

# A Short & Simple Technical Communication on Algorithms Design Using Python Based [ Applied Physics+AI+Imaging Mathematics+Data Bases ] → Image Processing Software R&D.

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## [I] Inspiration + Introduction :

Exploring Image Processing R&D Domains using multi-disciplinary approaches is suggested →

Recommender Systems/Self-Healing Mechanisms/Spin Glass Theory/Fuzzy Logic/QRNG-Devices or Services/ImageAI/ML/DL/IoT/High Performance Computing/SAP-HANA PAL/Mongo DB+Python for Heterogeneous Image Processing Environments.

[ index words/keywords ] → Please see the above mentioned Inspiration+Introduction.

### [a] Recommender Systems →

"A **recommender system**, or a **recommendation system** (sometimes replacing 'system' with a synonym such as platform or engine), is a subclass of [information filtering system](#) that seeks to predict the "rating" or "preference" a user would give to an item.<sup>[1][2]</sup> They are primarily used in commercial applications.

Recommender systems are utilized in a variety of areas and are most commonly recognized as playlist generators for video and music services like [Netflix](#), [YouTube](#) and [Spotify](#), product recommenders for services such as [Amazon](#), or content recommenders for social media platforms such as [Facebook](#) & [Twitter](#).<sup>[3]</sup> These systems can operate using a single input, like music, or multiple inputs within and across platforms like news, books, and search queries. There are also popular recommender systems for specific topics like restaurants and [online dating](#). Recommender systems have also been developed to explore research articles and experts,<sup>[4]</sup> collaborators,<sup>[5]</sup> and financial services.<sup>[6]</sup> "

[ Source – [https://en.wikipedia.org/wiki/Recommender\\_system](https://en.wikipedia.org/wiki/Recommender_system) ]

[ Source – <https://developers.google.com/machine-learning/recommendation> – Nice Tutorial.]

### [b] Complex Software Systems – Heal Thyself →

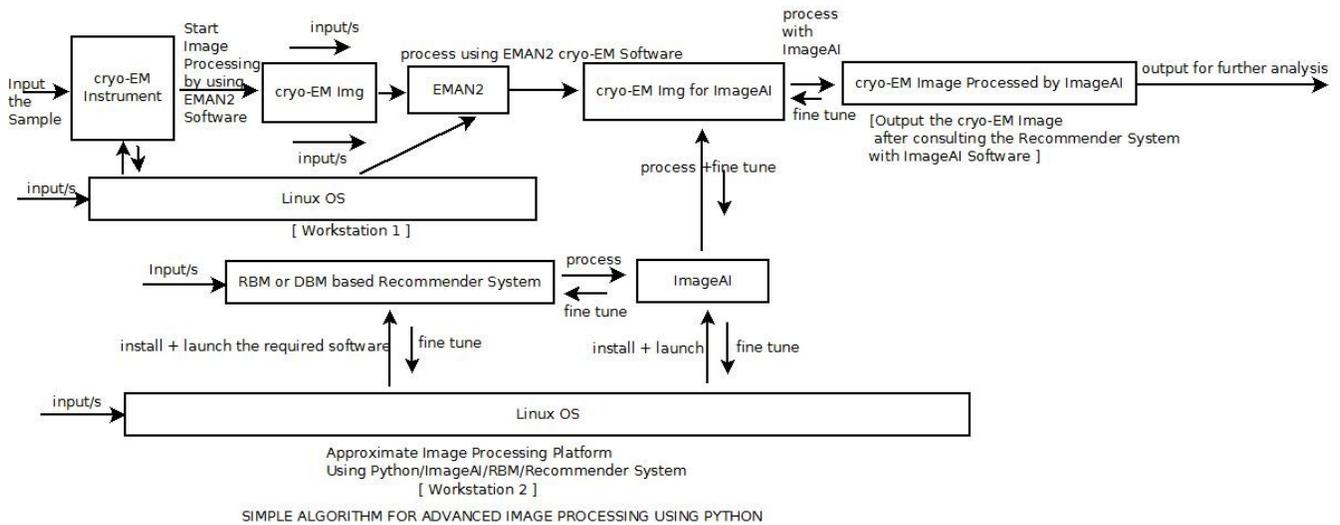
"(PhysOrg.com) -- Software underlies modern life, keeping everything from mobile phone networks functioning to planes in the air, but ensuring increasingly complex systems stay free of faults has become an epic task. What if software could heal itself? Researchers from Israel and six EU countries have carried out pioneering work on self-healing software capable of automatically and autonomously detecting, identifying and fixing errors in the copious lines of code that make up complex systems." [ <https://phys.org/news/2010-05-complex-software-thyself.html/> ]

