

Free/Open Source Software in Engineering Curriculum

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Outline

- What is Free/Open Source?
- Why FOSS for Education?
- A Taste of FOSS in Engineering Domains



FOSS Software

OPEN SOURCE SHORT LIST

Open source software permeates the software stack. This summary highlights the most prominent open source software in each area of the stack.

CLIENTWARE

OpenOffice
Mozilla Firefox
Ximian Evolution
GIMP

MIDDLEWARE

Openadaptor
OpenLDAP
Apache Axis
OpenJMS
Hibernate

PLATFORMS

Linux
FreeBSD
Globus/OGSA

MANAGEWARE

MX4J
MC4J
CVS

SERVERWARE

MySQL
Apache
JBoss
OpenCMS
jetspeed
Samba
Sendmail



Source: CSC with Flashmap Systems



Interesting Examples

- Google (millions of searches every hour)
- Apache (70% share)
- Mozilla Firefox
- Open Office
- Sendmail
- Postgres
- sourceforge.net
- ...



Economist Innovation Award 2004

Award Criteria

"Tonight's awards recognise top innovators whose work has both driven progress in their particular fields and contributed more widely to global social and economic prosperity," said Standage. "The Economist is proud to recognise and thank them for their achievements."

Computing, Linux: Linus Torvalds, Fellow, Open Source Development Lab.

Torvalds originated Linux in 1991 as a 21-year-old computer science student at the University of Helsinki, Finland. Dissatisfied with the MS-DOS (and early Windows) operating system standard prevalent on PCs, Torvalds made Linux freely available for downloading, releasing the source code so that people with knowledge of computer programming could modify Linux to suit their own needs. The software created a huge following, eventually



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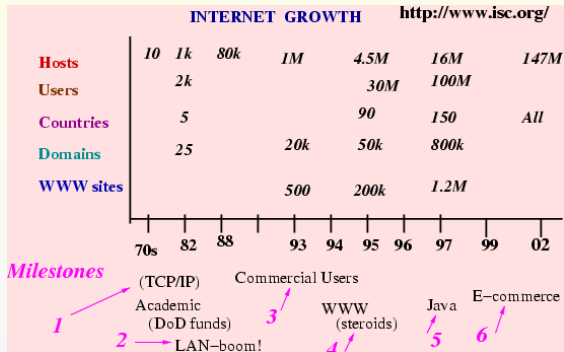
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Internet's Growth and Charter



Information **AnyTime, AnyWhere, AnyForm, AnyDevice, ...**
WebTone like DialTone



Internet Engineering Task Force



RFC 2026

The Internet, a loosely-organized international collaboration of autonomous, interconnected networks, supports host-to-host communication through voluntary adherence to open protocols and procedures defined by Internet Standards.

Overview

The Internet Engineering Task Force (IETF) is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. It is open to any interested individual.



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Why Open Standards?

- 1 **Availability**
For all to read and implement.
- 2 **Maximize End-User Choice**
Fair, competitive market. No lock-in to a particular vendor.
- 3 **No Royalty**
Free for all to implement, with no royalty or fee. Certification may involve a fee.
- 4 **No Discrimination**
Do not favor one implementor over another for any reason
- 5 **Extension or Subset**
However, certification organizations may place requirements upon extensions.
- 6 **Protection against Predatory Practices**
Embrace and enhance!



Free Software

<http://fsf.org.in/> Richard M. Stallman

Free software

is a matter of freedom, not cost. It is a matter of liberty, not price. The word *free* in free software has a similar meaning as in free speech, free people and free country ... Think of free software as software which is free of encumbrances, not necessarily free of cost. Think of it as *swatantra* software.

Degrees of Freedom

- 1 The freedom to **run the program, for any purpose**
- 2 The freedom to study how the program works, and adapt it to your needs
- 3 The freedom to redistribute copies so you can help your neighbor
- 4 The freedom to improve the program, and release your improvements to the public so that the whole community benefits



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The Free Software Foundation

Free software is a matter of liberty not price. You should think of "free" as in "free speech".

