

# OPTIMISING LLS IN CNNs

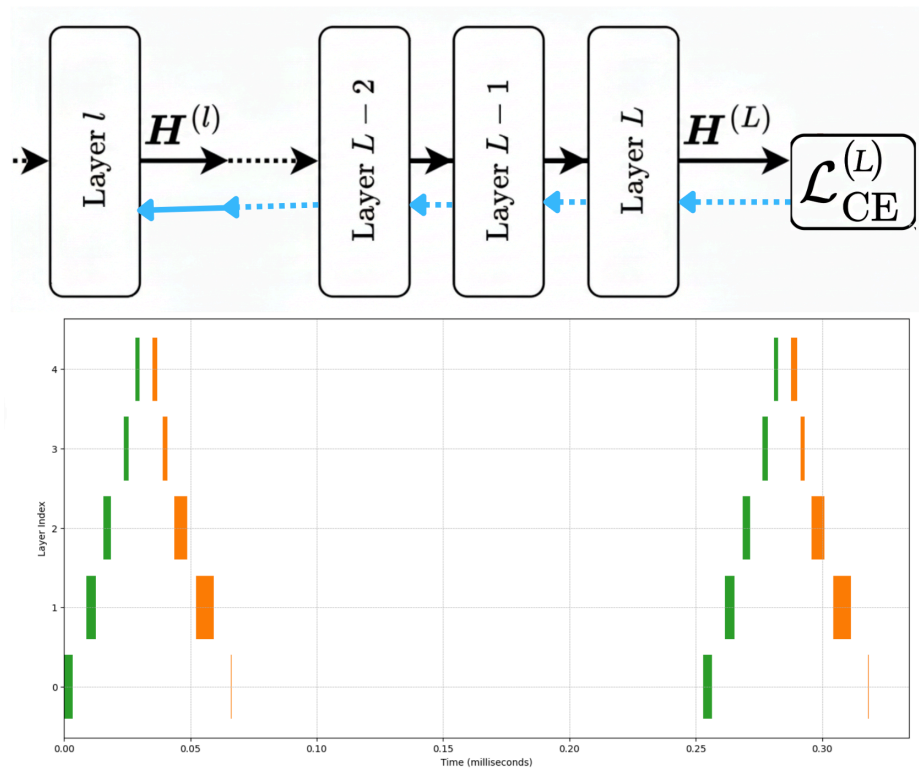
# LLS in CNNs::

LLS: Local Learning Rule for Deep Neural Networks Inspired by Neural Activity Synchronisation  
by Marco P. E., Apolinario, Arani Roy , Kaushik Roy

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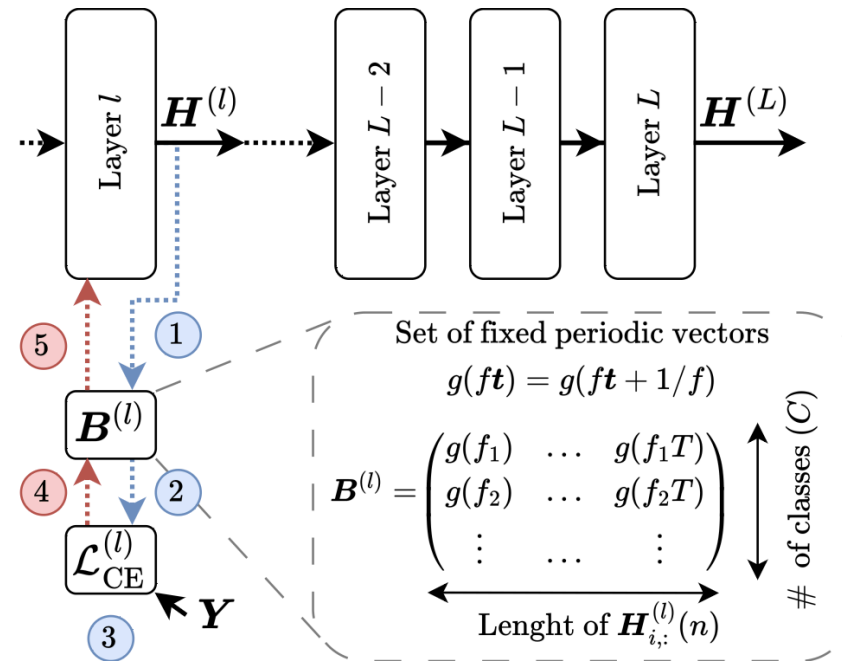
- Problem::  
In CNN's;  
BP: non-locality and update-locking