[ Source – Complex Software Systems -- Heal Thyself 3 May 2010 ].

### [c] Some Useful Information → <https://www.longdom.org/open-access/a-tribute-to-father-of-fuzzy-set-theory-and-fuzzy-logic-dr-lotfi-azadeh-2090-4908-1000170.pdf>

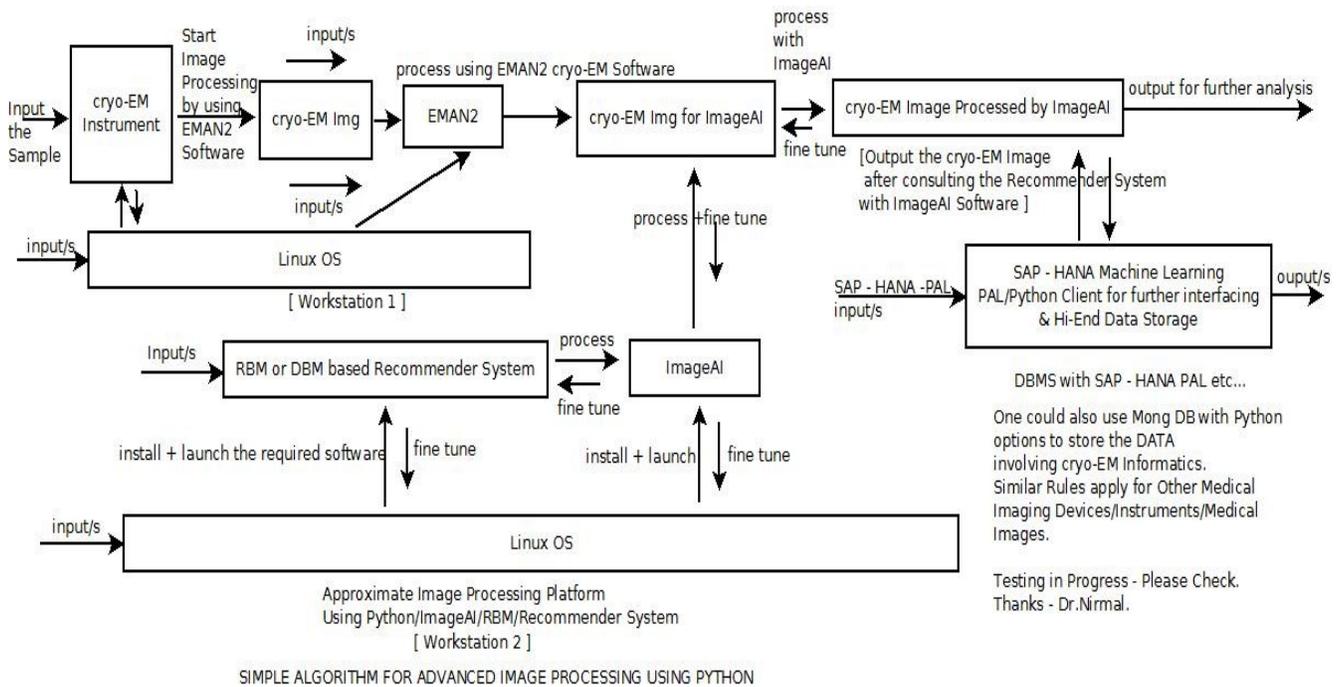
[ Ashfaq MS (2018) A Tribute to Father of Fuzzy Set Theory and Fuzzy Logic (Dr. Lotfi A. Zadeh). J Swarm Intel Evol Comput 7: 170. doi:10.4172/2090-4908.1000170 ]\*\*\*\*\*

