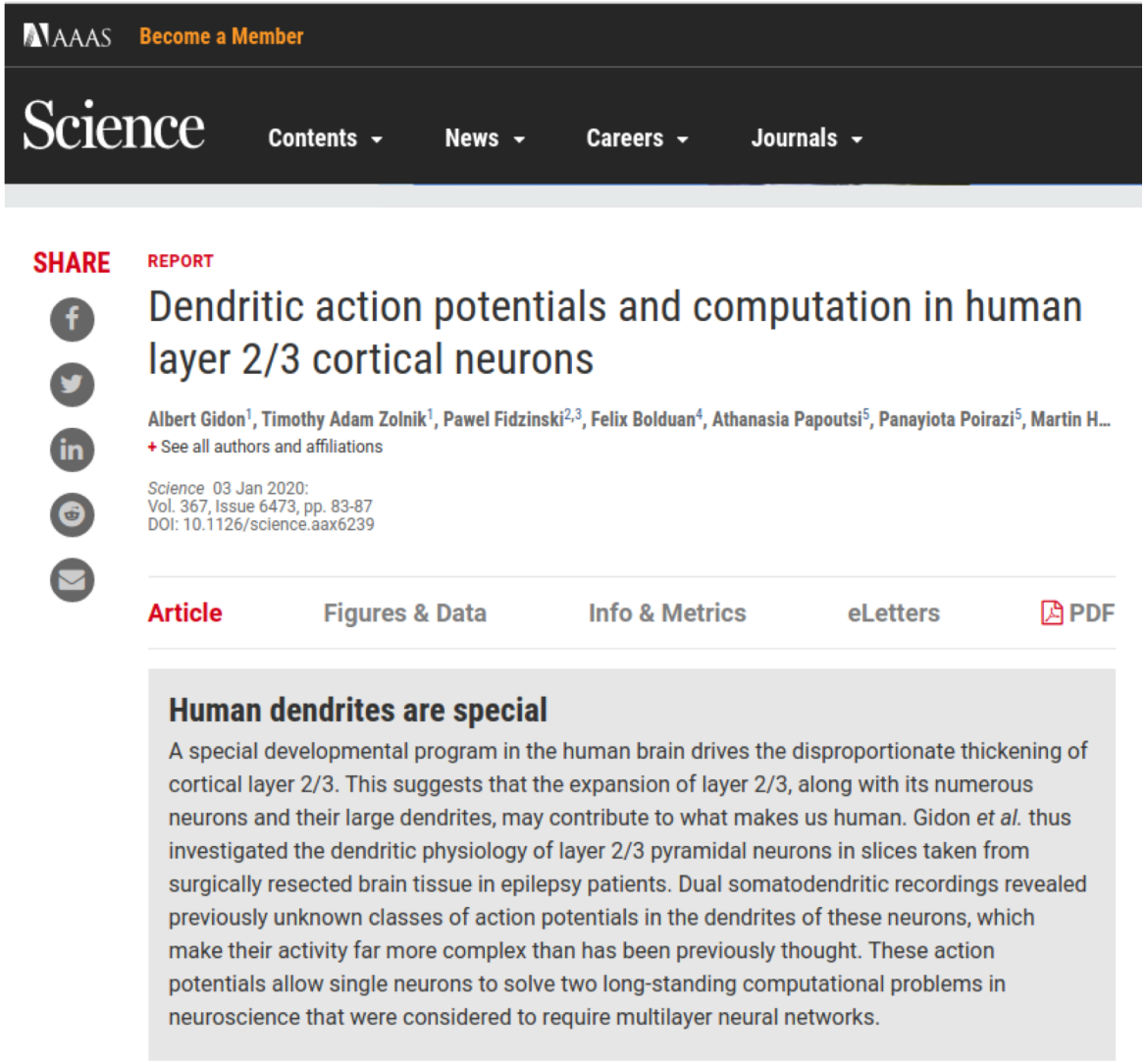
Towards High-End Scalability on Biologically-Inspired Computational Models

ALCF Computational Performance Workshop

Dario J. Dematties, George K. Thiruvathukal, and Silvio Rizzi

Dendritic Compartmentalization



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REPORT

Dendritic action potentials and computation in human layer 2/3 cortical neurons

Albert Gidon[1], Timothy Adam Zolnik[1], Pawel Fidzinski[2,3], Felix Bolduan[4], Athanasia Papoutsi[5], Panayiota Poirazi[5], Martin H…
+ See all authors and affiliations

