

# Using Free Software in Public Administration

.^ CALPP: Computer Aided Legal Procedures and Proceedings

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# Using Free Software for Public Administration

- Issues in using Free Software for Public Administration
  - Legal
    - Law as a simple truth system of moral percepts, commands and laissez faire
    - Law as a complex system of rules with International Law, Constitutional Law, Statutory Law, Rules, Regulations, Judicial Precedents, Customs, etc.
  - Technological
    - Computers as a simple truth system - Alan Turing and Church's theorem
    - Computers as a complex system - Artificial Intelligence is an unsolved problem
  - Practices and Approaches
    - Comments, Approaches to the AI problem, the Representation Principle
    - Desired qualities in laws and programs
- Calpp: Computer Aided Legal Procedures and Proceedings
  - Calpp Design
    - Procedures & proceedings; Steps & events; Particulars & details
    - Persons and Permissions
    - Index
  - Implementation
    - Tools used: Free Software, PHP, JavaScript, PostgreSQL
    - Centralisation vs Decentralisation :: Domain vs Sub-domain
    - <http://calpp.freeshell.in/calpp>
- Future
  - Reach the farthest cosmos and the innermost consciousness

# Law as a Simple Truth System

- Works of Ancient Law Givers
  - Avvayar's Attisudi : The Golden Alphabet with 108 aphorisms
    - Desire and do good; subside anger; letters and numbers claim esteem
    - Pursue customs, seek learning, adhere to excellence,
    - Your trade be free to own and ply, nor steal nor wish to take away
    - Don't do the business of war.
    - Try most to learn most, be open and sincere, speak pleasantly and plainly
    - Learn many sciences; Consult betters for advice;
    - Let candid lips report your eyes, In ways of justice keep your feet,
    - Live for fame, remember kindness
- “In their punchayats, Sleeman tells us, men adhere habitually and religiously to the truth, and 'I have had before me hundreds of cases', he says, 'in which a man's property, liberty, and life has depended upon his telling a lie, and he has refused to tell it”  
[p. 50, *India – What can it Teach us*, F. Max Muller, quoting from Colonel Sleeman's *Rambles and Recollections of an Indian Official*, published in 1844, written in 1836]
- “It is an ancient custom for the Sheriff to present a pair of white gloves to a Judge, who, when he takes his seat for criminal business at the quarter sessions finds no case, for trial.” [p. 117, *The Madras High Court 1862 – 1962 Centenary Volume*]
- Science and Arts flourished during the peaceful Golden Age of the Guptas, Cholas. Ashoka.. Motto: “Satyameva jayethe” – “truth triumphs” [Mundaka Upanishad]

# Law as a Complex System of Rules

- **Function of Law**: to maintain **peace** and bring about **peaceful changes**
- Law consists of Rules that are rooted in:
  - Dictates of **Reason** (Natural Law)
  - **Decrees** of the Sovereign (Imperative Law)
  - **Practice** of the Courts (Real Law)
- **Rules** are concerned with what **ought** to be done
- **Rules** are of **broad application** and **non-optional** character
- Law defines **Rights** and **Duties, Permissions** and **Privileges**
- **Higher rules** prevail over **lower rules**
  - **International Law, Constitutional Law, Statutory Law, Judicial Precedents, Customs and Contracts**
- Law is a **complex system of rules** involving **multiple jurisdictions, public & personal laws, customs, practices and precedents** and further the Law is **dynamically changing** all the time **while legal proceedings are in progress**.
- All questions which arise for **consideration** and **determination** in a court of law are of two kinds, being either:
  - questions of **law**, or
  - questions of **fact**
- They **resemble recipes, travel directions, maker's instructions, rules of games where the rules could change in the middle of the game**

-P.J. Fitzgerald, Salmond on Jurisprudence

# Computers and Programs

- Computer
  - includes any electronic or similar device having information processing capabilities
    - Machines: Desktops, laptops, mainframes, cell phones etc
    - Humans: endowed with natural abilities to compute, reason and act
- Computer program
  - means a set of instructions expressed in words, codes, schemes or in any other form, including a machine readable medium, capable of causing a computer to perform a particular task or achieve a particular result
    - Computer Languages: C, PHP, Python, HTML, etc.
    - Machine Code: binaries
    - Human Languages: English, Hindi, Tamil, Kannada, etc.
- Aid from Computers and Computer Programs
  - Versatile universal machines
  - High processing speed, efficiency and accuracy
  - Good error filtration and validation
  - Infinite storage capacity
  - Easy network connectivity
  - Very secure transactions

