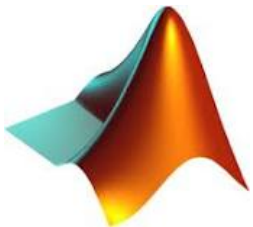
# Free alternatives to Matlab



Marc Fuentes - SED Bordeaux

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4. languages *a la* Matlab "may" seem more simple to learn than a true language

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5. R: syntax pretty different from Matlab . Very used in statistics community

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4. can be also used a stand-alone math & matrix C++ library

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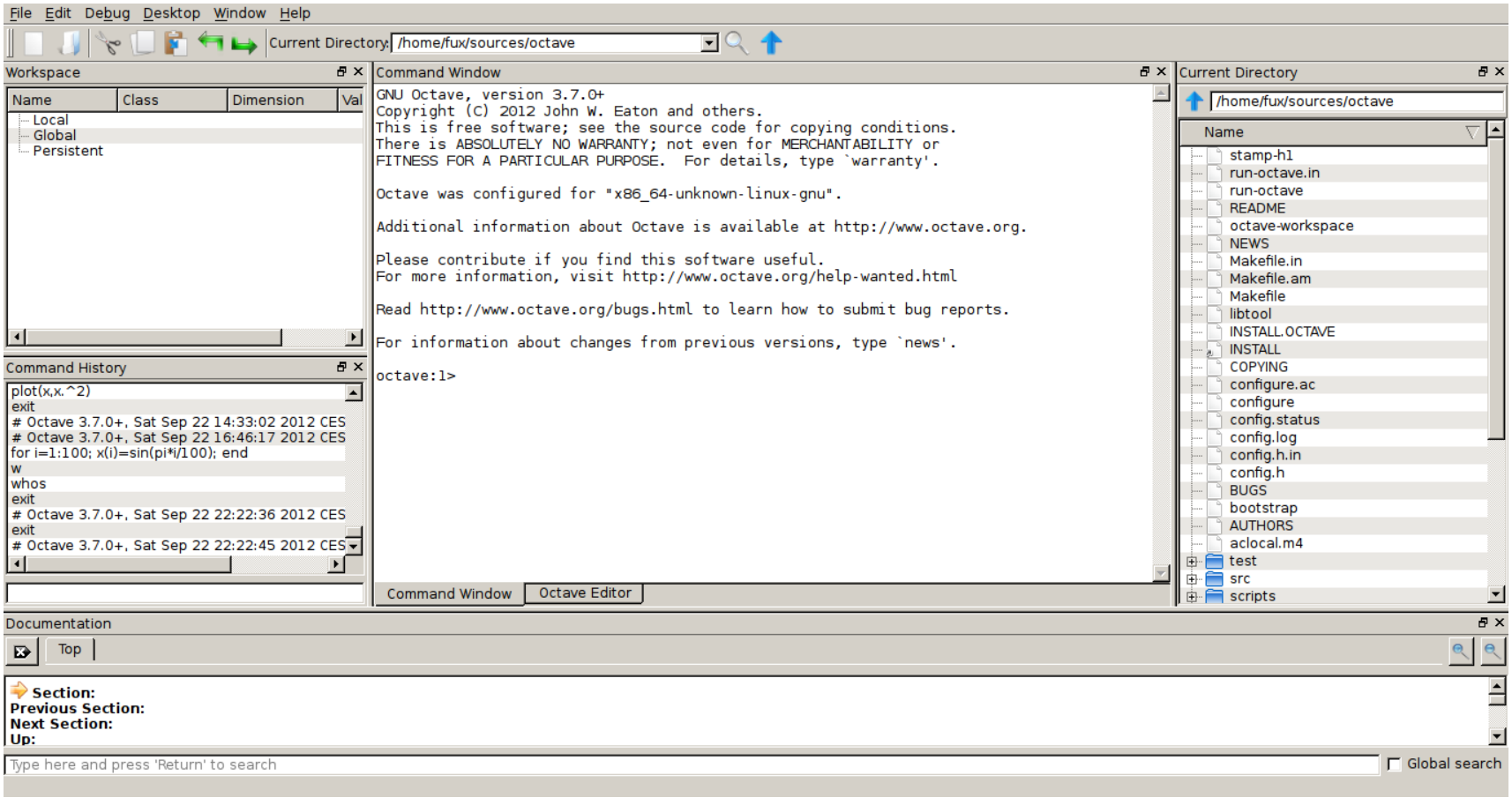
5. Uses `exist('OCTAVE_VERSION')` to define Octave specific parts of code


