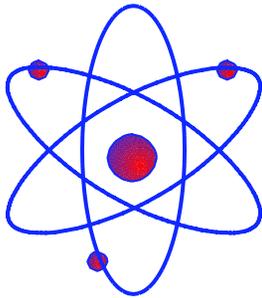


A large, expressive red brushstroke graphic that starts from the left side of the slide and curves upwards and then downwards, resembling a stylized letter 'S' or a calligraphic flourish.

# Scientific Computing with Octave

## Octave, GNUPlot and Other Tools

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Sept. 18, 1999





# Agenda

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- Octave Background, History and Uses
- Octave Description
- Installation and Support of Octave, GNUPlot and Other Tools
- Running Octave: How to Love the Command Line
- Plotting, Scripts and Other Tasks
- Summary





# Octave Description

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- "GNU Octave is a high-level language, primarily for numerical computations. It provides a command line interface for solving linear and nonlinear problems numerically, and for performing numerical experiments using a language that is compatible with Matlab. It may also be used as a batch-oriented language." - <http://www.che.wisc.edu/octave/>
- Short answer: it's just a sticky, mathematics-oriented blackboard





# Octave History

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- "Octave was originally conceived (in about 1988) to be companion software for an undergraduate-level textbook on chemical reactor design being written by James B. Rawlings of the University of Wisconsin-Madison and John G. Ekerdt of the University of Texas. We originally envisioned some very specialized tools for the solution of chemical reactor design problems. Later, after seeing the limitations of that approach, we opted to attempt to build a much more flexible tool."
- Short answer: Some U. of Wis. profs needed a tool so they decided to put something together. It turned out to be wildly successful.





# Octave's Uses and Value

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## ■ Analysis Tool

- solving numerical linear algebra problems
- finding the roots of nonlinear equations
- integrating ordinary functions
- manipulating polynomials
- integrating ordinary differential and differential-algebraic equations

## ■ System Simulation Tool

- Control Theory
- Signal Processing
- Image Processing
- Audio Processing

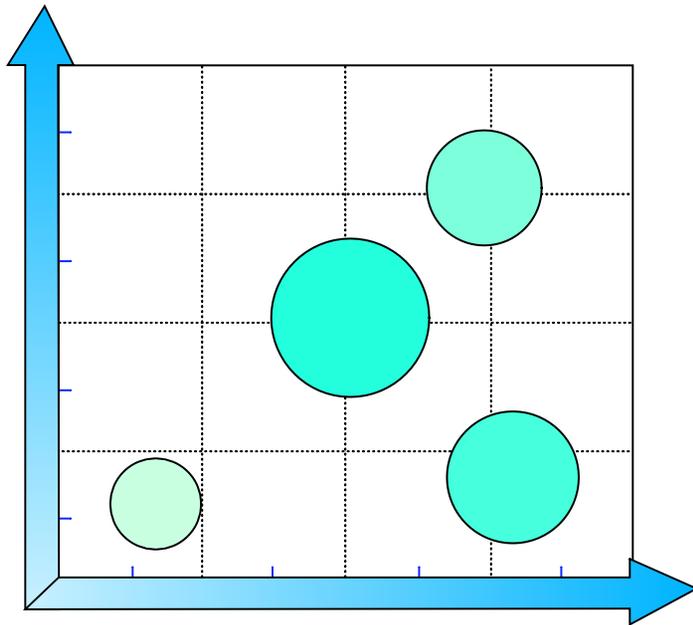
## ■ Computational Engine

- Programmable
- Easily Extendible
- Graphical Comparison Tool



# Octave Foundation for OS/2 Users

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- Octave is Open Source under GNU GPL
- Precompiled OS/2 executable is available
- Releases available for Windows, Linux et al.
- At least one OS/2-only enhancement is available





