NeuronRain is a new linux kernel fork-off from mainline kernel (presently overlayed on kernel 4.1.5 32 bit and kernel 4.13.3 64 bit) augmented with Machine Learning, Analytics, New system call primitives and Kernel Modules for cloud RPC, Memory and Filesystem. It differs from usual CloudOSes like OpenStack, VMs and containers in following ways:

(*) Mostly available CloudOSes are application layer deployment/provisioning (YAML etc.,) focussed while NeuronRain is not about deploying applications but to bring the cloud functionality into Linux kernel itself.

(*) There are application layer memcache softwares available for bigdata processing.

(*) There have been some opensource projects for linux kernel on GitHub to provide memcache functionality for kernelspace memory.

(*) NeuronRain VIRGO32 and VIRGO64 kernels have new system calls and kernel drivers for remote cloning a process, memcache kernel memory and remote file I/O with added advantage of reading analytics variables in kernel.

(*) Cloud RPCs, Cloud Kernel Memcache and Filesystems are implemented in Linux kernel with kernelspace sockets

(*) Linux kernel has access to Machine Learnt Analytics(in AsFer) with VIRGO linux kernel_analytics driver

(*) Assumes already encrypted data for traffic between kernels on different machines.

(*) Advantages of kernelspace Cloud implementation are: Remote Device Invocation (recently known as Internet of Things), Mobile device clouds, High performance etc.,.

(*) NeuronRain is not about VM/Containerization but VMs, CloudOSes and Containers can be optionally rewritten by invoking NeuronRain VIRGO systemcalls and drivers - thus NeuronRain Linux kernel is the bottommost layer beneath VMs, Containers, CloudOSes.

(*) Partially inspired by old Linux Kernel components - Remote Device Invocation and SunRPC

(*) VIRGO64 kernel based on 4.13.3 mainline kernel, which is 64 bit version of VIRGO32, has lot of stability/panic issues resolved which were random and frequent in VIRGO32 and has Kernel Transport Layer Security (KTLS) integrated into kernel tree.

NeuronRain - Repositories:

NeuronRain repositories are in:

(*) NeuronRain Research -

http://sourceforge.net/users/ka_shrinivaasan - astronomy datasets

(*) NeuronRain Green - https://github.com/shrinivaasanka - generic datasets

(*) NeuronRain Antariksh - https://gitlab.com/shrinivaasanka - Drone development

NeuronRain Documentation Repositories:

(*) https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs

(*) https://gitlab.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs

(*) https://sourceforge.net/u/userid-769929/Krishna_iResearch_DoxygenDocs/ci/master/tree/

NeuronRain Version:

Previously, each NeuronRain repository source in SourceForge, GitHub and GitLab was snapshotted periodically by a version number convention <year>.<month>.<day>. Because total number of repositories in NeuronRain spread across SourceForge, GitHub and GitLab is huge, release tagging each repository is arduous and therefore individual repository source tagging is hereinafter discontinued. Every NeuronRain source code release for SourceForge,GitHub and GitLab repositories henceforth would be notified in this documentation page and latest commit on the date of release (inferred from <year>#<month>#<day>) has to be construed as the latest source release. Latest NeuronRain Research, Green and Antariksh version is 2022#04#21.

NeuronRain - Features:

VIRGO system calls from include/linux/syscalls.h

```
asmlinkage long sys_virgo_clone(char* func, void *child_stack,
int flags, void *arg);

asmlinkage long sys_virgo_malloc(int size,unsigned long long
__user *vuid);
```

```
asmlinkage long sys_virgo_set(unsigned long long vuid, const char
__user *data_in);

asmlinkage long sys_virgo_get(unsigned long long vuid, char
__user *data_out);

asmlinkage long sys_virgo_free(unsigned long long vuid);

asmlinkage long sys_virgo_open(char* filepath);

asmlinkage long sys_virgo_read(long vfsdesc, char __user
*data_out, int size, int pos);

asmlinkage long sys_virgo_write(long vfsdesc, const char __user
*data_in, int size, int pos);

asmlinkage long sys_virgo_close(long vfsdesc);
```

VIRGO Kernel Modules in drivers/virgo

1. cpupooling virtualization - VIRGO_clone() system call and VIRGO cpupooling driver by which a remote procedure can be invoked in kernelspace.(port: 10000)

2. memorypooling virtualization - VIRGO_malloc(), VIRGO_get(), VIRGO_set(), VIRGO_free() system calls and VIRGO memorypooling driver by which kernel memory can be allocated in remote node, written to, read and freed - A kernelspace memcache-ing.(port: 30000)

3. filesystem virtualization - VIRGO_open(), VIRGO_read(), VIRGO_write(), VIRGO_close() system calls and VIRGO cloud filesystem driver by which file IO in remote node can be done in kernelspace.(port: 50000)

4. config - VIRGO config driver for configuration symbols export.

5. queueing - VIRGO Queuing driver kernel service for queuing incoming requests, handle them with workqueue and invoke KingCobra service routines in kernelspace. (port: 60000)

6. cloudsync - kernel module for synchronization primitives (Bakery algorithm etc.,) with exported symbols that can be used in other VIRGO cloud modules for critical section lock() and

unlock()

7. utils - utility driver that exports miscellaneous kernel functions that can be used across VIRGO Linux kernel

8. EventNet - eventnet kernel driver to vfs_read()/vfs_write() text files for EventNet vertex and edge messages (port: 20000)

9. Kernel_Analytics - kernel module that reads machine-learnt config key-value pairs set in /etc/virgo_kernel_analytics.conf (and from a remote cloud as stream of key-value pairs in VIRGO64). Any machine learning software can be used to get the key-value pairs for the config. This merges three facets - Machine Learning, Cloud Modules in VIRGO Linux-KingCobra-USBmd , Mainline Linux Kernel

10. SATURN program analysis wrapper driver.

11. KTLS config driver - for Kernel Transport Layer Security - only in VIRGO_KTLS branch of VIRGO64 repositories

Apart from aforementioned drivers, PXRC flight controller and UVC video drivers from kernel 5.1.4 have been changed to import kernel_analytics exported analytics variables and committed to VIRGO64.

Complete list of Features of NeuronRain (Research and Enterprise) are detailed in:
https://sites.google.com/site/kuja27/CV_of_SrinivasanKannan_alias_KaShrinivaasan_alias_ShrinivasKannan.pdf (Deleted and Mirrored at https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/CV_of_SrinivasanKannan_alias_KaShrinivaasan_alias_ShrinivasKannan.pdf)

Previous system calls and drivers do not have internal mutexes and synchronization is left to the userspace. Quoting Commit Notes from hash https://github.com/shrinivaasanka/virgo64-linux-github-code/commit/ad59cbb0bec23ced72109f8c5a63338d1fd84beb : "... Note on concurrency: Presently mutexing within system calls have been commented because in past linux versions mutexing within kernel was causing strange panic issues. As a design choice and feature-stability tradeoff (stability is more important than introducing additional code) mutexing has been lifted up to

userspace. It is upto the user applications invoking the system calls to synchronize multiple user threads invoking VIRGO64 system calls i.e VIRGO64 system calls are not re-entrant. This would allow just one kernel thread (mapped 1:1 to a user thread) to execute in kernel space. Mostly this is relevant only to kmemcache system calls which have global in-kernel-memory address translation tables and next_id variable. VIRGO clone/filesystem calls do not have global in-kernel-memory datastructures. ...". An example pthread mutex code doing VIRGO64 system calls invocation in 2 parallel concurrent processes within a critical section lock/unlock is at https://github.com/shrinivaasanka/virgo64-linux-github-code/blob/master/linux-kernel-extensions/virgo_malloc/test/test_virgo_malloc.c. Synchronization in userspace for system calls-drivers RPC is easier to analyze and modify user application code if there are concurrency issues than locking within kernelspace in system calls and drivers. This would also remove redundant double locking in userspace and kernelspace. Another advantage of doing synchronization in userspace is the flexibility in granularity of the critical section - User can decide when to lock and unlock access to a resource e.g permutations of malloc/set/get/free kmemcache primitive sequences can be synchronized as desired by an application.

NeuronRain - Architecture Diagrams:

.. image:: NeuronRainVIRGOArchitecture.jpg
https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/Krishna_iResearch_opensourceproducts_archdiagram.pdf
https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/NeuronRain_Architecture_Diagrams_29September2016.pdf

Products in NeuronRain Suite (Research,Green,Antariksh):

AsFer - AstroInfer was initially intended, as the name suggests, for pattern mining of Astronomical Datasets to predict natural weather disasters. It is focussed on mining patterns in texts and strings. It also has implementations of algorithms for analyzing merit of text, PAC learning, Polynomial reconstruction, List decoding, Factorization etc., which are later expansions of publications by the author (K.Srinivasan - http://dblp.dagstuhl.de/pers/hd/s/Shrinivaasan:Ka=) after 2012. Presently AsFer in SourceForge, GitHub and GitLab has implementations for prominently used machine learning algorithms.

USBmd - Wireless data traffic and USB analytics - analyzes internet traffic and USB URB data packets for patterns by AsFer machine learning (e.g FTrace, USBmon, Wireshark/Tcpdump PCAP, USBWWAN and kern.log Spark MapReduce) implementations and Graph theoretic algorithms on kernel function call graphs. It is also a module in VIRGO linux kernel.

VIRGO Linux Kernel - Linux kernel fork-off based on 4.1.5 (32 bit) and 4.13.3 (64 bit) has new system calls and drivers which abstract cloud RPC, kernel memcache and Filesystem. These system calls are kernelspace socket clients to kernelspace listeners modules for RPC,Kernelspace Memory Cacheing and Cloud Filesystems. These new system calls can be invoked by user applications written in languages other than C and C++ also (e.g. Python). Simply put VIRGO is a kernelspace cloud while present cloud OSes concentrate on userspace applications. Applications on VIRGO kernel are transparent to how cloud RPC works in kernel. This pushes down the application layer socket transport to the kernelspace and applications need not invoke any userspace cloud libraries e.g make REST http GET/POST requests by explicitly specifying hosts in URL. Most of the cloud webservice applications use REST for invoking a remote service and response is returned as JSON. This is no longer required in VIRGO linux kernel. Application code is just needed to invoke VIRGO system calls, and kernel internally loadbalances the requests to cloud nodes based on config files. VIRGO system call clients and driver listeners converse in TCP kernelspace sockets. Responses from remote nodes are presently plain texts and can be made as JSON responses optionally. Secure kernel socket families like AF_KTLS are available as separate linux forks. If AF_KTLS is in mainline, all socket families used in VIRGO kernel code can be changed to AF_KTLS from AF_INET and thus security is implicit. VIRGO cloud is defined by config files (virgo_client.conf and virgo_cloud.conf) containing comma separated list of IP addresses in constituent machines of the cloud abstracted from userspace. It also has a kernel_analytics module that reads periodically computed key-value pairs from AsFer and publishes as global symbols within kernel. Any kernel driver including network, I/O, display, paging, scheduler etc., can read these analytics variables and dynamically change kernel behaviour. Good example of userspace cloud library and RPC is gRPC - https://developers.googleblog.com/2015/02/introducing-grpc-new-open-source-http2.html which is a recent cloud RPC standard from Google. There have been debates on RPC versus REST in cloud community. REST is stateless protocol and on a request the server

copies its "state" to the remote client. RPC is a remote procedure invocation protocol relying on serialization of objects. Both REST and RPC are implemented on HTTP by industry standard products with some variations in syntaxes of the resource URL endpoints. VIRGO linux kernel does not care about how requests are done i.e REST or RPC but where the requests are done i.e in userspace or kernelspace and prefers kernelspace TCP request-response transport. In this context it differs from traditional REST and RPC based cloud - REST or RPC are userspace wrappers and both internally have to go through TCP, and VIRGO kernel optimizes this TCP bottleneck. Pushing down cloud transport primitives to kernel away from userspace should theoretically be faster because

(*) cloud transport is initiated lazy deep into kernel and not in userspace which saves serialization slowdown

(*) lot of wrapper application layer overheads like HTTP, HTTPS SSL handshakes are replaced by TCP transport layer security (assuming AF_KTLS sockets)

(*) disk I/O in VIRGO file system system-calls and driver is done in kernelspace closer to disk than userspace - userspace clouds often require file persistence

(*) repetitive system call invocations in userspace cloud libraries which cause frequent userspace-kernerspace switches are removed.

(*) best suited for interacting with remote devices than remote servers because direct kernelspace-kernelspace remote device communication is possible with no interleaved switches to userspace. This makes it ideal for IoT.

(*) VIRGO kernel memcache system-calls and driver facilitate abstraction of kernelspaces of all cloud nodes into single VIRGO kernel addresspace.

(*) VIRGO clone system-call and driver enable execution of a remote binary or a function in kernelspace i.e kernelspace RPC
An up-to-date description of how RPC ruled the roost, fell out of favour and reincarnated in latest cloud standards like Finagle/Thrift/gRPC is in
http://dist-prog-book.com/chapter/1/rpc.html - RPC is Not Dead: Rise, Fall and the Rise of Remote Procedure Calls. All these recent RPC advances are in userspace while VIRGO linux kernel abstracts RPC and loadbalancing within system calls itself requiring no user intervention (it is more than mere Remote Procedure Call - a lightweight Remote Resource System Call - a new paradigm in itself).

