

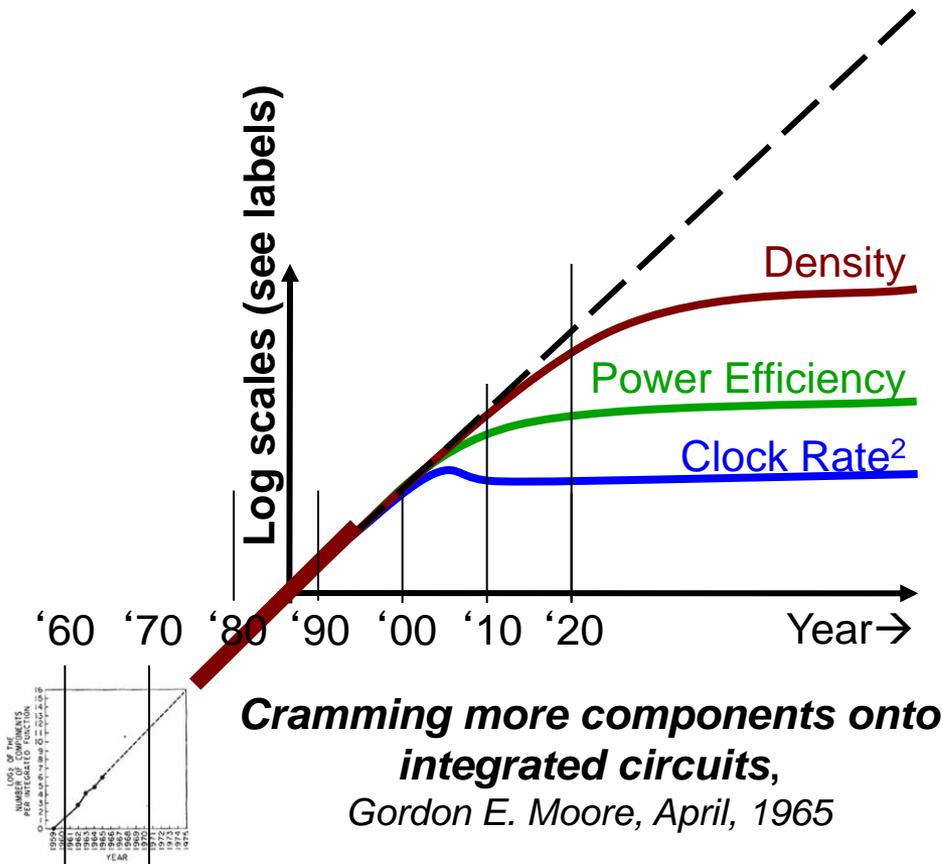
Computing, Neurons and National Security

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The motivating circumstance

- **Moore's Law:** “In fact, shrinking **dimension** on an integrated structure makes it possible to operate the structure at a **higher speed** for the same **power per unit area**”



Reflections on this circumstance

- Moore's Law represents the commoditization of the Turing/von Neumann vision
- National security was the early driver of big computing, and also depended intimately on it
 - Hydrogen bomb simulations
 - Secure and defeat communications
 - Ballistics tables calculations
 - Weather and climate simulations
- Moore's Law will likely peter out within the decade
- We are seeking a new approach that
 - Embraces national security concerns
 - Restores exponential rates of improvement (implying commoditization)
 - May not follow the Turing/von Neumann model