File Edit Debug Desktop Window Help
Current Directory: /home/fux/sources/octave
Workspace
Name Class Dimension Val
Local
Global
Persistent
Command History
plot(x,x.^2)
exit
# Octave 3.7.0+, Sat Sep 22 14:33:02 2012 CES
# Octave 3.7.0+, Sat Sep 22 16:46:17 2012 CES
for i=1:100; x(i)=sin(pi*i/100); end
w
whos
exit
# Octave 3.7.0+, Sat Sep 22 22:22:36 2012 CES
exit
# Octave 3.7.0+, Sat Sep 22 22:22:45 2012 CES
Command Window
GNU Octave, version 3.7.0+
Copyright (C) 2012 John W. Eaton and others.
This is free software; see the source code for copying conditions.
There is ABSOLUTELY NO WARRANTY; not even for MERCHANTABILITY or
FITNESS FOR A PARTICULAR PURPOSE. For details, type `warranty'.
Octave was configured for "x86_64-unknown-linux-gnu".
Additional information about Octave is available at http://www.octave.org.
Please contribute if you find this software useful.
For more information, visit http://www.octave.org/help-wanted.html
Read http://www.octave.org/bugs.html to learn how to submit bug reports.
For information about changes from previous versions, type `news'.
octave:1>
Command Window
Octave Editor
Current Directory
/home/fux/sources/octave
Name
stamp-h1
run-octave.in
run-octave
README
octave-workspace
NEWS
Makefile.in
Makefile.am
Makefile
libtool
INSTALL.OCTAVE
INSTALL
COPYING
configure.ac
configure
config.status
config.log
config.h.in
config.h
BUGS
bootstrap
AUTHORS
aclocal.m4
test
src
scripts
Documentation
Top
Section:
Previous Section:
Next Section:
Up:
Type here and press 'Return' to search
Global search

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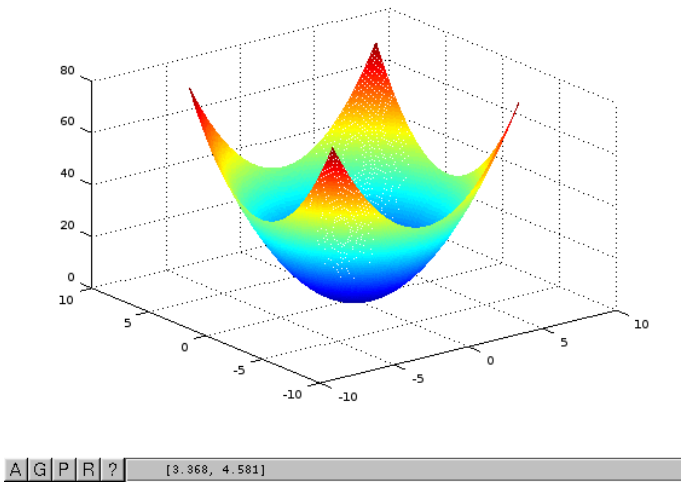
- say bye-bye to the ugly GNUPLOT: use `graphics_toolkit("fltk")`