# Tool Suite Elements

File	Description	Location	Size
emxrt.zip*	EMX Runtime Library	<a href="ftp://hobbes.nmsu.edu/pub/os2/dev/emx/v0.9d">ftp://hobbes.nmsu.edu/pub/os2/dev/emx/v0.9d</a>	0.5 MB
octave-2_0_14-b01.zip	Octave ver. 2.0.14 exe	<a href="ftp://ftp.che.wisc.edu/pub/octave/BINARIES/OS2/">ftp://ftp.che.wisc.edu/pub/octave/BINARIES/OS2/</a>	5.2 MB
octave-2_0_14-p02.zip	ver, 2.0.14 exe patch	<a href="ftp://ftp.che.wisc.edu/pub/octave/BINARIES/OS2/">ftp://ftp.che.wisc.edu/pub/octave/BINARIES/OS2/</a>	1.4 MB
gp37os2.zip	Base OS/2 GNUPlot	<a href="ftp://ftp.ucc.ie/pub/gnuplot/">ftp://ftp.ucc.ie/pub/gnuplot/</a>	1.0 MB
gp37os2-mouse.zip	OS/2 GNUPlot Enhancement	<a href="http://www.sci.muni.cz/~mikulik/gnuplot.html">http://www.sci.muni.cz/~mikulik/gnuplot.html</a> <a href="ftp://ftp.ucc.ie/pub/gnuplot/contrib/">ftp://ftp.ucc.ie/pub/gnuplot/contrib/</a>	0.4 MB
less329-2.zip	OS/2 paging utility	<a href="ftp://ftp.leo.org/pub/comp/os/os2/leo/unix/">ftp://ftp.leo.org/pub/comp/os/os2/leo/unix/</a>	0.3 MB
EPM or other	Favorite text editor	Included with OS/2	N/A
gnufutil.zip	GNU file utilities	<a href="ftp://ftp.leo.org/pub/comp/os/os2/leo/gnu/systools/">ftp://ftp.leo.org/pub/comp/os/os2/leo/gnu/systools/</a>	0.8 MB
atgreds.exe**	Grep (text find) utility	<a href="ftp://ftp.leo.org/pub/comp/os/os2/leo/unix/">ftp://ftp.leo.org/pub/comp/os/os2/leo/unix/</a>	0.3 MB

\* Octave includes and installs v0.9c of emx runtimes but should run with v0.9d

\*\* not required, just helpful





# Tool Suite Installation

---

## ■ Install Octave

- Put octave-2\_0\_14-b01.zip in x:\ to unzip to x:\octave retaining path information
- Check out the README., README.OS2 files
- Change to x:\octave and type "inst-cmd /install" to install
  - makes necessary changes to CONFIG.SYS, expands sample script files, adds desktop icons
- Apply the patch by putting octave-2\_0\_14-p02.zip in same location (x:\ in example), unzipping
- Change to x:\octave and type "updt-cmd" to apply the patch, type "inst-cmd /clean" to remove unneeded files





# Tool Suite Installation (cont.)

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## ■ Install GNUPlot

- Make a GNUPlot directory like x:\GNUPLOT
- Put gp37os2.zip in it, unzip retaining directory structure
- Check out README.OS2, INSTALL.OS2 files
- Add environment variables to CONFIG.SYS
  - SET GNUPLOT=x:\GNUPLOT
  - SET GNUHELP=x:\GNUPLOT.GIH
- Add OS/2 mouse extensions, if desired
  - Expand gp37os2-mouse.zip and overwrite existing GNUPlot files

## ■ Install less, gnu file utilities

- Unzip and make them accessible to Octave by putting .exe's somewhere on the path
- Add gnufu.dll, gnuintl.dll somewhere on the LIBPATH





# Running Octave

---

- Type "octave" at a command-line prompt or double click the Octave icon to get started

```
Octave 2.0.14 for OS/2 2.x, Warp 3 and Warp 4.  
(Patchlevel 2.0.14-b02).
```

```
Copyright (C) 1996, 1997, 1998 John W. Eaton.
```

```
OS/2-Port by Klaus Gebhardt, 1996 - 1999.
```

```
This is free software with ABSOLUTELY NO WARRANTY.
```

```
For details, type `warranty'.
```

```
octave:1>
```

- Define some variables for the "sticky blackboard":

```
octave:1>a=7
```

```
a = 7
```

```
octave:2>b=12;
```

```
octave:3>C=[ 1 2 3;4 5 6;7 8 9]
```

```
C =
```

```
 1  2  3
```

```
 4  5  6
```

```
 7  8  9
```

```
octave:4>
```





