

A Suggestion on CLIPS/JIProlog/JNNS/ImageJ/Java Agents/JikesRVM Based Analysis of Cryo-EM/TEM/SEM Images Using HDF5 Image Format – Some Interesting & Feasible Implementations of Expert Systems to Understand Nano-Bio Material Systems and Electron Microscopy Applications.

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Abstract :

In this short communication the importance of expert systems based imaging framework to probe Cryo-EM images is presented from a practical implementation point of view. Neural Networks or NN are an excellent tool to probe various domains of science and technology. Cryo-EM Technique holds bright future based on the application of NN. Prolog-NN based algorithms could form a powerful informatics and computational framework for researching the challenges of nano-bio Applications. Further, it is useful and important to study the behavior of NN in domains where knowledge does not exist, i.e. to use the models to make bold predictions which form the basis for Cryo-EM Image Processing tasks and the discovery of new nano-bio phenomena. Indeed, the performance of NN is most useful to researchers in domains where the modeling and predicting “uncertainty” is known to be the greatest factor. All the methods presented here are also applicable to TEM/SEM/other EM Image Processing tasks as well.

keywords: Prolog/NN/Expert Systems/JikesRVM/Informatics/EM/Cryo-EM/TEM/SEM/Material Science/Java Agents/Nanotechnology.

Introduction :

Neural networks are promising and very good at solving a wide variety of problems, most of which involve finding trends in large quantities of data. They are only getting better for NP-Hard problems involving complex data. For example, in challenging aspects of Cryo-EM image processing technique. And researchers worldwide are continually constructing neural networks that are better in providing solutions to these type of problems.

Inspiration :

“A traditional digital computer does many tasks very well. It's quite fast, and it does exactly what you tell it to do. Unfortunately, it can't help you when you yourself don't fully understand the problem you want solved. Even worse, standard algorithms don't deal well with noisy or incomplete data, yet in the real world, that's frequently the only kind available. One answer is to use an artificial neural network (ANN), a computing system that can learn on its own.” - by Alexx Kay – Computer World dated Computerworld - Feb 12, 2001.

{ Source : <http://www.computerworld.com/article/2591759/app-development/artificial-neural-networks.html> }

"Neural networks allow you to solve problems you don't know how to solve, said Leon Reznik, a professor of computer science at the Rochester Institute of Technology. Slowly, neural networks are seeping into industry as well. Micron and IBM are building hardware that can be used to create more advanced neural networks. On the software side, neural networks are slowly moving into production settings as well.” - by Joab Jackson U.S. Correspondent, IDG News Service | Dec 18, 2013.

{ Source : http://www.computerworld.com/article/2486964/emerging-technology/biologically-inspired--how-neural-nets-are-finally-maturing.html#tk.drr_mlt }

“ There are difficult problems in materials science where the general concepts might be understood but which are not as yet amenable to scientific treatment. Neural networks have had a significant impact on the development of materials and associated processes. This is because they represent a transparent and quantitative method which is able to deal with sophisticated problems typical in materials science.” by BHADESHIA./BHADESHIA et al.

Neural Networks in Materials Science by H.K.D.H BHADESHIA, University of Cambridge, UK. Department of Materials Science and Metallurgy. { Source : www.msm.cam.ac.uk/phase-tra }

To understand this technical note or communication the readers are advised to be familiar with : Prolog/Java/C/Concepts of Cryo-EM Image Processing, Neural Networks. Software used to test the ideas are CLIPS/JNNS/JI Prolog/ImageJ/JikesRVM. CLIPS has extensive manuals and examples for the readers to understand (first timers). Experts can easily develop novel applications straight away.