# Computers as Simple Truth Machines

- **ON-OFF** states represent **boolean values**
  - **OFF** represents **0** or **FALSE**
  - **ON** represents **1** or **TRUE**
- Each **0** or **1** is a “**binary digit**” or “**bit**” of **information**
- A **BYTE** (BinarY Table) is a **contiguous sequence of a fixed number of bits** which has come to mean 8 bits “octet” capable of holding 256 values from **00000000** to **11111111**
- **ASCII** – **American Standard Code for Information Interchange character encoding** based on the **English Alphabet** is the widely used standard
- The 95 printable ASCII characters are:  
**!"#\$%&'()\*+,-./0123456789:;<=>?**  
**@ABCDEFGHIJKLMNPQRSTUVWXYZ**  
**[]^\_`abcdefghijklmnopqrstuvwxyz{|}~**
- **Source code** by programmers is converted to **machine code** which **computers** understand **natively**

ASCII Chart binary	glyph
0011 0000	0
0011 0001	1
0011 0010	2
0011 0011	3
0011 0100	4
0011 0101	5
0011 0110	6
0011 0111	7
0011 1000	8
0011 1001	9
0100 0001	A to
0101 1010	Z ..

Boolean Logic		
<b>AND</b>		
$\wedge$	<b>0</b>	<b>1</b>
<b>0</b>	0	0
<b>1</b>	0	1
<b>OR</b>		
$\vee$	<b>0</b>	<b>1</b>
<b>0</b>	0	1
<b>1</b>	1	1
<b>NOT</b>		
<b>a</b>	<b>0</b>	<b>1</b>
$\neg a$	1	0



# The Artificial Intelligence Problem

Artificial Intelligence is the **study** of the **computations** that make it possible to **perceive**, **reason** and **act**.

-Patrick Henry Winston, Artificial Intelligence, p.3

- **Perception** is the **apprehension** born of the contact of an **organ** with an **object**.
  - **Sense organs** are the seats of perception and intelligence
    - To “sense” is to “know”, have "knowledge"
    - Sense of touch, taste, smell, vision, hearing, reasoning, ...
  - Kinds of Apprehension
    - **Indeterminate** apprehension: knowledge **without** any **attribute**
      - *this is something*
    - **Determinate** apprehension: **Attributive** knowledge
      - *this is a laptop computer, a desktop computer, a mainframe computer*
- To **Reason** is to test **validity** of perceptions and make **inferences** from what is known with an **object** or **purpose**.
- **Action** is through **movement**, **speech** and other **means**: **animate** or **inanimate**.

-Tarka Samgraha translated by Swami Virupakshananda



# Automation of Intelligence

- Sensors could detect or measure physical properties accurately
- Extensive memory, computational power, speed and connectivity
- Action through inanimate, strong, material movements without loss or risk to life.
- Repetitive tasks executed with perfection
- Creative assistance add value and meaning to life
- Intellectual tasks could be replaced with software automation
- Demand for beautiful, unique and meaningful designs
- Delivery of facts with emotion and feeling
- Fine details without losing the big picture
- The spirited mind will not be content to remain within itself.  
It will reach out for chances to prove its worth.
- Knowledge issuing out as action is wisdom
- Reaching out everywhere: Possess the cosmos!

# Goals of Artificial Intelligence

- The **engineering goal** of AI is **to solve real-world problems** using artificial intelligence as a collection of ideas about representing knowledge, **using knowledge and assembly systems**.
- The **scientific goal** of AI is to determine which **ideas** about **representing knowledge** explain various sorts of **intelligence**

-Winston, ibid, p.6

# AI Applications

- **Long Term Applications**
  - Applications **stagger imagination**
  - Farming, manufacturing, medical care, legal information processing, household work, education – and every conceivable field of human endeavour could use AI
- **Near Term Applications**
  - Create **new opportunities**
  - Intelligent people and intelligent computers have complementary abilities. Both can realize opportunities together that neither can realise alone

# Comments on legal tools & .^i

"A.I. is Brain-Dead"

-Marvin Minsky, Co-founder of MIT Artificial Intelligence Lab  
<http://www.wired.com/wired/archive/11.08/view.html?pg=3>

“I sometimes wonder whether our system of **case law** will stand the **strain**. The weight is not relieved by our **modern research tools** like 'Lexis' and 'Eurolex'. They only **aggravate it**. They tell you, not only of reported cases, but also of unreported cases. So there are more to look up.”

- Lord Denning, Landmarks in the Law, p. 369

If this [calpp] includes implementation of human-style common-sense reasoning, you may have tackled a problem that the Artificial Intelligence field has been struggling with for 35 years.