KingCobra - This is a VIRGO module and implements message

queueing and pub-sub model in kernelspace. This also has a userspace facet for computational economics (Pricing, Electronic money protocol buffer implementation etc.,)

Following are frequently updated design documents and theoretical commentaries for NeuronRain code commits which have been organized into
numbered non-linear section vertices and edges amongst them are mentioned by "related to <section>" phrase. NeuronRain Design is a unification of following repository specific documents (sections are numbered uniquely and spread out in multiple repository specific documents):

NeuronRain Green - GitHub - Repositories and Design Documents which include course material (repositories suffixed 64 are for 64-bit and others are 32-bit on different linux versions)

AsFer - https://github.com/shrinivaasanka/asfer-github-code/blob/master/asfer-docs/AstroInferDesign.txt

USBmd - https://github.com/shrinivaasanka/usb-md-github-code/blob/master/USBmd_notes.txt

USBmd64 - https://github.com/shrinivaasanka/usb-md64-github-code/blob/master/USBmd_notes.txt

VIRGO Linux - https://github.com/shrinivaasanka/virgo-linux-github-code/blob/master/virgo-docs/VirgoDesign.txt

VIRGO64 Linux - https://github.com/shrinivaasanka/virgo64-linux-github-code/blob/master/virgo-docs/VirgoDesign.txt

KingCobra - https://github.com/shrinivaasanka/kingcobra-github-code/blob/master/KingCobraDesignNotes.txt

KingCobra64 - https://github.com/shrinivaasanka/kingcobra64-github-code/blob/master/KingCobraDesignNotes.txt

GRAFIT - https://github.com/shrinivaasanka/Grafit/blob/master/README.md

Acadpdrafts - https://github.com/shrinivaasanka/acadpdrafts-github-code/blob/master/index.rst

Krishna_iResearch_DoxygenDocs - https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/index.rst

NeuronRain Antariksh - GitLab - Repositories and Design Documents which include course material (repositories suffixed 64 are for 64-bit and others are 32-bit on different linux versions)

AsFer - https://gitlab.com/shrinivaasanka/asfer-github-code/blob/master/asfer-docs/AstroInferDesign.txt

USBmd - https://gitlab.com/shrinivaasanka/usb-md-github-code/blob/master/USBmd_notes.txt

USBmd64 - https://gitlab.com/shrinivaasanka/usb-md64-github-code/blob/master/USBmd_notes.txt

VIRGO Linux - https://gitlab.com/shrinivaasanka/virgo-linux-github-code/blob/master/virgo-docs/VirgoDesign.txt

VIRGO64 Linux - https://gitlab.com/shrinivaasanka/virgo64-linux-github-code/blob/master/virgo-docs/VirgoDesign.txt

KingCobra - https://gitlab.com/shrinivaasanka/kingcobra-github-code/blob/master/KingCobraDesignNotes.txt

KingCobra64 - https://gitlab.com/shrinivaasanka/kingcobra64-github-code/blob/master/KingCobraDesignNotes.txt

GRAFIT - https://gitlab.com/shrinivaasanka/Grafit/-/blob/master/README.md

Acadpdrafts - https://gitlab.com/shrinivaasanka/acadpdrafts-github-code

Krishna_iResearch_DoxygenDocs - https://gitlab.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/-

/blob/master/index.rst

NeuronRain Research - Repositories and Design Documents which include course material (repositories suffixed 64 are for 64-bit and others are 32-bit on different linux versions)

AsFer - https://sourceforge.net/p/asfer/code/HEAD/tree/asfer-docs/AstroInferDesign.txt

USBmd - https://sourceforge.net/p/usb-md/code-0/HEAD/tree/USBmd_notes.txt

USBmd64 - https://sourceforge.net/p/usb-md64/code/ci/master/tree/USBmd_notes.txt

VIRGO Linux - https://sourceforge.net/p/virgo-linux/code-0/HEAD/tree/trunk/virgo-docs/VirgoDesign.txt

VIRGO64 Linux - https://sourceforge.net/p/virgo64-linux/code/ci/master/tree/virgo-docs/VirgoDesign.txt

KingCobra - https://sourceforge.net/p/kcobra/code-svn/HEAD/tree/KingCobraDesignNotes.txt

KingCobra64 - https://sourceforge.net/p/kcobra64/code/ci/master/tree/KingCobraDesignNotes.txt

GRAFIT - https://sourceforge.net/u/ka_shrinivaasan/Grafit/ci/master/tree/README.md

Acadpdrafts - https://sourceforge.net/projects/acadpdrafts/

Krishna_iResearch_DoxygenDocs - https://sourceforge.net/u/ka_shrinivaasan/Krishna_iResearch_DoxygenDocs/ci/master/tree/index.rst

NeuronRain Acadpdrafts - Drafts and Publications:

Academic Publications,Preprints and Draft publications of the Author are at portal https://acadpdrafts.readthedocs.io (which replaces erstwhile https://sites.google.com/site/kuja27) unifying :

(*) publications in https://scholar.google.co.in/citations?hl=en&user=eLZY7CIAAAAJ

(*) publication drafts in https://sites.google.com/site/kuja27/ (Deleted and Mirrored at https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/) and

(*) publication drafts in https://sourceforge.net/projects/acadpdrafts/files/

(*) Research Profiles - https://sites.google.com/site/kuja27/CV.pdf (Deleted and Mirrored at https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/CV.pdf)

Some Implementations in AsFer in GitLab, GitHub and Sourceforge are related to aforementioned publications and drafts

Free GRAFIT (portmanteau of Graph-Merit) course material:

Online free course material in:

(*) GitHub - https://github.com/shrinivaasanka/Grafit

(*) Sourceforge - https://sourceforge.net/u/userid-769929/Grafit/ci/master/tree/

(*) GitLab - https://gitlab.com/shrinivaasanka/Grafit

also refer to implementations in previous NeuronRain GitHub, GitLab and Sourceforge repositories and implement some additional example analytics - Advertisement Analytics by PageRank and Collaborative Filtering, PrefixSpan Astronomical Analytics of Celestial bodies, FPGrowth frequent itemset analytics, Set Partition Rank etc.,. Some of NeuronRain Sourceforge, GitHub and GitLab code commits and course material link to https://kuja27.blogspot.in which is meant for additional NeuronRain theory, expository graphics and large MP4 audio-visuals related to NeuronRain code commits in GitHub-GitLab-SourceForge repositories.

(*) GitHub Virtual Classroom for GRAFIT - https://classroom.github.com/classrooms/8086998-https-github-com-

shrinivaasanka-grafit
(*) GRAFIT course material in Moodle - https://moodle.org/pluginfile.php/4765687/user/private/Grafit-master.zip?forcedownload=1

BRIHASPATHI - Private Virtual Classrooms and JAIMINI Closed Source Private Repositories:

GitHub - Private repositories of virtual classrooms for various commercial online courses (BigData, Machine Learning, Topics in Mathematics and Computer Science,t which resembles Chaotic Verhulste logistic X(n+1) = Lambda*Xn*(1-Xn). References: (*) Numeric Weather Prediction - https://rams.atmos.colostate.edu/at540/fall03/fall03Pt7.pdf (*) Equation 1 and Section 3.1 on exceptional ocean waves - "Fluid mechanics and thermodynamics of tropical cyclones" - https://www.math.nyu.edu/caos_teaching/hurricanes/LighthillFMTC98.pdf. Similar explanation holds for Mars-Earth et al system too. There is an empirical evidence of Jupiter-Venus 2-body system affecting climate on Earth in a cycle of 405000 years - Empirical evidence for stability of the 405-kiloyear Jupiter 2011 - Decidability of Complementation - http://arxiv.org/abs/1106.4102 2010 - NIST TAC 2010 version of Algorithms for Intrinsic Merit - http://www.nist.gov/tac/publications/2010/participant.papers/CMI_IIT.proceedings.pdf

Important Cautionary Legal Disclaimer: All other theory drafts (excluding earlier publications) in NeuronRain design documents and http://sites.google.com/site/kuja27 (Deleted and Mirrored at https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/ - Linked by new expanded portal https://acadpdrafts.readthedocs.io) including theorem-proofs thereof are non-peer-reviewed, private, unvetted and unaffiliated research of the author (K.Srinivasan - https://sites.google.com/site/kuja27/ - Deleted and Mirrored at https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/ - Linked by new expanded portal https://acadpdrafts.readthedocs.io) aligned to features of NeuronRain codebases and as well significant expansions of previous publications (Refer to "NeuronRain Licensing" section of FAQ). Author is an independent professional and because of certain speculations and confusions about its monetization-commercialization by an anonymous entity and conflicts-violations brought to notice, it is hereby clarified that

NeuronRain codebases, architecture and development are private, independent, non-commercial, academic research and charity initiatives of author subject to NeuronRain licensing terms (GPL 3.0 and CC 4.0) and have nothing to do with any of the organizations and academic institutions (government or private) author may or may not have worked/affiliated with in the past including but not limited to any commercial derived clones of NeuronRain that might be in circulation by aforementioned entity with which author has no business relationship - author contributes to NeuronRain codebases as a noble charity gesture motivated towards academic enlightenment without monetary or royalty benefit from any external funding source. Cloning NeuronRain for production-commercial deployments is cautioned against because of certain known technical issues (mostly with respect to fragile low level linux kernelspace RPC) though academic usage is encouraged. Author has no involvement in any alleged commercialization of NeuronRain fork-off by aforementioned anonymous entity and bears no responsibility for misgivings caused - NeuronRain is not for sale and would remain as academic charity forever, safeguarding sanctity and spirit of FOSS though design and code of NeuronRain is being derived, cloned or extended by author within BRIHASPATHI organization (JAIMINI closedsource repositories in GitHub,GitLab and SourceForge) and used as textbook reference for BRIHASPATHI commercial online classrooms and repositories (reference: BRIHASPATHI print media advertisement - THE HINDU - 20 March 2022). Neuro Protocol Buffer Perfect Forward (Cloud Object Move) Cryptocurrency implemented in NeuronRain is only an academic research effort for modelling money changing problem and optimal denomination, economic networks, transaction hyperledgering and money trail. Neuro is a fictitious cryptocurrency and not a legal tender and cannot be used as a commercial denomination. Academic use of Neuro is subject to government regulations and statute.

Is there a central theme connecting the publications, drafts and their implementations mentioned previously?

---
781. (THEORY and FEATURE) Social Choice, Complexity and Learning theoretic motivations for Intrinsic Merit - this section is an extended unifying draft of theory and feature in AstroInfer,USBmd,VIRGO,KingCobra,GRAFIT,Acadpdrafts,Krishna_iResearch_DoxygenDocs
---

Yes. All these drafts revolve around the fundamental philosophical/mathematical question - Which choice is better? Group Social Choice by Majority or Any Choice function other than Majority? Is it possible to determine merit intrinsically unpolluted by mass opinions? This problem has been studied for centuries e.g Condorcet Jury Theorem. Drafts and publications above are efforts in this direction translating this question to problems requiring measurement of merit and ranking of text etc., in World Wide Web and Human Social Networks. These drafts bridge the usual chasm between Theoretical Computer Science and Engineering side of it like Machine Learning by concepts drawn from Boolean social choice, Pseudorandomness, Boolean Satisfiability, Learning theory etc.,. Notion of Complementing a Function has origins in computability theory (Hilbert's tenth problem, Solutions to Diophantine Equations, MRDP theorem etc.,) and closely relates to Ramsey Theory of Coloring sequences of real/integer lines. Complementation of a function is also another facet of social choice e.g Complement of a social choice function - "Who voted in favour" is a complement of a social choice function - "Who did not vote in favour". In complexity parlance, complementation is reminiscent of the definition of C and Co-C complexity classes for some class C. Integer partition and Locality Sensitive Hashing are theoretical gadgets for a multipartisan voting - votes are partitioned among candidates and each candidate has similar voters chained in an LSH bucket together. LSH Hash function of 2 buckets is nothing but the boolean majority function in tabulation and each bucket has a generating function which are mutually complement functions. Complement Functions are special subsets of Diophantine Equations in which two complementary sets (or sets in an exact cover) are defined by Diophantine Equations. Integer Factorization is also a diophantine problem e.g. Brahmagupta's Chakravala and Solutions to Pell Equation etc., Integer Factorization is a peripheral requirement for integer partitioning - each number can be partitioned in as many ways as sum of products of frequencies of partition and size of partition - defined by coefficients in partition generating function. Space filling/Circle filling algorithms are packing constraint satisfaction problems which can be social choice functions too (each packing problem is an objective function of a voter maximized by a candidate). Complement Functions can be generalized to Diophantine Equations for sets in exact cover and are thus special subproblems of Space filling/Packing/Tiling problems (e.g Pentominoes tiling exact

cover of plane). These drafts describe a parallel PRG cellular automaton algorithm for space filling. Last but not the least, Complement Function generalizes the well-known patterns in primes problem (which is related to real part of non-trivial zeros of Riemann Zeta Function) - a function complementing integer factorization implies pattern in primes. Prime-Composite complementation is also related to Jones-Sato-Wada-Wiens Theorem - http://www.math.ualberta.ca/~wiens/home%20page/pubs/diophantine.pdf - set of primes is exactly the set of values of a polynomial in 25 degree - 26 variables - because primes are recursively enumerable Diophantine set. Pattern in primes is also a problem related to energy levels of Erbium nuclei - Freeman Dyson and Montgomery statistics - http://seedmagazine.com/content/article/prime_numbers_get_hitched/ . Intrinsic merit versus perceived merit dichotomy has immense complexity theoretic ramifications which are analyzed in the drafts which have to be read with the caveat: equating majority and non-majority social choices subsume all classes of complexity zoo under equal goodness (in the context of Condorcet Jury Theorem Group Decision vis-a-vis a non-conventional social choice) and completeness assumptions. Intrinsic merit is about objectively determining value of an entity (text, academic papers, audio-visuals and humans too) whereas Condorcet Jury Theorem and its later enhancements are about correctness of subjective Majority Voting Decision. Notion of Intrinsic Merit already has been widely studied in the name of Intrinsic Fitness of a vertex in Social Networks (ability to attract links) - e.g Bianconi-Barabasi Network Bose-Einstein Fitness and its later derivative papers. Previous publications till 2010 devote only to intrinsic merit of text documents and later draft expansions after 2011 generalize it to merit of any(text, audio, visuals, people). Most of the literature assumes a probability distribution of fitness/merit and not finding it. These drafts are efforts in this direction to pinpoint how to quantize intrinsic fitness/merit. Obviously defining intrinsic merit is a difficult problem, but there are precedents to solving it e.g individual social merit is measured by examinations/question-answering/contests etc., not much by voting. Both these problems reduce to satisfying a boolean formula (e.g 3SAT) of arbitrary complexity class because "judging" implies extent of constraints satisfied e.g Voters have varied 3CNFs to rank a candidate making it subjective while Intrinsic merit requires an absolute 3CNF. Finding an absolute CNF is the leitmotif of all Intrinsic Merit algorithms

implemented in NeuronRain - this is computational learning theory problem viz.,PAC Learning, MB Learning etc., All Deep Learning algorithms including BackPropagation, Convolution, Recurrent Neural Networks etc., learn from errors and iteratively minimize. Neural networks are theoretically equivalent to threshold AC=NC=TC circuits. Learning theory goes beyond just constructing formulas and places limits on what is efficiently learnable. Merit computed by these can be translated to variables in a CNF. NeuronRain implements a Least Square Approximate MaxSAT solver to rank the targets by the percentage of clauses satisfied.