The national security landscape



Global

War

- Conventional engage.
- Nuclear deterrence
- Military containment

Environmental

- Resource conflicts
- Sustainable dev.
- Ecomigration

Destructive

Constructive

Homeland

- Terrorism
- Crime

Human need

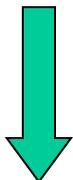
- Prosperity
- Health care
- Education



Local

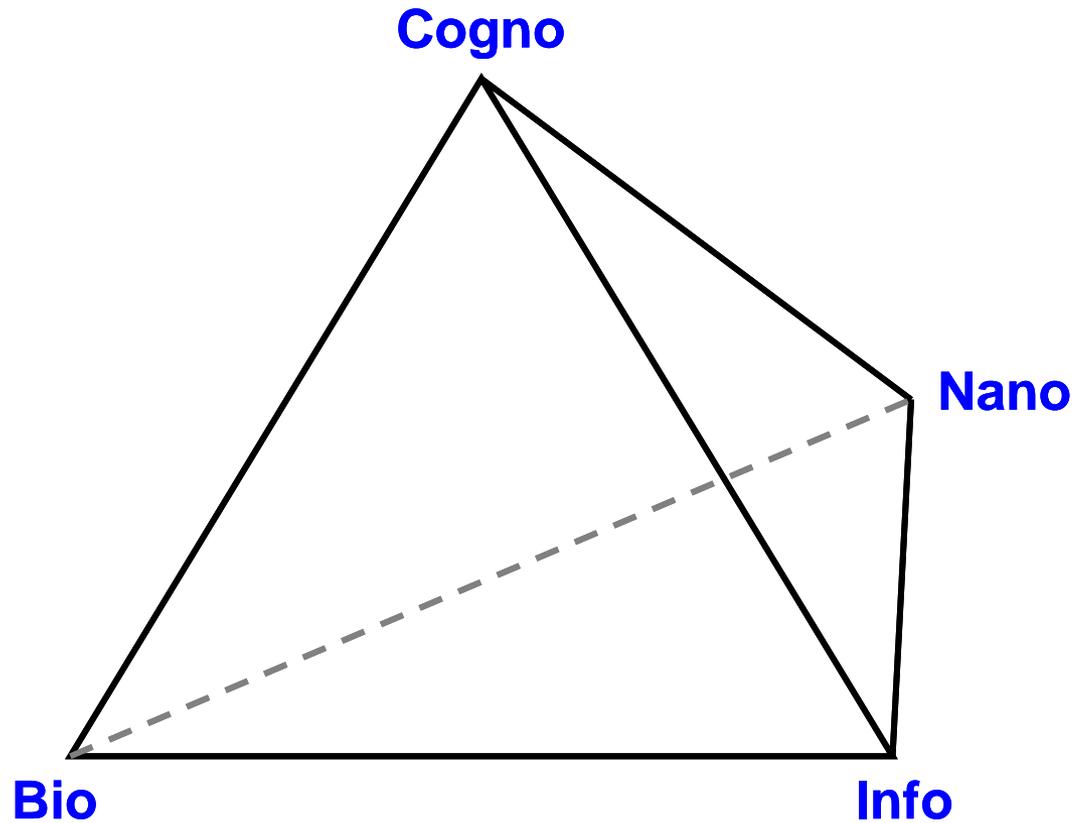
Technology "convergence"