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BP: non-locality and update-locking
- Solution::  
Synchronise at layer-level to features  
~~BP: non-locality and update-locking~~

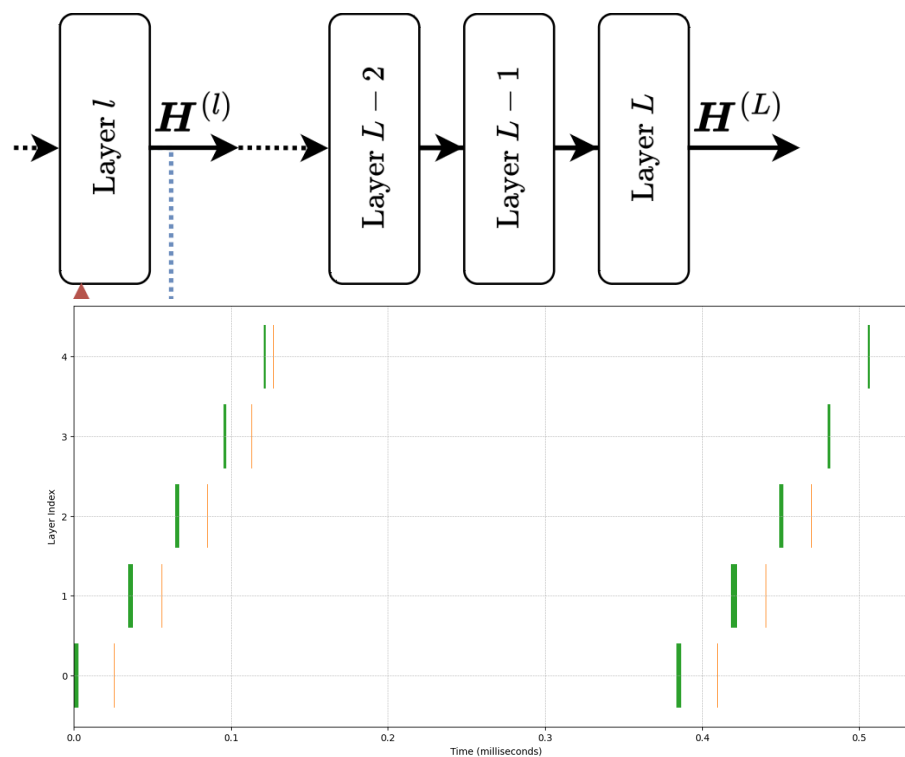


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- Solution::  
Synchronise at layer-level to features  
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# Evaluation::

## On training:

- T = 9mins;
  - dataset CIFAR10 —num-epochs 25
  - training-mode BP ...

- T = 11mins;
  - dataset CIFAR10 —num-epochs 25
  - training-mode LLS ...

The image displays two side-by-side Google Colab notebooks, both titled 'Untitled1.ipynb', showing the training progress of a CIFAR10 model. The left notebook is configured for training mode 'BP' (Backpropagation) with 25 epochs, while the right notebook is configured for training mode 'LLS' (Least Squares) with 25 epochs. Both notebooks show a table of training and testing metrics (Loss, Acc@1, Acc@5) for each epoch. The left notebook shows a final accuracy of 99.84% at epoch 25, while the right notebook shows a final accuracy of 99.84% at epoch 25.