---

864. (THEORY and FEATURE) Conceptual Graph of Theory aligned to Features of NeuronRain

---

1. Intrinsic Merit is a Non-majority Social Choice Function and quantifies merit of text, audio/music, visuals, people and economies. Intrinsic merit is omnipresent - wherever rankings are required intrinsic merit finds place vis-a-vis perceptive/fame rankings. Intrinsic merit is defined as any good, incorruptible, error-resilient mathematical function for quantifying merit of an entity which does not depend on popular perception and majority voting where goodness has wider interpretations - sensitivity, block sensitivity, noise sensiivity/stability, randomized decision tree evaluation being one of them but not limited to in boolean setting and BKS conjecture implies there is a stabler function than majority (example: examinations,interviews and contests are objective threshold functions for evaluating people which do not involve subjective voting; counterexample: stock market indices though mathematically derived are not intrinsic since they are computed from perceptive human valuations of market, but high frequency algorithmic trading platforms and quantitative finance algorithms might find equilibrium pricing solutions between perception and absolute). An alternative measure of merit is "Originality" of an entity which distinguishes from rest. Following classes of merit have been defined in the drafts and most of them are implemented(excluding dependencies):

1.1 Alphanumeric Text(WordNet, ConceptNet, compressed sensing and vowelless string complexity, text restoration, Numeric compression by unique integer factorization, syllabification and TeX hyphenation, language independent phonetic syllable vector embedding of strings - String tensors, recursive

gloss overlap,recursive lambda function growth, Question-Answering, Coh-Metrix, Berlekamp-Welch error correction, Polynomial text encoding, Named Entity Recognition, Sentiment Analysis, Graph Mining, Graph Edit Distance between Text graphs, Locality Sensitive Hashing, Unsorted search, Set Partition Analytics, FP Growth frequent itemset mining, Machine translation, Originality by Word2Vec embedding,Bibliometrics-merit of academic publications by Meaning Representation in first order logic and Beta reduction of Lambda calculus,Novelty detection and Patent search,Multilingual strings-code switching),

1.2 Alphanumeric Text(String Analytics - Longest Repeated Substring-SuffixArray-LongestCommonPrefix, BioPython/ClustalOmega Multiple Sequence Alignment, Sequence Mining, Minimum Description Length, Entropy, Support Vector Machines, Knuth-Morris-Pratt string match, Needleman-Wunsch alignment, Longest common substring, KNN clustering, KMeans clustering, Decision Tree, Bayes, Edit Distance, Earth Mover Distance, Linear Complexity Relaxed Word Mover Distance, PrefixSpan - astronomical,binary,numeric and generic encoded string datasets - astronomical datasets are encoded strings of celestial bodies obtained from ephemeris corresponding to various extreme weather events),

1.3 Audio-speech(Speech-to-Text and recursive lambda function growth,Graph Edit Distance),

1.4 Audio-music(Music Information Retrieval-MIR, mel frequency cepstral coefficients, Learning weighted automata from music notes waveform, Graph Edit Distance between weighted automata, Equivalence of Weighted automata by Table filling, Kullback-Leibler and Jensen-Shannon divergence, Novelty detection and Originality of a score by waveform distance, AI music synthesis by functions-automata-fractals, Dynamic Time Warping distance similarity between music timeseries, Music synthesis from sum of damped sinusoids, Contours of Functional MRI medical imageing for music stimuli - https://openneuro.org/datasets/ds000171/versions/00001) - AI Music Synthesizer from mathematical functions is the converse of Learning weighted automata from music notes wherein innate fractal self-similar structure of music is exploited by machine learning to churn out music - JS Bach + Fractals = New Music - https://www.nytimes.com/1991/04/16/science/j-s-bach-fractals-new-music.html, https://link.springer.com/chapter/10.1007/978-3-642-78097-4_3. Learning a polynomial from music waveform as against weighted automaton learning (graph structure of music) could extract algebraic structure of music - NeuronRain implements a Degree 5 (Quintic) polynomial learner for music waveforms -

Unsolvability of Quintic polynomial (Degree >= 5) by Abel-Ruffini Theorem intuitively means roots of polynomial learnt from music waveform could not be expressed as formulae on radicals - tough nut to crack and could be irreducible. Earth Mover Distance Triple Sequence from moves of Towers of Hanoi Single Bin Sorted LIFO histogram exhibits a Collatz-like Chaotic structure suitable for Music and Financial Timeseries modelling ending always in (0,0,0) for 3 buckets.

1.5 Visuals-images(Compressed Sensing,ImageNet ImageGraph algorithm, Graph Edit Distance between FaceGraphs of segmented images, GIS Remote Sensing Analytics, Weather analytics, Climate analytics, Clustering Analytics of celestial bodies in sky imagery from planetarium software and their correlation to extreme weather events - visual analogue of textual astronomical datasets, Modularity-Community Detection, Urban planning analytics (Dynamic Facegraph, Cellular Automata and Polya Urn Urban Growth Models), Machine Learning models of Urban Extent-NASA SEDAC GPW,Facebook HRSL,European Union GHSL and NASA VIIRS NightLights, Voronoi Tessellation, Delaunay Triangulation, GMSH Trimesh-Quadmesh, Preferential attachment, Face and Handwriting Recognition, Neural network clustering, DBSCAN Clustering, Medical imageing, Convex Hull, Patches Extraction-RGB and 2-D, Segmentation, Random forests, Drone Aerial Imagery Analytics) - GDP and other socioeconomic indicators can be estimated from GIS Imagery analytics,

1.6 Visuals-videos(ImageNet VideoGraph EventNet Tensor products algorithm for measuring Tensor Rank connectivity merits of movies,youtube videos and Large Scale Visuals, Graph Edit Distance between Video EventNet, Sentiment analysis of predictions textgraphs for youtube and movie videos by Empath-MarkovRandomFields Recursive Gloss Overlap Belief Propagation-SentiWordNet, Topological Sort for video summary, Digital watermarking, Drone Aerial Video Streaming Analytics, GIS Imagery Contour graphs for A-Star motion planning and Road Geometry Airspace Drone obstacle avoidance),

1.7 People(Social and Professional Networks) - experiential and intrinsic(recursive mistake correction tree, Question-Answering in Interviews/Examinations/Contests),

1.8 People(Social and Professional Networks) - lognormal least energy(inverse lognormal sum of education-wealth-valour,Sports Analytics-Intrinsic Performance Ratings-IPR e.g Elo ratings,Real Plus Minus, Non-perceptive Rankings in Sports, Wealth, Research and Academics),

1.9 People(Professional Networks)-analytics(attritions, tenure histogram set partitions - correlations, set partition

analytics, analytics driven automatic recruitment of talent - an alternative to manual Interviews, Career transition score, Career Polynomials and Inner Product Spaces, Chaotic Hidden Markov Model and Weighted automata model of Tenures, Originality of a profile measured by tenure choices-equivalence of state transition automata, Novelty detection-Innovation-Patents, Fibonaccian Search of sorted unique id(s)),

1.10 People-election analytics(Boyer-Moore Streaming majority, set partition EVMs, drone electronic voting machine by autonomous delivery, voting analytics, efficient population count, pre-poll and post-poll forecast analytics, Bertrand ballot theorem, Arrow and Gibbard-Satterthwaite No-Go Theorems on Impossibilty of Fair Voting satisfying criteria for 3 or more candidates),

1.11 People(Social and Professional Networks)-unique person search (similar name clustering by phonetic syllable vectorspace embedding of names - String Tensors, People profiles as Tensors, Graph Edit Distance, contextual name parsing, unique person identification from multiple datasources viz.,LinkedIn,Twitter,Facebook,PIPL.com,Emails)

1.12 People(Social and Professional Networks,Archaeology-Civilizations)-face and handwriting recognition (textual,topological and graph theoretic handwriting and face recognition-physique recognition-gender recognition for unique identification, Decipherment of ancient scripts by Rebus principle topological script recognition - Homeomorphism/Product Homotopy/Pasting Lemma/Graph Edit Distance and Earth mover distance/Gromov-Hausdorff distance/Multiple Netrd Graph distances/Graph matching/Exact-Approximate Graph and Subgraph Isomorphisms/Trimesh-Quadmesh/Bezier-animated Mesh Deformations/Dynamic Time Warping/Common Subgraph Problem/Approximate Topological Matching between Dlib face landmark detected and segmented Image Voronoi tessellation FaceGraphs,Delaunay Triangulation graphs and Quadrilateral Mesh Graphs/Euler Characteristic of 2D and 3D Voronoi tessellations),Sentiment Analysis based Reciprocal Recommender Systems for Bipartite Social Network Graphs - Matrimonial and other Match making Services,Gale-Shapley Stable Marriage Problem,Hall's Marriage Theorem, Physique recognition by Dynamic Time Warping Timeseries similarity of trimesh-quadmesh sequences of full body video footages - claimed to be more accurate than face recognition. Decipherment of ancient writing systems is a harder problem of handwriting recognition where no prior training data are available for an AI model to decipher an unknown inscription on potsherds-painted_gray_ware into natural language

and Rebus principle is often resorted to e.g Asko Parpola's Rebus decipherment of Indus script - four conditions for Rebus principle - https://www.harappa.com/content/indus-script-6 - [Iravatam Mahadevan] - The Indus Script: Texts, Concordance and Tables - https://www.harappa.com/content/indus-script-texts-concordance-and-tables. Rebus principle topological script recognition from textgraph of ImageNet predictions of inscription imagery could extract deeplearnt meanings of individual script pictograms graph theoretically and serve as a validation of a decipherment - For example following fictitious undeciphered inscriptions:

Inscription1 - ABCD - ImageNet prediction Textgraph1

Inscription2 - BFGH - ImageNet prediction Textgraph2

Inscription3 - KBPQ - ImageNet prediction Textgraph3

isolate the meanings of common pictogram B in two ways by set intersection of 1) Textgraph1-Textgraph2 (extracts textgraphX for B) and 2) Textgraph2-Textgraph3 (extracts textgraphY for B) - For a valid Rebus decipherment textgraphX and textgraphY for pictogram B must concur or be highly isomorphic (based on natural language assumption that any word or letter is used recurrently with almost same meaning throughout - for instance, multiple occurrences of word "Elephant" in an English text have same meaning) - any high deviation is a false decipherment.

1.13 Economic merit(Financial Fraud Analytics, Quantitative Finance, Stock Market Tickers ARMA-ARIMA timeseries analysis, Economic Networks, Dynamic Time Warping similarity of financial timeseries - similarity of timeseries implies an indirect causality, Graph Edit Distance between economic networks, Poverty alleviation Linear Program, Neuro Cryptocurrency Proof-of-Work Hardness, Colored Money as Flow Conservation Problem, Production Networks-Supply Chain, Human Development Index, Gross Domestic Product, Purchasing Manager Index, Social Progress Index,Intrinsic Pricing Vs Demand-Supply Market Equilibrium, Quantitative Majority circuit, Bargaining problem, Product Recommendations-Collaborative Filtering-ALS, Brand loyalty switch graph, media analytics, Granger causality, Graphical Event Models-Graphical Causal Models - advertisement analytics, business analytics, logistic regression and Gravity model in economic networks for predicting trade between nations based on GDP as fitness measure, Software Valuations) - Demand-Supply pricing and Auction Design for commodity are majority driven while Theory of Value (Labor Theory of Value by Adam Smith and Ricardo and Scarcity Theory of Value - https://www.researchgate.net/publication/302454600_Samuelson_and_the_93_Scarcity_Theory_of_Value/link/5cbb1e2c92851c8d22f822d2/

download) is an example of intrinsic economic merit. Cryptocurrency mining rigs award currencies by Proof of Work proportional to hardness (which could be a function of labour necessary to produce a commodity from scratch) of computation performed and hence reinstate the glory of Labour Theory of Value in new avatar. An example derivation of intrinsic pricing for two factors labour and land from Samuelson–Stolper theorem – https://en.wikipedia.org/wiki/Stolper%E2%80%93Samuelson_theorem – Price of Cloth and Wheat in two-good economy. GDP can be estimated by linear or logistic regression on various independent variables sourced from GIS imagery analytics (e.g Electricity consumption from NASA VIIRS NightLights)

1.14 Streaming Analytics for different types of streaming datasources – Spark streaming, many NoSQL DBs and other backends – text, audio, video, people, numeric, frequent subgraphs, A-star graph best first search for Drone motion planning, histograms for music spectrograms–set partitions–business intelligence, OS scheduler runqueue etc., – by standard streaming algorithms (LogLog counter, HyperLogLog counter, Bloom Filter, CountMinSketch, Boyer–Moore majority, CountMeanMinSketch, Approximate counting, Distinct Elements)

1.15 Deep Learning Analytics for different types of datasources – text, PSUtils OS Scheduler analytics – ThoughtNet Reinforcement Learning, Recommender Systems, LSTM/GRU Recurrent Neural Networks, Convolution Networks, BackPropagation

1.16 Computational Learning Theory Analytics – Complement Diophantines Learning, PAC Learning from numeric and binary encoded datasets

1.17 Time Series Analysis for different types of datasources – Leaky Bucket, ARMA and ARIMA, miscellaneous statistics functions based on R and PythonR (Economic merit – Poverty alleviation example by timeseries correlation of poverty and financial deepening – https://www.researchgate.net/publication/287580802_Financial_development_and_poverty_alleviation_Time_series_evidence_from_Pakistan, Granger causality)

1.18 Fame–Merit Equilibrium(any Semantic Network) – applies to all previous merit measures and how they relate to perceptions. In the absence of 100% good intrinsic merit function, it is often infeasible to ascertain merit exactly. But Market Equilibrium Pricing in algorithmic economics solves this problem approximately by finding an equilibrium point between intrinsic and perceived price of a commodity. Similar Intrinsic(Merit) Versus Perceived(Fame) equilibria can be defined for every class of merit above and solution is only approximate.

[Conjecture: Fame-Merit equilibrium and Converging Markov Random Walk (PageRank) rankings should coincide - Both are two facets of mistake-minimizing Nash equilibrium per Condorcet Jury Theorem for infinite jury though algorithmically different - former is a convex program and latter is a markov chain. Convex Optimization has been shown to be solved by Random Walks - https://www.mit.edu/~dbertsim/papers/Optimization/Solving%20Convex%20Programs%20by%20Random%20Walks.pdf]

2. Complement Functions are subset of Diophantine Equations (e.g Beatty functions). Polynomial Reconstruction Problem/List decoding/Interpolation which retrieve a polynomial (exact or approximate) for set of message points is indeed a Diophantine Representation/Diophantine Approximation problem for the complementary sets (e.g. approximating Real Pi by Rational Continued Fractions). Undecidability of Complement Diophantine Representation follows from MRDP theorem and Post's Correspondence Problem. Prime-Composite complementation is a special diophantine problem of finding patterns in primes which relies on non-trivial zeroes of Riemann Zeta Function (Riemann Hypothesis). ABC Conjecture can be rephrased as a complementation problem. Riemann Hypothesis has Diophantine representation by Davis-Matiyasevich-Robinson Theorem.

3. Factorization has a Diophantine Representation (Brahmagupta's Chakravala and Pell Equation: $x^2 - y^2 = N = (x+y)(x-y)$)

4. Tiling/Filling/Packing is a generalization of Complement Functions (Exact Cover).

5. Majority Function has a Tabulation Hashing definition (e.g Electronic Voting Machines) i.e Hash table of candidates as keys and votes per candidate as chained buckets

6. Integer Partitions and Tabulation Hashing are isomorphic e.g partition of an integer 21 as 5+2+3+4+5+2 and Hash table of 21 values partitioned by keys on bucket chains of sizes 5,2,3,4,5,2 are bijective. Both Set Partitons and Hash tables are exact covers quantified by Bell Numbers/Stirling Numbers. Partitions/Hashing is a special case of Multiple Agent Resource Allocation problem. Thus hash tables and partitions create complementary sets defined by Diophantine equations. Pareto Efficient resource allocation by Multi Agent Graph Coloring - coloring partition of vertices of a graph - finds importance in GIS and Urban Sprawl analytics, Resource Scheduling in Operating Systems (allocating processors to processes), Resource allocation in People Analytics (allocating scarce resources - jobs, education - to people) by a Social welfare function e.g Envy-Free, Pareto efficient Multi Agent Graph Fair Coloring of Social

Networks to identify communities, allocate resources to communities of social networks in proportion to size of each community.

7. Ramsey Coloring and Complementation are equivalent. Ramsey coloring and Complement Diophantines can quantify intrinsic merit of texts.

8. Graph representation of Texts and Lambda Function Composition are Formal Language and Algorithmic Graph Theory Models e.g parenthesization of a sentence creates a Lambda Function Composition Tree of Part-of-Speech.