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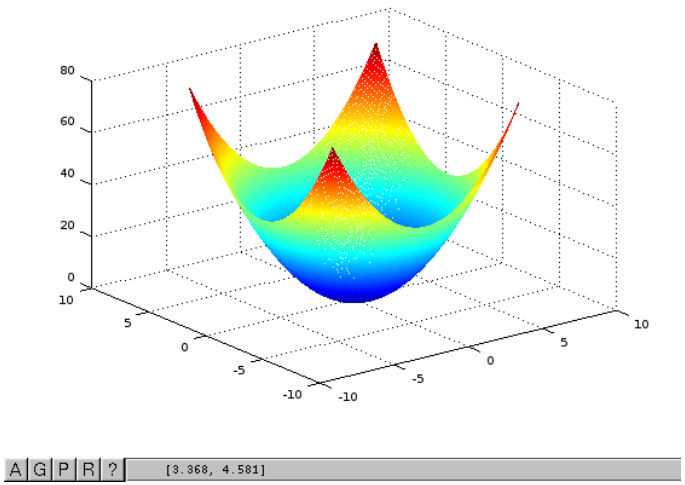
  - example: plot a parabola $M = \{(x, y, z) \in \mathbb{R}^3 \mid z = x^2 + y^2\}$

```
graphics_toolkit("fltk");
x=linspace(-2*pi,2*pi,200);
[X,Y]=meshgrid(x);
mesh(X,Y,X.^2+Y.^2);
```



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5. do not forget to launch Octave with "`--traditional`'' or ``--braindead''

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....en voiture Simone!

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5. all operations all by default component-wise:

   `c=a.*b` $\Leftrightarrow$ `c=a*b` but `c=a*b` $\Leftrightarrow$ `c=dot(a,b)`

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# Survival kit for Matlab user

| Matlab /Octave | Python |
|---|---|
| `size(a)` | `a.shape` |
| `a'` | `a.conj().T` or `a.conj().transpose()` |
| `a(:)` | `a.flatten('F')` or `a.T.flatten('C').` |
| `b=reshape(a,[2,8])` | `b=a.reshape(2,8)` or `b=a.copy(); b.shape=(2,8)` |
| `V(:,end)` | `V[:,-1]` or `V[:,-1:]` |
| `[a,b]` | `c_[a,b]` or `hstack((a,b))` |
| `[a;b]` | `r_[a,b]` or `vstack((a,b))` |
| `(1:p:n)` | `arange(1,n+1,p)` or `r_[1:n+1:p]` |
| `find(a>5)` and `a(a>5)` | `nonzero(a>5)[0]` and `a[a>5]` |
| `x= V\b` | `x=linalg.solve(V,b)` if V is square |

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- since version 3.6, Octave supports automatic broadcasting for element-wise operations

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- We want to generate the following matrix

$$V(x_0, \cdots, x_n) = \begin{pmatrix} 1 & \dots & 1 & \dots & 1 \\ \vdots & & \vdots & & \vdots \\ x_0^{i-1} & \dots & x_{j-1}^{i-1} & \dots & x_n^{i-1} \\ \vdots & & \vdots & & \vdots \\ x_0^n & \dots & x_{j-1}^n & \dots & x_n^n \end{pmatrix}$$

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- in Julia: `[ i^j for j=0:3,i=1:4]`

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Scipy is a high-Level Python package for scientific computing; it is based on Numpy and provides:

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- ☹ do not use any parallelism, but neither does MATLAB (only PyTrilinos)

# Matplotlib: basic 2D plots...

- plot $x \mapsto sin(x)$ on $[0, 2\pi]$: launch `ipython --pylab`

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from pylab import *
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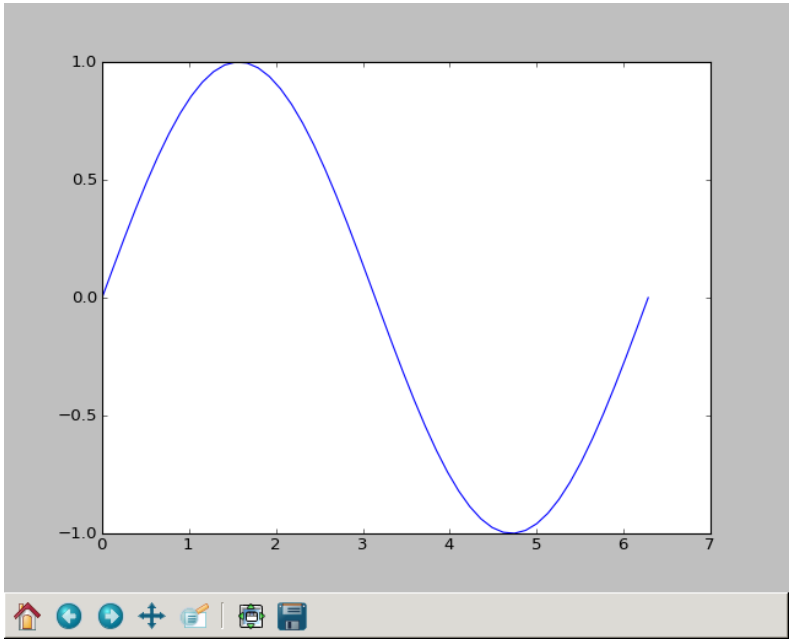
- we obtain the following window