## [II] Informatics R&D Framework Using Software Tools+Mathematics :



[ Figure I – Algorithm I – Image Processing Framework Using Python ]

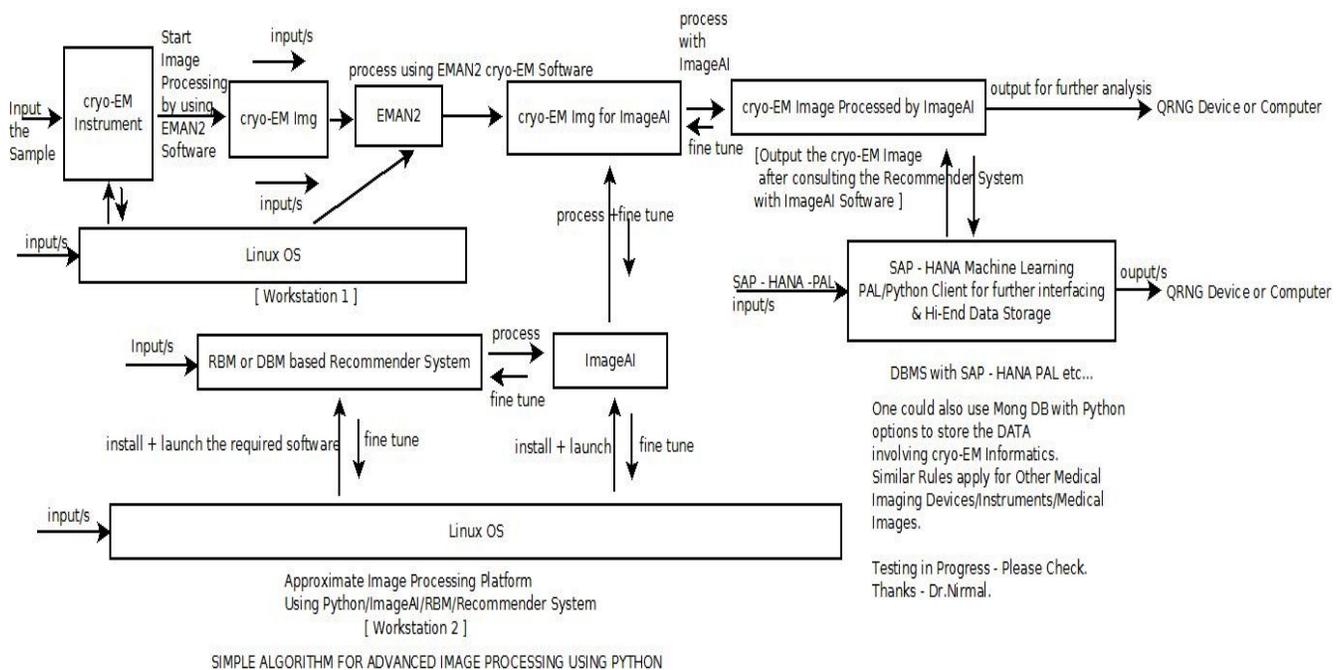
Approximate Ideas Only – Actual Implementation Will Certainly Vary – Please Check.



[ Figure II – Algorithm II – Image Processing Framework Using Python ]

Approximate Ideas Only – Actual Implementation Will Certainly Vary – Please Check.

\*\*\* We are not discussing here Hardware/Firmware/IoT/HPC related issues but only Image Processing Software R&D related issues. Please make a note of it. In the past, we have tested our Algorithms using Bosch-XDK-IoT/Raspberry PI/Solid Run/Zerynth/Other Smart Devices successfully \*\*\*



**[ Figure III – Algorithm III – Image Processing Framework Using Python ]**

Approximate Ideas Only – Actual Implementation Will Certainly Vary – Please Check.