9. Majority Function - Voter SAT is a Boolean Function Composition Problem and is related to an open problem - KRW conjecture - and hardness of this composition is related to another open problem - P Vs NP and Knot Theory. Theoretical Electronic Voting Machine (which is a LSH/set partition for multipartisan election) for two candidates is the familiar Boolean Majority Circuit whose leaves are the binary voters (and their VoterSATs in Majority+VoterSAT circuit composition). Pseudorandom shuffle of leaves of Boolean majority circuit simulates paper ballot which elides chronology. Pseudodrandomly shuffled Electorate Leaves of the Boolean Majority Circuit are thus Ramsey 2-colored (e.g Red-Candidate0, Blue-Candidate1) by the candidate indices voted for. Pseudorandom shuffle and Ramsey coloring are at loggerheads - arithmetic progression order arises in pseudorandomly shuffled bichromatic electorate disorder and voters of same candidate are equally spaced out which facilitates approximate inference of voting pattern. Hardness of inversion in the context of boolean majority is tantamount to difficulty in unravelling the voters who voted in favour of a candidate - voters_for(candidate) - pseudorandom shuffle of leaves of boolean majority circuit must minimize arithmetic progressions emergence which amplifies hardness of the function voters_for(candidate).

10. Majority Versus Non-Majority Social Choice comparison arises from Condorcet Jury Theorem (recent proof of Condorcet Jury Theorem in the context of Strength of Weak Learnability - Majority Voting in Learning theory - AdaBoost Ensemble Classifier - https://arxiv.org/pdf/2002.03153.pdf) and Margulis-Russo Threshold phenomenon in Boolean Social Choice i.e how individual decision correctness affects group decision correctness. Equating the two social choices has enormous implications for Complexity theory because all complexity classes are subsumed by Majority-VoterSAT boolean function composition. Depth-2 majority (Majority+Majority composition) social choice function - boolean and non-boolean - is an instance of Axiom of Choice (AOC) stated as "for any collection of nonempty sets X, there exists a

function f such that f(A) is in A, for all A in X". Depth-2 majority (both boolean and non-boolean voters set-partition induced by candidate voted for), which is the conventional democracy, chooses one element per constituency electorate set A of set of constituencies X in the leaves, at Depth-1.

11. Intrinsic Merit Ranking can be defined as a MAXSAT problem. Random matrix based LSMR/LSQR SAT solver approximately solves MAXSAT in polynomial time on an average. Ranking of texts based on distance similarity is also a problem solved by collision-supportive Locality Sensitive Hashing - similar texts are clustered in a bucket chain.

12. Question-Answering/Interview Intrinsic Merit is a QBFSAT problem. Question-Answering is also a Linear or Polynomial Threshold Function in Learning theory perspective

13. Pseudorandom Choice is a Non-Majority Social Choice Function

14. Voter SAT can be of any complexity class - 3SAT, QBFSAT etc.,

15. Space Filling by circles is a vast area of research - Circle Packing. Parallel Circle Packing unifies three fields - Parallel Pseudorandom Generators (classical or quantum PRGs - ordinates on 2-D plane are generated in parallel and at random which is underneath most natural processes - including but not limited to Rain, Teapot Shards, Agriculture), 0-1 Integer Linear Programming and Circle Packing. Efficient parallel circle packing has computational geometric importance - geometric search where each circle is a query which might contain expected point - planar point location. Random Close Packing and Circle Packing are Constraint Satisfaction/SAT Problems. Polynomial packing which generalizes circle packing to arbitrary closed curves sparsely or closely packed on a surface finds applications in GIS analytics of Urban sprawl contour polynomials embedded on a space forming a finite multiply connected region - https://www.sciencedirect.com/topics/engineering/simply-connected-region. Closely packed Urban sprawl contour polynomials can be approximated by Voronoi diagram tessellation polygons (follows from Jordan curve theorem and Weirstrass theorem for approximation of a function by polynomials)

16. Intrinsic Merit is the equivalent of Intrinsic Fitness in Social Networks and Experiential learning is defined in terms of intrinsic merit and mistake bound learning. Recursive Lambda Function Growth Algorithm for creating lambda function composition trees from random walks of Definition Graphs of Text simulates Human Brain Connectomes. High Expander Definition Graphs are intrinsically better connected and meritorious because

average links incident per vertex or sets of vertices is high from definition of Expander Graphs. This parallels Bose-Einstein Condensation in Networks in which least energy nodes attract most links. An algorithm for EventNet and ImageNet Graph based Intrinsic Merit for Large Scale Visuals and Audio has been described in AstroInfer Design Documents (EventNet Tensor Products Algorithm) and has been implemented in AstroInfer for the hardest Video Merit - Large Scale Visual Recognition Challenge (LSVR). Images can be ranked by Exact-Approximate Graph-Subgraph isomorphism percentage of their Voronoi facegraphs thus implementing an intrinsic merit image search engine.

17. Intrinsic Merit versus Perceived Merit and Non-Majority Versus Majority Social Choice are equivalent - Absolute Versus Subjective - and can be defined in terms of Mechanism Design/Flow Market Equilibrium in Algorithmic Economics. In Social Networks this is well-studied Fame Versus Merit Problem. Intrinsic Merit in the context of economies pertains to affixing value to commodities - the old school of labour theory of value (LTV) does not depend on perception in deciding value but only on labour involved in making a commodity while Demand-Supply pricing is a perception on the contrary: Demand or Fame for a commodity in effect is the result of perceived majority desire for a commodity - a majority voting for it. Market Equilibria (Eisenberg-Gale, Fisher et al) which are the basis for Fame-Merit equilibrium assume equal demand and supply. Condorcet Jury Theorem which bounds correctness of majority decision and its later variants thus find importance in economics because CJT implies Nash equilibrium - or in other words labour theory of value might coincide with demand-supply curve as jurors (consumers constituting demand) minimize their mistakes and market corrections happen.

18. Money Changing Problem/Coin Problem/Combinatorial Schur Theorem for Partitions and Tabulation Hashing are equivalent i.e expressing an integer as a linear combination of products, which defines distribution of buckets in a hash table.

19. ThoughtNet/EventNet are theoretical reinforcement learning simulations of Cognitive Evocation, Cause-Effect ordering and events involving actors in Clouds. ThoughtNet is a (contextual multiarmed bandit and hypervertex intersection) Hypergraph which evokes thought/knowledge of maximum potential. Potential of thoughts/knowledge in Hypergraph is proportional to their intrinsic merit. Name ThoughtNet is a misnomer because it focuses only on evocation and doesn't exactly reflect human thought in its fullest power which is a far more complicated, less-understood open problem. Name ThoughtNet was chosen to

differentiate between another evocation framework - Evocation WordNet (https://wordnet.princeton.edu/sites/wordnet/files/jbj-jeju-fellbaum.pdf - "...assigned a value of **representing how much the first concept brings to mind the second...")**

20. Neuro Electronic Currency is an experimental, minimal, academic, fictitious cryptocurrency for modelling Intrinsic Merit and Optimal denomination in economic networks (AstroInfer and KingCobra repositories - Intrinsic and Market Equilibrium Pricing, Perfect Forward-Zero Copy Move e.g C++ move constructor https://en.cppreference.com/w/cpp/language/move_constructor, Google Cloud Object Move API - https://cloud.google.com/storage/docs/renaming-copying-moving-objects#move). EventNet is an economic network for Money Flow Markets/Trade. Intrinsic merit in economic network is the economic influence of each vertex in trade. Optimal Denomination Problem/Money Changing Problem/Knapsack Problem is an open research area in economics and theoretical computer science ([Kozen] - https://www.cs.cornell.edu/~kozen/Papers/change.pdf, https://www.jstor.org/stable/2673933?seq=1). Monetary transactions are events leaving a trail of causality footprints and could be formulated as Graphical Event Models and Causal Event Models including NeuronRain-native GEM implementation - EventNet. A minimal Global EventNet Graphical Event Model HyperLedger has been implemented for high frequency algorithmic trading of commodities in NeuronRain KingCobra as blockchain equivalent which include stocks and put-call derivatives forward tradings betting on a futuristic price of a commodity. High Frequency Trading platforms are prone to Order Flow Toxicity (insider information possessed by one party causing disadvantage to counter party) leading to a crash - Academic Research on Flash Crash of 2010 - https://en.wikipedia.org/wiki/2010_flash_crash#Academic_research. Neuro Cryptocurrency mining rig implements following Proof of Work algorithms of varying complexity classes:

20.1 BPP - Pseudorandom choice of Boost UUID Hashes of leading "ff" hexadecimal digits

20.1 BPP + P + MRC-NC + NP-Hard - Pseudorandom integer partition of an integer equalling the value of Neuro cryptocurrency is reduced to a Square tile cover of a rectangle of area equal to value of Neuro cryptocurrency by Lagrange Sum of Four Squares Theorem reduction, Factor sides of the rectangle are found by Computational Geometric Factorization and factor sides of the rectangle are equated to 2 Money Changing Problem Frobenius Coin Diophantines solved as 2 Integer Linear Programs. Integer Partition to Rectangular Square Tile Cover reduction is a

kernel lifting from 1 dimensional vector of partitions to 2 dimensional area.

21. Text sentences are Ramsey colored by Part-of-Speech tags and alphabet positions. Similarly graph representation of texts are Ramsey edge-colored by relations (e.g WordNet, ConceptNet relations). Text-graph complement to convert cliques to independent sets and vice-versa is a special application of Complement Functions. Coloring texts by vowel-consonant and alphabets creates 2-coloring and 255 coloring respectively and imply existence of monochromatic APs in texts. Vowel-consonant 2-coloring and vowelless string complexity are equivalent to Compressed Sensing sketches i.e extracted APs are sketches compressing text.

22. Shell Turing Machines are experimental novelty in definition of Turing computability which introduce dimension of truth as an additional parameter in addition to tapes, alphabets, head of tape etc., to simulate hierarchy of truths across dimensions E.g 2-D Turing Machine has no knowledge about concept of Volume which is defined only in a 3-D Turing Machine. This has similarities to Tarski Truth Undefinability - Object language versus Meta Language and parallels Goedel Incompleteness. Shell Turing machines have applications in intrinsic merit definitions in the context of word2vec embeddings of words in vector spaces. NeuronRain implements a word2vec embedding of academic publication bibliographies (bibliometrics) for originality merit measure. Colloquial example: Two Turing machines computing name of "Tallest building" on two vector spaces (or universe of discourses in First Order Logic) of different dimensions - "Country" and "World" - Country is a subspace of World - might return two different results though question is same. Formally, Shell Turing Machines have parallels to Turing Degrees which are measures of unsolvability of a set. Turing Degree is an equivalence class and two Turing machines X and Y have degrees defined by partial order d(X) > d(Y) meaning X solves a more difficult set than Y. Essentially, Shell Turing machines defined over two vector spaces of two dimensions d1 > d2 can be construed as two machines of varying Turing degrees.Reduction from Turing degrees to Dimensions of Shell Turing Machines: Shell Turing machines defined on vector space of dimension d+x have oracle access to a shell Turing machine on vector space of dimension d creating a Turing jump. Hilbert Machines defined on Hilbert Spaces, Eilenberg Linear Machines defined on vector spaces are examples of Shell Turing Machines - http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.36.73&rep=rep1&type=pdf - "... The notion of a linear

machine goes back at least 25 years to Eilenberg [14]. The basic idea is to base a machine (or automata) not just on a non-interpretable set of symbols but instead use a linear structure. That means, that the data this type of machines operates on are vectors in some vector space ..." , https://www.nap.edu/read/10169/chapter/9#107 - "...One of my fonder memories comes from sitting next to Sammy in the early 1960s when Frank Adarns gave one of his first lectures on how every functor on finite-dimensional vector spaces gives rise to a natural transformation on the K-functor...". Shell Turing Machines go farther than mere embedding of Turing machines in a vectorspace - they delve into feasibility of exporting truth values of logical statements embedded in space S1 to another space S2 by linear transformations. There is a close resemblance between Shell Turing Machines and Category of Topological Spaces (Top) - https://en.wikipedia.org/wiki/Category_of_topological_spaces - Top is a category of topological spaces as its objects and morphisms are continuous functions (e.g computable by a Turing machine) amongst the topological space objects - Top formalizes a multiverse/universe in computational physics: Multiverse is a Top category of universes each of which is an object in Top category and linear transformations are morphisms amongst the universes - each morphism can be imagined as conduit Turing Machine exporting truth of logical statements between two universe topological space objects. TOP category abstraction of Shell Turing Machines has weird implication: For n-level nested kernel lifting by Conduit Turing Machines, truth values could be exported only upto (n-1) levels. There is no outward kernel lifting from outermost TOP category space - Proof is by contradiction: If there is a lifting from biggest space to bigger-than-the-biggest space, bigger-than-the-biggest space dons the mantle of biggest TOP space (in other words, there is no exit possible from the biggest outermost shell - leaving it would imply entering a bigger shell,an anamoly).

23. Pseudorandomness and Random Close Packing are equivalent - a random close packing is generated by a pseudorandom generator e.g shaking a container of balls shuffles the centroids of balls at random. Cellular Automaton algorithm uses Parallel PRGs to simulate Filling of Space by random strewing of solids/liquids. Computational Chaos is a randomness source - https://sites.google.com/site/kuja27/ChaoticPRG.pdf (Deleted and Mirrored at https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/ChaoticPRG.pdf)

defines an RNC pseudorandom generator based on [Palmore-Herring] Chaotic PRG - https://dl.acm.org/citation.cfm?id=71608. Chaos Machines are randomness extractors for pseudorandom oracles - https://en.wikipedia.org/wiki/Chaos_machine, Czyzewski Chaos Machine [2016] - https://eprint.iacr.org/2016/468, Merkle-Damgard construction - https://en.wikipedia.org/wiki/Merkle%E2%80%93Damg%C3%A5rd_construction. Conventional Buy-Sell monetary transactions create Money Trail EventNet Graphs whose edges are labelled by currency unique id(s)/commodities and vertices are any economic entity - people,financial instruments,institutions. Because of its sheer magnitude and unpredictability, Money Trail graph is a potential expander graph having least Cheeger constant (low eigenvalues, high regularity and less bottleneck) and thus a candidate for Expander Graph Random Walk Pseudorandom Generators e.g Blockchain Distributed Ledger (Bitcoin - [Satoshi Nakamoto]) is a consensus replicated money trail graph - http://documents.worldbank.org/curated/en/177911513714062215/pdf/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf

24. A random integer partition can be generated by a Pseudorandom generator. This extends the Partition-HashTable isomorphism to PRG-Partition-Hashtable transitive equivalence: PRG produces random partitions of integer, random partitions map to random buckets in tabulation hashing.

25. Computational Geometric Parallel RAM Factorization applies datastructures (e.g Parallel construction of segment trees/wavelet trees/interval trees/k-d trees) and algorithms (Planar Point Location, ray shooting queries) from Computational Geometry and Number Theory. Factorization in number theory is a multiplicative partition problem - Factorisatio Numerorum - as opposed to additive partitions. Quantum Computational version of Computational Geometric factorization has also been described in the context of quantum to classical decoherence. Computational Geometric Parallel RAM Factorization allocates O((logN)^k) arithmetic progression line segments (or a PSLG formed by a pixel array polygon) of a rasterized hyperbolic arc, to O(N/(logN)^k) PRAM-multicore processors which could be binary or interpolation searched in O((logN)^(k+1)) or O((logN)^k*loglogN) parallel RAM time. Parallel Rasterization of hyperbolic curve which creates line segments of pixels from hyperbola in parallel could be performed by advanced GPU architectures - e.g NVIDIA CUDA - illustrations - https://research.nvidia.com/sites/default/files/pubs/2011-08_High-Performance-Software-Rasterization/laine2011hpg_paper.pdf.