Decreasing
cycle time
&
increasing
synergy

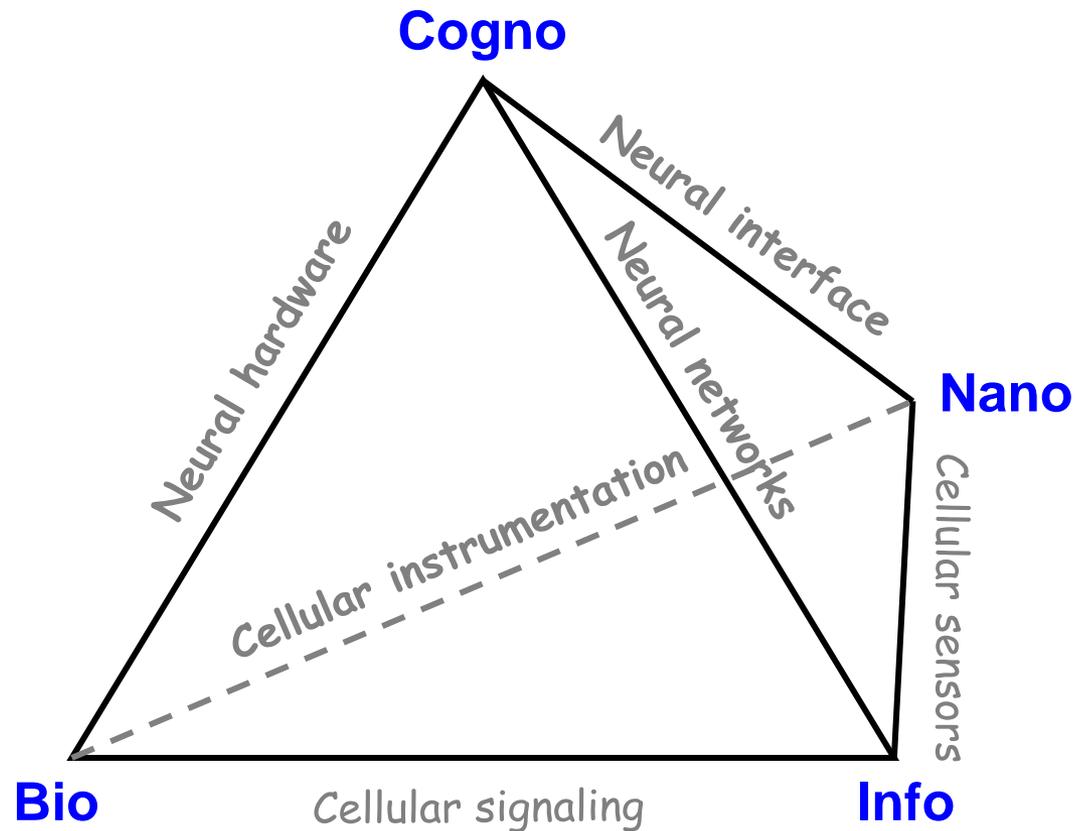


Generation index	Technological Event
-10,000	Tool use
-500	Drawing
-400	Agriculture, writing
-40	Universities
-24	Printing
-16	Modern scientific method, accurate clocks
-10	Industry
-5	Telephone
-4	Radio
-3	Television
-2	Digital computers
-1	Space age, microbiology
-.5	Internet, nanoscience
0	What's next?

