Open source Software for scientific computing

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- Project can be assigned to students on Free Software and they can do it in vacations, science exhibition.

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- Maths Lab session will give clarity of concepts in maths.
- Maths will get popular in students community.
- One can distribute software to students that way they can their own copy of the software to try things at home.

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Good start, with Free Maths Software

- Dr Geo - Interactive Geometry software: School Geometry
- Geogebra - Algebra and Geometry: College level
- YACAS - Undergraduate Calculus: Trigonometry, Calculus
- GNUPLOT - Function plots
- LaTeX- Mathematical Documentation preparation system, useful for typesetting question papers, research papers, books, worksheet, question banks etc.

Software for Undergraduate studies

- Euler - Numerical Analysis
- Maxima - Symbolic Computations
- Scilab - Linear Algebra, Numerical Analysis
- GAP - Commutative Algebra

Research Level Software

- Singular - Algebraic Geometry
- Macaulay-2 - Algebraic Geometry
- Cocoa - Computational Commutative Algebra
- KASH/KANT - Algebraic Number Theory
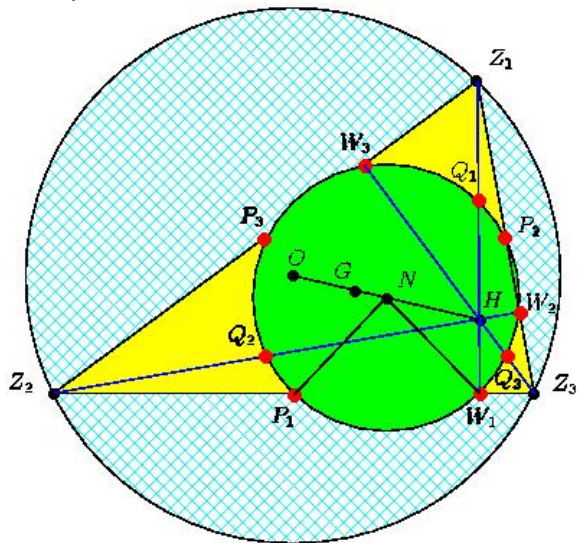 Very much tested

Dr Geo

Can prepare figures that can be included in the books, notes, projects and presentations which are prepared by LaTeX.
http://www.ofset.org/drgeo

Nine point Circle

GNUPLOT

Function plotting: Easy to draw figures
Basic command to start is `plot`

```
plot x*x
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This will output graph of x^2.

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This will output graph of x^2.
Gnuplot understands functions like $\sin, \log, \exp$ etc.
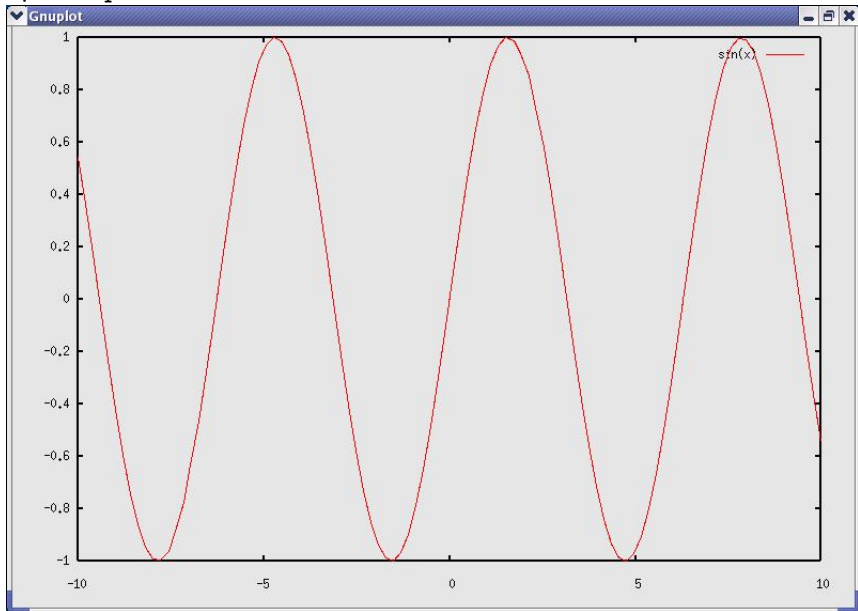`plot exp(x)`
Automatic range is taken by GNUPLOT.

Range

Range chosen by GNUPLOT is best to understand behavior of the function.

If we want to observe the function in the particular interval. We can specify the range. To plot surface use `splot x*y`

Output of plot sin(x)

Website for gnuplot
www.gnuplot.info

YACAS

- Can solve Ordinary differential Equations
- Can do Number Theoretical Computations
- Can solve Trigonometric Identities
- Elementary Calculus: Solve Limits, Derivatives, Integration
- Can do Linear Algebra
- Permutations

To Solve Ordinary Differential Equation