-Richard Stallman

# Traditional approach to AI

- Unity of knowledge is neither seen nor appreciated.
  - For instance, the study of AI is usually organised as follows:
    - Part I
      - A basic understanding of how **knowledge** can be **represented** and what methods can make use of that knowledge
    - Part II
      - **Learning** is sine qua non for intelligence. A variety of learning methods
    - Part III
      - **Visual perception** & **language** understanding
- LAW is generally not seen as an important core part of AI
  - How would a robot know if it is wrong to hit a person?
  - Without law, it is not possible to build AI systems
  - Porting law to computers would aid public administration and is also crucial to solving the AI problem
  - Law provides a common background for all mankind
  - Law is ubiquitous and the best link to connect all fields of human endeavour
  - Law provides a strong foundation for building robust AI systems

# Consilience

- **Consilience**, or the **unity of knowledge** (literally a "jumping together" of knowledge), has its roots in the ancient Greek concept of an intrinsic orderliness that governs our cosmos, inherently comprehensible by logical process, a vision at odds with mystical views in many cultures that surrounded the Hellenes. . The **converse of consilience** in this way is **Reductionism**. **Avvayar** talked about "**onraka kaanbathe kaatchi**" (**to see is to see as one**)
- The word consilience was apparently coined by William Whewell, in *The Philosophy of the Inductive Sciences*, 1840. In this synthesis Whewell explained that, "The Consilience of Inductions takes place when **an Induction, obtained from one class of facts, coincides with an Induction obtained from another different class**. Thus Consilience is a test of the truth of the Theory in which it occurs." The Scientific method has become almost universally accepted as the exclusive method for testing the status of any scientific hypothesis or theory. "Inductions" which arise out of applications of the scientific method are, by definition, the only accepted indicators of consilience.
- Modern views understand that each branch of knowledge studies a subset of reality that depends on factors studied in other branches. Atomic physics underlies the workings of chemistry, which studies emergent properties that in turn are the basis of biology. Psychology can no longer be separated from the study of properties emergent from the interaction of neurons and synapses. Sociology, economics, and anthropology are each, in turn, studies of properties emergent from the interaction of countless individual humans. Their limits have constrained history. [Source: Wikipedia]
- **We need a new paradigm** for **addressing Information Integrity**. The **current approach** to **Information Integrity** is **unscientific, ad hoc, sporadic and costly**. Apart from privacy and security, there has been scant attention on the trustworthiness or integrity of information and of the interconnected, integrated information processes and systems. By and large, Information Integrity is addressed from isolated perspectives within each organization, or as specific issues unique to accounting, finance, law, medicine, engineering, hardware, software and the like. Consequently, **industry, government and society are paying an inordinately high price** for the level of Information Integrity that there is, and **facing enormous, unforeseen risks from catastrophic Information Integrity failures**.

# The Representation Principle

Once a **problem** is **described** using an appropriate representation, the **problem** is almost **solved**.

-Winston, ibid, p.18

## Representation Is the Essence of Programming

Much more often, strategic breakthrough will come from redoing the **representation of the data or tables**. This is where the **heart** of a **program** lies. Show me your flowcharts and conceal your tables, and I shall continue to be mystified. Show me your tables, and I won't usually need your flowcharts; they'll be obvious. ...

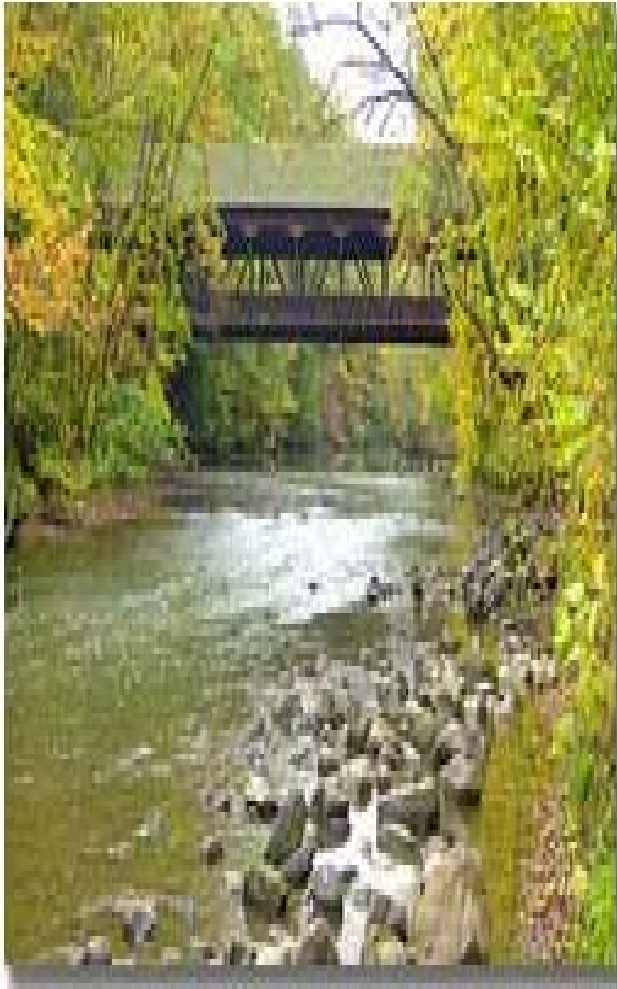
- The Mythical Man-Month, Frederick P. Brooks, Jr. p. 102