# ...and 3D plots

- we want to plot $(x, y) \mapsto \frac{\sin\sqrt{x^2+y^2}}{\sqrt{x^2+y^2}}$ on $[-2\pi, 2\pi]^2$

```
from pylab import *
from mpl_toolkits.mplot3d import Axes3D
XX,YY=mgrid[-2*pi:2.*pi:200j,-2*pi:2.*pi:200j]
fig = figure()
ax = Axes3D(fig)
N=(sqrt(XX**2+YY**2))
ax.plot_surface(XX, YY, sin(N)/N,cmap=cm.hot)
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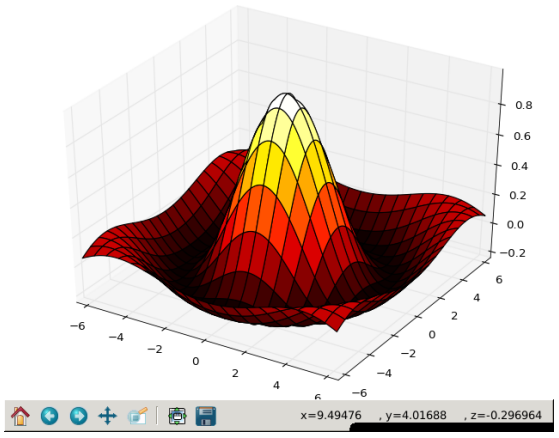

# Mayavi: parametrized surface

- visualize a surface $M = \{x(\phi, \theta) \in \mathbb{R}^3 \mid (\theta, \phi) \in I \times J\}$

```
from numpy import *
from mayavi.mlab import *

dphi, dtheta = pi/250.0, pi/250.0
[phi,theta] = mgrid[0:pi+dphi*1.5:dphi,
                    0:2*pi+dtheta*1.5:dtheta]
m0=4; m1=3; m2=2; m3=3; m4=6; m5=2; m6=6; m7=4;
r = sin(m0*phi)**m1 + cos(m2*phi)**m3 \
  + sin(m4*theta)**m5 + cos(m6*theta)**m7
x = r*sin(phi)*cos(theta)
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mesh(x, y, z)
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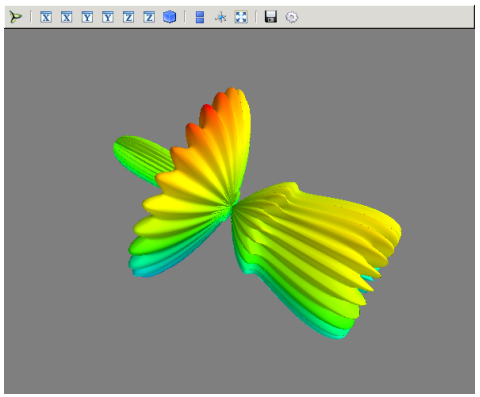
- result



