 3] series (sin(x), x, 60)

$$\begin{aligned}
 & (x - \frac{1}{6} x^3 + \frac{1}{120} x^5 - \frac{1}{5040} x^7 + \frac{1}{362880} x^9 - \frac{1}{39916800} x^{11} + \frac{1}{6227020800} x^{13} - \\
 & \frac{1}{1307674368000} x^{15} + \frac{1}{355687428096000} x^{17} - \frac{1}{121645100408832000} x^{19} + \\
 & \frac{1}{51090942171709440000} x^{21} - \frac{1}{25852016738884976640000} x^{23} + \\
 & \frac{1}{15511210043330985984000000} x^{25} - \frac{1}{10888869450418352160768000000} x^{27} + \\
 & \frac{1}{8841761993739701954543616000000} x^{29} - \frac{1}{8222838654177922817725562880000000} x^{31} + \\
 & \frac{1}{8683317618811886495518194401280000000} x^{33} - \\
 & \frac{1}{10333147966386144929666651337523200000000} x^{35} + \\
 & \frac{1}{13763753091226345046315979581580902400000000} x^{37} - \\
 & \frac{1}{20397882081197443358640281739902897356800000000} x^{39} + \\
 & \frac{1}{33452526613163807108170062053440751665152000000000} x^{41} - \\
 & \frac{1}{60415263063373835637355132068513997507264512000000000} x^{43} + \\
 & \frac{1}{119622220865480194561963161495657715064383733760000000000} x^{45} - \\
 & \frac{1}{258623241511168180642964355153611979969197632389120000000000} x^{47} + \\
 & \frac{1}{608281864034267560872252163321295376887552831379210240000000000} x^{49} - \\
 & \frac{1}{1551118753287382280224243016469303211063259720016986112000000000000} x^{51} + 1/4274883\backslash \\
 & 284060025564298013753389399649690343788366813724672000000000000 x^{53} - 1/12696403353\backslash \\
 & 658275925965100847566516959580321051449436762275840000000000000 x^{55} + 1/40526919504\backslash \\
 & 877216755680601905432322134980384796226602145184481280000000000000 x^{57} - 1/13868311\backslash \\
 & 8545689835737939019720389406345902876772687432540821294940160000000000000 x^{59} + \\
 & O(x^{61})
 \end{aligned}$$

Maple 4]

Pari GP

GP/PARI CALCULATOR Version 2.6.0 (development git-389eb16)
i386 running darwin (x86-64/GMP-5.0.5 kernel) 64-bit version
compiled: Oct 27 2012, gcc version 4.2.1 (Apple Inc. build 5664)
(readline not compiled in, extended help enabled)

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Type ? for help, \q to quit.

Type ?12 for how to get moral (and possibly technical) support.

parisize = 8000000, primelimit = 500509

Pari] mathilbert (10)

$$\%1 = \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} & \frac{1}{8} & \frac{1}{9} & \frac{1}{10} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} & \frac{1}{8} & \frac{1}{9} & \frac{1}{10} & \frac{1}{11} \\ \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} & \frac{1}{8} & \frac{1}{9} & \frac{1}{10} & \frac{1}{11} & \frac{1}{12} \\ \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} & \frac{1}{8} & \frac{1}{9} & \frac{1}{10} & \frac{1}{11} & \frac{1}{12} & \frac{1}{13} \\ \frac{1}{5} & \frac{1}{6} & \frac{1}{7} & \frac{1}{8} & \frac{1}{9} & \frac{1}{10} & \frac{1}{11} & \frac{1}{12} & \frac{1}{13} & \frac{1}{14} \\ \frac{1}{6} & \frac{1}{7} & \frac{1}{8} & \frac{1}{9} & \frac{1}{10} & \frac{1}{11} & \frac{1}{12} & \frac{1}{13} & \frac{1}{14} & \frac{1}{15} \\ \frac{1}{7} & \frac{1}{8} & \frac{1}{9} & \frac{1}{10} & \frac{1}{11} & \frac{1}{12} & \frac{1}{13} & \frac{1}{14} & \frac{1}{15} & \frac{1}{16} \\ \frac{1}{8} & \frac{1}{9} & \frac{1}{10} & \frac{1}{11} & \frac{1}{12} & \frac{1}{13} & \frac{1}{14} & \frac{1}{15} & \frac{1}{16} & \frac{1}{17} \\ \frac{1}{9} & \frac{1}{10} & \frac{1}{11} & \frac{1}{12} & \frac{1}{13} & \frac{1}{14} & \frac{1}{15} & \frac{1}{16} & \frac{1}{17} & \frac{1}{18} \\ \frac{1}{10} & \frac{1}{11} & \frac{1}{12} & \frac{1}{13} & \frac{1}{14} & \frac{1}{15} & \frac{1}{16} & \frac{1}{17} & \frac{1}{18} & \frac{1}{19} \end{pmatrix}$$