# Qualities of Good Representations

- Make the important **objects** and **relations explicit**.  
You can **see** what is going on **at a glance**
- They **expose** natural **constraints**. You can express the way one object or relation influences the other
- They **bring** objects and relations **together**.  
You can **see** all you **need** to see at one time
- They **suppress irrelevant detail**.
- They are **transparent**.  
You can understand what is being said
- They are **complete**. You can say all that needs to be said.
- They are **concise**.  
You can say what you need to say **efficiently**.
- They are **computable**.



# Four Friends



One **night**, four travellers named **One**, **Two**, **Five** and **Ten** walking through a forest, come to a deep gorge and find that they have to continue their journey across a weak **wooden bridge**, that **won't stand the weight of more than any two of them at a time**. The bridge has a few missing logs and they had only **one torch** with them **to guide** them across. Also, **One** takes **1** minute, **Two** takes **2** minutes, **Five** takes **5** minutes and **Ten** takes **10** minutes to cross the bridge, due to their individual abilities. What is the **minimum time** within which the four friends could cross the bridge?

# Representation of the problem

Task	::: Time in minutes
-----	
1 and 10 take torch and walk across	: 10
1 returns with torch	: 1
1 and 5 walk across with the torch	: 5
1 returns with torch	: 1
1 and 2 cross with the torch	: 2
-----	
Total time:	::: 19 minutes

Reasoning:

One being the fastest, could take Two, Five and Ten across in about 19 minutes.

Is there a better solution ?

# 4 Friends find a solution!

Task	::: Time taken in minutes
------	------------------------------

---

1 and 2 take torch and walk across	: 2
1 returns with torch	: 1
10 and 5 walk across with the torch	: 10
2 returns with torch	: 2
1 and 2 cross with the torch	: 2

---

Total time:	::: 17 minutes
-------------	----------------

# Philosophy of the Four Friends

With **good representations** of the problem, it is possible to **work out** or **evaluate solutions**.

Though **One** is the fastest, if he were asked to do all the work he would get tired too soon, but with **good distribution**, we can **save time**, **conserve resources**, and **achieve goals** with **efficiency**.

We could replace the **elements** in the story with modems, data packets, bandwidth; fuel, cars, trips; developers, users, project goals. **Distributing resources** in an intelligent manner **maximises efficiency** and **minimises strain**.

# Attributes of Good Program Design

- Clarity, simplicity, and unity
  - Should provide:
    - a conceptual framework for thinking about algorithms
    - means for expressing algorithms
  - programs should be easily readable
- Orthogonality
  - Attribute of being able to combine various features with every combination being meaningful
- Naturalness for the application
- Support for abstraction
  - Minimise gap between the problem and the solution
- Ease of program verification
- Programming environment
- Portability of programs
- Cost of use
  - Cost of program creation, testing and use
  - Cost of program maintenance

# Legal Procedures and Proceedings

- Legal
  - having to do with, required or permitted by law
  - anything defensible with reasoning
- Procedures
  - act or steps in any action or process
  - mode of conducting legal, parliamentary, executive, judicial or other business operations, transactions and processes
  - “No person shall be deprived of his life or personal liberty except according to procedure established by law” (Article 21 of the Constitution of India)
- Proceedings
  - Records of the doings of entities including judicial authorities
  - Course of action and conduct by entities
  - “The word 'proceedings' covers any proceedings of a legal nature, even though they do not take place in a court of law. The application to a rent officer to fix fair rent is a proceeding”  
[R. v. West Minister Rent Officer, (1973) 3 All ER 119, 121 ]