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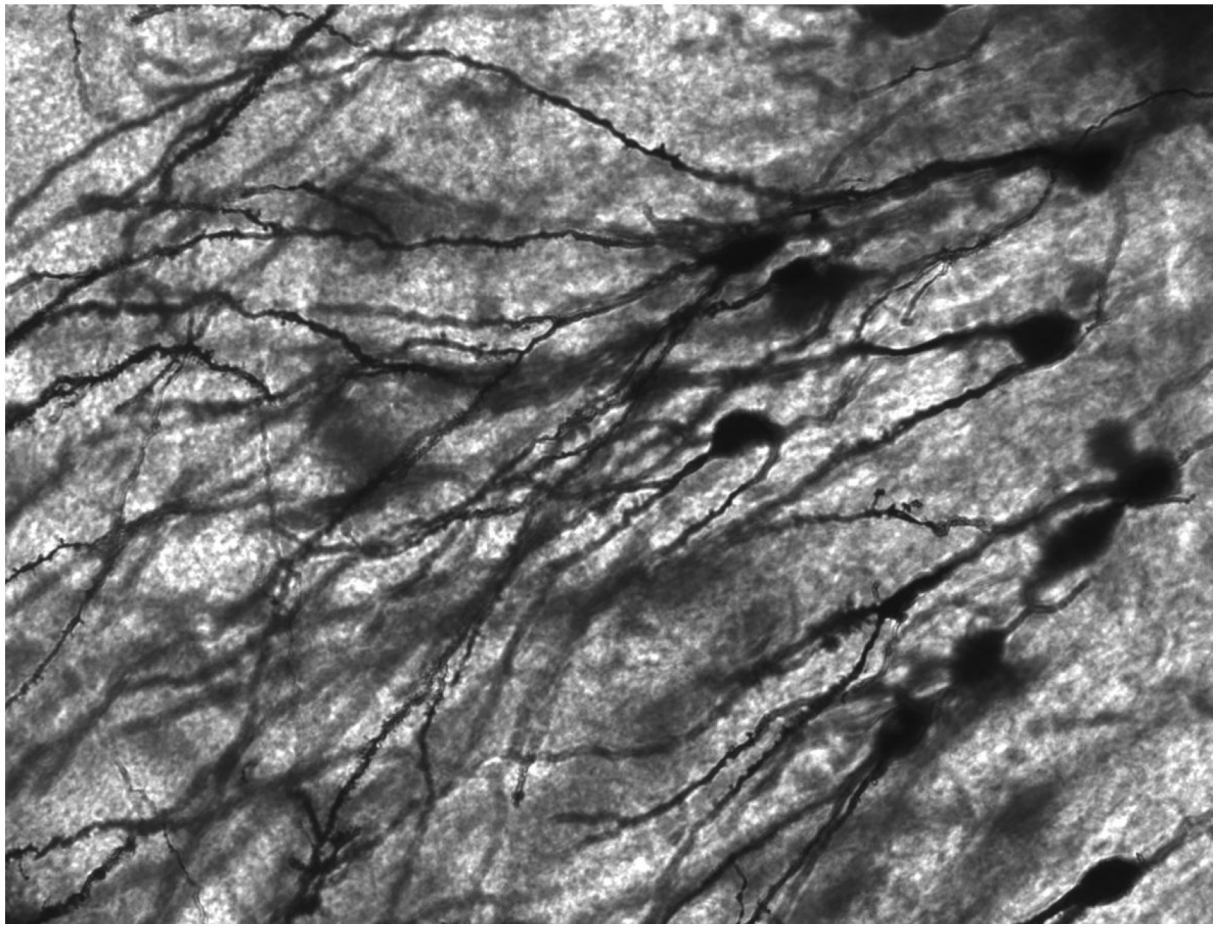
Article Figures & Data Info & Metrics eLetters PDF

