Theory in biology: Physicists have advantages and disadvantages. Biology needs theory. Three kinds of theory: analytic techniques, models, and physics-style theories. Physicists have advantages: They are best theorists. Physicists have disadvantages because of the nature of theory in biology: primacy of function for biological systems. Steps in biological theory construction: (1) Select a system, (2) understand its function, (3) identify properties required for the function, and (4) use the properties to make quantitative predictions. Central role of the evolutionary perspective. Two examples: (1) brain circuits and (2) the visual system. Biological systems have disadvantages because of the nature of theory in biology: primacy of function for biological systems. Physicists have advantages: They are best theorists. Three kinds of theory: analytic techniques, models, and physics-style theories. Biology needs theory.
Brain circuits: Background.
Brain circuits: function, compute efficiently, minimize conduction delays, minimize signal attenuation, maximize component density and connectivity.
Brain function: Result

3/5 of the neuropil volume should be wire to maximize efficiency.

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Wires - axons & dendrites

Non-wires - synapses, neurotransmitters, glia cells
Brain circuits: Sketch of theory

Which of the following conclusions is correct:

1. Null hypothesis = 0
2. Median = 0
3. Confidence interval

\[ \frac{v}{\tau} = \frac{7}{7} \]
Brain circuits: Is the theory right?
\[ P(x) = \langle \phi^\theta (x^n) | \phi^\theta (x) \rangle \]

Visual system: Background
Visual system: Function

Extract objects; properties of objects must be preserved until the objects have been extracted.
Visual system: Result

Cabinet function
Visual system: Sketch of theory
Visual system: Is the theory right?