# Representation of Legal Rules

- **Procedures**
  - Logical set of connected rules with a well defined **object**
  - A procedure has one or more **steps**
  - Procedures are invoked as **proceedings**
- **Steps**
  - Sequence in which rules are executed as **events**
  - **Particulars** are collected at each step
  - Describe the work flow transparently
- **Particulars**
  - Grouped under **headings** to collect **details**
  - **Data** type, **controls** used, **defaults** and **descriptions**
  - **Maximum** and **Minimum** limits

# Representation of Procedures

- Top level **ROOT** table that gives the **big picture** about the **legal system**
- **Universal** in **scope**
- Ideally, it should be **located** in a large **central server** and **globally mirrored**
- **Fields** in the **procedures** table
  - **procedure\_id**: Unique primary key; sequentially generated number
  - **procedure\_code**: **Unique primary key**; connects **steps** to procedures  
Also connects **proceedings** to procedures  
-eg: *in\_chits; in\_tax; in\_copyrights, ..., utopia*
  - **procedure\_name**: **Description** of the procedure
  - **source** : **root** from where the procedure originated
  - **main\_head**: broad **genus** -eg: *chits; taxation; intellectual\_property; utopia*
  - **sub\_head**: **sub-species**
  - **country\_code**: country of **origin** -eg: *India, USA, utopia*
  - **first\_step\_code**: name of the first step
  - **first\_step**: the first step, by default
  - **sub\_procedure\_of** : name of a **parent** procedure, if any.
  - **script**: **code** that will be executed whenever a step is invoked
  - **procedure\_note**: **object** of the procedure



# Representation of Steps

task	step	next_step
filing	1	2
service	2	3
reply	3	4
hearing	4	5
adjournment	4	4
verdict	5	0

columns **step** and **next\_step**  
implement the constructs

if ... then ...

do ... while

- if (step = filing) then  
    collect particulars  
    take action
- elseif (step = notice) then  
    send notice to parties  
    await service
- elseif (step = hearing) then  
    hear parties  
    grant adjournments
- elseif (step = verdict) then  
    pronounce verdict

- do  
    adjournment  
    collect evidence  
    arguments  
while ( hearing)

# Adding new steps

task	step	next_step
filing	1	1.5
corrections	1.5	2
service	2	3
reply	3	4
evidence	4	4
hearing	4	5
adjournment	4	4
verdict	5	0

New steps are added at the mean point  
between two existing steps

# Fields in steps table

- Every record in the procedure table connects to one or more records here:
  - `step_id`: automatically generated sequential number
  - `step_code`: grouping code for a given set of logically connected steps
  - `step_name`: description
  - `procedure_code`: foreign key connecting procedure with step
  - `step`: sequence number
  - `next_step_code`: `step_code` of next sequence of steps
  - `next_step`: next in sequence
  - `next_time_gap`: interval
  - `next_time_limit`: due
  - `time_bar_code`: `step_code` of error handler
  - `time_bar_step`: sequence number of error handler
  - `default_step`: select if true for a given set of `step_code` and `step`
  - `role_of`: entity
  - `step_source`: authority
  - `is_multi_step`: loop
  - `script`: code
  - `step_note`: help

# Representation of Particulars

General format:

[+][-]Headings

[+][-]Particulars: Details

Example: Particulars connected to the step "filing"

[+][-]Applicant(s) ::

+1                   Name: John  
                      Address: White-acre

[+][-]Respondent(s) ::

+1                   Name: Doe  
                      Address: Black-acre

+2                   Name: Bim  
                      Address: Grey-area

# Representation of Particulars ...

General format:

[+][-]Headings

[+][-]Particulars: Details

Example: Particulars connected to the step "filing"

[+][-]Claims(s) ::

+1 [+][-]Causes

+1 : Agreed to my terms ..

+2 : Refused to act accordingly ..

[ ][ ]Prayer : Please enforce agreement ..

[ ][ ]Value : Rs. 1,00,000/-

+2 [+][-]Causes

+1 : Causing nuisance ..

+2 : Disturbing peace ..

+3 : Unbearably bad ..

[ ][ ]Prayer : Please grant injunction against R...