# Using the Command Line

---

## ■ What variables are on the blackboard now?

```
octave:6>who
*** currently compiled functions:
length
*** local user variables:
C          a          b          oct_home
octave:9>whos
```

```
*** currently compiled functions:
```

prot	type	rows	cols	name
====	====	====	====	====
wd	user function	-	-	length

```
*** local user variables:
```

prot	type	rows	cols	name
====	====	====	====	====
wd	matrix	3	3	C
wd	scalar	1	1	a
wd	scalar	1	1	b
wd	string	1	9	oct_home





# Saving, Loading and Graphics

---

## ■ Save the workspace

- octave:10>save test
- octave:11>clear
  
- octave:12>who

## ■ Loading a previously saved workspace

- octave:13>load test
- octave:14>who
- \*\*\* local user variables:  
  
■ C      a      b      oct\_home

## ■ Plotting a sequence of numbers and annotating it

- octave:16>for k=1:20;d(k)=sin(2\*pi\*k/20);end
- octave:17>plot(d)
- octave:18>xlabel("x text");ylabel("y text"); # Actually MATLAB syntax
- octave:19>replot
- octave:20>gset xlabel "xlabel"; gset ylabel "ylabel"; # Normal Octave syntax
- octave:21>replot



# Example 1: Basic Problem Solving

---

■ Simple linear algebra problem: 3 ind. equations in 3 unk.

- $x_1 - 12x_2 - 4x_3 = -5$ ;  $-20x_1 + 3x_2 - 5x_3 = -119$ ;  $-14x_1 - 3x_2 - 17x_3 = -53$
- This can be represented using the matrix equation  $Ax=b$
- Using Octave, this can be solved as follows:

```
octave:48>A=[1 -12 -4;-20 3 -5;-14 -3 -17]
```

```
A =
```

```
 1 -12 -4
-20  3 -5
-14 -3 -17
```

```
octave:49>b=[-5;-119;-53]
```

```
b =
```

```
-5
-119
-53
```

```
octave:50>A\b
```

```
ans =
```

```
 7.0000
 2.0000
-3.0000
```



# Example 2: Basic Signal Processing

---

- Define a basic sine wave;  $x(k)=3\sin(2\pi k/10)$  as  
 $k=1,2,3\dots 256$ ; Type

```
octave:51>for k=1:256;s(k)=cos(2*pi*k/10);end
```

