Scale-free behavior of weight distributions of connectomes

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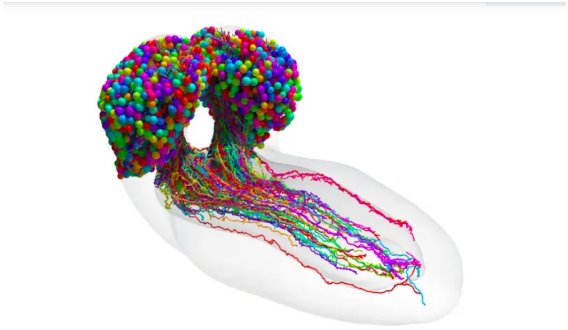
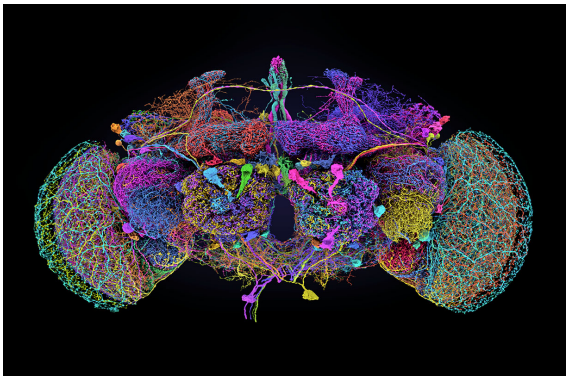


Larva Fly: Michael Winding et al. ,The connectome of an insect brain.Science379,eadd9330(2023).DOI:10.1126/science.add9330



Adult Fly: Dorkenwald, S., Matsliah, A., Sterling, A.R. et al. Neuronal wiring diagram of an adult brain. Nature 634, 124138 (2024). https://doi.org/10.1038/s41586-024-07558-y

To understand how critical learning mechanisms affect the structure, we studied the weighted edge weights and connection length distribution of various brain connectomes. We found that the behavior differs depending on the scale being considered: the global edge weights follow a power-law behavior with exponents near 3, indicative of manifestation of criticality. However, at the node level, the strength of the connections follow log-normal and stretched exponential behaviors which emerged from multiplicative processes underpinning the non-locality of learning at the local scale. Finally, the connection length distributions decay exponentially.

References:
https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.7.013134