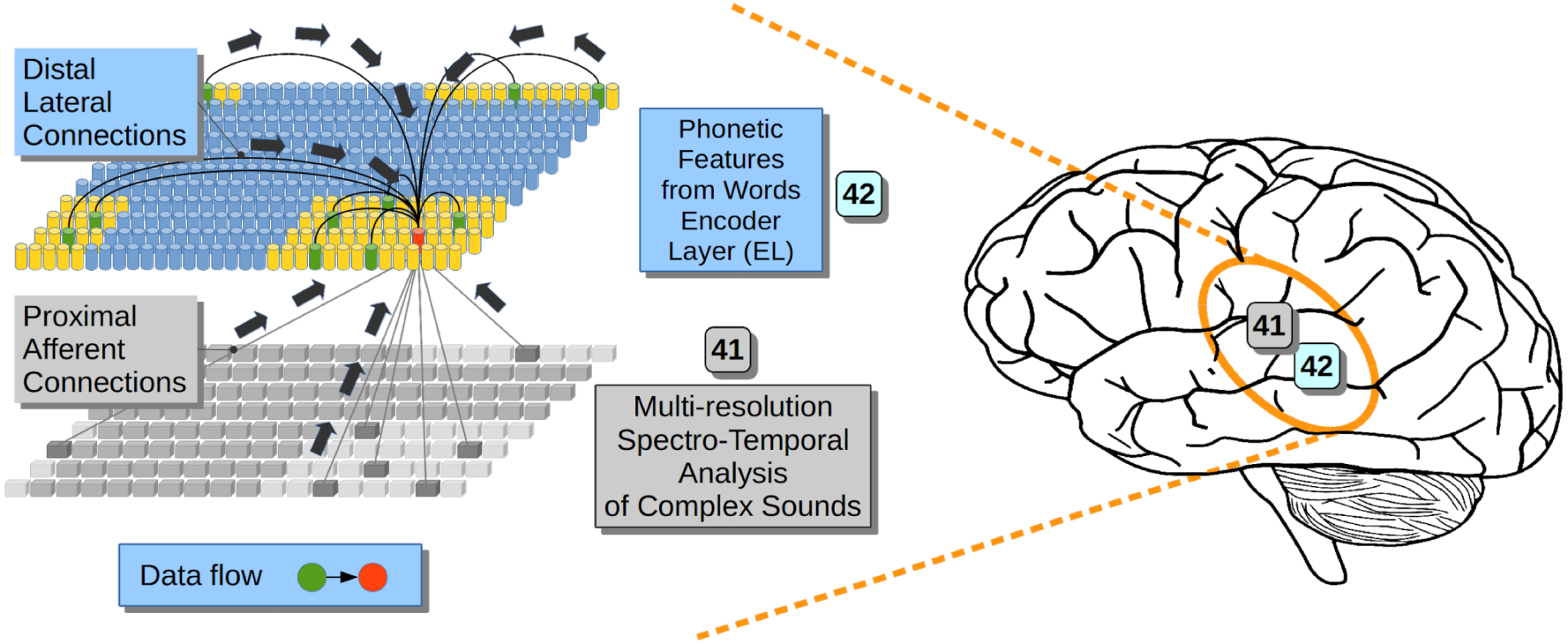
Human dendrites are special

A special developmental program in the human brain drives the disproportionate thickening of cortical layer 2/3. This suggests that the expansion of layer 2/3, along with its numerous neurons and their large dendrites, may contribute to what makes us human. Gidon *et al.* thus investigated the dendritic physiology of layer 2/3 pyramidal neurons in slices taken from surgically resected brain tissue in epilepsy patients. Dual somatodendritic recordings revealed previously unknown classes of action potentials in the dendrites of these neurons, which make their activity far more complex than has been previously thought. These action potentials allow single neurons to solve two long-standing computational problems in neuroscience that were considered to require multilayer neural networks.