Informatics Framework Design,Implementation & Analysis :

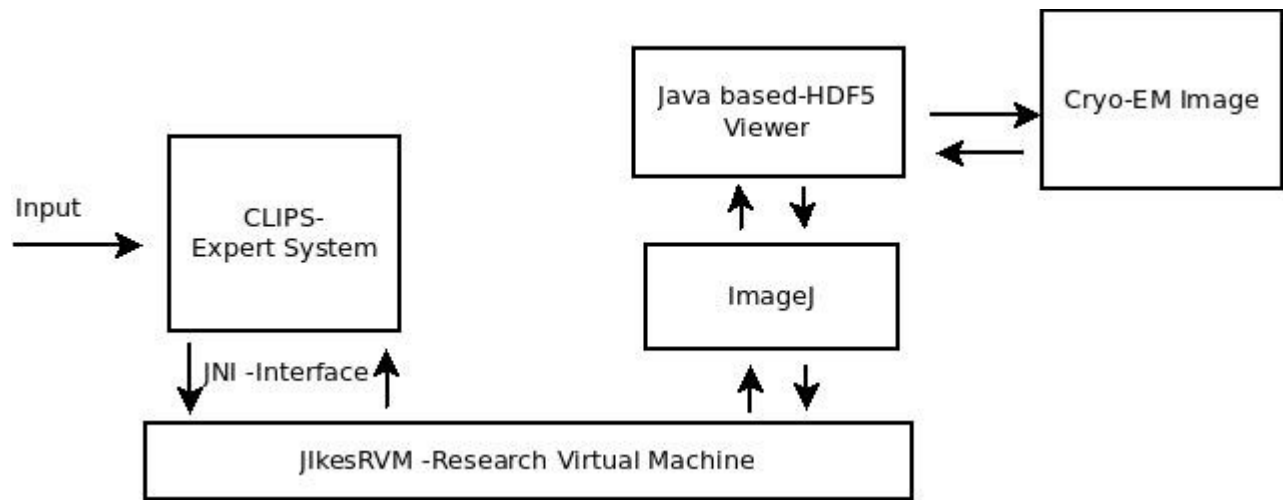


Figure I. CLIPS based Expert System Implementation

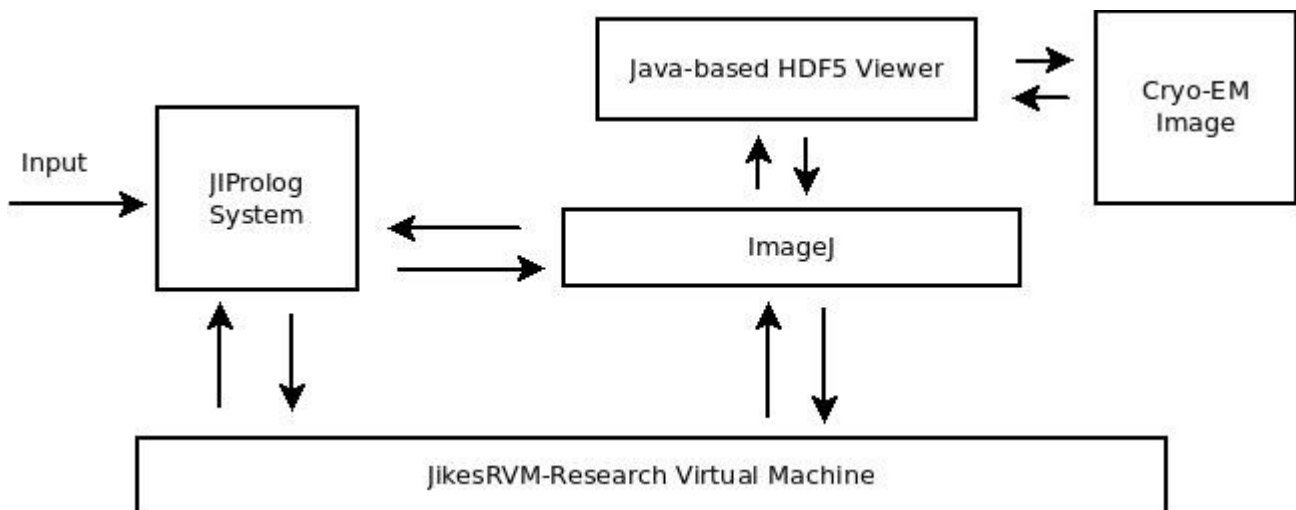


Figure II. JIProlog based Expert System Implementation

Note : Eclipse IDE or Netbeans IDE could be used to experiment with Cryo-EM Image Processing.