26. Program Analysis is a converse of complement diophantine

problem and is an approximation of Rice Theorem which ordains any non-trivial property of recursively enumerable sets is Undecidable

27. Software Analytics based on static and dynamic analyses (SATURN CFG/Valgrind CallGraphs/FlameGraphs/Points-to Graphs/FTrace) and applying Centrality/Graph Mining/Latent Semantic Indexing/Graph Edit Distance/Graph Isomorphism on them is a Program Analysis problem. Various Program Analyzers in userspace and kernelspace have been implemented in AstroInfer,USBmd and VIRGO linux kernel repositories which use Degree centrality,PageRank,Cyclomatic Complexity measures,Graph Isomorphism,Degree Sequence EMD Similarity among others. Some userspace usecases for Read-Copy-Update, Software Transactional Memory - Lockfree - synchronization have also been implemented for wrapping VIRGO32 and VIRGO64 kernelspace RPC cloud system calls. VIRGO32 and VIRGO64 linux kernels feature a kernelspace Bakery algorithm kernel driver implementation for Cloud synchronization. GRAFIT course materials have some spillover analytics implementations and catechisms for classroom pedagogy - notable of them being Earliest Deadline First Worst Case Execution Time (EDF WCET Survival Index Timeout) OS Scheduler which depends on static code analyzers - IPET,CFG,SyntaxTree,LongestPath - or Master Theorem for WCET approximation.

28. Automated Debugging (e.g delta debugging, streaming common program state subgraphs) and Debug Analytics(finding minimum size program state automaton for isolating and resolving buggy code changes - finding and resolving bugs are two different problems because resolution of bug might necessitate major refactoring and rewrites) is a Software Analytics problem. Epidemics are modelled by Chaotic Strange attractors and Game theory (adversarial game between pestilence and infected) and Cybercrimes are epidemics infecting electronics. Software Analytics for Cybercrime forensics therefore have game theoretic reasoning (adversarial game between criminals and affected)

29. Set Partitions (Complementary Sets, LSH Partitions, Separate Chaining Hash tables, Histograms, Electronic Voting Machines etc.,) have a reduction to Space Filling/Packing by Exact Square Tile Cover of Rectangle from a fundamental result in number theory - Lagrange Four Square Theorem. This kind of square tile cover of a rectangle can be written as a non-linear quadratic programming optimization which solves integer factorization indirectly. Lagrangian Square Tiles are arranged in rectangle found by computational geometric factorization which is also an instance of NP-Hard exact Coin Problem/Money Changing

Problem/Integer Linear Programming and polynomial time approximation problem by least squares (e.g LSMR). NeuronRain implements both Exact (CVXOPT GLPK Integer Linear Programming) and Approximate (LSMR least squares) reductions from set partitions to square tile cover by computational geometric factorization.

30. Computational Geometric Factorization by Parallel Planar Point Location rectifies a hyperbolic continuous curve to set of straightline segments as part of factorization which are searched. Each rectified segment is an arithmetic progression defineable by an arithmetic progression diophantine or generating functions and set of these diophantines represent the exact cover (set of subsets) of points on rectified hyperbolic curve. Arithmetic progressions arise in Ramsey theory while arbitrarily coloring integer sequences. This rectification of a hyperbola by axis-parallel line segments is a union of arithmetic progressions.

31. Question-Answering Interview Intrinsic Merit as a threshold function (linear or polynomial) is related to an open problem in boolean functions - BKS conjecture. BKS conjecture predicts existence of a function which is more resilient or stabler than majority function. Stability is a measure of incorruptibility of a function. Question-Answering can also be formulated by a TQBF (Totally Quantified Boolean Formula) Satisfiability problem.

32. Category Theory is the most fundamental abstraction of mathematics. Morphisms and Functors of Categories on algebraic topological spaces can be formulated as Shell Turing Machines on some topological space defined on objects embedded in topological space.

33. EventNet Logical Clock which has been applied for EventNet Tensor Products merit of Large Scale Visuals can be formalised by Category Theory - as Event Categories and Morphisms amongst Actors with in an Event and Causation Functors across Events. EventNet causality has an unusual connection to one-way functions, Quantum computation and Bell non-locality of hidden variables (QM predicts Future influences Past - https://www.sciencealert.com/quantum-physics-theory-predicts-future-might-influence-the-past-retrocausality), Pseudorandom generators, Hardness amplification, P != NP and Retrocausality/time reversal - EventNet causality DAG can be partitioned to past,present and future components by 2 cuts/vertex separators and if Retrocausality is false there exist atleast two one way future functions defined on the partition (f1(past)=present, f2(present)=future) which are hard to invert

ruling out bidirectional time. Partitioning EventNet DAG into more than 2 disjoint components gives birth to multiple one way functions (not just 2) - for every vertex separated component triple (px,py,pz) of EventNet DAG partition two one-way future functions f1(px) = py and f2(py) = pz which are hard to invert could be defined - Falsification of Retrocausality and bidirectional arrow of time implies Hardness amplification. Tensor Decomposition of EventNet implies time has component basis similar to any vectorspace.

34. Shell Turing Machines have connections to Diophantine Equations - set of languages of all Shell Turing Machines cover the set of Recursively Enumerable languages and MRDP theorem equates Diophantine Equations and Recursively Enumerable sets. Relation between dimension of topological space of a Shell Turing Machine and (degree, number of unknowns) of its Diophantine representation is an open problem. Set Partitions to Lagrangian Four Square Theorem Tile Cover Reduction for Rectangle Square tile filling by Computational Geometric Factorization is a Shell Turing Machine Kernel Lifting from one dimensional partition space to 2 dimensional square tile cover space. Shell Turing Machines are universal category of topological spaces (TOP) abstractions for any computation in STEM(Science-Technology-Engineering-Mathematics) e.g. Support Vector Machine Kernels, Reproducing Kernel Hilbert Space (functions embedded in Hilbert space), Hilbert Quantum Machines, Linear Machines, Word Embeddings for BigData sets, NP-Hard Set partitions to Lagrange's Sum of Four Square Theorem Square tile cover Integer Linear Program 1 dimension to 2 dimension kernel lifting implemented in NeuronRain as Neuro cryptocurrency proof-of-work(POW).

35. ThoughtNet Modal Hypergraph Evocation Model and Randomized versions of Electronic Voting Machines/Integer Partitions/Set Partitions/Locality Sensitive Hashing/Linear Programs are instances of Coupon Collector Balls-Bins problem.

36. Conventional Search Engine Rankings are scalar total orderings while in reality two URLs may not be totally comparable which makes search results per query to be partial ordered sets - each URL is assigned a merit vector of features and one URL might be better in some feature dimensions and other URL in rest. Galois connections can be defined between partial ordered search results of two different queries. An exception to this is Zorn's Lemma which is equivalent to Axiom of Choice (AOC) stated as - "a partial ordered set containing upperbounds for every totally ordered subset of it (chain) has atleast one maximal element".Implications of Zorn's lemma and AOC for search engine results poset are immediate - maximal ranked element of the

search query results exists if every totally ordered chain of the results poset have an upperbound which implies unique oneupmanship might arise. Search Engine Intrinsic Merit Rankings are as well instances of Envy-Free Multiple Agent Resource Allocation (MARA) or Fair Division problem - every URL is fairly rated.

37. Shell Turing Machines Kernel Lifting and their Category of Toplogical Spaces version are in a sense space filling gadgets e.g Each Shell Turing Machine is embedded in an n-sphere topological space bubble and Environment(Truth values) Kernel Lifting Export Morphisms are defined between them - visually a "Graph of Nested Pearls" or an n-dimensional nested Apollonian Gasket - Shell Topological space bubbles can be nested creating a tree of spaces.

38. Linear Programming formulation of Pseudorandom RNC Space filling is an algorithmic version of Berry-Esseen Central Limit Theorem - Sum (and Average) of random variables tend to Normal distribution.

39. Multiple variants of Computational Geometric Space filling algorithms mentioned in NeuronRain theory drafts are:

39.1 Pseudorandom space filling linear programming algorithm in RNC of a rectangle by ordinate points generated by parallel PRG or circles of small radii around them which simulates natural processes by Berry-Esseen Central Limit Theorem

39.2 Cellular Automaton space filling algorithm in NC which simulates natural processes. An one dimensional Chaotic Cellular Automata PRG has been implemented in NeuronRain

39.3 Random Closed Packing of balls in a container which is a Structural Topology problem

39.4 Constraint Satisfaction, Linear Programming, Circle Packing and Apollonian Gasket, Circle Packing Theorem for Graph Planarity, Thue's theorem, Kepler's theorem, Apollonian Networks - planar dual graphs of finite Apollonian Gasket (which has chromatic number <= 4 by Four Color Theorem)

39.5 Shell Turing Machines Category of Topological Spaces (TOP) which are non-nested and nested n-sphere shell spaces filling n-dimensional space having export Conduit Turing Machine morphisms amongst them, define hierarchy of environment of truths and linear transformation lifting between spaces - Section 1228 of NeuronRain Design describes a Kernel lift random walk in tree of TOP Category Shell Turing Machines by UNIX Shell Tree Game Example.

39.6 Set partitions to Lagrangian Four Square Theorem square tile cover of rectangle sides of which are found by factorization

39.7 Set partitions to n-dimensional space cover by Chinese Remainder Theorem

39.8 Apart from monochromatic fillings above, Planar Multichromatic Filling (Coloring) of a Contiguous Disjoint Space Partition Cover is the most obvious byproduct of Four Color Theorem e.g Watershed algorithm for image segementation which partitions an image into irregular multicolored segments. For every segmented image, there is a Voronoi tesselation available considering the centroids of the segments as points on a planar subdivision. Every Voronoi diagram of segmented image is a facegraph - facets of tesselation are faces of the graph containing segment centroids. Pareto efficient Multi Agent coloring of a Voronoi diagram facegraph has far reaching applications in Urban sprawl analytics, fair division, computational economics and multiple agent resource allocation(MARA). NeuronRain theory states (without implementation) a 4-color theorem based MARA for Urban sprawl analytics by analyzing facegraphs of segmented Urban sprawl GIS as 4-colored Residential,Commercial,Manufacturing-IT-ITES,Greenery faces. Naive areawise MARA for 4-colored segmented urban sprawls could be 25% each though standards mandate 33% area for greenery. Urban land use 4-coloring MARA has been formulated as DNFSAT.

40. Algorithms for Problems of - *) Planar Point Location Computational Geometric Factorization in NC, Quantum NC and Randomized NC *) Hyperplanar point location for algebraic curves on arbitrary dimensional space *) Pseudorandom linear program space filling (e.g monte carlo sampling, cellular automaton, circle packing, random closed packing, set partition to lagrangian tile cover of rectangle by factorization and arbitrary n-dimensional space by Chinese remainder theorem) in Randomized NC which simulates many natural processes by Berry-Esseen Central Limit Theorem *) Vector space embedding and kernel lifting of intrinsic merit feature vectors in text,audio,video,people,econometric analytics *) Chaotic non-linear pseudorandom generators in Randomized NC *) Kernel lifting by Shell Turing Machine Category of Topological spaces and environment Export Morphisms amongst shell spaces - unify fields of Computational Geometry, Sorting, Geometric Search, Pseudorandomness, Chaos, Category Theory, Algebra, Set Partitions, Topology, Quantum Computation, Probabilistic Methods, Turing Degrees, Linear Programs, Formal languages, Software analytics, Kernels and Linear Transformations between vector spaces, Fame-Merit Rankings, Operating Systems theory, Parallel computing and theory of Nick's class.

41.Bibliometrics is the problem of intrinsic merit of

academic publications - a machine learning alternative to peer-review and a subclass of broader textual merit. NeuronRain defines and implements SkipGram word2vec embedding of academic publications (BibTex). Every academic article proving a result could also be viewed as a set of first order logic statements as opposed to natural language text which abide by various Proof calculi - Sequent, ProofNets (Geometry of Interactions-GoI) - and conceptual distance between 2 publications could be derived from graph edit-distance between their ProofNet-GoIs.Proof entailments could also be represented as TOP Category of first order logic statements and morphisms among them (Quiver) which applies to any natural language text. Word2Vec embedding prepares the groundwork by embedding concepts - model for the FOL statements - in a topological space. Meaning representation (MR) could be done by translating a natural language text to Lambda Functions and First order logic statements. Recursive Lambda Function Growth algorithm in NeuronRain learns a lambda function composition via beta reduction from natural language texts.

42.Cellular Automaton Space filling algorithm which has Parallel PRG plane sweep and Increment Growth rule underneath it, has widespread applications in Chaotic modelling of natural processes,diffusion of memes,fads,pandemics,concepts and cybercrimes in a community. NeuronRain envisages a new random graph model based on 2-dimensional Cellular Automaton - CAGraph - which could be another social network model similar to Erdos-Renyi Susceptible-Infected-Recovered,Susceptible-Infected-Susceptible random graph models. Logistic/Linear Regression models for diffusion could be inferred from CAGraph.

43.Universally Unique Identifier Generation is a challenge in Cloud Computing (Algorithms for UUID creation - RFC 4122 - https://tools.ietf.org/html/rfc4122#section-4.3). There are known vulnerabilities in RSA cryptosystem which could churn similar repetitive semiprime moduli for digital certificates of different users (https://blog.keyfactor.com/the-irony-and-dangers-of-predictable-randomness) and efficient integer factorization for RSA grade huge PKI semiprimes weakens ecommerce. Unique ID creation for NeuronRain VIRGO cloud system calls, Unique Identification in NeuronRain People Analytics and Boost UUID for NeuronRain KingCobra Neuro protocol buffer cryptocurrency depend on cloudwise unique ID creation.

44. In Social Networks and State issued Unique ID databases, Searching sorted unique id(s) is a daunting task and advanced search techniques - Fibonaccian search, Interpolation search - are better suited to architectures having costly numeric division instruction sets. Fibonaccian search and Interpolation search

could also be used in place of binary search in Computational Geometric Factorization. Interpolation search assumes the range of the elements are predetermined and in Computational Geometric Planar Point Location Factorization, range of each tile segment/pixel polygon array/interval can be computed by elementary calculus thus enabling interpolation search which is O(loglogN). This implies local tile search optimization in factorization - which assigns O((logN)^k) segments to O(N/(logN)^k) PRAMs and each PRAM sequentially binary searches O((logN)^k) implicitly sorted tile arithmetic progressions - could be O((logN)^k*loglogN) an improvement from O((logN)^(k+1)).

45. Finding Closest Pair of Points in a set of points is a Computational Geometric Problem and finds use in Air and Sea Vehicle Collision Avoidance. Theoretically if strings are embedded in a vectorspace of alphabets finding closest pair of string points is an edit distance alternative. Finding closest pair of points is a perfect fit for People Analytics if People profiles are points on a vectorspace - particularly for measuring extent of how much crowd flocks to a social profile vertex, distances of neighbours and its resultant impact on spread of memes,gossips and even cybercrimes/pandemics.