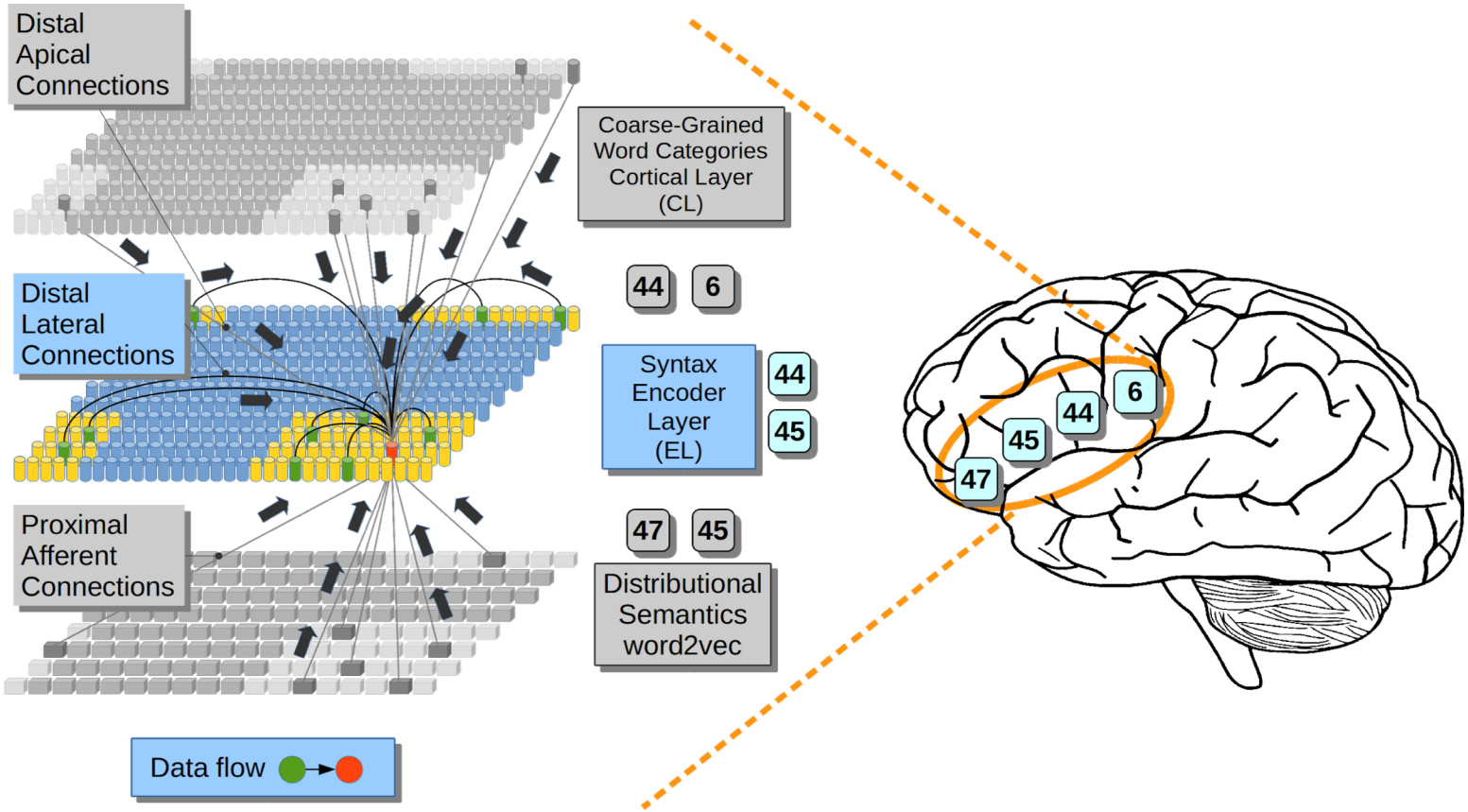
Motivating Sparse Activation and Connectivity



Phonetics



Grammar



Parallelization

Parallel Computing: Technology Trends
I. Foster et al. (Eds.)

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Towards High-End Scalability on Biologically-Inspired Computational Models

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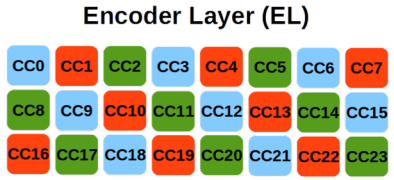
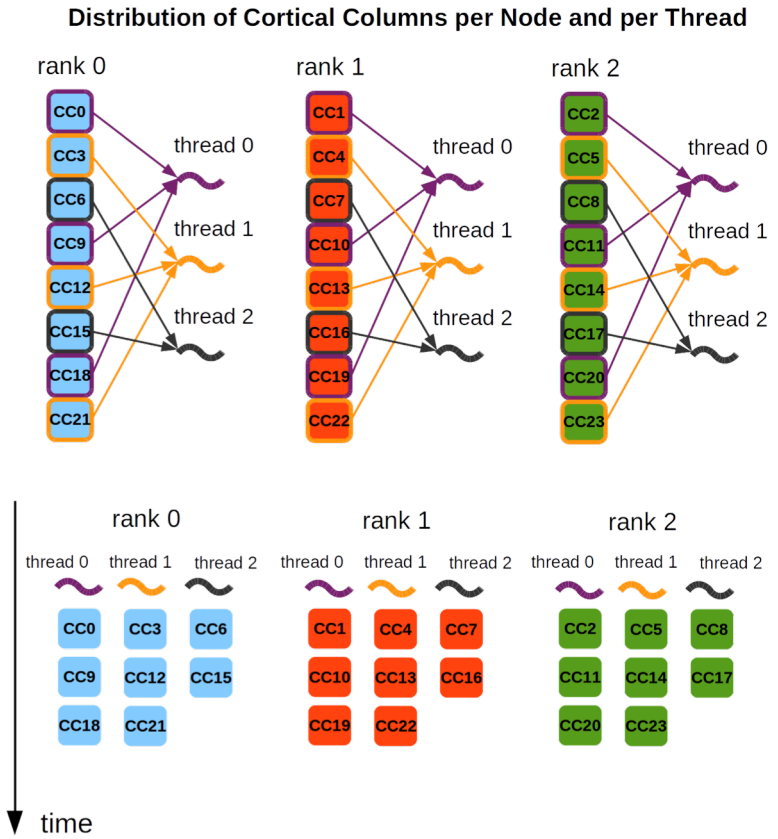
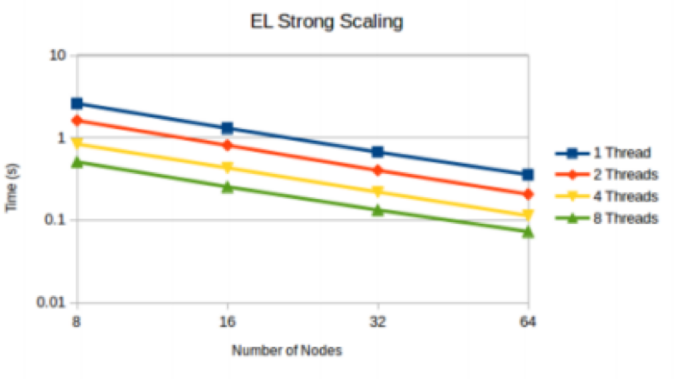
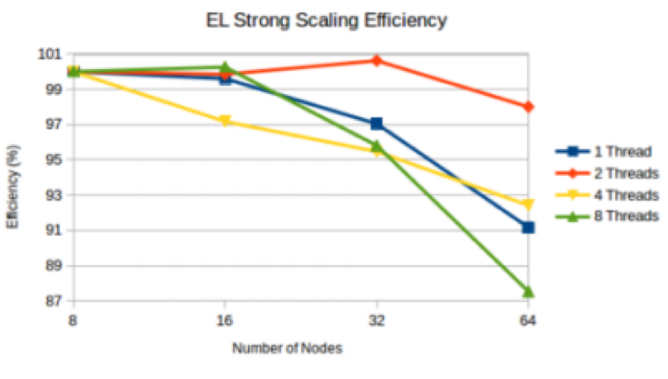