# Mayavi: quiver

- to visualize a vector field:

```
import numpy
from mayavi.mlab import *
x, y, z = numpy.mgrid[-2:3, -2:3, -2:3]
r = numpy.sqrt(x**2 + y**2 + z**4)
u = y*numpy.sin(r)/(r+0.001)
v = -x*numpy.sin(r)/(r+0.001)
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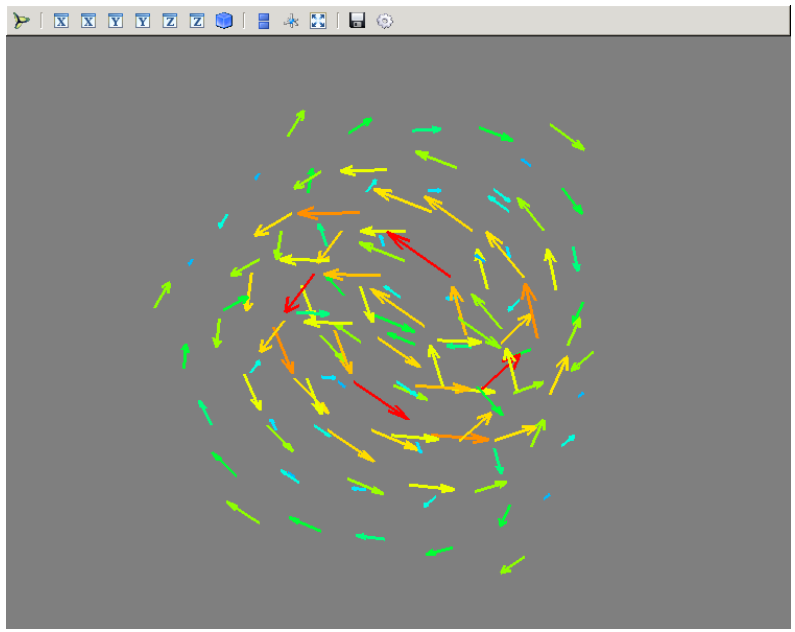

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    - ☹ "Rube Goldberg machine"

# MPI4py: sum reduction

```
import numpy as np
N=8*2*10**8
tab=np.r_[:N]
s=tab.sum()
print s
```

time -p python somme_seq.py

$\Rightarrow$

1279999999200000000

real 8.94

user 4.68

sys 4.23

