Calpp & .^.i

CALPP: Computer Aided Legal Procedures and Proceedings & Artificial Intelligence

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Definition of Artificial Intelligence

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

- Automation of Intelligence could help because:
  - Sensors could detect or measure physical properties accurately
  - Extensive memory, computational power, speed and connectivity
  - Action through inanimate, strong, material movements without 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
  - Enable man to reach 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

Winston, ibid, pp.6-7

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

- 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

The Representation Principle

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

-Winston, ibid, p.18

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.

-Winston, ibid, p.18

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

Representing everything with ON & OFF

- 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:;<=>?
  @ABCDEFGHIJKLMNOPQRSTUVWXYZ
  [\]^_`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

AND

∧	**0**	**1**
0	0	0
1	0	1

OR

∨	**0**	**1**
0	0	1
1	1	1

NOT

a	**0**	**1**
¬a	1	0

ASCII Chart :::::::::::::::::::::::::::: Intelligence

ASCII Code	**Most Significant Bits [MSB]**							
LSB	**000**	**001**	**010**	**011**	**100**	**101**	**110**	**111**
0000	NUL,^@	DLE,^P	spc	0	@	P		p
0001	SOH,^A	DC1,^Q	!	1	A	Q	a	q
0010	STX,^B	DC2,^R	“	2	B	R	b	r
0011	ETX,^C	DC3,^S	#	3	C	S	c	s
0100	EOT,^D	DC4,^T	$	4	D	T	d	t
0101	ENQ,^E	NAK,^U	%	5	E	U	e	u
0110	ACK,^F	SYN,^V	&	6	F	V	f	v
0111	BEL,^G	ETB,^W		7	G	W	g	w
1000	BS,^H	CAN,^X	(	8	H	X	h	x
1001	HT,^I	EM,^Y	)	9	I	Y	i	y
1010	LF,^J	SUB,^Z	*	:	J	Z	j	z
1011	VT,^K	ESC,^[	+	;	K	[	k	{
1100	FF,^L	FS,^\	,	<	L	\	l	|
1101	CR,^M	GS,^[	-	=	M	]	m	}
1110	SO,^N	RS,^^	.	>	N	^	n	~
1111	SI,^O	US,^_	/	?	O	-	o	DEL

ASCII integers are converted to binary integers by flipping bits 5 & 4 to 0

Uppercase alphabetical characters are converted to lowercase by flipping bit 5 from 0 to 1

Uppercase characters are converted to the equivalent control characters by flipping bit 6 (msb) from 1 to 0

Church-Turing Thesis

- According to the Church–Turing thesis, a computer with a certain minimum threshold capability is in principle capable of performing the tasks of any other computer.
- A Turing machine has only a single data structure, a variable-length linear array called the tape. Each component of the tape contains just a single character.

- **....1000110100101100101110010101101001011110000....**
  .^. --->read/write/shift pointer

- Any computable function can be computed by a Turing machine
- It takes almost no machinery to achieve universality, other than some sort of unlimited storage capacity. Even an extremely simple set of data structures and operations are sufficient to allow any computable function to be expressed.
- Anything can be done in LISP, Python, PHP, C...
  The differences between programming languages is not quantitative but qualitative in how elegantly, easily, and effectively things can be done
- Computers with capabilities ranging from those of a personal digital assistant to a supercomputer may all perform the same tasks, as long as time and memory capacity are not considerations.
- The same computer designs may be adapted for tasks ranging from processing company payrolls to controlling unmanned spaceflights.

AI Proof?

- Humans and other life forms are endowed with natural computing abilities.
- If we admit the Church-Turing thesis, in theory, all our computing functions could be performed by a computer.
- But then, why is it that common sense reasoning is not yet possible and the AI problem is without a solution?
- How would a robot know how to deal with humans and others?
- Assimov's three laws of robotics or are too simplistic - Law is more detailed in describing such matters and the best judge of what is relevant and what is not.
- The computing field has not taken law seriously enough, and that has prevented the evolution of robust AI systems.
- Porting the rules relating to the legal system, language, computing, arithmetic, vision, and other fields of knowledge would give computers a chance to do common sense reasoning.

Law as a 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
- They resemble recipes, travel directions, maker's instructions, rules of games etc.
- Rules are of broad application and non-optional character
- Higher rules prevail over lower rules
- 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

-P.J. Fitzgerald, Salmond on Jurisprudence

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 ...