**Left Notebook (BP Training Mode):**

```
!cd LLS-DNN/; python main.py --dataset CIFAR10 --num-epochs 25 --training-mode BP --lr 0.01 --test-batch-size 128 --optimizer Adam
```

Epoch	Time	Loss	Acc@1	Acc@5
151	0.022	0.010	0.818	0.990
152	0.022	0.010	0.818	0.990
153	0.022	0.010	0.818	0.990
154	0.022	0.010	0.818	0.990
155	0.022	0.010	0.818	0.990
156	0.022	0.010	0.818	0.990
157	0.022	0.010	0.818	0.990
158	0.022	0.010	0.818	0.990
159	0.022	0.010	0.818	0.990
160	0.022	0.010	0.818	0.990
161	0.022	0.010	0.818	0.990
162	0.022	0.010	0.818	0.990
163	0.022	0.010	0.818	0.990
164	0.022	0.010	0.818	0.990
165	0.022	0.010	0.818	0.990
166	0.022	0.010	0.818	0.990
167	0.022	0.010	0.818	0.990
168	0.022	0.010	0.818	0.990
169	0.022	0.010	0.818	0.990
170	0.022	0.010	0.818	0.990
171	0.022	0.010	0.818	0.990
172	0.022	0.010	0.818	0.990
173	0.022	0.010	0.818	0.990
174	0.022	0.010	0.818	0.990
175	0.022	0.010	0.818	0.990
176	0.022	0.010	0.818	0.990
177	0.022	0.010	0.818	0.990
178	0.022	0.010	0.818	0.990
179	0.022	0.010	0.818	0.990
180	0.022	0.010	0.818	0.990
181	0.022	0.010	0.818	0.990
182	0.022	0.010	0.818	0.990
183	0.022	0.010	0.818	0.990
184	0.022	0.010	0.818	0.990
185	0.022	0.010	0.818	0.990
186	0.022	0.010	0.818	0.990
187	0.022	0.010	0.818	0.990
188	0.022	0.010	0.818	0.990
189	0.022	0.010	0.818	0.990
190	0.022	0.010	0.818	0.990
191	0.022	0.010	0.818	0.990
192	0.022	0.010	0.818	0.990
193	0.022	0.010	0.818	0.990
194	0.022	0.010	0.818	0.990
195	0.022	0.010	0.818	0.990
196	0.022	0.010	0.818	0.990
197	0.022	0.010	0.818	0.990
198	0.022	0.010	0.818	0.990
199	0.022	0.010	0.818	0.990
200	0.022	0.010	0.818	0.990
201	0.022	0.010	0.818	0.990
202	0.022	0.010	0.818	0.990
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222	0.022	0.010	0.818	0.990
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224	0.022	0.010	0.818	0.990
225	0.022	0.010	0.818	0.990
226	0.022	0.010	0.818	0.990
227	0.022	0.010	0.818	0.990
228	0.022	0.010	0.818	0.990
229	0.022	0.010	0.818	0.990
230	0.022	0.010	0.818	0.990
231	0.022	0.010	0.818	0.990
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240	0.022	0.010	0.818	0.990
241	0.022	0.010	0.818	0.990
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246	0.022	0.010	0.818	0.990
247	0.022	0.010	0.818	0.990
248	0.022	0.010	0.818	0.990
249	0.022	0.010	0.818	0.990
250	0.022	0.010	0.818	0.990

**Right Notebook (LLS Training Mode):**

```
!cd LLS-DNN/; python main.py --dataset CIFAR10 --num-epochs 25 --training-mode LLS --lr 0.01 --test-batch-size 128 --optimizer Adam
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# Goals::

## Hierarchy

- CUDA implementation for the SmallConv (5-layer) LLS;
- CUDA implementation for the SmallConv (5-layer) LLS-M; LLS-MxM
- (CUDA implementation for the VGG8, MobileNet-V1 LLS;...)

- Generalising this approach to provide Parallel Local Learning Support using more generic framework via Triton for LLS; LLS-M; LLS-MxM; future-variants

Feedback:  
Check feasibility of purple goal  
thoroughly to deliver that.

“Gratitude is not only the  
greatest of virtues, but  
the parent of all others”

MARCUS TULLIUS CICERO



“Thank you”,  
TAs Ayush, Rahul:  
timely help, believing in me.  
Teachers Gopal, Karthik:  
for this opportunity and teachings : )