Network Visualization in Biology

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The Connectome
Discovering the Wiring Diagram of the Brain
Collaborators

• Harvard Center for Brain Science
  • Jeff Lichtman & Clay Reid

• Kitware Inc.
  • Will Schroeder, Charles Law, Rusty Blue

• VRVis Vienna
  • Markus Hadwiger, Johanna Beyer

• SEAS
  • Amelio Vazquez, Won-Ki Jeong
  • Hanspeter Pfister
The Scientific Challenge

- What do large brain circuits do?
The Scientific Challenge

- What is their connectivity?

Ramón y Cajal, 1905
The Challenge

- Human brain:
  - ~100 billion neurons
  - ~250 trillion connections

- Mouse brain:
  - ~16 million neurons
  - ~128 billion connections
Imaging at 5 nm x 5 nm x 40 nm

430µm$^3$, 113 TB

1mm$^3$, 1.5 PB

Rat barrel cortex
modified from Feldemeyer et al. 2002 J. Physiol. 538: 803-822
14,000 x 11,000 pixels, 300 sections = 40 GB
Reconstruction

- Active Ribbons [Vazquez 09]

Section 1
NeuroTrace [Jeong 09]
Cerebellum
Convergent evolution?
C. Elegans Neural Network
The World Wide Web
Comparative Functional Genomics
PATHLINE

PATHWAY  METRIC OVERVIEW

SPECIES  OVERLAYS

KEY Genes
  - forward
  - reverse
  - bidirectional

Metabolites  Metrics
  - PearsonCrabNeg
  - PearsonCrabPos
  - PearsonALL
The Tree of Life
Mammals Phylogenetic Tree

Source: WikiMedia Commons
Mammals Phylogenetic Tree

Source: WikiMedia Commons
SDR @ Harvard

INVOLV
Exploring Life Science with Multi-Touch

IIC BioVisions
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