**Algorithms I,II & III → Applied Physics Meets Deep Learning in the Context of Restricted Boltzmann Machines (RBMs) to Probe the Frontiers of Medical Images/Electron Microscopy(EM) Images Using :**

**Simple Description of our above mentioned Algorithm/s :**

- [a] Prepare the cryo-EM Samples and feed them to cryo-EM Instrumentation System.
- [b] Acquire the cryo-EM Images using the specified procedures.
- [c] Investigate them with EMAN2+Recommender System+ImageAI combination or individually. There is no particular order just check different options to suit your requirements to obtain the best possible image processing solutions. Here, we are presenting the reader with some options/suggestions only.
- [d] Further process+store the cryo-EM Data Sets using SAP-HANA PAL/Python Client Options/ Mongo DB-Py.
- [e] Monitor the output/s using QRNG Devices+Services based on certain Algorithms.
- [f] Conclude & Present your research findings.
- [g] Read all the specified literature 100% before starting or testing any Algorithm/s.

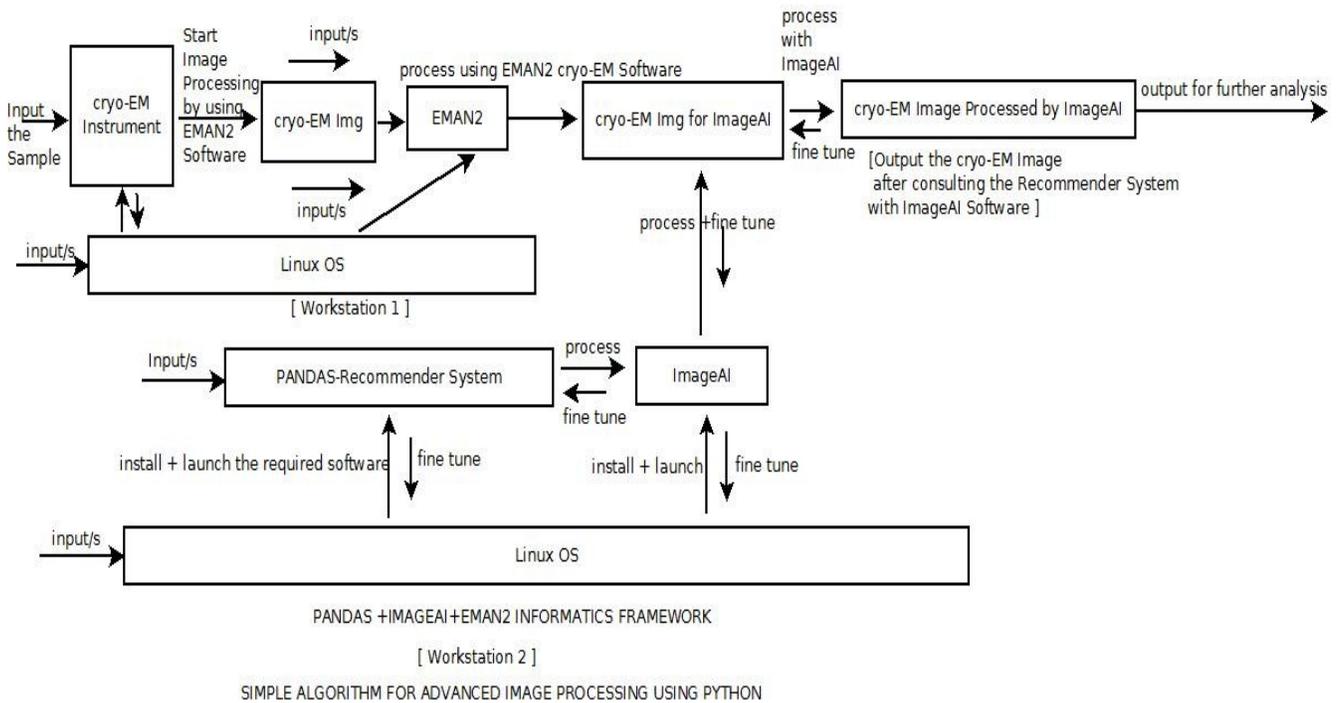
**Important Information on SAP-HANA PAL →**

{ “ **SAP HANA** is an in-memory database which keeps data resident in memory for quick access. At the same time, the physical disk storage is also used as a data backup and logging to prevent data loss in case of losing power. This architecture greatly reduced the time of data access and makes SAP HANA is “**High Speed**”.”