```
from mpi4py import MPI
from numpy import *
comm = MPI.COMM_WORLD
size = comm.size
rank = comm.rank
paquet=2*10**8
N=paquet*size
tab_loc=r_[rank*paquet:
           (rank+1)*paquet]
sloc=tab_loc.sum()
stot = 0
#on reduit
stot=comm.reduce(sloc,stot,
MPI.SUM,0)
if (comm.rank == 0):
  print stot
```

time -p mpirun -np 8 python somme_par.py

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| appli | fib | mandel | quicksort | pisum | randstat | randmul |
|---|---|---|---|---|---|---|
| Malab | 289 | 33 | 45 | 89 | 142 | 67 |
| Octave | 924 | 310 | 1138 | 21159 | 484 | 109 |
| Python | 4 | 6 | 12 | 1073 | 248 | 107 |
| Julia | 0.32 | 0.34 | 0.68 | 45 | 27 | 45 |
| Fortran | 0.08 | $\leqslant 10^{-6}$ | 0.62 | 44 | 16 | 275(16) |

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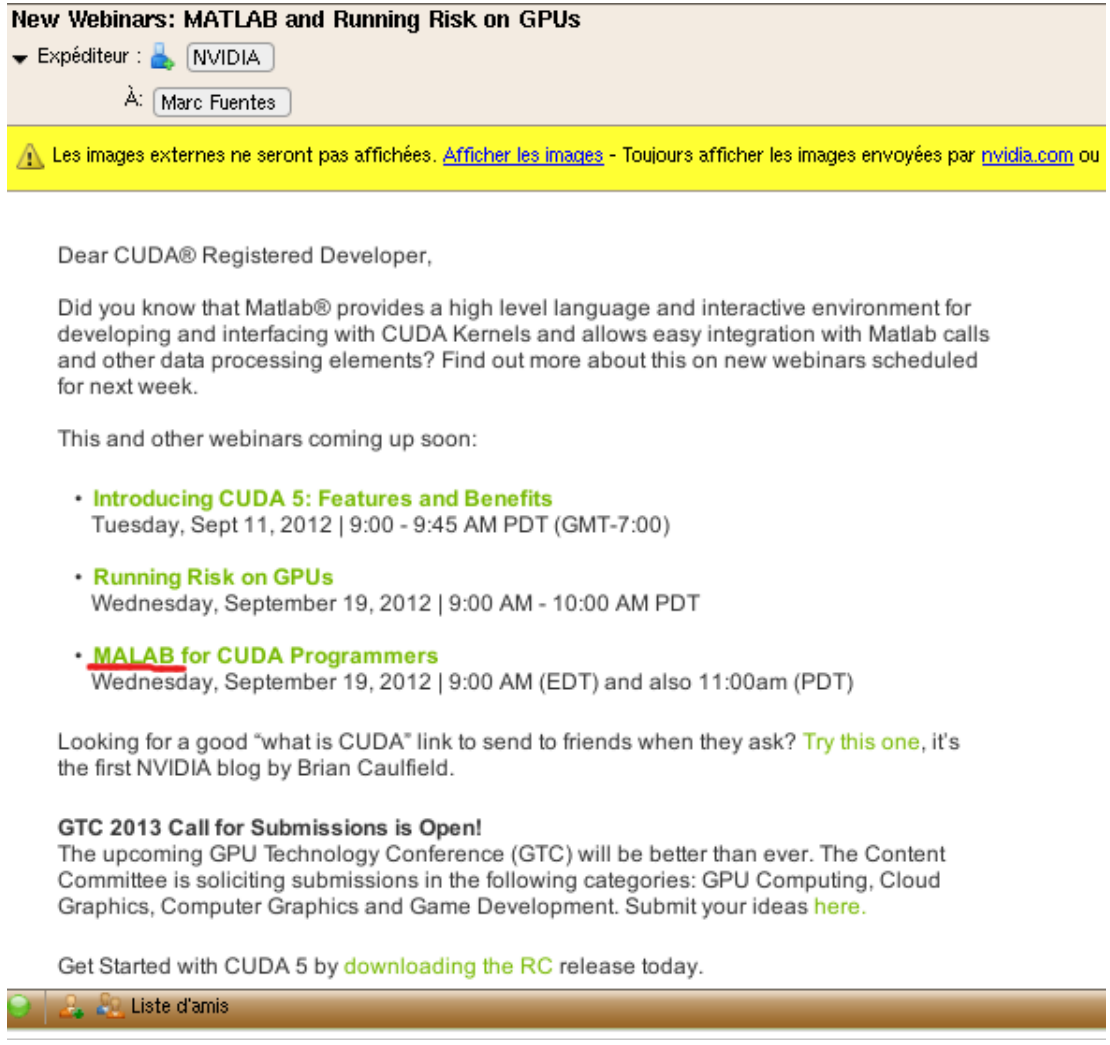
- When you start a new project in Matlab , think to develop in parallel, the Octave version (necessitate a few work in addition)
- If you are ready "to take the plunge": throw Matlab out, and go on with Python

# Why Malab?

- because



**New Webinars: MATLAB and Running Risk on GPUs**

Expéditeur : NVIDIA

À: Marc Fuentes

Les images externes ne seront pas affichées. Afficher les images - Toujours afficher les images envoyées par nvidia.com ou

Dear CUDA® Registered Developer,

Did you know that Matlab® provides a high level language and interactive environment for developing and interfacing with CUDA Kernels and allows easy integration with Matlab calls and other data processing elements? Find out more about this on new webinars scheduled for next week.

This and other webinars coming up soon:

- **Introducing CUDA 5: Features and Benefits**
  Tuesday, Sept 11, 2012 | 9:00 - 9:45 AM PDT (GMT-7:00)
- **Running Risk on GPUs**
  Wednesday, September 19, 2012 | 9:00 AM - 10:00 AM PDT
- **MALAB for CUDA Programmers**
  Wednesday, September 19, 2012 | 9:00 AM (EDT) and also 11:00am (PDT)

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The upcoming GPU Technology Conference (GTC) will be better than ever. The Content Committee is soliciting submissions in the following categories: GPU Computing, Cloud Graphics, Computer Graphics and Game Development. Submit your ideas here.

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