- Generate some Gaussian noise

```
octave:52>n=2*randn(256,1);
```

- Add it to the signal

```
octave:54>x=s+n;
```

- Take the magnitude of the Fourier transform of the time series

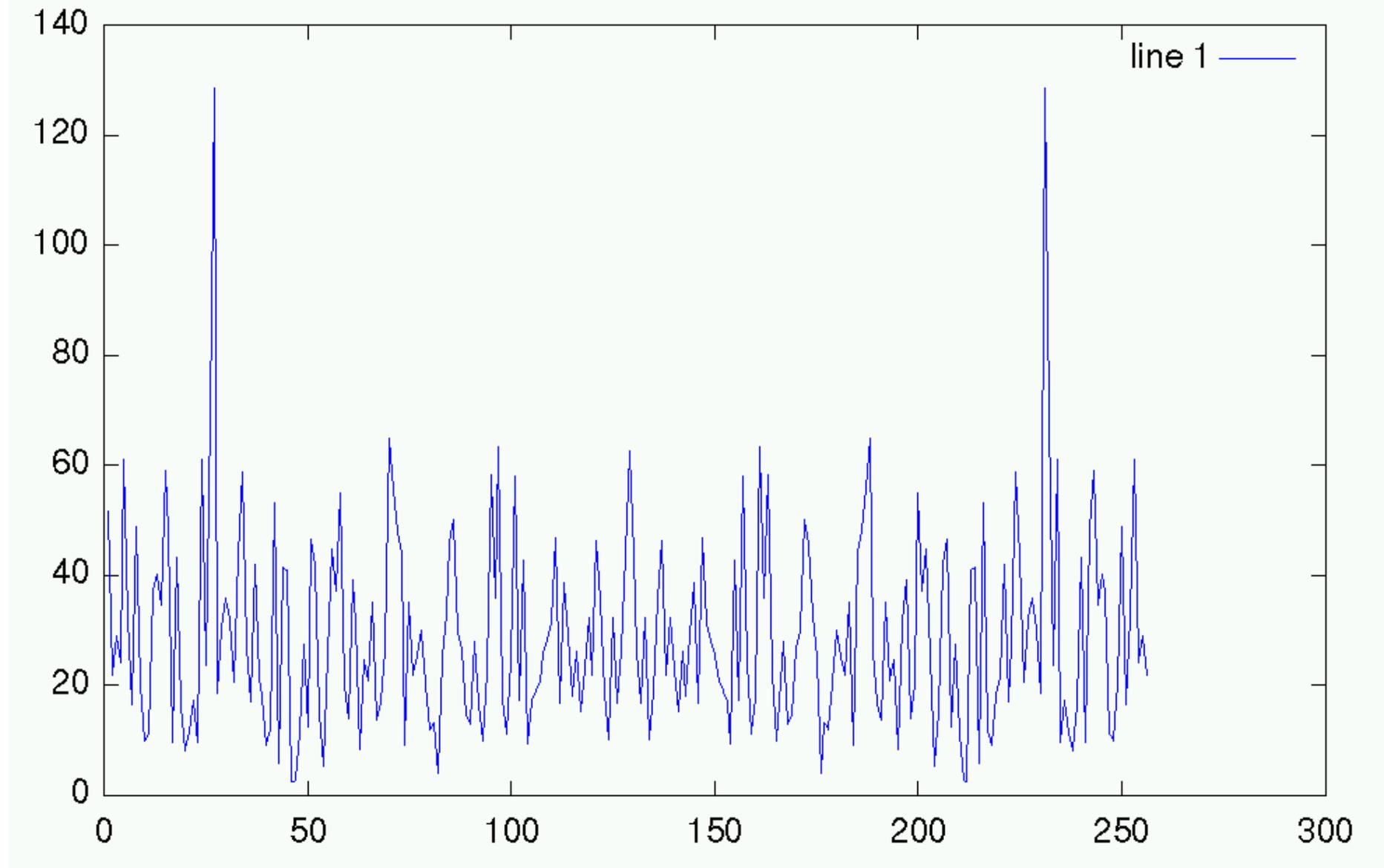
```
octave:55>p=abs(fft(x));
```

- Plot the result

```
octave:56>plot(p)
```



# Resulting Plot





## Example 3: Editing a script

---

- Create a basic text file, a few comment lines (#) to start
- Add a string of commands legal Octave commands
- Save the file somewhere on the Octave LOADPATH (type "path" at the prompt) with a .m suffix, like testum.m
- Type "testum" at the prompt, the commands will execute
- Type "help testum", the first comment lines will display

```
octave:22>testum
```

```
a = 7
```

```
b = 3
```

```
ans = 21
```

```
octave:23>help testum
```

```
testum is the file: C:/doc/misc/expopres/testum.m
```

```
This is a text file; This might a message I want to see quickly
```

```
if I need to remind myself of the contents of this file later on.
```



# Example 4: Some Interesting Plots

---

```

clg
domain = [-3:0.2:3];
range = [-5:0.2:5];
[x,y] =
meshgrid(domain,domain);
r = sqrt(x.^2 + y.^2) +
0.00001;
z = sin(pi*r)/(pi*r);
title('Sombrero')
mesh(z)
pause

```

```

clg
t = range;
s = sinc(t);
s2 = s*s;
mesh(t,t,s2)
pause
clg
c = cos(t);
c2 = c*c;
mesh(t,t,c2)
pause
contour(c2)
pause