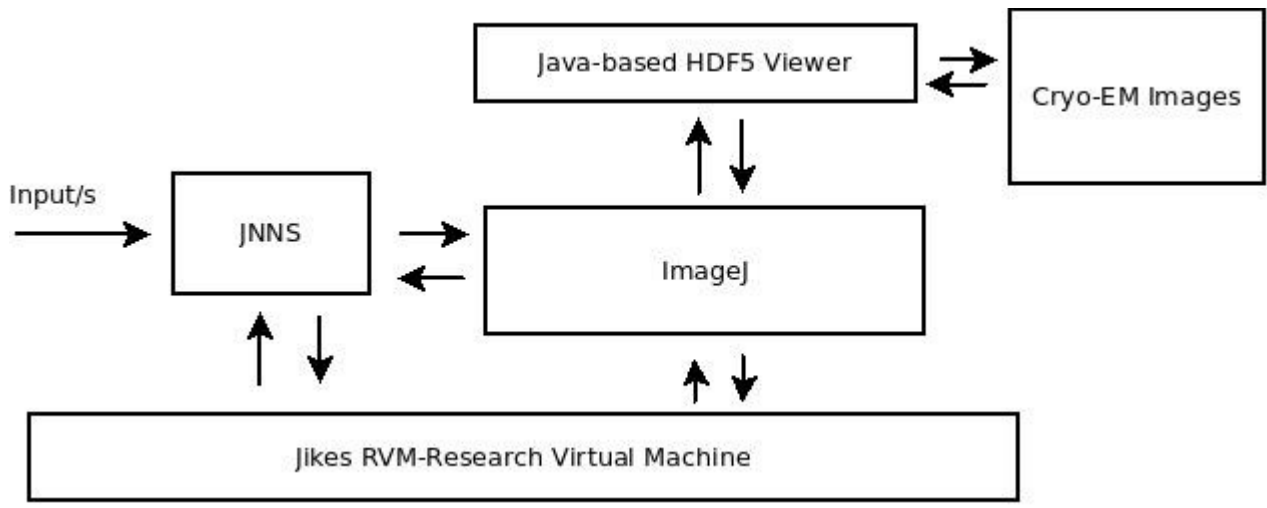


Figure III. JNNS based Expert System Implementation

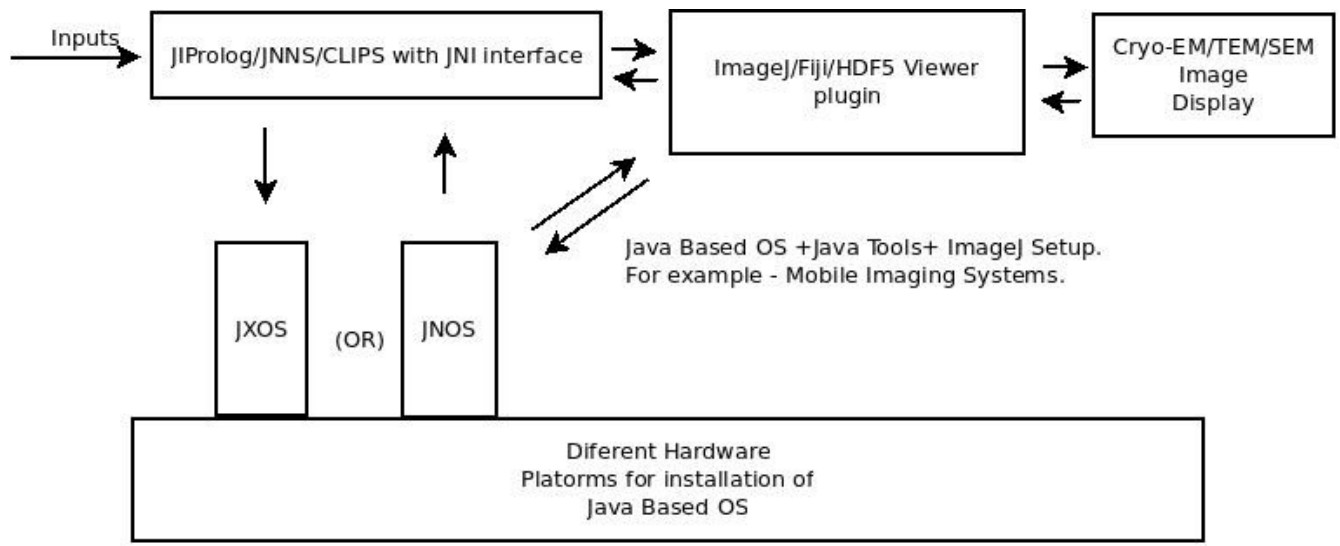


Figure IV. JxOS/JnOS Based Schema - Mobile Imaging Systems
 (Experimenting by focusing on future image processing in mobile environments/HPC/IoT)

Please make a note : When dealing with Java based Operating Systems like JxOS/JnOS, in the first instance try to play with Oracle virtualbox or any other virtual machine. Satisfy yourself and then proceed with your experimental architectures on different hardware/software platforms.