46. Almost every BigData set is multidimensional and could be formalized by Tensors - EventNet Logical Clock for Causality in Cloud, Video EventNet Tensor Products for Merit of Large Scale Visuals having EventNet Logical Clock underneath, Alphabet-Syllable Vectorspace Embedding of Textual strings, People Profiles for Social Network,Human Resource and Talent Analytics are implemented as Tensors in NeuronRain.

47. Finding distance between two tensors of unequal dimensions is a non-trivial problem e.g Computation of distance between two String Syllable Hyphenated 2D Tensors of unequal rows and columns - [["ten"],["sion"]] and [["at"],["ten"],["tion"]] - requires histogram distance measures(Earth Mover Distance,Word Mover Distance,...) because each syllable hyphenated string is a histogram set-partition of the string and each syllable is a bucket.Conventional Edit Distance measure for two strings is 1-dimensional and does not give weightage to acoustics while Earth Mover Distance between two Syllable hyphenated strings is 2-dimensional and more phonetic. In complexity theoretic terms, bound for edit distance is quadratic while Earth mover distance is cubic though there are recent linear complexity EMD and WMD approximation measures - LC-RWMD - Linear Complexity Relaxed Word Mover Distance - https://www.ibm.com/blogs/research/2019/07/earth-movers-distance/ , https://www.ibm.com/blogs/research/2018/11/word-movers-

embedding/ . Subquadratic string distance measures if reduced to edit distance imply SETH is false. Closest Pair of N Points algorithm in Computational Geometry is subquadratic O(NlogN) which could be applied to syllable hyphenated String tensor point sets. Towers of Hanoi Problem concerns hardness of moving a single bucket histogram of disks (Animation: http://towersofhanoi.info/Animate.aspx) sorted by descending radii bottom-top to itself preserving sorted order always (Fixed point computation) and only exponential time (2^N - 1 for N disks) algorithms are known for it. Weird counterintuitive fact about Towers of Hanoi: Earth mover distance upon completion of aforementioned exponential number of fixed point moves is 0 - Histogram remains identical after complete move though partial intermediate moves (require minimum 3 single bucket histograms of sorted order) could have Earth mover distance > 0 - or Sequence of EMDs between 3 histograms sinusoidally fluctuates over time for 2^N - 1 moves before eventually reaching 0 (3 histograms unite to 1), a feature strikingly reminiscent of Collatz conjecture. Towers of Hanoi is NP-Hard (Every problem in NP is polytime many-one reducible to Towers of Hanoi) but not known to be in NP (no NP algorithm has been found). Technically, NP-Hard class is unaffected irrespective of P != NP or P = NP - https://en.wikipedia.org/wiki/NP-hardness#/media/File:P_np_np-complete_np-hard.svg. Previous reduction from Towers of Hanoi histograms to EMD sequence is a #P-Complete parsimonious reduction bijection preserving number of solutions - https://en.wikipedia.org/wiki/Parsimonious_reduction#Examples_of_parsimonious_reduction_in_proving_#P-completeness. Towers of Hanoi and other problems in NP-Hard class and #P-Complete problems are thus obvious choice for cryptocurrency proof-of-work (POW) as the hardness (or labour value) of cryptocurrency is insulated from and independent of P!=NP or P=NP. NeuronRain implements Towers of Hanoi (Single Bin Sorted LIFO Histogram) NP-Hard problem as Neuro Cryptocurrency Proof-Of-Work,a harder alternative to NP-Complete ILP Proof-Of-Work.

48. Graph Edit Distance (GED) is the most fundamental clustering similarity measure which pervades Text-Audio-Visual-People Graph Analytics and Program Analyzers in NeuronRain. Graph Edit Distance generalizes String Edit Distance - every String (and thus Text) is a connected, directed acyclic graph of maximum degree 1 and alphabets are its vertices. Graph Edit Distance between EventNet of a Video and ImageNet ImageGraphs of Images quantifies visual similarity. Graph Edit Distance between weighted automata of two music clips differentiates music (In theory, automata can be checked for equivalence by Table filling

algorithm) while GED between Speech-to-Text textgraphs measures audio similarity. Graph Edit Distance between Social Community Graphs, Connections Graph and proper noun filtered (e.g dictionary filter) Textgraphs of People Profiles measures People similarity. Graph Edit Distance between Control Flow Graphs from SATURN, Program Slice Dependency Graphs, FTrace Kernel callgraphs, Valgrind/KCacheGrind/Callgrind userspace callgraphs identify similar codeflow and malwares. While Graph Isomorphism finds similar graphs by vertex relabelling (Exact Graph Matching), Graph Edit Distance generalizes to dissimilar graphs (Inexact Graph Matching).

49. Transformers are recent advances in Text analytics - NeuronRain Textgraph implementations for Recursive Lambda Function Growth and Named Entity Recognition extend transformers to textgraph vertices degree attention for inferring importance of word vertices of textgraphs.

50. Graphical Event Models (OGEM,PGEM) decipher graph dependency amongst timeseries of real life events (politics,economic and other bigdata streams). EventNet theory and implementation in NeuronRain is a Graphical Event Model for interevent and intraevent actor-model causality. EventNet Tensor Product algorithm for Videos is a Graphical Event Model based on ImageNet for extracting dependencies between frames (Video is a timeseries stream of frames)

51. Digital Watermarking overlay of segmented large scale visuals is in a sense a primitive image classifier - vertices of facegraphs of similar segmented images when overlayed on one another are highly superimposed and isomorphic (and thus a measure of similarity) creating a multiplanar graph in which each vertex is a stack - a visual version of ThoughtNet.

52. Integer Partitions and String complexity measures are related - Every string is encoded in some alphabet (ASCII or Unicode) having a numeric value and thus every string is a histogram set partition whose bins have sizes equal to ASCII or Unicode values of alphabets which partition the sum of ASCII or Unicode values of constituent alphabets of a string. This enables partition distance (a kind of earth mover distance - e.g. Optimal transport and integer partitions - https://arxiv.org/pdf/1704.01666.pdf) between string histograms as a distance measure between strings apart from usual edit distance measures.

53. Byzantine Fault Tolerance (BFT) has theoretical implications for mitigating faults including cybercrimes in electronic networks and containment of pandemics in social networks modelled by Cellular automaton graphs.

54. Economic Merit – fluctuations in economy and stock markets are modelled by Chaotic multifractals wherein single exponent is not sufficient and behaviour around any point is defined by a local exponent. NeuronRain envisages Collatz conjecture model of market vagaries which is a 2-colored pseudorandom sequence of odd and even integers always ending in 1.

55. Graph theory originated from an urban sprawl analytics problem – Euler circuit and Closed trail of Seven bridges of Konigsberg. Reallife problems of urban areas are solvable by vertex cover, edge cover, maxflow-mincut, leaky bucket model of traffic, strongly connected components, dense subgraphs of transportation network graphs aiding efficient drone navigation. NeuronRain implements ranking of Urban Sprawls from segmented Contour polynomial areas bounding urban sprawls based on NASA VIIRS NightLights imagery which is a polynomial variant of Space filling problem usually limited to Packing by Circles and Chaotic Mandelbrot set curves. Delaunay triangulation graph of SEDAC and VIIRS Urban sprawl contours approximates transportation graph and could be an estimator of Euler Circuit and Hamiltonian for efficient drone navigation.

56. Quantum Circuits in Deustch Model could be translated to classical Parallel RAMs by Memory Peripheral Model which maps quantum circuits to PRAM instruction set – https://uwspace.uwaterloo.ca/bitstream/handle/10012/16060/Schanck_John.pdf. This bridges a missing link between Quantum and Classical computations which might resolve lot of conflicts involving derandomization of Shor BQP Factorization to P and NC, Classical PRAM-NC-BSP and Quantum NC Computational Geometric factorizations described and implemented in NeuronRain.

57. In NeuronRain complement implementation, Complement Diophantines are learnt by Least Squares and Lagrangian interpolations which are total functions while Lagrange Four Square Theorem complement map is a partial surjective function (not all domain tuples are mapped to a point in complementary set)

58. MapReduce cloud parallel computing framework (on which Hadoop, Spark are based) has separate complexity class MRC (MapReduce Class) defined for itself:

58.1 [Karloff-Suri-Vassilvitskii] – http://theory.stanford.edu/~sergei/papers/soda10-mrc.pdf – Section 4.1, Theorem 4.1 and Theorem 7.1. DMRC is a generic version MRC which allows deterministic randomization (Las Vegas algorithms which always return correct answers). Most problems in NC are in DMRC but converse is not true unless NC=P. CREW PRAM algorithms can be simulated by MapReduce class (MRC). Thus

NeuronRain MapReduce implementations including Spark Computational Geometric Factorization and Recursive Gloss Overlap Interview Algorithm for intrinsic merit are in MRC though the computational geometric factorization algorithm is in NC-PRAM-BSP which is a limitation of Cloud computing and MapReduce software though Supercomputers running proprietary software might be in exact NC e.g Fugaku Supercomputer - https://www.bnl.gov/modsim2019/files/talks/SatoshiMatsuoka.pdf - ARM - Exascale - Petaflop. It is known that SAC=NC=AC=TC or Nick's Class-Bounded Fanin, Semi-unbounded Fanin, Unbounded Fanin and Threshold Circuits (made of Majority gates - theoretical formalism of Neural networks) are equivalent - http://users.uoa.gr/~glentaris/papers/MPLA_thesis_lentaris.pdf - and thereby Neural Networks can compute Integer Factorization in parallel, an unusual connection between Number Theory and Machine Learning (or Factorization is computationally learnable from training data).

58.2 [Fish-Kun-Lelkes-Reysin] - class of regular languages (and all of sublogarithmic space) is in constant round MRC - https://www.researchgate.net/publication/266376763_On_the_Computational_Complexity_of_MapReduce/link/56cc71e908aee3cee54375d6/download.

58.3 Simulating BSP+PRAM in MapReduce - https://www.cs.utah.edu/~jeffp/teaching/cs7960/L18-MR-simulate.pdf

58.4 Complexity Measures for Map-Reduce and Comparison to Parallel Computing - https://users.cs.duke.edu/~kamesh/mapreduce.pdf

59. Almost all Autonomous Drone Delivery Problems including Drone Electronic Voting Machines, Online Shopping Delivery, Autonomous Combat Drone Swarms are NP-Complete which have to navigate along Hamiltonians optimally on surface and aerial transportation graphs. NeuronRain theory describes a Graph Masking Drone Obstacle Avoidance algorithm by dynamically overlaying segmented (convexhull) weather GIS imagery on terrestrial transportation graph for weather obstacles which is crucial for faultless delivery of payload carried by drones. Graph Masking which is a computational geometric planar intersection problem of graph and convex hull polygons, removes (or masks) subgraphs below aerial weather obstacles (e.g cloud) from transportation graph thereby creating a stripped-down topologically punctured transportation graph which bypasses weather obstacles. Optimal best route in this masked transportation graph could be found by A* Best First Search Robotic Motion Planning algorithm. Segmenting wind speed and

temperature obstacle convex hulls from Weather GIS imagery is non-trivial because of high fluidity of atmosphere. Obstacles for UAVs are two fold - Natural (Inclement weather, Mountains) and Artificial (Man-made structures). Artificial obstacles can be avoided by choosing airstrip directly above surface transportation graph edges (Road network) as airspace above roads is usually free of obstacles and structures except interchanges which could be bypassed by raising drone altitude to atleast the maximum height of the structures. Natural obstacles (Rains, Wind, Heat) are not so obvious to tackle - Though cloud formations in Weather GIS are somewhat static and can be bounded by convex hull polygon boxes, segmenting wind and heat obstacle convex hulls requires sensors transmitting wind speed and temperature either from Satellite GIS or from points on Road network. Gathering wind and heat data along the points on transportation graph minimizes number of sensors. Onboard sensors in Drones for wind and heat may not be sufficient because drone has to learn obstacle data which are located at some distance ahead from drones so as to backtrack and realign the mission trajectory.

60. Two Set Partitions are classified as Complementary Partitions or Connected Partitions if their least upperbound is the unpartitioned set - https://royalsocietypublishing.org/doi/pdf/10.1098/rspa.1988.0018 . There is another definition of Category Theoretic Complementary Set Partitions which finds use in Deep Learning Recommender Systems and Computational advertising - https://arxiv.org/pdf/1909.02107.pdf - each pair of elements of partitioned set S are distinguished (present in different equivalence classes of partition sets) by atleast one partition. Conjugate Partitions are kind of complementary set partitions whose Ferrer Diagrams are inverted along diagonal (rows and columns of Ferrer Diagram are interchanged) - https://en.wikipedia.org/wiki/Partition_(number_theory)#Conjugate_and_self-conjugate_partitions. NeuronRain definition of complementary set partition differs - Set Partition S is complementary to Set Partition S' if there exists an equidepth (all buckets have equal size) set partition E and E / S = S'. E,S and S' have same number of buckets and buckets of S' fill the buckets of S to make rectangular equidepth E. Complement of Set Partition version of boolean majority function (2 buckets for votes to 0 and 1) is another boolean majority set partition function inverting the output. In other words, complementary set partitions S,S' split an equidepth partition E into two and each of the complementary set partitions S and S' could be written as equidepth partitions by rearranging items in buckets. Example of

NeuronRain definition of Complementary set partitions:

```
                1 2 3
     S    =     6 7 8 9
                11 12

                4 5
     S'   =     10
                13 14 15

     E    =     1 2 3 4 5
                6 7 8 9 10
                11 12 13 14 15
```

size(E) = 3 * 5 = 15 = size(S) + size(S') = 9 + 6
size(S) = 9 which can be rearranged to an equidepth partition as 3 * 3
size(S') = 6 which can be rearranged to an equidepth partition as 2 * 3

For 20 voters indexed by integers 1 to 20:

```
                E = 0: 1 2 3 4 5 6 7 8 9 10
                    1: 11 12 13 14 15 16 17 18 19 20
```

Set Partition version of Boolean Majority (0 wins):

```
                S = 0: 1 2 3 4 5 6
                       1: 11 12
```

Set Partition Version of Complementary Boolean Majority (1 wins):

```
                S' =  0: 7 8 9 10
                      1: 13 14 15 16 17 18 19 20
```

61.NeuronRain theorizes and implements multiple Logical clocks for (unidirectional and bidirectional) Timeout and Graphic Event Models-Causal Event Models:

61.1 EventNet GEM Tensor – a Graphical Event Model of events and actors per event for capturing Causality relationship between events on Cloud (e.g Money Trail – Monetary Transactions, Causality between frames of video in Large Scale Visuals). EventNet logical clocks do not rule out cycles and retrocausality and can be decomposed as linear function of Tensor component basis implying time could be multidimensional similar to any topological space.