```

```

clg
sq = t.^2;
sq2 = sq'*sq;
mesh(t,t,sq2)
pause
clg
mesh(t,t,1-sq2)
pause
S = fft(log(t));
clg
plot(S)
pause
clg
t = 0.1:0.1:100;
polar(t,t.*log(t))

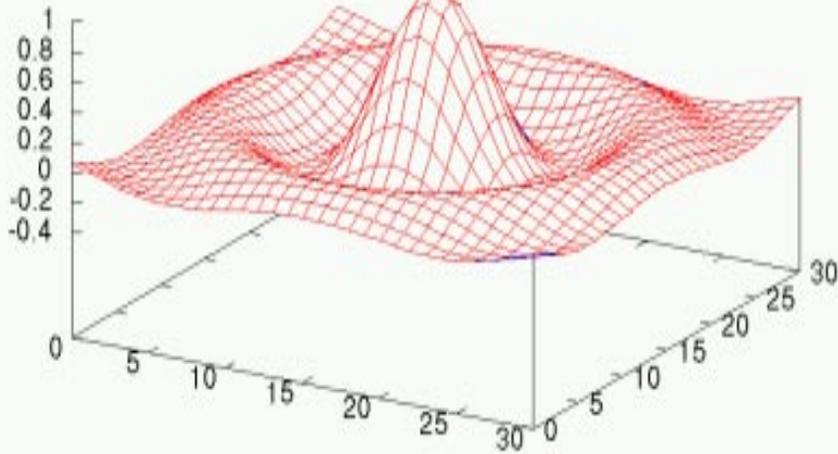
```