[ ][ ]Value : Rs. 100/-

# Fields in the particulars table

- Every step connects to several records in the particulars table, that has the following fields:
  - `particular_id`: automatically generated **sequential primary key**
  - `step_id`: **foreign key** connecting the particular with a step
  - `particular_code`: internal **variable name**
  - `particular_name`: **description**
  - `data_type`; `data_nature`: date, numeric, text ...; required, optional
  - `control`; `control_tags`: **heading**, text, select, radio, ...; rows=5 cols=7...
  - `rank`: **order**
  - `min`: **minimum count** allowed
  - `max`: **maximum count** allowed
  - | <code>min</code> | <code>max</code> | <code>effect</code>                   |
|------------------|------------------|---------------------------------------|
| 0                | 0                | hidden                                |
| n                | x                | min n and max x (if, x > n && n != 0) |
| n                | 0                | min n and max unlimited               |
  - `default_min`: average count
  - `stored_in_table`; `field_name`: given if data is not stored in details table
  - `default_value`: **sql queries** are allowed
  - `script`: **code**

# Permissions of owners, groups and others

- owner – u; group – g; world – o;
- read – r(4) ; write – w(2); execute – x(1);
- octal representation of permissions:
  - 0 – none
  - 1 – x
  - 2 – w
  - 3 – w, x
  - 4 – r
  - 5 – r, x
  - 6 – r, w
  - 7 – r, w, x
- -perms of ugo respectively rwx r-w r-w
- All procedures, steps and particulars have owners, groups with permissions set
- Most information is accessible to the public to read with permissions set to 755  
-rwx r-x r-x

Our Supreme Court had the occasion in Naresh v. State of Maharashtra [AIR 1967 SC 1] to consider the merits of open and public trials for "healthy objective and fair administration of justice," and quoted Bentham with approval as follows:

"In the darkness of secrecy, sinister interest, and evil in every shape, have full swing. ... Publicity is the very soul of justice. It is the keenest spur to exertion, and the surest of all guards against improbity. It keeps the Judge himself while trying under trial in the sense that the security of securities is publicity."



# Representation of Proceedings

- **Proceedings** <=> **Procedures**
  - Every proceeding is given a unique name and proceeding\_id
  - Stores last completed step, next\_step due date
  - Records start, closure time\_stamps
- **Events** <=> **Steps**
  - Stores proceeding\_id, step\_id invoked and step\_count
  - Audit trail with details about:
    - entry\_person\_id along with time\_stamp
    - verification\_person\_id with time\_stamp
    - audit\_person\_id with time\_stamp
- **Details** <=> **Particulars**
  - Stores detail\_id, event\_id and particular\_id
  - heading\_count
  - key\_count
  - **DETAIL**

# Index to Indexes

- **Index**
  - Procedures
  - Procedures, steps
  - Procedures, steps, particulars
  - Proceedings
  - Proceedings, events
  - Proceedings, events, details
  - Procedures and Proceedings
  - Procedures, Proceedings, steps and events
  - Procedures, Proceedings, steps, events, particulars and details
  - Index any field by any field
- **The plane of the mind**
  - Automate index generation
  - Perform computations with procedures and proceedings
  - Automate creation of procedures
  - **Artificial Intelligence** is here to stay

# Chief reasons for using Free Software in Public Administration

- The Free Software licenses give freedom
  - to **run** the program, for any purpose
  - to **modify** the program to suit your purpose
  - to **redistribute** copies, either gratis or for a fee
  - to **distribute modified versions** of the program
  - to **access source code** to effectively exercise the above rights
- A wide variety of Operating Systems under different licenses:
  - GNU/Linux, GNU/HURD released under the GPL
  - FreeBSD, NetBSD, OpenBSD \*BSD under BSD license
  - Plan 9, Open Solaris etc under their respective free licenses
- Applications to suit many requirements:
  - **Shells**: bash, sh, tch etc
  - **Programming Languages**: gcc, perl, python, php, javascript, ..
  - **Web Servers**: Zope, Apache ...
  - **Database Servers**: PostgreSQL, MySQL ...
  - **Office Suites**: Koffice, OpenOffice, ...
  - **Text editors**, ide's : emacs, vi, eclipse
  - **Browsers and Mail** : Firefox, Mozilla,...
  - **Security**: OpenSSH
  - **Graphic tools**: Gimp, Inkscape, ImageMagic,
  - **Others**: BIND, Sendmail, postfix, GNU Mailman ...

Free Software &  
Open Standards

{Vendor Neutral}

IEEE - POSIX

ANSI C, SQL

W3C

HTML

XML

DOM

CSS

NSA HTTP 1.1

# Calpp Implementation

- **Calpp implemented using:**
  - PostgreSQL database server
  - PHP for server side scripting
  - JavaScript for client side scripting
  - Documentation for source code generated using Doxygen
  - Runs on Free Software using Apache or compatible
  - Browser: Firefox, Mozilla
- **Calpp Project CVS and mailing list hosted at GBORG**
  - <http://gborg.postgresql.org/project/calpp/projdisplay.php>
  - <http://gborg.postgresql.org/mailman/listinfo/calpp-calpp-general>
- **Online implementation hosted at**
  - <http://calpp.freeshell.in/calpp>
- **Centralisation vs Decentralisation**
  - Policy decision based on resources available
  - Decentralised implementations may gradually migrate towards centralisation
  - Calpp may be run as a sub-domain on web sites
- **How you can help implement Calpp**
  - Contribute to the Calpp base project to add or maintain features
  - Contribute by writing tables and code for various procedures
  - Enable porting of useful tools to help automation

# Functions

A function is a named block of code that performs a specific task, possibly acting upon a set of values given to it, or parameters, and possibly returning a single value.