- 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 ... while

- 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

```
min  max effect
 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
- rwxrwxrwx give perms of ugo respectively
- 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
- **....10001101001011001011101000010001011010101101001011110000....**

  .^. .^. .^. .^. .^. .^. --->read/write/shift pointers

  _____|_____|_____|___|_____/ --->Index / plane of intelligence

- The plane of the mind
  - Automate index generation
  - Perform computations with procedures and proceedings
  - Automate creation of procedures
  - Artificial Intelligence is here to stay

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

- Solution: 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.

       -c, --bytes             print the byte counts

       -m, --chars             print the character counts

       -l, --lines             print the newline counts

       -L, --max-line-length   print the length of the longest line

       -w, --words             print the word counts

       --help                  display this help and exit

       --version               output version information and exit

Written by Paul Rubin and David MacKenzie.
```

steps and particulars for proc wc

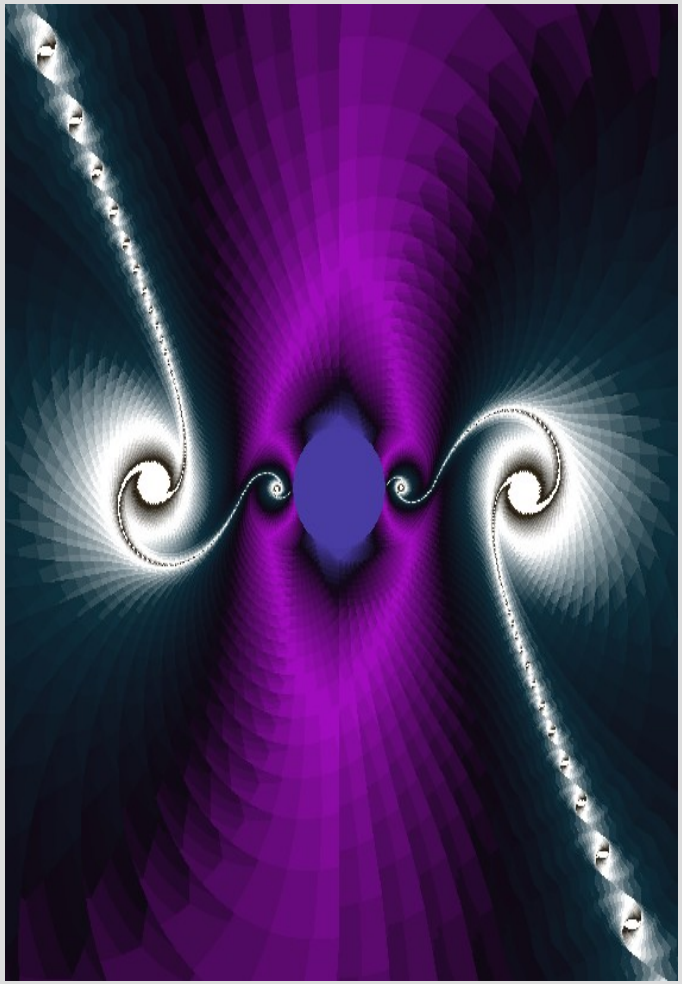
```
Procedure: wc

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

Commentary on “What is Biggest”?

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 serpant 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 !**

Facts about human vision

"The Emerging Mind" - Vilayanur Ramachandran, Reith Lectures 2003.

- You have two tiny, upside-down distorted images inside your eyeballs but what you see is a vivid three dimensional world out there in front of you.
- A common fallacy is to assume the optical image is transmitted by the optic nerve and displayed on a screen called visual cortex. If it is displayed on a screen in the brain, then you have to have someone else in there watching the image, and that someone needs someone else in his head, and so on adinfinitum.
- The first step we must take towards understanding perception is to forget the idea of images in the brain and think instead of transforms or symbolic representations of objects and events in the external world.
- We primates are highly visual creatures with not just one visual area the visual cortex, but thirty areas in the back of our brains which enable us to see the world.
- Perhaps each area is specialised for a different aspect of vision
  - V4 seems to be concerned mainly with processing color information
  - Middle temporal area is concerned with seeing motion
  - The message from the eyeball on the retina goes through the the optic nerve to two major visual centres of the brain
    - Old pathway goes to the brain stem – handles eyeball movement, etc
    - New pathway goes to the visual cortex – object recognition etc.

Machine vision

- 360 degrees field of view
  - How many cameras are required for this?
- Binocular or monocular vision
- Color detection
- Motion detection
  - Object identification by doing a diff on moving and static objects in the visual stream
- Low priority to display visually what is seen by the machine on a screen
  - Focus on computations based on input

References

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