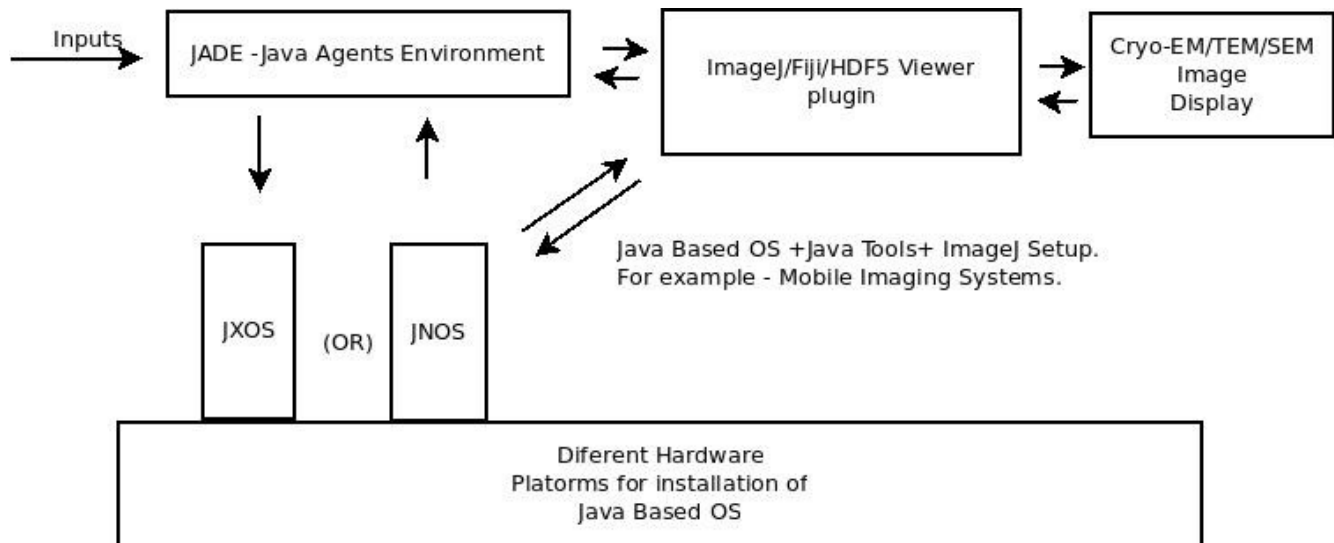


Figure V. JxOS/JnOS JADE Based Schema - Mobile Imaging Systems
 (Experimenting by focusing on future image processing in mobile environments/HPC/IoT)

Some Explanation :

Figures from I-V are designed implemented and tested based on References from [1-9] shown below. CLIPS, JIProlog and JNNS are very useful tools in designing, implementing and testing novel Electron-microscopy image processing frameworks in the IoT/HPC Environment. So far, this is one of the pioneering research papers to highlight “C-Prolog-Java-NN-JxOS/JnOS based solutions” to tackle Electron-Microscopy Image Processing based challenging tasks to handle Nano-Bio Material Systems.

JNOS - “JNode is a simple to use & install Java operating system for personal use. It runs on modern devices. Any java application will run on it, fast & secure”. See the additional information section below.

JXOS - “JX is a flexible Java Operating System that can be customized for different execution environments. It provides separate protection domains for operating system components. Each protection domain may have its own execution environment.” See the additional information section below. JX is a Java operating system that focuses on a flexible and robust operating system architecture.

NetbeansIDE/EclipseIDE/OSGi concepts are on the web. Readers could visit those websites for more information. For example – JADE Java Agents Environment was run by the developers using Eclipse IDE.