They improve readability by isolating code that performs specific tasks.

Functions are generally evaluated this way:

```
$value = function_name([ parameter, ...]);
```

The number of parameters a function requires differs from function to function, and may even vary for the same function.

The parameters supplied to the function may be any valid expression and should be in the specific order expected by the function.

A function's documentation will tell what parameters the function expects and what values are returned

# Function parameters, steps and particulars

- **Problems with functions**
  - **Parameters** are **not described clearly** to enable automation of computation
  - There is a need to refer to **documentation** which **may also not disclose logic**
  - **Functions** are **overloaded** with steps
    - **different return values** for **different parameters**
    - the **relationship** between parameters and return values are **not apparent**
- **Soution:** Represent functions logically as **steps** and **particulars**
  - **Function parameters** become **well defined** when represented as steps and particulars
  - **Invalid calls** to the functions become **redundant** and **reduce errors**
  - Well defined functions help to **automate calling** of functions with appropriate parameters
  - Enables easier **understanding** of how a function **takes in and returns values**

# Sample command function : wc

WC(1)

User Commands

WC(1)

**NAME**            `wc` - print the number of newlines, words, and bytes in files

**SYNOPSIS**        `wc` [OPTION]... [FILE]...

## DESCRIPTION

Print newline, word, and byte counts for each FILE, and a total line if more than one FILE is specified. With no FILE, or when FILE is -, read standard input.

<code>-c, --bytes</code>	print the byte counts
<code>-m, --chars</code>	print the character counts
<code>-l, --lines</code>	print the newline counts
<code>-L, --max-line-length</code>	print the length of the longest line
<code>-w, --words</code>	print the word counts
<code>--help</code>	display this help and exit
<code>--version</code>	output version information and exit

Written by Paul Rubin and David MacKenzie.

# steps and particulars for proc wc

Procedure: `wc`

Steps: [step\_code::`wc`]

Particulars:

Details:

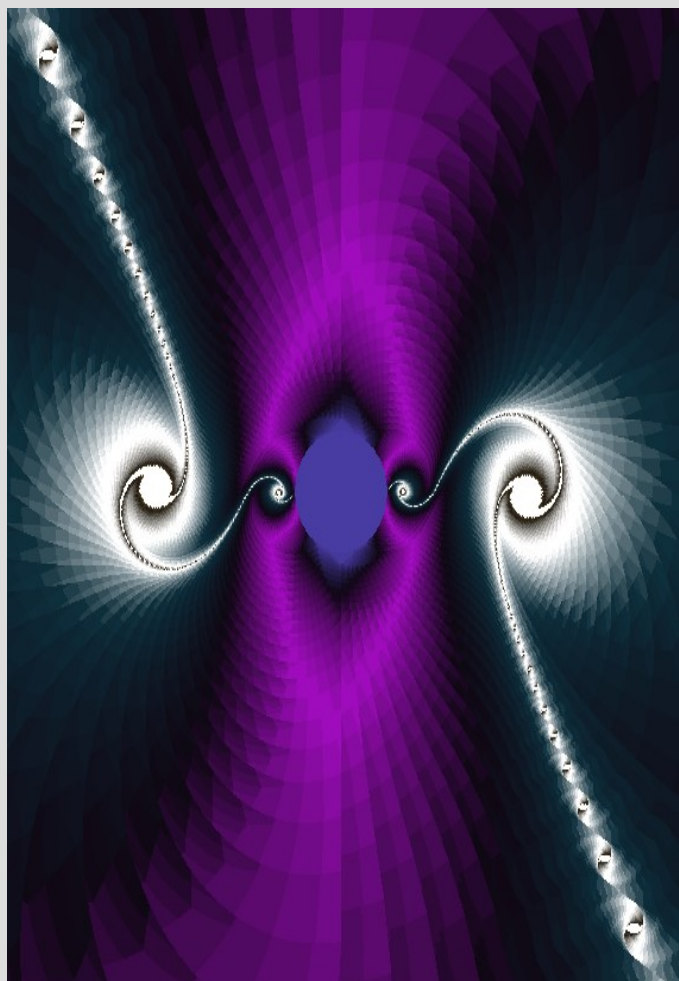
step_name	step	next_step	key	particulars	detail
version	1	0	[ ][ ]	--version	:
help	1	0	[ ][ ]	--help	:
word_count	1	0	[ ][ ]	--bytes	: -b
			[ ][ ]	--chars	:
			[ ][ ]	--lines	: -l
			[ ][ ]	--max-line-length	:
			[ ][ ]	--words	: -w
			[+][-]	--files	:
			+1		: /home/raman/*.txt
			+2		: /home/calpp/*.txt
			+n		: /home/index/*.txt