The Free Software Foundation (FSF), established in 1985, is dedicated to promoting computer users' rights to programs. The FSF promotes the development and use of [free software](#), particularly the GNU operating system helps to spread awareness of the ethical and political issues surrounding freedom in the use of software.

Here are the FSF's current projects.

[GNU](#)

FSF remains the primary sponsor of the GNU Project. In addition to the services provided by Savannah for GNU projects, FSF provides development systems for GNU software maintainers, including full email and shell services. We are committed to furthering the development of the GNU Operating System and enabling volunteers to easily contribute to that work.

[Free Software Licensing and Compliance Lab](#)

The commencement of the GNU project in 1984, with its goal to give users freedom, required the establishment of new distribution terms that would prevent the project being turned into proprietary software. The method used was Copyleft and the resulting license was called the GNU General Public License (GNU GPL). Today the GNU GPL is the most widely used Free Software license, and as its author, the FSF works to help the wider community use and comprehend it.

[Free Software Directory](#)

The Free Software Directory was started in September 1999 to catalog all useful free software that runs under free operating systems. The Directory contains over 3,000 entries. Recently, FSF has developed a partnership with [UNESCO](#) to combine our Free Software Directory with [UNESCO's Free](#)



Open Source Definition

From <http://www.opensource.org> (Author: Bruce Perens)

- 1 Free Redistribution
- 2 Source Code
- 3 Derived Works
- 4 Integrity of The Author
- 5 No Discrimination Against Persons or Groups
- 6 Distribution of License
- 7 License Must Not Be Specific to a Product
- 8 License Must Not Restrict Other Software
- 9 License Must Be Technology-Neutral



Open Source Licencing



:: License Index ::

[License Approval Process](#)
[License Information](#)

- *[Academic Free License](#)
- *[Apache Software License](#)
- *[Apache License, 2.0](#)
- *[Apple Public Source License](#)
- *[Artistic license](#)
- *[Attribution Assurance Licenses](#)
- *[BSD license](#)
- *[Common Public License](#)
- *[CUA Office Public License Version 1.0](#)
- *[EU DataGrid Software License](#)
- *[Eclipse Public License](#)
- *[Eiffel Forum License](#)
- *[Eiffel Forum License V2.0](#)
- *[Entessa Public License](#)





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Track thousands of Web sites in one place: [Newsburst](#)

Enterprise Software >> [Open source](#)

Indian president calls for open source in defense

Published: July 7, 2004, 10:03 AM PDT

By [Dinesh C. Sharma](#)
Special to CNET News.com

[TalkBack](#) [E-mail](#) [Print](#) [TrackBack](#)

In another public-sector boost to open-source software, Indian President A.P.J. Abdul Kalam called for his country's military to use such nonproprietary technology to ward off cybersecurity threats.

"Software maintenance and software upgrade is an important issue for defense," [Kalam](#) said at a meeting of Indian Navy's Weapons and Electronic System Engineering Establishment in New Delhi last week.

Without naming any proprietary software products, the president asked defense engineers to develop and implement on open platforms. "Even though the required software for the equipment could be developed by the private industry, it is essential that the technical know-how and the architecture is fully available with these services for ensuring provision of lifetime support for the software which may or may not be forthcoming from the



Freeduc in Schools

Freeduc is a **Live CD** with wealth of FOSS for school kids.

- What does it cost to produce?
- How to distribute? (Postman: once in 3 months!)
- What expertise does it need?

What **innovation** is needed for India?

- Localization!
- Relevant content.

Who can/will do this innovation?

Compare with **proprietary** software!



Super Highways are good, but why wait for that?

Freeduc is just one example.

eMoviX:

a micro Linux distro meant to be embedded in a CD together with all video/audio files you want, so that the CD will be able to boot and automatically play all files;

MoviX:

A mini CD Linux distro able to boot directly from CD and load in RAM a console interface to MPlayer. From the interface you can easily play DVDs, VCDs, audio/video files Audio CD, internet radios, TV, you name it!