61.2 Survival Index Based Timeout for OS Schedulers – Unidirectional (Downward clockticks) Dynamic Hashing based Process Timeout mechanism for OS Scheduler – derived from an earlier proprietary Survival Index Transaction Timeout Manager (Sun Microsystems-Oracle: patent pending) implemented in iPlanet

Application Server (iAS) now opensourced as Eclipse GlassFish and Oracle GlassFish - https://projects.eclipse.org/proposals/eclipse-glassfish, https://www.oracle.com/middleware/technologies/glassfish-server.html

61.3 Expirable C++ Objects - Reference Counting of objects (mostly images and Neuro currencies) which is a bidirectional logical clock of increment and decrement (Upward and Downward clockticks) - Object is reaped by Garbage collector when refcount reaches 0. Collatz conjecture defined as: {x(n+1) = x(n)/2 if x(n) is even and 3x(n) + 1 if x(n) is odd and {x(n)} sequence always ends in 1} is a bidirectional clock and might be useful to simulate lifetime reference count (trajectory of ups and downs) of an object. EMD sequence for Towers of Hanoi intermediate computations mentioned earlier (47) is a Collatz-like sequence of exponential number of elements terminating always in 0 and could be another instance of bidirectional refcount clock.

61.4 KingCobra Atomic Transactional Refcounting within linux kernel for cloud RPC - reference count of an object is globally persisted within move semantics - For an object move over VIRGO64 cloud kernelspace RPC, sender decrements global refcount of object and receiver increments its global refcount within an atomic transactional block - requires XA transactional Linux kernel supporting 2-phase commit. An example Userspace Distributed Reference Counting framework - Ray Actor Model - https://docs.ray.io/en/master/ray-core/memory-management.html - maintains a global ledger of objects, ip-addresses and processes holding references to those objects.

62. Factorization and Multiplication (Mutual Nick's Class reducibility of Division,Multiplication and Iterated integer addition - [Beame-Cook-Hoover] Theorem - Wallace Tree Circuits and FFTs - https://courses.cs.washington.edu/courses/cse532/08sp/lect08.pdf) are mutual inverses - Efficient circuits for linear complexity integer multiplications have been devised making room for the possibility of efficient factorization e.g Russian Peasant or Egyptian multiplication example multiplication of 101 * 115 = 11615 is a tableau of 2 columns that could be written as product of factor and sum of exponents of 2 (Right columns in Rows of odd Left columns are added) - Tableau is of size O(log(factor)):

101 115 +
50 230
25 460 +
12 920

6 1840
3 3680 +
1 7360 +

Last row of the tableau always ends in 1 and right column is of the form 115 * (1 + 2^2 + 2^5 + 2^6) [a decimal factor multiplied by another binary factor written as exponential sum - 110011 is the binary for 101]. Hardness of inverting the tableau bottom-up (to get the factors) involves a non-trivial efficient guessing (from number theory estimates - quite similar to number theoretic ray shooting query optimization in NC-PRAM-BSP-Multicore NeuronRain Computational Geometric Factorization) of bottom row-right column(7360 above) and reversing the computation from bottom to top - Irreversibility of the tableau might imply an One-Way function and Hardness amplification.

What are some unusual applications of Factorization implemented in NeuronRain?

---

861. Computational Geometric Factorization - Applications to Numeric Compression and Space filling
by Tile cover - related to 814 and all sections on Factorization, Compressed Sensing, Integer Partitions and Space Filling, Goldbach Conjecture, Primality Testing, Fermat's Sum of Two Squares Theorem

---

Integer Factorization and Discrete logarithm problem traditionally have been a mere theoretical fancy. But following are some unusual connections of an efficient factorization of huge integers to other seemingly unrelated silos:

(*) Partitions of an integer N which are one dimensional could be lifted to a 2-dimensional square tile cover of a rectangle by Lagranges Four Square Theorem whose sides are the factors of N.

(*) Sublogarithmic Numeric compression of huge integers by Unique Integer Factorization has benefits for memory intensive ecommerce websites which transact millions of PKI Diffie-Hellman exchanges per day - mostly 2048 bits semiprimes

(*) Sublogarithmic Numeric compression by Unique factorization is helpful in designing better CPU instruction sets - registers can have lesser number of bits

(*) Even Goldbach Conjecture (every even integer > 2 is sum of 2 odd primes) and Odd Goldbach Conjecture (every odd integer > 5 is

sum of three odd primes - which has been proved for odd integers > 7 because 7 can be partitioned only as 3+2+2) are the greatest unsolved problems of Number theory. Even Integers upto 4*10^18 and Odd Integers upto 8.37 * 10^26 have been computationally verified for truth of 2 Goldbach conjectures by many variants of Segmented Sieve of Eratosthenes which is O(NloglogN) sequential time - Algorithm 1.1 to generate all primes in interval (A,B) - https://www.ams.org/journals/mcom/2014-83-288/S0025-5718-2013-02787-1/S0025-5718-2013-02787-1.pdf - Prerequisite for this algorithm is a list of prime integers < sqrt(B) and first prime > sqrt(B). Factorization in NC-PRAM-BSP implies Primality testing is in NC which is already proved to be in larger class P by AKS primality test. This list of primes for segmented Eratosthenes sieve can be efficiently found in O(sqrt(B)*(logB)^k) parallel RAM time by Computational Geometric Factorization Primality test. (*) Even Goldbach conjecture could be written as a reduction of integer partition to square tile cover of a rectangle:

(*) Even Goldbach Conjecture: N = 2n = P + Q for all positive integers n and odd primes P and Q.

(*) Computational Geometric Factorization by parallel RAM planar factor point location on hyperbola N = xy (factors x and y) could be equated to some random integer partition of N = p1 + p2 + p3 + ... + pk

(*) Previous partition N = p1 + p2 + p3 + ... + pk is expanded by Lagrange Four Square Theorem as Sum of Squares (SOS) i.e. N = 2n = P + Q = xy = p1 + p2 + p3 + ... + pk = p1a^2 + p1b^2 + p1c^2 + p1d^2 + ... + pkd^2 in which each part pi is written as sum of 4 squares pia^2 + pib^2 + pic^2 + pid^2 = pi.

(*) If Even Goldbach conjecture is True, Primes P and Q can be written as two sum of squares one per prime: N = 2n = P + Q = xy = p1 + p2 + p3 + ... + pk = p1a^2 + p1b^2 + p1c^2 + p1d^2 + ... + pkd^2 = SOS(P) + SOS(Q).

(*) In Additive Number Theory, Fermat's Sum of Two Squares Theorem - https://en.wikipedia.org/wiki/Fermat%27s_theorem_on_sums_of_two_squares - states that Every odd prime p can be written as sum of two squares x^2 and y^2 if p = 1 (mod 4). Such primes are termed Pythagorean Primes. Previous Sum of Squares expansion is a generic case of Fermat's Theorem on Sum of Two Squares.

(*) By Fermat's Sum of Two Squares Theorem, Previous partition to Sum of Squares reduction solves a special case of Even Goldbach Conjecture if P = 1 (mod 4), Q = 1 (mod 4) and thus SOS(P) = a1^2 + b1^2 and SOS(Q) = a2^2 + b2^2 => N = 2n = xy = P + Q = SOS(P) + SOS(Q) = a1^2 + b1^2 + a2^2 + b2^2 which is Lagrange Sum of 4 squares.

(*) Finding factor pair p and q of integer N=pq such that ratio p/q is closest to 1 is non-trivial problem of almost-square factorization of N (factor sides of rectangle of area N are almost equal - an integer equivalent of real square root algorithm). Such an almost-square is best suited for solutions to two ILPs (equated to factors) of square tile packing of rectangle of area N.

****Why is Intrinsic Merit necessary? Are there counterexamples to perceptive voting based ranking? Why is voting based merit judgement anachronistic?****

---

797. Intrinsic Merit versus Majority Voting - Fame-Merit usecases - (this section is an extended unifying draft of theory and feature in AstroInfer,USBmd,VIRGO,KingCobra,GRAFIT,Acadpdrafts,Krishna_iResearch_DoxygenDocs)

Following counterexamples on merit-fame(prestige) anachronism and Q&A already mentioned in AstroInfer Design Document are quoted herewith as they are pertinent to this question:
***) Performance of an academic personality is measured first by accolades,awards,grades etc., which form the societal opinion - prestige (citations). That is prestige is created from intrinsic merit. But measuring merit from prestige is anachronistic because merit precedes prestige. Ideally prestige and intrinsic merit should coincide when the algorithms are equally error-free. In case of error, prestige and merit are two intersecting worlds where documents without merit might have prestige and vice-versa. Size of the set-difference is measure of error. *) Soccer player, Cricket player or a Tennis player is measured intrinsically by number of goals scored, number of runs/wickets or number of grandslams won respectively and not subjectively by extent of votes or fan following to them (incoming edges). Here reality and perception coincide often and an intrinsically best player by records is also most revered. Any deviation is because of human prejudice. Here intrinsic merit precedes social prestige. *) Merits of students are judged by examinations (question-answering) and not by majority voting by faculty. Thus question-answering or interview is an algorithm to measure intrinsic merit objectively. Here again best student in terms of marks or grades is also the most favoured. Any deviation is human prejudice.**

Interview of a document is how relevant it is to a query measured by graph edit distance between recursive gloss overlap graphs of query and text. Here also intrinsic merit precedes social prestige. Caveat is these examples do not prove voting is redundant but only exemplify that Voting succeeds only when all voters decide merit with high degree of accuracy (Condorcet Jury Theorem). *) Legal System rests on this absoluteness - People frame law, reach consensus on its clauses and Everyone agrees and accepts Law as a standard. *) Most obvious counterexample to perceptive ranking is the pricing in money flow markets. Same Good and Service is differentially priced by different Sellers. Widely studied question in algorithmic economics is how to fix an absolute price for commodity. There are only equilibrium convex program solutions available (Nash,Fisher,Eisenberg-Gale) where buyer-seller may reach an agreement point which is not necessarily intrinsic. This problem is parallel to existence of Intrinsic Merit/Fitness in world wide web and social networks. *) Stock buy-sell decisions are often influenced by Credit Rating agencies which is also an intrinsic merit assessment in financial markets. *) Darwin's Theory of Natural Selection and Survival of the Fittest is one of the oldest scientific example for Intrinsic merit or fitness in anthropology - Nature makes beings to compete with each other for survival, less fit become extinct and the fittest of them emerge victorious and evolve. *) Economic Networks for Shock Propagation(https://economics.mit.edu/files/9790) - Gravity Model of Economic Networks and GDP as intrinsic fitness measure in World Trade Web - https://www.nature.com/articles/srep15758 and https://arxiv.org/pdf/1409.6649.pdf (A GDP-driven model for the binary and weighted structure of the International Trade Network) *) Human Development Index Rankings of Countries which is a geometric mean of Life Expectancy Index, Education Index and Income Index - http://hdr.undp.org/sites/default/files/hdr_2013_en_technotes.pdf - is an intrinsic macroeconomics merit measure. *) Software Cost Estimation models - COCOMO (Constructive Cost Model), Function Point Analysis and SLOC are intrinsic merit measures for software effort valuations though disputed - e.g OpenHub Open Source Analyzer estimated cost of GitHub NeuronRain AsFer repository - https://www.openhub.net/p/asfer-github-code/estimated_cost - by COCOMO formula per https://en.wikipedia.org/wiki/COCOMO - "...E=ai(KLoC)^(bi)(EAF) where E is the effort applied in person-months, KLoC is the estimated number of thousands of delivered lines of code for the project, and EAF is the factor calculated above..."

Why should intrinsic merit be judged only by mapping a text to a graph?

---

798. Cognition and Neuro-Psycho-Linguistic motivations for Intrinsic Merit - (this section is an extended unifying draft of theory and feature in AstroInfer,USBmd,VIRGO,KingCobra,GRAFIT,Acadpdrafts,Krishna_iResearch_DoxygenDocs)

This is not the only possible objective intrinsic merit judgement. There could be other ways too. Disclaimer is intrinsic merit assumes cerebral representation of sensory reception (words, texts, visuals, voices etc.,) and its complexity to be the closest to ideal judgement. Simulating cerebral representation of meaning by a neural network therefore approximates intrinsic merit well (BRAIN initiative - circuit diagram of neurons - http://www.braininitiative.org/achievements/making-the-connection/ - neurons for similar tasks are closely connected). Usually cognition of text or audio-visuals, can be approximated by bottom-up recursive lambda function composition tree evaluation on each random walk of the Definition Graph. Graph representation of a text can be easily made into a Graph Neural Network, a recent advance in Deep Learning, and thus closely resembles internal neural synaptic activation in brain on reading a text. AstroInfer implements this as Graph Neuron Tensor Network (GNTN) on lambda composition tree of random walks on definition graph which is a merger of Graph Neural Networks(GNN) and Neural Tensor Network(NTN). Neural Tensor Networks formalize similarity of two vertices connected by a relation as a Tensor Neuron and are ideally suitable for ontologies like WordNet. Intrinsic Merit can also have errors similar to Perceptive Majority Vote Ranking. But Intrinsic Merit has an inherent cost advantage compared to aggregating votes.

Intrinsic Merit in the context of psychology has its origins in various types of cognition - Grounded Cognition, Embodied Cognition etc., - Embodied Cognition puts forth revolutionary concept of "body influencing mind and cognition is not limited to cerebral cortices" while Grounded cognition defines how language is understood. Following excerpts from psychology literature

illustrate cognition:

***) Barsalou's Grounded Cognition - https://www.slideshare.net/jeannan/on-barsalous-grounded-cognition**

***) Grounded Cognition - http://matt.colorado.edu/teaching/highcog/readings/b8.pdf - 1) "...Phrasal structures embed recursively.(e.g The dog the cat chased howled). Propositions extracted from linguistic utterances represent meaning beyond surface structure.e.g extracting chase(cat,dog) from either "The cat chased the dog" or "The dog was chased by the cat"..." 2) "...as an experience occurs (e.g easing into a chair) brain captures states across modalities and integrates them with a multimodal representation stored in memory (e.g how a chair looks and feels,the action of sitting,introspections of comfort and relaxations). Later on when knowledge is needed to represent a category (e.g chair) multimodal representations captured during experiences are reactivated to simulate how brain represented perception, action and introspection associated with it ...". Recursive phrasal structure in Grounded cognition and Currying/Beta reduction in Lambda calculus have uncanny similarities.**

***) Embodied Cognition - https://blogs.scientificamerican.com/guest-blog/a-brief-guide-to-embodied-cognition-why-you-are-not-your-brain/**

ThoughtNet and Recursive Lambda Function Growth algorithms in NeuronRain exactly implement previous grounded cognition theory - Language sentences are parsed into a recursive tree of lambda function compositions and each lambda function subtree composition can be simulated by composing images from a semantic network e.g ImageNet for approximate movie representation of meaning. ThoughtNet Hypergraph vertices are categories (modalities or classes) and each thought/sentence/experience is pigeonholed to classes (or modalities by a classifier). Previous example experience "easing into a chair" can be a hyperedge sprawling the modal classes "comfort","chair","sitting" which are ThoughtNet hypervertices for modals. Any future experience of chair or sitting might evoke this experience based on its merit potential by Contextual Multi Armed Bandit.

References:

798.1 Compilers - [Ravi Sethi-Aho-Ullman] - Page 387 - Type inferences, Currying and applying function predicates to arguments

Wouldn't cerebral representation vary from person to person and thus be subjective?