Please note – Only approximate frameworks are shown in this paper to encourage the readers. Actual implementations will vary. The readers are advised to check all the references and the additional materials provided in this paper to develop their research further.

Conclusion with Future Perspectives :

Different implementations of an expert system frameworks involving Jikes RVM/JIProlog/JNNS are successfully presented with a promising potential to extend these frameworks over Internet of Things Environment(IoT).JIProlog/NN are very useful in the IoT scenario.Future scientific instruments will work using IoT/High Performance Computing Architectures/Mobile Image Processing Systems based on Jade/JxOS/JnOS.

Additional Information on Mathematics & Software Used :

[a]. <https://www.ma.utexas.edu/users/hadani/>

[b]. <http://www.math.tau.ac.il/~bernstei/>

[c]. <https://sourceforge.net/projects/jikesrvm/> - Jikes RVM is a flexible infrastructure for virtual machine research.

[d]. <http://cryoem.berkeley.edu/cryoem>

[e]. https://lmb.informatik.uni-freiburg.de/resources/opensource/imagej_plugins/hdf5.html – ImageJ/Fiji etc..

[f]. <https://support.hdfgroup.org/HDF5/> && <https://imagej.nih.gov/ij/>

[g]. <http://www.jiprolog.com/> ; http://www.ra.cs.uni-tuebingen.de/software/JavaNNS/welcome_e.html

[h]. <http://www.swi-prolog.org/> ; <http://clipsrules.sourceforge.net/> { CLIPS Expert System } ;

[i].<http://www.clipsrules.net/?q=AboutCLIPS>

{ **CLIPS** - was developed at NASA's Johnson Space Center from 1985 to 1996, the 'C' Language Integrated Production System (CLIPS) is a rule-based programming language useful for creating expert systems. }

[j]. <http://www.cs.cmu.edu/afs/cs/project/ai-repository/ai/areas/expert/systems/babylon/0.html>

{ **BABYLON** - BABYLON is a modular, configurable, hybrid environment for developing expert systems. Its features include objects, rules with forward and backward chaining, logic (Prolog) and constraints. BABYLON is implemented and embedded in Common Lisp,Source : [j] }

[k].<https://www4.cs.fau.de/Projects/JX/publications/jx-sec.pdf> / <https://www4.cs.fau.de/Projects/JX> ; <https://www4.cs.fau.de/Projects/JX/poster/jx-poster.pdf> – JXOS – Java OS.

[l]. <http://www.jnode.org/> ; <https://sourceforge.net/projects/jnode/> - JNode OS – Java OS.

[m]. <http://jade.tilab.com/> - JAVA Agent DEvelopment Framework is an open source platform for peer-to-peer agent based applications. Useful in Mobile Imaging & Informatics.

(It is useful if the readers are familiar with Prolog/LISP/Java languages and concepts.)

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References :

[1].<https://www.phase-trans.msm.cam.ac.uk/abstracts/neural.review.html>

[2]. <https://cs.stanford.edu/people/eroberts/courses/soco/projects/neural-networks/Future/index.html>

[3]. https://en.wikipedia.org/wiki/Artificial_neural_network

[4]. Understanding JikesRVM in the Context of Cryo-EM/TEM/SEM Imaging Algorithms and Applications –A General Informatics Introduction from a Software Architecture View Point by D.N.T. Kumar and Gagik Shmavonyan;DOI: 10.5958/0975-8089.2016.00001.4 (or)
<https://www.researchgate.net/publication/303462482>

[5]. <https://cs.stanford.edu/people/eroberts/courses/soco/projects/neural-networks/Sources/index.html>

[6]. https://www.phase-trans.msm.cam.ac.uk/2009/review_Bhadeshia_SADM.pdf

[7]. <https://www.phase-trans.msm.cam.ac.uk/2009/performance.html>

[8].Christaller, T., Di Primio, F., Vo', A. (eds). "The AI-Workbench BABYLON: An open and portable development environment for expert systems", Academic Press, London, 1992, ISBN 0-12-174235-0.

[9].Christaller Th., di Primio F., Voss A. (Hrsg.), "Die KI-Werkbank Babylon: Eine offene und portable Entwicklungsumgebung fuer Expertensysteme" Addison-Wesley, Bonn, 1989. ISBN 3-89319-155-0.