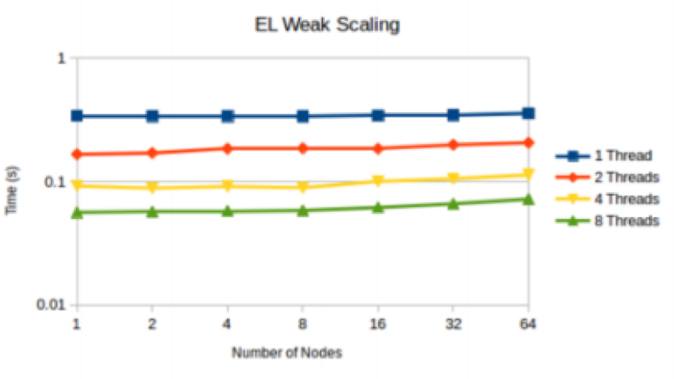




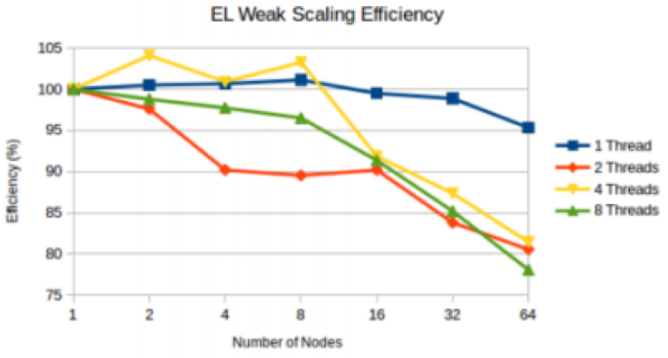
(a) Strong Scaling. Run time vs. the number of nodes for different number of threads per node.



(b) Strong Scaling. Efficiency vs. the number of nodes for different numbers of threads per node. Race line (reference) is taken at 8 computing nodes.



(c) Weak Scaling. Run time vs. the number of nodes for different number of threads per node.



(d) Weak Scaling. Efficiency vs. the number of nodes for different numbers of threads per node.

PLOS ONE

RESEARCH ARTICLE

Phonetic acquisition in cortical dynamics, a computational approach

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Abstract

frontiers in Neural Circuits

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A Computational Theory for the Emergence of Grammatical Categories in Cortical Dynamics

Dario Dematties[1]*, *Silvio Rizzi*[2], *George K. Thiruvathukal*[2,3], *Mauricio David Pérez*[4], *Alejandro Wainselboim*[5] *and B. Silvano Zanutto*[1,6]

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Thanks!
Questions ?