---

799. Cognition and Neuro-Psycho-Linguistic motivations for Intrinsic Merit - (this section is an extended unifying draft of theory and feature in AstroInfer,USBmd,VIRGO,KingCobra,GRAFIT,Acadpdrafts,Krishna_iResearch_DoxygenDocs)

There are standardized event related potential (ERP) datasets (N400,LAN,P600 etc., - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3822000/) and Event Related Functional MRI datasets gathered from multiple neuroscience experiments on human subjects. Such ERP data are similar for most brains. Variation in potential occurs because cerebral cortex and its sulci&gyri vary from person to person. It has been found that cortex and complexity of gray matter determine intelligence and grasping ability. Intrinsic merit should therefore be based on best brain potential data. ERP is non invasive compared to fMRI. An example of how ERP related to "meaningfulness"/"semantic correctness" of two texts - meaningful and meaningless - is plotted in https://brainlang.georgetown.edu/research/erplab.

Isn't perception based ranking enough? Why is such an intrusive objective merit required?

---

800. Social network centrality motivations for Intrinsic Merit - (this section is an extended unifying draft of theory and feature in AstroInfer,USBmd,VIRGO,KingCobra,GRAFIT,Acadpdrafts,Krishna_iResearch_DoxygenDocs)

Perception majority voting based ranking is accurate only if all voters have decision correctness probability > 0.5 from Condorcet Jury Theorem. PageRank works well in most cases because incoming edges vote mostly with >50% correctness. This correctness is accumulated by a Markov Chain Random Walk recursively - vote from

a good vertex to another vertex implies voted vertex is good (Bonacich Power Centrality) and so on. Initial goodness is based on weight of an edge. Markov iteration stabilizes the goodness. Probability that goodness of stationary Markov distribution < 0.5 can be obtained by a tail bound and should be exponentially meagre.

****Can Intrinsic Merit for a human social network vertex, a text document or any other entity be precisely defined as opposed to a probability distribution for Intrinsic Fitness defined for Social network vertices?****

----

801. Social networks, Bipartite and General Graph Maximum Matching, Permanent, Boolean majority, LTF, PTF, Votes aggregation, KRW Conjecture and Majority-VoterSAT Boolean Composition, Communication Complexity, BKS Conjecture, Condorcet Jury Theorem, Sharp Thresholds, Preferential attachment versus Fit-get-richer, Correlated Majority, Boolean Sensitivity measures, Majority Hardness Amplification Lemma - motivations for Intrinsic Merit - (related to Sections 14, 555, 678, 682 and an extended unifying draft of theory and feature in AstroInfer,USBmd,VIRGO,KingCobra,GRAFIT,Acadpdrafts,Krishna_iResearch_DoxygenDocs)

Boolean Composition of Majority Voting and VoterSATs and its Goodness in the context of Karchmer-Raz-Wigderson [1995] conjecture and various versions of Condorcet Jury Theorem have been researched extensively in NeuronRain Theory Drafts. In section 682, Depth of the Majority and VoterSAT composition is lower bounded by (= CommunicationComplexity(Majority+Voter))

~~**2*log m s product recommendations. Netflix Prediction markets. Google**asymptotically complete aggregation of information~~oral transmission of SARS-CoV-2-https://www.nature.com/articles/s41575-021-00416-6], Saliva, Phlegm, Animals) and 3 social groups of nodes in ER-SIR CAGraph could be P(Infected), Q(Uninfected), R(Uninfected) and role of corrupted message in BFT solution is accomplished by disease bearing vectors. P infects (virus is the message) Q and R. Q cannot discern if infection originated from P or R while R cannot distinguish if infection originated from P or Q.

From previous BFT reduction, it could be sufficient if 67% neighbours of a node in CAGraph are protected (by vaccination in social network or by securing nodes in electronic network) so as to contain cybercrimes or pandemics - BFT reduction is obvious if CAGraph has lot of triangles - vertices of each triangle enact 2 generals,1 traitor BFT solution. Each vertex of CAGraph has 8 neighbours and 67% of its (5.28) uninfected neighbours are sufficient for fault tolerance in social network and electronic network. Most IT systems are connected by grids and CAGraph formalism readily applies (There are some non-BFT solutions to resolve fault - e.g failed ATM transactions could be reconciled if network of ATMs keep track of serial numbers of currency dispensed and thereby maintaining money trail audit). COVID19 has fatality rate of 1% implying 99% population is protected statistically despite infection while vaccine efficacy has a maximum of 95% which is a paradox. While social distancing might contain spread in human social networks, proximity is irrelevant for IT systems.

1148. (THEORY and FEATURE) Decidability of Intrinsic Merit in general case - related to 801 and all sections on Merit versus Fame, LTFs and
PTFs, BKS Conjecture, Consensus versus Intrinsic merit, Byzantine Fault Tolerance, Condorcet Jury Theorem and its variants, Complexity theoretic aspects of merit, Quantum Computation - 24 June 2021

By BKS conjecture, there exists an LTF or PTF which is stabler than boolean majority and thus resilient to voting errors. Defining merit has
been a subject of debate and following are two accepted ways of it:

(1148.1) By consensus - everyone agrees on merit of an entity judged (or) everyone votes "yes"

(1148.2) No voting - there is an absolute 100% perfect universal LTF or PTF which everyone uses as a standard to measure merit (quest for such an LTF or PTF is elusive and hinges on BKS Conjecture) - realworld examples of LTFs/PTFs are contests,interviews,examinations which are far from being

errorfree.

In Byzantine Fault Tolerance which tolerates faults by consensus,all nodes in a cloud agree on value of a message despite corruption - in other words:

(*) Consensus does not imply intrinsic merit - universal agreement on some value does not imply merit

(*) But converse is true - Intrinsic merit implies Consensus - everyone must agree

Hypothetically assume a majority voting on merit of an entity by infinite number of voters - Each voter votes on merit of an entity as "Good" or "Bad". By CJT-Black-Ladha-Margulis-Russo theorems on sharp thresholds if each voter decides correctly on merit by > 50% probability, group decision tends to 100% and everyone agrees on merit in the infinity. This is counterintuitive because if infinte majority is a recursively enumerable problem (RE - Turing machine computing infinite majority might loop forever), merit has a definitive outcome (if p-bias is 0 for all voters) and 100% consensus on merit is attained by 1148.1. By a recent result RE=MIP* and eventually recursively enumerable infinite majority problem is solvable by quantum computers.

1152. (THEORY and FEATURE) Integer Factorization, Boolean Majority-VoterSAT composition, KRW Conjecture, CJT-Black-Ladha-Margulis-Russo
sharp thresholds for majority, BQP as VoterSAT, Derandomization, Quantum decoherence - a hypothetical scenario - related to 801 and all
sections on Factorization, KRW communication complexity and Majority Voting - 19 July 2021, 20 July 2021, 21 July 2021, 5 September 2021

1152.1 Quoting 801:

"...Boolean composition of leaves of Boolean majority circuit and individual VoterSATs has a curious implication when all voters are quantum voters (all VoterSATs are in BQP): By Condorcet Jury Theorem and its later versions by [Black] and [Ladha] and Margulis-Russo sharp threshold at p-bias > 0.5, infinite majority + BQP VoterSAT boolean composition tends to goodness 1 or quantum world derandomizes to P (by phenomena of Decoherence,

Wavefunction collapse) implying one of the superimposed quantum states of some amplitude (defined in Hilbert space) is chosen for certainty by nature. Majority is in non-uniform NC1 and thus in P which in turn is in BPP and the larger class BQP which implies boolean majority is in BQP. If boolean composition of BQP majority function and BQP voter SATs are relativizable (conjectural assumption: boolean composition is equivalent to oracle access Turing machines) as BQP^BQP (BQP majority function having oracle access to BQP voter SATs) and since BQP is low for itself, BQP^BQP = BQP. By CJT-Black-Ladha-Margulis-Russo threshold theorems for infinite majority quantum boolean composition tends to 100% goodness or in other words BQP asymptotically dissipates quantum error and derandomizes to P...."

1152.2 Conjecture: Boolean composition of BQP majority and BQP voter SATs is relativizable - Draft Proof outline: Compute boolean majority function on a BQP Turing machine whose leaves have oracle access to infinite number of BQP VoterSAT Turing machines. This oracle machine simulates boolean composition as BQP^BQP relativization.

1152.3 Some peculiar conclusion is arrived at if all VoterSATs depend on Shor's BQP factorization: Every voter factorizes same integer N by Shor's BQP factorization and votes 1 if factors are correct and 0 if factors are wrong. By definition of BQP more than 2/3 of infinite voters factorize N correctly (67%).

1152.4 But CJT and its variants for infinite majority imply 100% correct factorization because each VoterSAT has p-bias error <= 1/3 and group decision correctness (whether factors of N are right or not) tends to 100% probability implying Shor's BQP factorization derandomizes to P (or) success of BQP factorization is amplified to exact and CJT implies quantum decoherence.

1152.5 Factorization is known to be in complexity class ZPP^BQNC (https://arxiv.org/abs/quant-ph/0006004, ZPP = intersection of one-sided error classes RP and coRP). Thus factorization has been already shown to have semiclassical algorithm querying quantum oracle. If VoterSATs for every voter are in ZPP^BQNC, depth-2 infinite majority voting earlier is in nonuniform NC^ZPP^BQNC. By definition of ZPP and BQNC, each voter finds factors correctly in atleast 67% of the trials (ZPP returns 100% correct answer but with polynomial overhead while BQNC is > 67% correct) and therefore by Condorcet Jury Theorem and Margulis-Russo thresholds, infinite majority asymptotically decides factors 100% correctly, potentially derandomizing semiclassical ZPP^BQNC to classical P or NC.

1152.6 Previous derandomization algorithm is relevant to any

bounded error VoterSAT and not just limited to BQP factorization.

NeuronRain Licensing:

How is NeuronRain code licensed? Can it be used commercially? Is technical support available?

(*) NeuronRain repositories are spread across following SourceForge, GitHub and GitLab URLs:

(*) NeuronRain Research - http://sourceforge.net/users/ka_shrinivaasan

(*) NeuronRain Green - https://github.com/shrinivaasanka

(*) NeuronRain Green (replicated) - https://gitlab.com/shrinivaasanka

(*) All repositories of NeuronRain (in Sourceforge, GitLab and GitHub) excluding Grafit course materials, Krishna_iResearch_DoxygenDocs NeuronRain PDF/HTML documentation and NeuronRain Design Documents are GPLv3 copyleft licensed.

(*) Grafit course materials (includes NeuronRain Design Documents) and Krishna_iResearch_DoxygenDocs PDF/HTML documentation (in SourceForge, GitLab and GitHub) are Creative Commons 4.0 NCND licensed.

(*) As per license terms, NeuronRain code has no warranty. Any commercial derivative is subject to clauses of GPLv3 copyleft licensing. Please refer to https://www.gnu.org/licenses/gpl-faq.html#GPLCommercially for licensing terms for commercial derivatives ("Free means freedom, not price"). GPLv3 copyleft license mandates any derived source code to be open sourced (Sections on Conveying Verbatim Copies, Conveying Modified Source and Non-Source versions - https://www.gnu.org/licenses/gpl-3.0.en.html). Present model followed is as below:

(*) NeuronRain repositories also have implementations of author's publications and drafts - respective GPLv3 and Creative Commons 4.0 NCND clauses apply

(*) Premium Technical support for NeuronRain codebases is provided only on direct request based on feasibility and time constraints.

(*) GPLv3 license terms do not prohibit pricing.

(*) Commercial derivatives (for individuals or organizations who clone NeuronRain repositories and make modifications for commercial use) if any have to be GPLv3 copyleft and Creative Commons 4.0 NCND compliant.

(*) Drone code (Autonomous Delivery, EVM) in NeuronRain

is a conceptual implementation only (Python DroneSDK and Linux Kernel PXRC Flight Controller driver code have not been tested on a licensed drone but only on JMAVSIM simulator)

What is dual licensing?

Closedsource, proprietary, premium version derived and completeley different from NeuronRain Open Source codebases is in research, architecture and development - JAIMINI. Some features of JAIMINI have been Opensourced and made part of NeuronRain. Only opensource codebases of NeuronRain in SourceForge,GitHub and GitLab are copyleft licensed under GPL v3 and Creative Commons 4.0 NCND. Dual licensing implies dichotomous licensing - NeuronRain is free (open) and free (without price) while Closedsource is at premium.

Who owns NeuronRain repositories?

NeuronRain GitHub, GitLab and SourceForge repositories licenses for Krishna iResearch Open Source Products repositories at:
http://sourceforge.net/users/ka_shrinivaasan,
https://github.com/shrinivaasanka,
https://gitlab.com/shrinivaasanka,
https://www.openhub.net/accounts/ka_shrinivaasan
Krishna iResearch GitHub Organization:
https://github.com/Krishna-iResearch
Personal website(research): https://sites.google.com/site/kuja27/
(Deleted because of Google Classic Sites Discontinuation and Mirrored at
https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/ and similar relative paths in GitLab and SourceForge)

are owned by:

P.R.S.Kannan and Alamelu Kannan (alias Rukmini Kannan)
[Dedicated to memory of late P.R.S.Kannan - https://twitter.com/ka_shrinivaasan/status/1504761670794883073]
Emails: preskannan@gmail.com, alamelukannan1941@gmail.com

commentaries on NeuronRain code commits and related theory) : https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/Creative%20Commons%20%E2%80%94%20Attribution-NonCommercial-NoDerivatives%204.0%20International%20%E2%80%94%20CC%20BY-NC-ND%204.0.html (replicated in SourceForge and GitLab)

Licensing 2 - GPL v3.0 for other NeuronRain GitLab, GitHub and SourceForge repositories (excluding GRAFIT open learning repositories, NeuronRain Design Documents and Krishna_iResearch_DoxygenDocs HTML/PDF documentation which are Creative Commons 4.0 NCND licensed): https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/The%20GNU%20General%20Public%20License%20v3.0%20-%20GNU%20Project%20-%20Free%20Software%20Foundation%20(FSF).html (replicated in SourceForge and GitLab)

Previous license ownership attribution supersedes all other copyleft notice headers within NeuronRain GitLab, GitHub and SourceForge source code files and design documents.

and contributed by:

Author:

K.Srinivasan
Emails: ka.shrinivaasan@gmail.com, shrinivas.kannan@gmail.com, kashrinivaasan@live.com
NeuronRain mailing lists:
https://sourceforge.net/p/virgo-linux/mailman/virgo-linux-mailing-list/ (not recently updated),
https://in.groups.yahoo.com/neo/groups/grafitopenlearning/info (archived because of Verizon-Oath-Yahoo-Apollo groups shutdown)

Contributor has no government,industry and academic affiliations (as JRF) and does not accrue any monetary benefit for Opensource research and development effort (contribution is a charity). Name "Krishna iResearch" is non-funded, not a commercially registered entity but only a profile name registered in SourceForge and later in GitHub and GitLab. Because of certain cybercrimes, mistaken identity and copyleft violation problems in the past (and possibility of a signature forgery too which is neither confirmed nor denied), sumptuous id proofs of the author have been uploaded to https://sourceforge.net/projects/acadpdrafts/files/ and https://sites.google.com/site/kuja27/CV_of_SrinivasanKannan_alias

_KaShrinivaasan_alias_ShrinivasKannan.pdf (Deleted and Mirrored at https://github.com/shrinivaasanka/Krishna_iResearch_DoxygenDocs/blob/master/kuja27_website_mirrored/site/kuja27/CV_of_SrinivasanKannan_alias_KaShrinivaasan_alias_ShrinivasKannan.pdf)