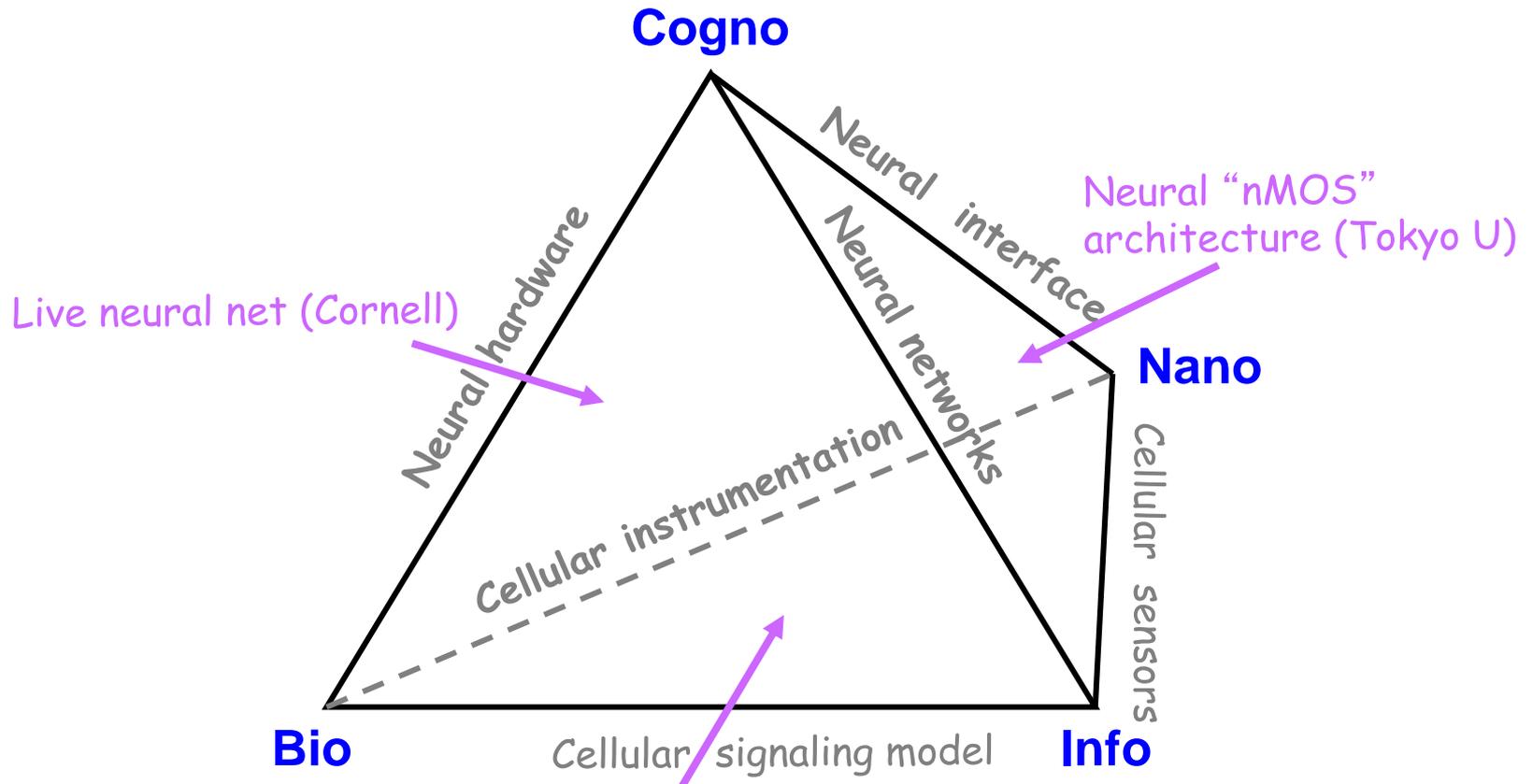
One conjecture



Edge examples



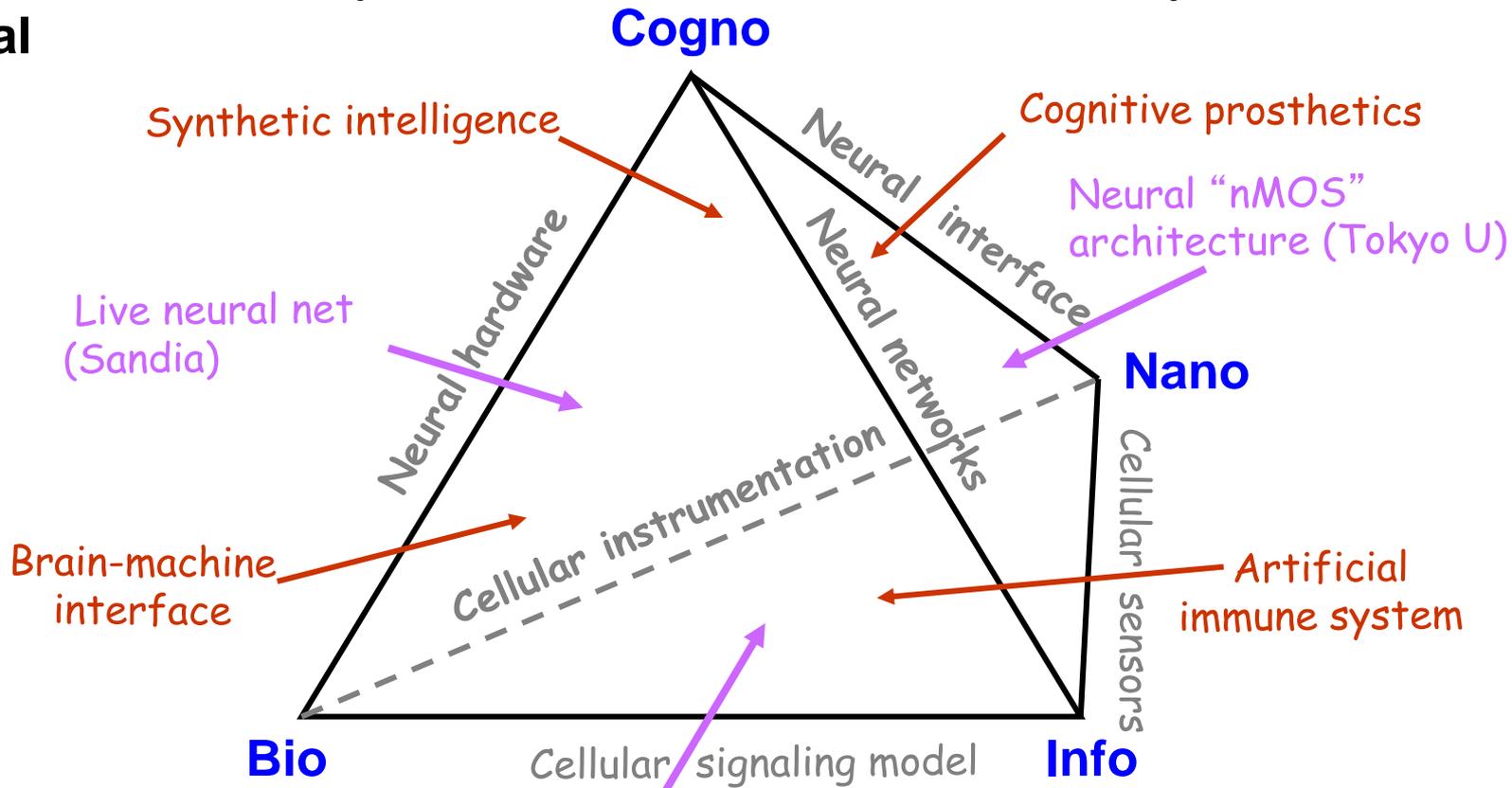
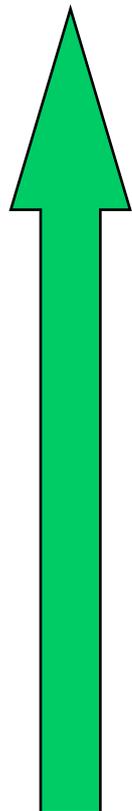
Plane examples



- Neuron "tunnel" (SNL)
- "Digital" antibodies ... viral sized logic chips (HP)
- Tissue based and in-vivo sensors
 - nanotube monitors in brain blood vessels (NYU)
 - optical nanosensors for chemical analysis within cells (U Mich.)
- DNA regulated nano assembly of circuit devices (U Minn.)

Neuro-Inspired computing: a (very) notional roadmap

Behavioral



- "Digital" antibodies ... viral sized logic chips (HP)
- Tissue based and in-vivo sensors
 - nanotube monitors in brain blood vessels (NYU)
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- DNA regulated nano assembly of circuit devices (U Minn.)

Physical

Acknowledgements

- **Moore's Law:** Derived from Erik DeBenedictis, Computing Research, Sandia, 2012
- **National Security Landscape:** Derived from Gerry Yonas, Sandia's Advanced Concepts Group, Sandia, ca. 2000
- **Technology convergence:** NSF report on first NBIC Convergence conference, 6/02
- **The Cognohedron:** In dialogue with colleagues in Sandia's Advanced Concepts Group, ca. 2000