“PAL( Predictive Analysis Library) is one of the library under the AFL framework, mainly used for prediction and analysis , providing a lot of data mining algorithm. “

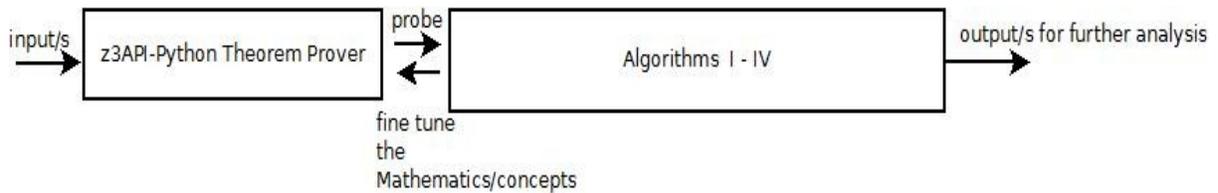
[ Source – <https://blogs.sap.com/2014/05/01/sap-hana-pal-quick-start/> ] }

## Pandas+ImageAI+EMAN2 Software Informatics Framework :

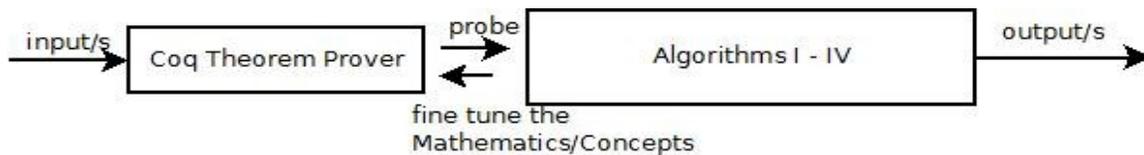


**[ Figure IV – Algorithm IV – Image Processing Framework Using Python ]**

Approximate Ideas Only – Actual Implementation Will Certainly Vary – Please Check.



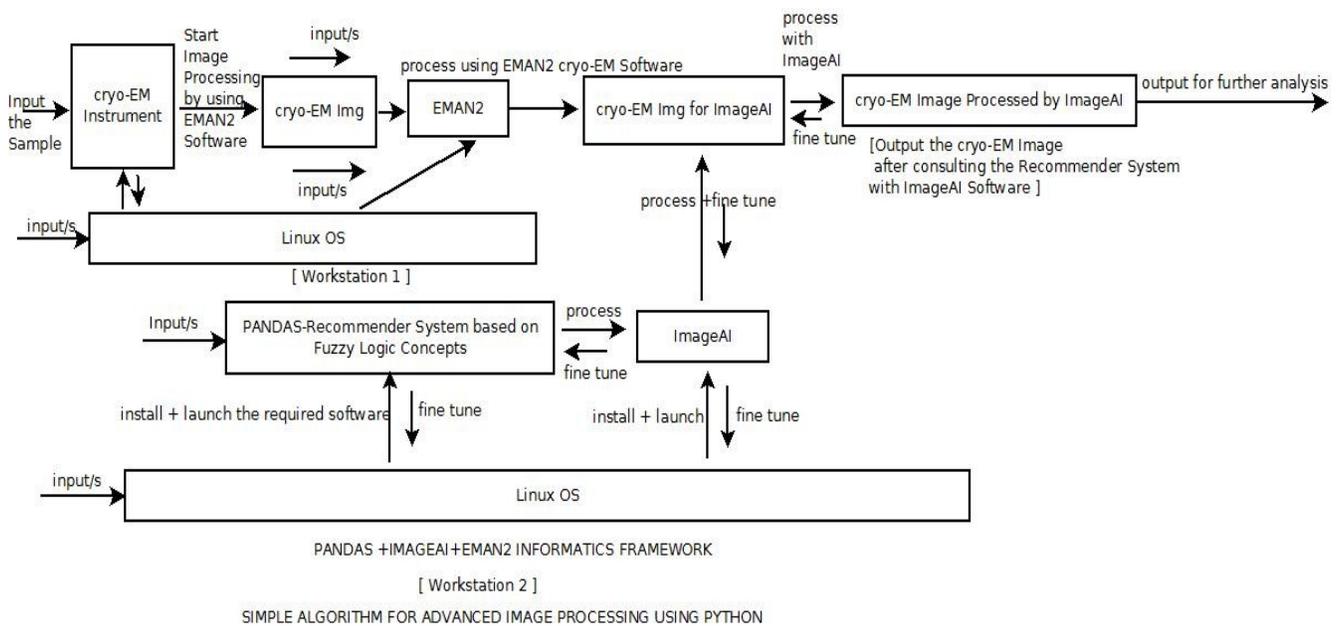
Algorithm for Theorem Proving With z3 API- Python Theorem Prover