Supported formats- AVI, MPG, QuickTime, MP3, OGG/VORBIS and a few others. See <http://movix.sourceforge.net/>
Easy, cost effective way to distribute information!

Static vs. Dynamic content



Sharing data and results is the foundation!

Way of Genius

If I have seen further [than others] it is by standing on the shoulders of giants... [Issac Newton](#)

Results are accepted only if they can be **replicated!** (sharing)
Open Access is a must!



Why FOSS in Academia

Tamil Proverb

What has been learned is like a fistful of sand, what remains is like the whole earth!

Solution?

Giving a scholar access only to *raw information* is like giving only seeds to a *hungry man*.

Way Forward?

Giving a student access only to *executable code* is like giving only *cooked rice* to a *farmer*.

How can *FOSS* close this gap?

Students move from being mere *users/consumers* to *producers*.

Great Empowerment!



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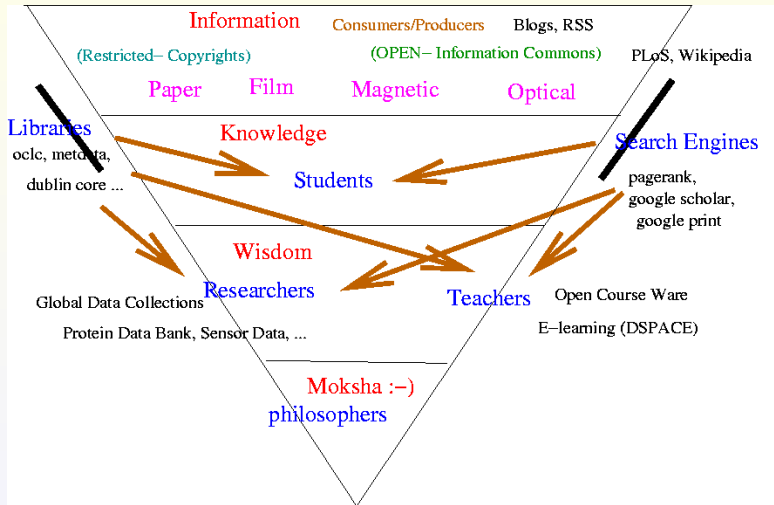
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Information Hierarchy



Open Access Journals

Public Library of Science - Mozilla Firefox

View Go Bookmarks Tools Help http://www.plos.org/

PLoS PUBLIC LIBRARY of SCIENCE

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PLoS Biology

PLoS Medicine

About PLoS

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News

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Search

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PLoS Medicine

Announcing New Open-Access Community Journals: PLoS is embarking on a new phase of its ambitious plan to transform scientific publishing, announcing the 2005 launch of three new open-access journals—*PLoS Computational Biology*, *PLoS Genetics*, and *PLoS Pathogens*. These PLoS Community Journals answer the increasing calls of scientists, scientific societies, and governments around the world for the free and open sharing of discoveries and data through reputable, high-quality, peer-reviewed journals targeted to specific research communities. [Read the [PLoS Pathogens announcement](#) and previous [press release](#)]

PLoS COMPUTATIONAL BIOLOGY

June 2005

PLoS GENETICS

July 2005

PLoS PATHOGENS

Sept 2005



What is open access publishing?

- 1 Free and unrestricted online access to the research literature and databases
- 2 Users are licensed to download, print, copy, redistribute, and use
- 3 Author retains copyright and the right to be acknowledged
- 4 Papers are deposited in a public database that allows sophisticated searches (such as PubMedCentral)
- 5 (Bethesda Principles, April 2003)