```
In> OdeSolve(y''-y==0)
Out> C65*Exp(x)+C69*Exp(-x)
```

Factorization of large number

```
1  In> Factor(2000000000345555555555);
2  Out> 5*45707*213415583*410063531
```

Factorization of large number

```
1  In> Factor(20000000000345555555555);
2  Out> 5*45707*213415583*410063531
```

Checking for Prime number

```
In> IsPrime(45707);
Out> True
```

```
In> Permutations({a,b,c,d});
Out> {{a,b,c,d},{a,b,d,c},{a,d,b,c},{d,a,b,c},
{a,c,b,d},{a,c,d,b},{a,d,c,b},{d,a,c,b},{c,a,b,d},
{c,a,d,b},{c,d,a,b},{d,c,a,b},{b,a,c,d},{b,a,d,c},
{b,d,a,c},{d,b,a,c},{b,c,a,d},{b,c,d,a},{b,d,c,a},
{d,b,c,a},{c,b,a,d},{c,b,d,a},{c,d,b,a},{d,c,b,a}}
```

```
In> Inverse(A)
Out> {{(-2)/169,(-25)/169,8/169},
{225/169,(-145)/169,(-55)/169},
{(-93)/169,105/169,34/169}}
In> PrettyForm(%)
/                              \
| / -2  \ / -25 \ /  8  \ |
| | --- | | --- | | --- | |
| \ 169 / \ 169 / \ 169 / |
|                              |
| / 225 \ / -145 \ / -55 \ |
| | --- | | ---- | | --- | |
| \ 169 / \ 169  / \ 169 / |
|                              |
| / -93 \ / 105 \ / 34  \ |
| | --- | | --- | | --- | |
| \ 169 / \ 169 / \ 169 / |
```

Finding Factorial of 200.

```
In> 200!
Out> 7886578673647905035523632139321850622951359
77687173263294744033429203042840119846239041772
121389196388302576427902426371050111346285727076
33172373969889439224456214516642402540332918641
31242424075739032403212574055795686602260319041
70324062351700858797038973747200000000000000000
0000000000000000000000000000000000000000
```

To check number is prime

```
In> IsPrime(123111111111231117)

Out> False
```

To obtain prime number

```
In> NextPrime(231112330909)
Out> 231112330919

In> IsPrime(%)
Out> True
```

Website for YACAS
http://yacas.sourceforge.net/homepage.html

Scilab

Scilab can handle and compute

1. Vectors: Handles data by vectors

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Website:
http://www.scilab.org/

GAP

GAP is for Computational Group Theory
GAP is live project. There are notes on web which gives lab sessions on
Contemporary Abstract Algebra by Joseph Gallian. Book it self is very
nicely written and lab sessions will give ready material to work more.
Website for GAP:
`http://www-gap.mcs.st-and.ac.uk`

More software..

- R : Statistical Analysis, Data handling
- SAGE : Maths server, Combines many software like GAP, PARI-GP etc.itemize

Singular

In Singular, variable type is ring.

Very good for Algebraic Geometry.

National workshop on Singular was arranged in Allahabad in 2003.

Books on Singular

1.Singular Introduction to Commutative Algebra, Gert - Martin Greuel, Gerhard Pfister, Springer.

2.Computational Algebraic Geometry, W. Decker and C. Lossen, Hindusthan Book Agency

Computer Algebra software GAP, YaCaS, Maxima, Singular

Numerical Computations Scilab, Euler, Octave.

Statistical Computing R.

Figure Drawing Software GNUPLOT, PsTricks with LaTeX, Dia, TeXCad, Xfig, XYPiC, DrGeo.

Geometry Software DrGeo

Computational Geometry PoVRaY.

Technical Typesetting LaTeX: Useful for Research Papers, Mathematical / Technical articles, Books, Notes, Technical Projects write-ups, Question Papers etc.

SAGE Is a collection of most of the software listed above.

Python is a programming language that lets you work more quickly and integrate your systems more effectively.

GAP	http://www.gap-system.org/
YACAS	http://yacas.sourceforge.net/homepage.html
MAXIMA	http://maxima.sourceforge.net/
SINGULAR	http://www.singular.uni-kl.de/
SCILAB	http://www.scilab.org/
Euler	http://euler.sourceforge.net/
Octave	http://www.gnu.org/software/octave/
GNUPLOT	http://www.gnuplot.info/
PsTRicks with LaTeX	http://tug.org/PSTricks/main.cgi/
Dia	http://projects.gnome.org/dia/
TeXCaD	http://texcad.sourceforge.net/
Xfig	http://www.xfig.org/
XYPic	http://www.tug.org/applications/Xy-pic/
DrGeo	http://www.ofset.org/drgeo
PovRay	http://www.povray.org/
LaTeX	www.tug.org
SAGE	http://www.sagemath.org/
R	http://www.r-project.org/
Python	http://www.python.org/

Thanks!

- www.bprim.org
- www.plug.org.in
- www.tug.org.in