Algorithm for Theorem Proving With Coq Theorem Prover + OCaml+Python interfacing.

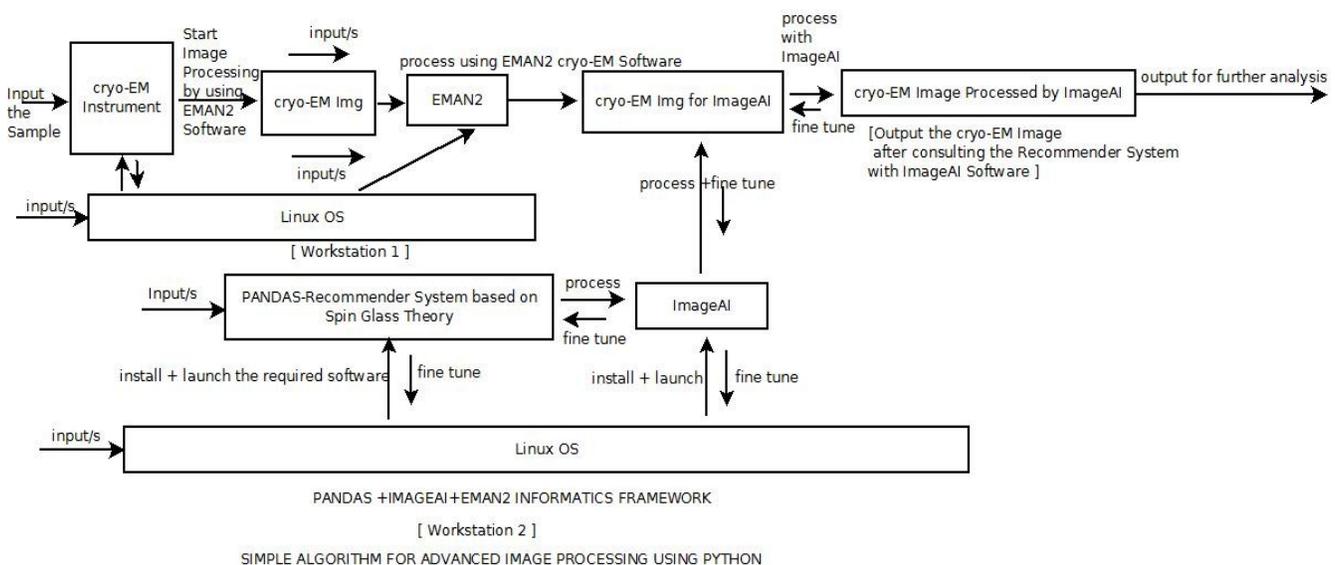
**[ Figure V – Algorithm V – Image Processing Framework Using Python ]**

Approximate Ideas Only – Actual Implementation Will Certainly Vary – Please Check.