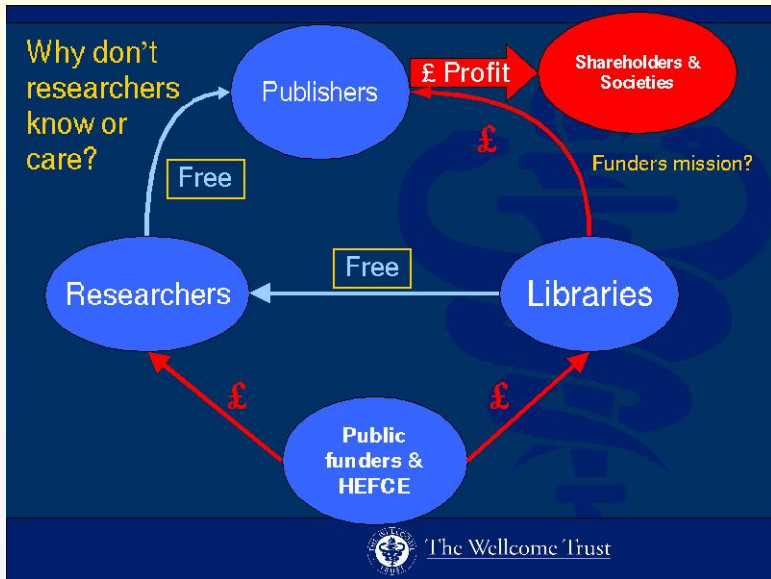
Why is open access important?

- 1 Maximum impact for authors
access to the largest possible audience
- 2 New ways to access and use literature
full-text searching and mining (e.g. Google Scholar)
- 3 Greatly expanded access to research
for scientists, educators, physicians, the public

Economic analysis at

http://www.wellcome.ac.uk/doc_WTD003181.html





Open Access not only for Consumers!

Wikipedia - Mozilla Firefox

ew Go Bookmarks Tools Help | W http://wikipedia.org/

WIKIPEDIA

English <i>The Free Encyclopedia</i> 533 000+ articles	Deutsch <i>Die freie Enzyklopädie</i> 225 000+ Artikel
日本語 フリー百科事典 110 000+ 記事	Français <i>L'encyclopédie libre</i> 100 000+ articles
Svenska <i>Den fria encyklopedin</i> 71 000+ artiklar	Polski <i>Wolna Encyklopedia</i> 64 000+ hasel
Nederlands <i>De vrije encyclopedie</i> 66 000+ artikelen	Español <i>La enciclopedia libre</i> 46 000+ artículos
Italiano <i>L'enciclopedia libera</i> 40 000+ articoli	Português <i>A enciclopédia livre</i> 37 000+ artigos



Main Page - Wikipedia, the free encyclopedia - Mozilla Firefox

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article discussion view source history


Main Page

From Wikipedia, the free encyclopedia.

Welcome to [Wikipedia](#), the free-content encyclopedia that [anyone can edit](#). In this English version, started in 2001, we are currently working on [559341](#) articles.

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Today's featured article



Louis Riel was a [Canadian](#) politician and leader of the [Métis](#) people of [western Canada](#). He led two [resistance movements](#) against the [Canadian government](#) that sought to preserve Métis rights and culture as their homelands came under the Canadian sphere of influence. During the first, the [Red River Rebellion](#), the [provisional government](#) established by Riel ultimately negotiated the terms under which the modern [province of Manitoba](#) entered the [Canadian Confederation](#). He was forced into exile as a result of the controversial execution of [Thomas Scott](#), but in [1884](#) he returned to what is now the province of [Saskatchewan](#) to participate in the [North-West Rebellion](#) of [1885](#). It ended in his [arrest](#), [trial](#) and eventual [execution](#) for [treason](#). Riel was viewed sympathetically in [francophone](#) regions of Canada, and his execution has had a lasting influence on relations between the province of [Quebec](#) and [English-speaking](#) Canada. Whether he is seen as a *de facto* [Father of Confederation](#) or as a [traitor](#), he remains one of the most complex, [controversial](#) and ultimately [tragic](#) figures in the [history of Canada](#).