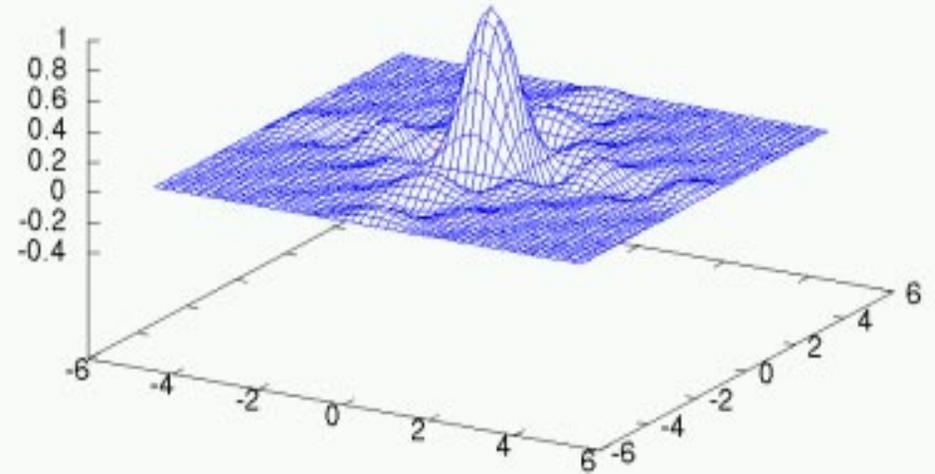
# Resulting Plots

Sombrero

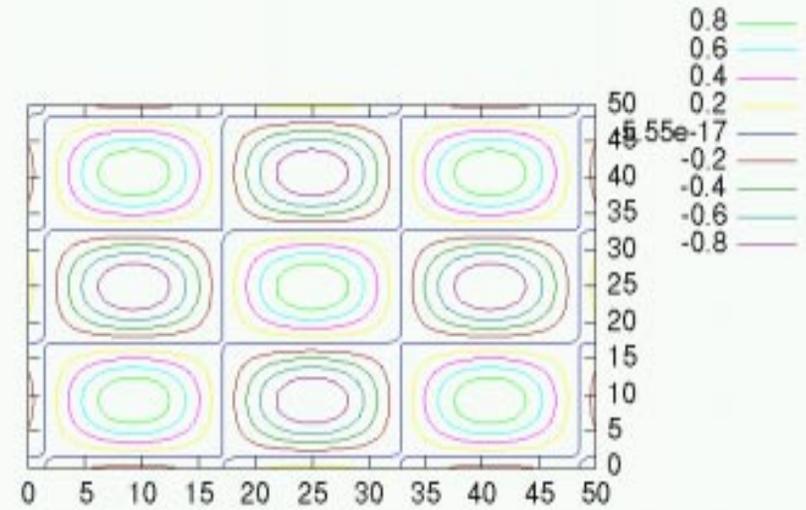
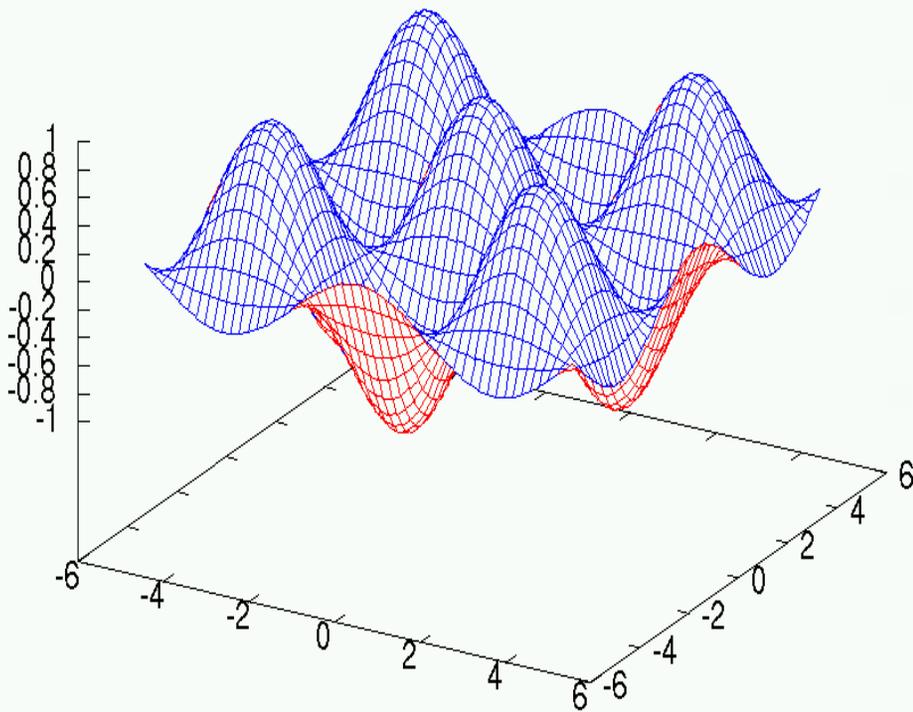
line 1 —



