**Questions regarding HTM – (Itay, openHTM)**

**Itay Somebody** [itay2541 at yahoo.com](mailto:nupic%40lists.numenta.org?Subject=Re%3A%20%5Bnupic%5D%20Questions%20regarding%20HTM&In-Reply-To=%3C1369116062.73469.YahooMailNeo%40web163805.mail.gq1.yahoo.com%3E)   
*Tue May 21 02:01:02 EDT 2013*

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Hi Jeff

Thank you for the good answers..

Indeed I hope that Numenta will share some information about how CLA hierarchies work / other experiments

But in general it's a long chase after relevant information in biological research papers..

I want to expand my question about the temporal pooler :

We in OpenHTM are having problems with a problem we  call "context forking". We've been trying to deal with it for about two months now and have a few directions. It's almost certainly you have encountered this problem in the past and have dealt with it.

OK, this problem goes like this : If you give (the region's temporal pooler) a repeating sequence input such "ABBCBB" or "AAAX" or "ABABABC", then in all of these examples there's a context forking property - after "B" there could be "A", "B", or "C" - or after "A" there could be "A" or "X" (in the "AAAX" example). In all of these examples we've had problems with learning and couldn't get the temporal pooler to learn these sequences well.

Some harder real-world example we've been trying to work with that fully demonstrates the forking problem is an animation of a ball that jumps up and down.

Here are some questions that can help to pinpoint where to look

1) In one old research paper published in association with Numenta, there was a mention of an algorithm called "State splitting algorithm" in regards to learning the sequences in the temporal pooler. Is there still use of such an algorithm?

2) When learning, do you always form segments from the current active cells to the last learning cells? (or is there a possibility that you will learn to other kinds of cells who are not previous learning cells?). There was not even mention in the whitepaper for learning to the last learning cells - we've had to figure this on our own..

3) Does making simple experiments for debugging the temporal pooler, such as one column active for 'A', one column active for 'B', one column active for 'C' makes sense? or does the temporal pooler algorithm designed to only work with many active columns at once with large scale action?

4) When using "boosting" from the spatial pooler, does the boosting separates the patterns who share input '1' bits into a completely different and separated '1' columns or is there always a specific acceptable percentage of overlapping columns?

5) Is there some acceptable percentage of overlapping columns between sequential timeframes that the temporal pooler can accept? Does the temporal pooler designed to work at all without applying boosting and separating overlapping '1' bits in the inputs between sequential timeframes into non-overlapping columns? does the temporal pooler must have spatial boosting otherwise it wouldn't work?

6) Should the predictions made by the temporal pooler be completely noise-free and completely clear even for complex sequence?

7) In my experiments I have designed an experimental temporal pooler that only forms a linked list to the last learning cells using one segment per cell maximum. That's an experimental design that works to some degree, but I wonder what are the principles that makes you able to reuse the same cell for other patterns/context and what is the way to choose which cell in the column to insert or delete segment, and which segment to mess with.

Sorry if my language causes problems, I'm not an American native speaker :)

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Itay

OpenHTM team

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From: Jeff Hawkins <[jhawkins at numenta.org](http://lists.numenta.org/mailman/listinfo/nupic_lists.numenta.org)>

To: 'NuPIC general mailing list.' <[nupic at lists.numenta.org](http://lists.numenta.org/mailman/listinfo/nupic_lists.numenta.org)>

Sent: Tuesday, May 21, 2013 1:46 AM

Subject: Re: [nupic] Questions regarding HTM

Itay,

- High order sequences, such as ABBCBB are handled by using a columns of cells.  This is detailed in the CLA whitepaper and I have talked about it in numerous talks available online.   The short answer is every cell in a column has the same feedforward receptive field (spatial pooler feature) but each cell responds differently in temporal context.  If we have two learned sequences ABCD and XBCY the BC part will invoke the same columns in both sequences but a unique cell within those columns.  Sometimes we write this as ABCD and  XB’C’Y.  If we have 2000 columns and 40 are active at a time and 10 cells per column, then there are 10^40 ways to represent the same input pattern in different contexts.  Almost all these representations will share 4 out of 40 cells (because there are only ten cells per column) and therefore are easily distinguishable.  The CLA can learn arbitrarily high order sequences.  Sorry if you already knew this and were

asking a more detailed question.  If so then please restate the question in more detail.

- We did some work with CLAs in a hierarchy.  The biggest issue we had was the time it took to run our experiments.  These were vision experiments that required a lot of resources and ran slowly.  It could take a day or two sometimes to run experiments.  Hierarchies would be more practical in simpler problems.  This is a big topic in that it gets into all sorts of questions about exactly how the hierarchy should work.  We have a general understanding but it remains a research project.

- We settled on a single CLA region because we found it was very useful and fast enough that we could make a practical product with it.  Real machine intelligence will require large hierarchies.  These will likely require HW acceleration.  There are people interested doing that.

- The open source project came about because people were asking for it.  Some want to study the algorithms from a research and academic point of view.  Others want to build them into products.  We don’t know yet how people will contribute.  Here are a few ideas.

Improve performance/execution time.  Although we spent a lot of time on this there are probably some big wins we missed.

Characterize the algorithms and contrast them to other models.

Apply the CLA to other data types such as text, music, etc.

Work on getting CLA to work in hierarchies.

Help with documentation and references for biological machine intelligence.

And my favorite, and a big one, add a motor component.  All regions in the neocortex do both inference and generate behavior.  We know a lot about how this is done but there are still mysteries.  Goals would be part of this effort.

- There are no great sources to recommend on how the neocortex works.  The difficulty is there is so much of it in fractured form that is hard to read.  One of my goals for NuPIC is to accelerate the creation and distribution of this type of knowledge.  I will be writing about what we have learned and posting regularly (hopefully).

Jeff

From:nupic [mailto:[nupic-bounces at lists.numenta.org](http://lists.numenta.org/mailman/listinfo/nupic_lists.numenta.org)] On Behalf Of Itay Somebody

Sent: Monday, May 20, 2013 2:53 PM

To: [nupic at lists.numenta.org](http://lists.numenta.org/mailman/listinfo/nupic_lists.numenta.org)

Subject: [nupic] Questions regarding HTM

Hi, I have questions that are not related to nupic but are related to Numenta in general.

First, I would like to say I like the approach the algorithm takes so far. It makes a relatively simple, structural and biological approach, rather than a complex mathematical formalization.

I have some questions about the temporal pooler - for an example, how does the algorithm learns the sequence "ABBCBB" while still able to maintain contextual information. But I'm guessing these questions will be answered when the nupic source will come out.

I have other questions :

What problems did Numenta encounter with hierarchy of regions? why did the progress have stopped with one region only? what problems are you working on right now and what do you want to solve? What kind of cooperation are you looking for from open source developers?

What about the state of the development of a feedback mechanism, and some ideas of a goal chasing module?

Does more simulated neuronal layers are needed to provide full cognitive abilities? or is it enough to have just the CLA regions as it is (with feedback) connected in hierarchy?

And what is the most efficient way (in your experience) to get knowledge/experiments information about how the neocortex works in detail level?

Thanks

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Itay

OpenHTM team

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nupic mailing list

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