Recently featured: [Brian Close](#) – [Diamond](#) – [Samantha Smith](#)

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In the news

- A planned new [N3 motorway](#) past the [Iri mediaeval Hill of Tara](#) is approved, raising international outcry from environmentalist historians and [Celtic](#) scholars.
- The [Sellafield nuclear plant](#)'s Thorp repro [Cumbria, UK](#), is closed down due to a 20-tc [nitric acid](#).
- [John Conyers](#) and 87 other members of [George W. Bush](#) about secret [2002](#) agreeer [invade Iraq](#).
- The wreckage of [NASA's Mars Polar Lan](#) have been found on [Mars](#) in images from t

[Wikinews](#) · [Recent deaths](#)

Did you know...

From Wikipedia's [newest articles](#):
...that [Starry Night Over the Rhone](#), paint



[article](#) [discussion](#) [edit this page](#) [history](#)

Wikipedia

From Wikipedia, the free encyclopedia.

Wikipedia is a [Web](#)-based, [free-content encyclopedia](#) that is written collaboratively by volunteers. It consists of editions sponsored by the [non-profit Wikimedia Foundation](#). Entries on traditional encyclopedic topics exist along with [current events](#) topics. Its purpose is to create and distribute, worldwide, a free encyclopedia in as many languages as possible. It is one of the most popular reference sites on the Web^[1], receiving around 60 million hits per day.

Wikipedia contains approximately 1.5 million articles, more than 500,000 of which are in its [English language](#) edition, [German language](#) and more than 100,000 each in [Japanese](#) and [French](#). It began as a complement to the [2001](#). Having steadily risen in popularity,^[2] it has spawned several conceptually related sister projects such as [Wiktionary](#). Its articles are edited by volunteers in [wiki](#) fashion, meaning articles are subject to change by nearly anyone. Wikipedia's policy of "neutral point of view." Under this, the views presented by notable persons or literature are summarized in an [objective](#) truth. Because of its open nature, [vandalism](#) and inaccuracy are problems in Wikipedia.

Wikipedia's status as a [reference work](#) has been controversial. It has received praise for being free, editable, and authoritative for a perceived lack of accountability and authority when compared with traditional encyclopedias, [systemic bias](#) has been cited by the [mass media](#) and [academia](#). Wikipedia's articles are available under the [GNU Free Document License](#), distributed on [compact discs](#), and many of its other editions are [mirrored](#) or have been [forked](#) by [websites](#).

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[2.1 Policies](#)

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[3 Evaluation](#)



Why no Indian Languages?

Wikipedia - Wikipedia, the free encyclopedia - Mozilla Firefox

File Edit View Go Bookmarks Tools Help W http://en.wikipedia.org/wiki/Wikipedia

Wikipedia as a source [as a source](#)

Language editions

Wikipedia encompassed 92 "active" language editions in [March 2005](#).^[9] Its five largest editions were, in descending order [English](#), [German](#), [Japanese](#), [French](#) and [Swedish](#). In total, Wikipedia contained 195 language editions of varying states with combined 1.5 million articles.^[9]

Language editions operate independently of one another. Editions are not bound to the content of other language editions and are only held to global policies such as "neutral point of view". Articles and images are nonetheless shared between Wikipedia editions, the former through pages to request translations organized on many of the larger language editions, the latter through the [Wikimedia Commons](#) repository. Translated articles represent only a small portion of articles in an edition.^[10]

The following is the list of major editions in the order of article number in [May 2005](#).^[11]

1. [English](#) (558,813)
2. [German](#) (228,000)
3. [Japanese](#) (116,000)
4. [French](#) (105,000)
5. [Swedish](#) (74,000)
6. [Dutch](#) (69,000)
7. [Polish](#) (66,000)
8. [Spanish](#) (48,000)
9. [Portuguese](#) (44,000)
10. [Italian](#) (42,500)
11. [Chinese](#) (27,300)
12. [Danish](#) (24,600)

Editing



- [1 Root terminology](#)
- [2 Open source model](#)
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OSS Model and Tools

From the Wikipedia page examine the following.