**[ Figure VI – Algorithm VI – Image Processing Framework Using Python ]**

Approximate Ideas Only – Actual Implementation Will Certainly Vary – Please Check.



**[ Figure VII – Algorithm VII – Image Processing Framework Using Python ]**

Approximate Ideas Only – Actual Implementation Will Certainly Vary – Please Check.

[ To develop Python based Recommender Systems for Complex Tasks in Advanced Image Processing Software, we are suggesting here Spin Glass Theory or Fuzzy Logic Approaches. Further, it is also possible to implement Self-healing mechanisms in those applications. Testing in progress. Please Check & Satisfy Yourselves. Very much interesting+challenging for R&D. ]

[ \*\*\* Written in Free Style – No Specific Publication Format/s Followed ]

[ \*\*\* The methods, we present here, are applicable to both Medical Images & Electron Microscopy Images ]

### [III] Information on Publication Involving Mathematics+Software Used/Useful :

[a] <https://pypi.org/project/pydbm/> - Deep Learning Library: pydbm→

“ pydbm is Python library for building Restricted Boltzmann Machine(RBM), Deep Boltzmann Machine(DBM), Long Short-Term Memory Recurrent Temporal Restricted Boltzmann Machine(LSTM-RTRBM), and Shape Boltzmann Machine(Shape-BM). From the view points of functionally equivalents and structural expansions, this library also prototypes many variants such as Encoder/Decoder based on LSTM with an Attention mechanism, Convolutional Auto-Encoder, ConvLSTM, and Spatio-temporal Auto-Encoder.”

[b] <https://rubiksgcode.net/2018/10/22/implementing-restricted-boltzmann-machine-with-python-and-tensorflow/>

[c] <https://github.com/echen/restricted-boltzmann-machines>

[d] <https://heartbeat.fritz.ai/guide-to-restricted-boltzmann-machines-using-pytorch-ee501ed21a8>

[e] <https://towardsdatascience.com/deep-learning-meets-physics-restricted-boltzmann-machines-part-i-6df5c4918c15>

[f] <https://towardsdatascience.com/deep-learning-meets-physics-restricted-boltzmann-machines-part-ii-4b159dce1ffb>

[g] [Quantis QRNG Chip - ID Quantique](#) - [www.idquantique.com](http://www.idquantique.com) > Random Number Generation > Products

[h] <https://blogs.sap.com/2013/08/01/setting-up-hana-pal-for-use-with-sap-predictive-analysis-guide/> &&  
<https://blogs.sap.com/2014/05/01/sap-hana-pal-quick-start/> [ Excellent Information on SAP-HANA PAL ]

[i] <https://github.com/saphanaacademy/PAL>

[j] <https://blogs.sap.com/2019/02/07/machine-learning-with-sap-hana>

[k] <https://stackabuse.com/creating-a-simple-recommender-system-in-python-using-pandas/>

[l] <https://blake.bcm.edu/emanwiki/EMAN2> - cryo-EM Image Processing Software.

[m] <https://vixra.org/abs/1812.0454> - Our Own Technical Notes on Image Processing Using ImageAI.

[n] “A **recommender system** studies the past behaviour of a user and recommends relevant and accurate items for the user from a large pool of information. ...**Fuzzy logic** has been extensively used in the design of a **recommender system** to handle the uncertainty, impreciseness and vagueness in item features and user’s behaviour. Jan 11, 2018”

[ Source - [Fuzzy Logic in Recommender Systems | SpringerLink](#) ]

[o] [https://www-liphy.ujf-grenoble.fr/pagesperso/bahram/biblio/Zadeh\\_FuzzySetTheory\\_1965.pdf](https://www-liphy.ujf-grenoble.fr/pagesperso/bahram/biblio/Zadeh_FuzzySetTheory_1965.pdf) \*\*\*\*\*

[p] **Spin Glass Theory Information** - <https://global.oup.com/academic/product/statistical-physics-of-spin-glasses-and-information-processing-9780198509417?c>

[q] <https://blog.janestreet.com/using-python-and-ocaml-in-the-same-jupyter-notebook/> \*\*\*\*\*

[r] <https://www.radiologytoday.net/archive/rto118p10.shtml> → AI+Radiology Articles/Other Information.