# Traditional Grades of Intelligence

- Ranked in order depending on **presence** of **sense organs**
- **Tholkappiam**, the ancient **Tamil Grammar Text**, makes the following gradation:
  - [1] **Or Arivu**: Endowed with only sense of **touch**
    - *Plants and Trees*
  - [2] **Er Arivu**: Senses of **touch** and **taste**
    - *Slugs and other Molluscs*
  - [3] **Mo Arivu**: Senses of **touch**, **taste** and **smell**
    - *Ants and Termites*
  - [4] **Na Arivu**: Senses of **touch**, **taste**, **smell**, and **vision**
    - *Wasps and Dragon-flies*
  - [5] **Iy Arivu**: Senses of **touch**, **taste**, **smell**, **vision** and **hearing**
    - *Cows and all animals*
  - [6] **Ar Arivu**: Senses of **touch**, **taste**, **smell**, **vision**, **hearing** and **reasoning**
    - *Men*
- What could be the **most obvious sign of intelligence** in a **tree**?
  - **Maintains balance** and has **survived well**
  - Have the **trees evolved** into a sophisticated **inverted form**?
- Future **Partnership** between **Men and Machines**
  - **Unlimited** sensors, computational power and action

# The Biggest



## What is Big?

If you ask what is big, thrower of the fiery spear,  
Big, big the world is big,  
But the world was created by Brahma,  
Four headed [Brahma] came from dark Thirumal's  
middle,

Dark Thirumal rests on the milky ocean,  
Milky ocean fits the fist of the short sage,  
The short sage was born in kalasam,  
Kalasam is a tiny grain in the Universe,  
Universe is borne on a head of the serpent,  
Serpant is Uma's little finger ring,  
Uma is within Sivan's half,  
Sivan is within the beholder's mind,

Could there be anything bigger than  
praising the beholder's mind?

-Avvayar

# Possess the Cosmos

Lord Muruga, son of Lord Siva, asks Avvayar, the Tamil poetess, what is big?

Avvayar starts with the world that is big. But bigger is Brahma who created the world. Even bigger is Vishnu from whose middle, Brahma emanated. But then, Vishnu himself rests on the milky ocean. The ocean fits the fist of the short sage Agathiar. Agathiar is believed to have swallowed the ocean once, and he was born in the "kalasam". The "porul" or meaning in tamil poems is usually very deep and varied. In Ramayanam, Sage Valmiki narrates the birth of Agathiar in a pot or kalasam. It could also be taken to mean the birth of Agathiar under the constellation of kumba, that is represented by the symbol of a pot or kalasam. The next line makes sense with either interpretation. The kalasam in which Agathiar was born is but a tiny grain in the universe. The constellation kumba, under which Agathiar was born is also a tiny grain in the scheme of the cosmos. The universe is lightly borne by the serpent. The serpent is a symbol for the sense organs, and also a symbol for the string of heavenly objects that appear like a snake. The serpent is merely a ring for Umai, who is exactly half of Sivan. Sivan is a symbol for life, love, mind, and the cosmos. Such Sivan is in the mind of the beholder. Sivan is believed to hold court in the plane of the mind, lying between the eyes.

# Mind & Cosmos

Tirumular's Tirumantiram says:

Straight within the fore-head  
Between the eye-brows  
Is the astral space vast;  
Peer, peer within there  
The luminous Mantra (Aum) will be;  
The place where they in yearning sought Him  
Is the place where He in yearning is;  
That verily is the Holy Temple of Chittambara  
And there did I firmly sit. [2770] -[Translation by Dr. B. Natarajan]

Avvayar concludes that the biggest is indeed praising and admiring the vast cosmos that is experienced within the mind, the macrocosm within the microcosm.

The plane of judgement is not perturbed by movement.

Vision possesses the cosmos.

Reach the stars with Calpp & .^i !

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