- Open Source **Model**
- Open Source **Participants**
- OSS **Development Tools**
- OSS **Advocates and Projects/Organizations**



Benefits of FOSS in Academia

FOSS, like academia, is

- **Parallel**, rather than linear
- **Large globally distributed community**
- **Highly talented, highly motivated collaborators.**
- **Truly independent *peer review***
- **Prompt feedback to users/developers.**
- **Rapid release schedules.**



Other Educational Sector Examples

- Linux Cluster (32 nodes) at IIT-Bombay
 - Most Value for money!
 - Molecular modelling
 - Circuit Simulation
 - Aerodynamics
- Online Course Management
 - dotLRN
 - Moodle
- Examples from Science and Engineering



SciLab vs Matlab



- 2-D and 3-D graphics, animation
www.scilab.org
- Linear algebra, sparse matrices
- Polynomials and rational functions
- Simulation: ODE solver (ODEPACK) and DAE solver (DASSL)
- Scicos: a dynamic systems modeler and simulator
- Classic and robust control, LMI optimization
- Differentiable and non-differentiable optimization
- Signal processing
- Metanet: graphs and networks
- Parallel Scilab using PVM
- Statistics
- Interface with Computer Algebra (MuPAD)

Which is better for **student?** for your *college?*



Finite Element Analysis

:: elCalc

A program for engineering calculation of structures (steel, concrete and other), being an add-on to any FEM (Finite Element Method) program, which is able to produce textual output.

:: femML

femML is an XML-based language for describing finite element models and associated results for inter - and intra- application data exchange and integration.

:: Meshgen

Meshgen is designed to interactively generate 2D FEM meshes composed of triangular and quadrilateral elements.

:: Pfem

Pfem is a python-based finite element program aimed at solving solid mechanics and heat transfer problems with flexibility, efficiency and sound object-oriented design.

:: Openfem

Develop finite element stress analysis programs, that work with free cad systems (Maybe OCad). Right now there's only



Numerical Analysis Libraries

:: GSL (GNU Scientific Library)

A modern numerical library for C and C++ programmers. The routines have been written from scratch by the GSL team in ANSI C.

:: Blitz++

Blitz++ is a C++ class library for scientific computing which provides performance on par with Fortran 77/90. It uses template techniques to achieve high performance.

:: TNT (Template Numerical Toolkit)

A collection of interfaces and reference implementations of numerical objects useful for scientific computing in C++. The toolkit defines interfaces for basic data structures, such as multidimensional arrays and sparse matrices, commonly used in numerical applications.



GRASS: Documentation

Home	Introduction	Download	Documents	Community
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Tutorial and Courses

- English:
 - ◊ [GDF Hannover: GRASS 6 Course material](#)
 - ◊ [GRASS 6 WIKI tutorial](#)
 - ◊ [GRASS 5.0/5.3 tutorial project](#), especially Part III of the full tutorial: GRASS in 10 minutes - Quick
 - ◊ [GRASS 5.4/6 Tutorial](#) (translation of Italian Tutorial)
 - ◊ [GRASS GIS: A Useful Tool for the Mountain Cartographer](#) (Pat Dunlavy, 2002)
 - ◊ [An Introduction to: Geographic Resources Analysis Support System \(GRASS GIS 4.x\)](#) (ISAT Envir
 - ◊ [Introduction to GRASS GIS software \(2. ed., 1998\)](#) in English language (80 pages, online and PS)
 - ◊ [GRASS 4.2 Seeds Beginner's Tutorial](#) (1995, University of Leicester/Project ASSIST)
 - ◊ [Spearfish database description](#) (Postscript, 8 pages)
- Czech:
 - ◊ Translation of [GDF Hannover: GRASS 6 course script](#)
 - ◊ [České sdružení uživatelů GISu GRASS](#) (Jáchym Cepicky, online)
- French: [French translation of the GRASS 5 tutorial project](#)