[s] <https://www.apriorit.com/dev-blog/599-ai-for-image-processing> \*\*\*\*\* → Superb Technical Communication.

[t] [https://blogs.sciencemag.org/pipeline/archives/2013/08/16/an\\_hiv\\_structure\\_breakthrough\\_or\\_complete\\_rubbish](https://blogs.sciencemag.org/pipeline/archives/2013/08/16/an_hiv_structure_breakthrough_or_complete_rubbish)\*

[u] Reply to Subramaniam, van Heel, and Henderson: Validity of ...[www.ncbi.nlm.nih.gov/pmc/articles/PMC3831492](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3831492)\*

[v] <http://iopscience.iop.org/article/10.1088/0953-8984/28/50/501001/pdf>

[w] [https://en.wikipedia.org/wiki/Philip\\_Warren\\_Anderson](https://en.wikipedia.org/wiki/Philip_Warren_Anderson) – Nobel Prize Winner in Physics – 1977.

[x] [https://en.wikipedia.org/wiki/Spin\\_glass](https://en.wikipedia.org/wiki/Spin_glass)

[y] IJARITAC-10(2) 2019 (6) → Haskell based Cryo-EM Imaging/Machine Learning/Algorithms etc....

Kumar NT. [Higher Order Logic (HOL)-Haskell-Erlang FFI-Erlang Yanni Machine Learning Library]-Based Mechanisms to Implement Cryo-EM Image Processing Framework/s in the Context of Electron Microscopy Heterogeneous Computing and Informatics R&D Environment/s-An Interesting Insight and Short Technical Communication. International Journal of Applied Research on Information Technology and Computing (IJARITAC) 2019;10(2):43-47.

[z] **Information on Theorem Provers :**

[z<sub>a</sub>] <https://coq.inria.fr> – Coq Theorem Prover → Always interesting for future challenges in R&D.  
[ INRIA – France ]

[z<sub>b</sub>] <http://z3prover.github.io/api/html/z3.html> → Always interesting for future challenges in R&D.  
[ Microsoft ]

**[IV] Acknowledgment/s :**

Special Thanks to all WHO made this happen in my Life. Non-Profit R&D.

**[V] Conclusion/s With Future Perspectives :**

Developing Image Processing Software using multi-disciplinary approaches is highly useful.Hence,this presentation.

**Rigorous Testing in Progress.**

**R&D Algorithms → Designing + Developing Complex Software Systems With Self-Healing Mechanisms.**

**Think Different → Go Against the Flow.**

**Thanks.**

**[VI] Important References :**

[1].<http://people.cs.vt.edu/karpatne/teaching/MLmeetsPhysics>

[2].<https://www.microsoft.com/en-us/research/event/physics-ml-workshop/>

[3].<https://arxiv.org/pdf/1903.03516>

[4].<https://www.semanticscholar.org/author/Nirmal-Kumar/12354503/suggest>

[5].<http://www.math.unist.ac.kr/~yunhokim>

**[VII] Our Short Communications & Suggestions (((via))) Vixra.org :**

[a] <http://www.vixra.org/author/nirmal>

[b] [http://www.vixra.org/author/d\\_n\\_t\\_kumar](http://www.vixra.org/author/d_n_t_kumar)

[c] [http://www.vixra.org/author/n\\_t\\_kumar](http://www.vixra.org/author/n_t_kumar)

[d] [http://www.vixra.org/author/nirmal-tej\\_kumar](http://www.vixra.org/author/nirmal-tej_kumar)

**[ THE END ]**

**Dated : 23<sup>rd</sup> February 2020.**