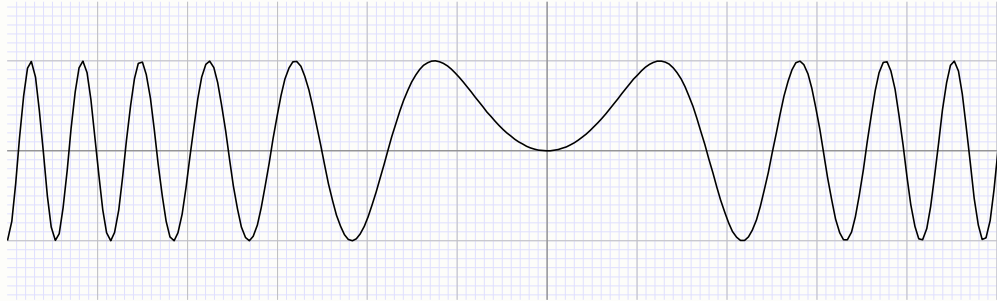
Pari] mathilbert (30)

$$\sqrt{2} = \left(1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{1}{8}, \frac{1}{9}, \frac{1}{10}, \frac{1}{11}, \frac{1}{12}, \frac{1}{13}, \frac{1}{14}, \frac{1}{15}, \frac{1}{16}, \frac{1}{17}, \frac{1}{18}, \frac{1}{19}, \frac{1}{20}, \frac{1}{21}, \frac{1}{22}, \frac{1}{23}, \frac{1}{24}, \frac{1}{25}, \frac{1}{26}, \frac{1}{27}, \frac{1}{28}, \frac{1}{29}, \frac{1}{30}, \frac{1}{31}, \frac{1}{32}, \frac{1}{33}, \frac{1}{34}, \frac{1}{35}, \frac{1}{36}, \frac{1}{37}, \frac{1}{38}, \frac{1}{39}, \frac{1}{40}, \frac{1}{41}, \frac{1}{42}, \frac{1}{43}, \frac{1}{44}, \frac{1}{45}, \frac{1}{46}, \frac{1}{47}, \frac{1}{48}, \frac{1}{49}, \frac{1}{50}, \frac{1}{51}, \frac{1}{52}, \frac{1}{53}, \frac{1}{54}, \frac{1}{55}, \frac{1}{56}, \frac{1}{57}, \frac{1}{58}, \frac{1}{59} \right)$$

Pari]

```
Mmx] include "graphix/graphics.mmx"
```

```
Mmx] $show ($graph (x :-> sin(x^2)))
```