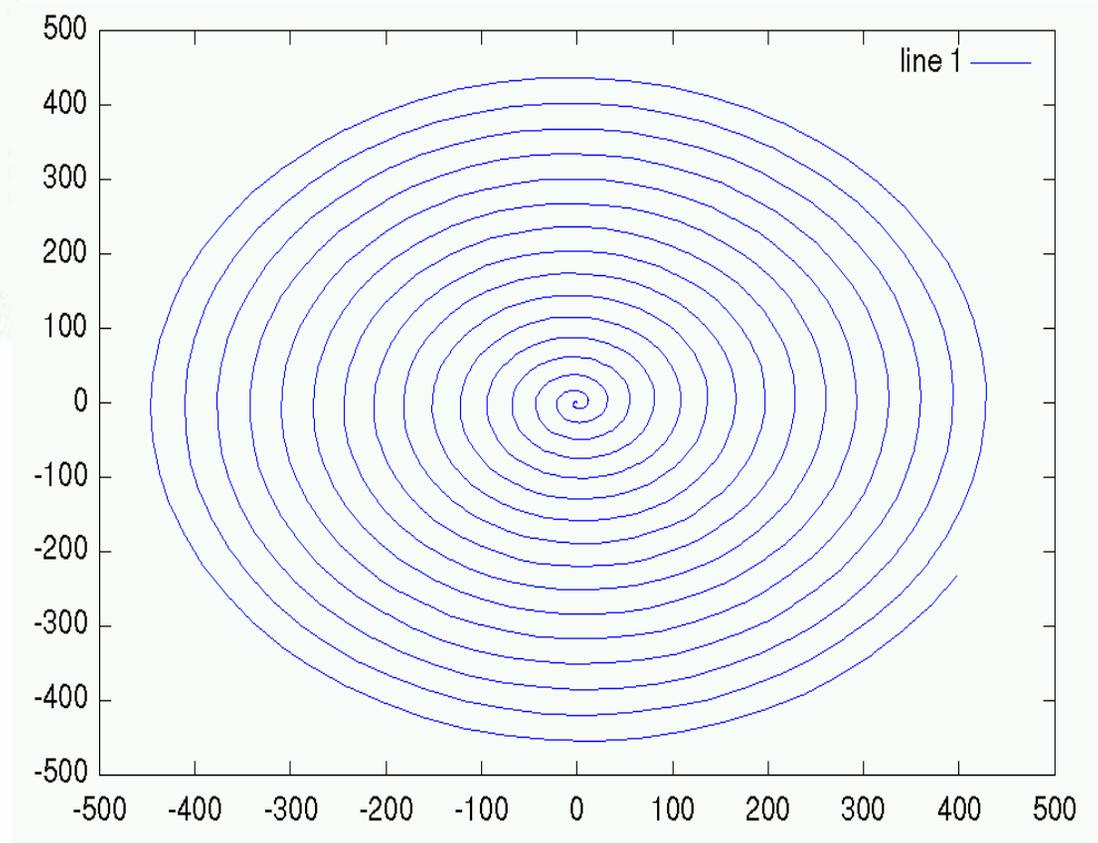
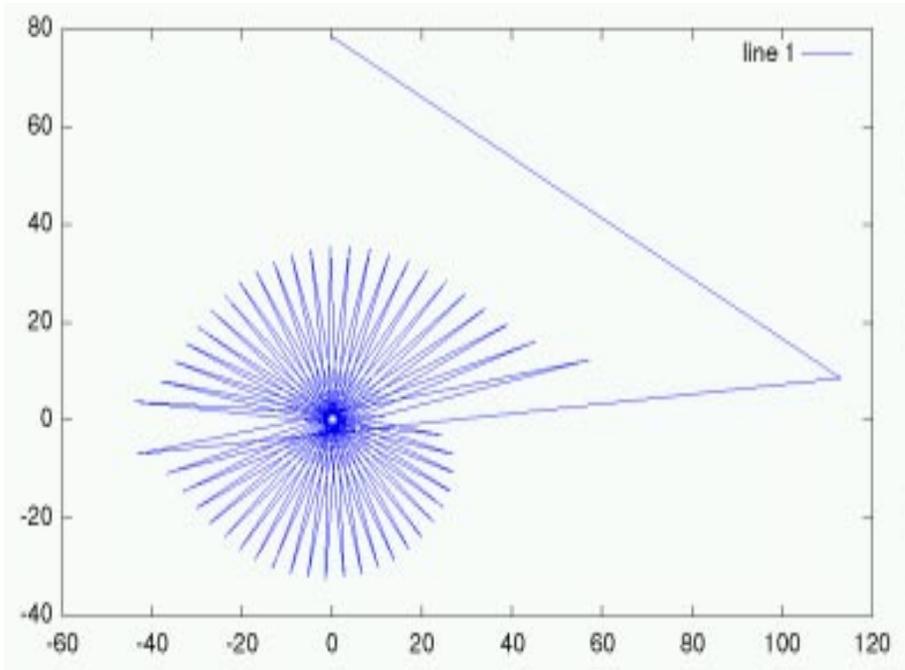
line 1 —



# Resulting Plots (cont.)



# Resulting Plots (cont.)





# OS/2-only Mouse Enhancement

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- OS/2 benefits from mouse-plot interaction enhancements
- You can
  - copy locations in plot coordinates to the clipboard,
  - find the distance between two locations in a plot,
  - and more





# Resources

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## ■ More Octave resources:

### ■ Octave FAQ:

<http://www.che.wisc.edu/octave/FAQ.html>

### ■ Gnuplot Site:

<http://www.geocities.com/SiliconValley/Foothills/6647/>

## ■ Octave Mailing List

- Put subscribe in body of an e-mail to [help-octave-request@bevo.che.wisc.edu](mailto:help-octave-request@bevo.che.wisc.edu) to subscribe to the Octave mailing list





# Conclusion

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- Octave is an accessible, easy to use numerical computation utility that can span the uses of the high school level to that of the complex tool needed by engineers
- We've shown how to start from scratch, assemble the utilities necessary to set up this powerful tool on your home computer