GRASS GIS Development

GRASS Development

[Mailing list](#) - [Download/CVS](#) - [Help wanted!](#) - [Compiling GRASS](#) - [Programmer's Manual](#) - [Code submission](#) - [Related software](#)

GRASS - Geographic Resources Analysis Support System has been under continual development since 1982 and has involved a large number of universities, and private companies. The core components of GRASS and the management of the efforts into GRASS release are managed by the Construction Engineering Research Laboratory (CERL) in Champaign, Illinois. It has been estimated that several million dollars of GRASS development efforts across the government have been completed since the 4.1 release. Since 1997 a worldwide network of developers continue to release GRASS (see [GRASS history](#)).

The strength and success of GRASS relies on the user community. This in mind, the philosophy of the GRASS Development Team is to encourage the development of unique tools and applications for GRASS. If you develop tools and techniques that you feel would benefit other GRASS users, let us know how to follow the coding style described in SUBMITTING file (which you find in the main directory of GRASS source code). GRASS GIS is developed and maintained by the [GRASS Developers Team](#) [see the incomplete [GRASS Developers World Map](#) (big: 500k)]. As GRASS is growing, we have plenty of opportunities to join the team and improve the powerful GRASS GIS under terms of [GNU General Public License](#).

[Many people](#) have contributed to the GRASS GIS. Without any one of them, GRASS would not exist in its current form. The authors of the index at the end of their manual page in GRASS users manual, however, numerous authors of bug fixes and enhancements as well as people who coordinate, integration, documentation and testing are not mentioned. Therefore, this page is an attempt to acknowledge those who contribute to development. Please allow us to extend our most cordial thanks to all of you. If you contributed to GRASS at any point during its existence, please provide your name and e-mail address so we can add your name [here](#).

Development happens in [GRASS 6](#).

Developers Mailing List

Please join our mailing list which shall help and coordinate ongoing development in GRASS GIS development. Join the list if you are programmer and/or want to follow the development discussion. If you have questions concerning compilation of the CVS-GRASS, please ask here.

◆ How do I subscribe to GRASS Developers Mailing List?

[Visit the GRASS mailing list \(un\)subscription page](#)

◆ [GRASS5 mailing list Archive](#)

◆ [Search](#) Mailing List

How you can help

- ◆ **Bug reports:** You are kindly requested to report bugs through our [bug tracking form](#). Our system keeps you informed about progress.
- ◆ **Bug fixing:** Please assist in fixing known bugs from the [GRASS known bugs list](#).
- ◆ **Implementation of wishes:** Open wishes are listed in the [GRASS wish list](#).
- ◆ **Write missing man pages:** Help us to write missing man pages. Check against the existing [GRASS 6 manual pages](#).



GRASS GIS Development

Roadmap

See the [GRASS Development roadmap](#)

Download the latest GRASS software

To follow GRASS development, get the latest code from CVS server:

- ◆ [Download official GRASS releases](#)
- ◆ [CVS repository](#) (latest code)
- ◆ New Developers: [How to get GRASS CVS write access with ssh](#). To

Compiling GRASS

Compiling GRASS is only recommended to people with experience (that's why). The **configuration** requires a set of installed libraries which are described in the `INSTALL` file (which you can find in the [code tarball](#)). The **compilation** is described in the [INSTALL](#) file (which you can find in the [code tarball](#)). You should search the [developers mailing list archive](#) before asking developers - mail

GRASS Programmer's Manual

Please cite GRASS when using it as we have invested a lot of time and effort in its development.
Citation:

GRASS Development Team (<year>). Geographic Resources Analysis S



▲ GRASS 5.0/5.2/5.4 (old):

Cost of FOSS

- There is no **Free** Lunch! What is the tradeoff?
- **Skilled Human Resources** versus **Money**!
- Which one does India have in **abundance**? Which one should we bet on?
- Goals of OSSRC centre (<http://ossrc.org.in>)
- Goals of this course (Train the Trainers)
- **We need your help!** (Ramakrishna sweets story)