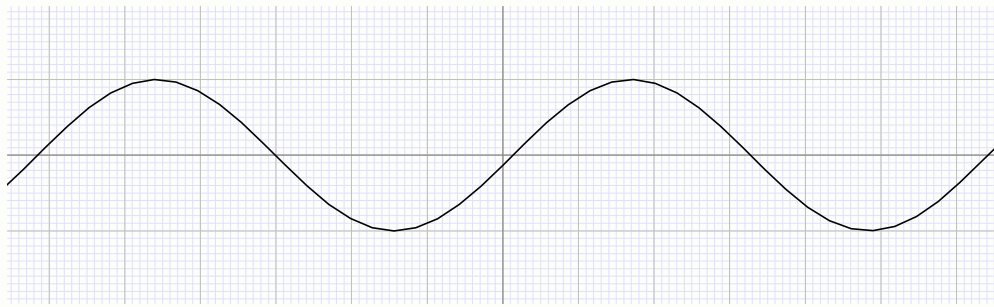


```
Mmx]
```

```
Mmx] include  
      "~/vdh/vdhoeven/seminar/2016/cadgme16/wave.mmx"
```

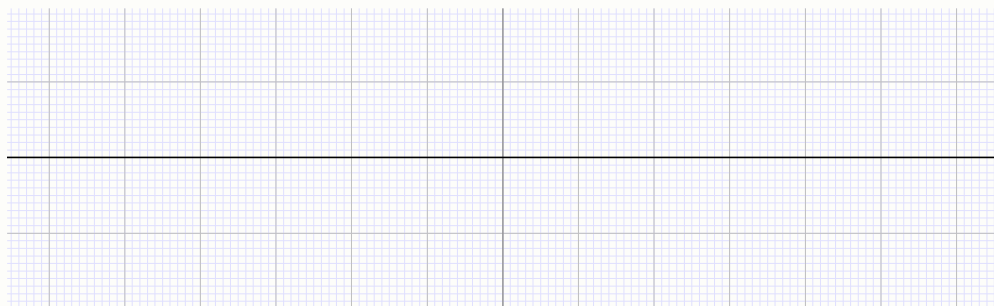
```
Mmx] sin_wave (x,t) == sin (x+0.5*t);
```

```
Mmx] $wave sin_wave
```



```
Mmx] gauss_wave (x, t) == exp (-(x + 0.25*(10.0-t))^2);
```

```
Mmx] $wave gauss_wave
```



```
Mmx]
```

Repeated differentiation

Example 1. Let $g(x) = \sin(x)$. Then

$$g(x) = \sin(x)$$

$$g'(x) = \cos(x)$$

$$g''(x) = -\sin(x)$$

$$g'''(x) = -\cos(x)$$

$$g''''(x) = \sin(x)$$

Can you give other examples of functions $g(x)$ with $g''''(x) = g(x)$?

Example 2. Let $f(x) = x^x$. Then

$$f(x) = x^x$$

$$f'(x) = (\log(x) + 1)x^x$$

$$f''(x) = (\log(x) + 1)^2 x^x + \frac{x^x}{x}$$

$$f'''(x) = (\log(x) + 1)^3 x^x + 3 \frac{(\log(x) + 1)x^x}{x} - \frac{x^x}{x^2}$$

$$f''''(x) = 6 \frac{(\log(x) + 1)^2 x^x}{x} - 4 \frac{(\log(x) + 1)x^x}{x^2} + (\log(x) + 1)^4 x^x + 2 \frac{x^x}{x^3} + 3 \frac{x^x}{x^2}$$

Basic arithmetic

Exercise 1. Perform the following additions

$$1 + 10 = 11$$

$$10 + 4 = 14$$

$$18 + 8 = 26$$

$$18 + 30 = 48$$

Exercise 2. Perform the following multiplications

$$7 \times 1 = 7$$

$$6 \times 10 = \dots\dots$$

$$7 \times 4 = \dots\dots$$

$$19 \times 3 = \dots\dots$$

Quadratic equations

Exercise 1. Solve the following equations:

$$x^2 - 12x + 20 = 0 \Rightarrow x = 10 \vee x = \dots\dots$$

$$x^2 - 11x + 28 = 0 \Rightarrow x = 4 \vee x = 7$$

$$x^2 + 12x + 27 = 0 \Rightarrow x = 9 \vee x = -3$$

$$x^2 - 7x + 12 = 0 \Rightarrow x = \dots\dots \vee x = \dots\dots$$