The Futurist CTO: Moore's Law and Cognitive Enhancement as Career Planning Rails

Trent McConaghy, PhD
Founder & CTO @ ascribe
Oct 8, 2015

Would you start a horse-and-buggy company in 1900?

Would you start a PC company in 1990?


How do you reconcile
the future
with your career?

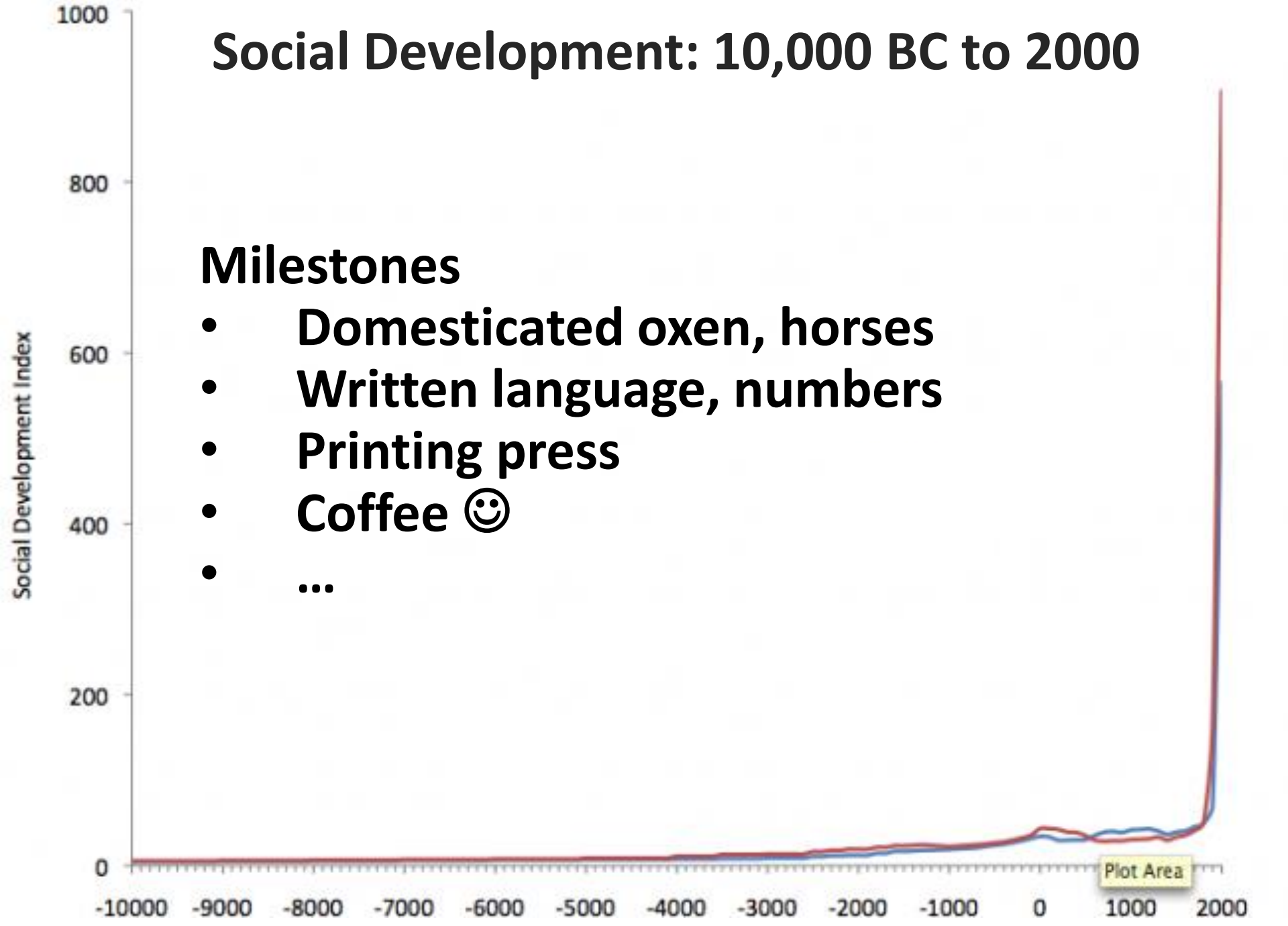

How do you reconcile
the future
with your career?
Step 1: Have a model of the future
Step 2: Insert yourself into it

My model:

The Future,
And Advancement of Humanity,

is all about
Cognitive Enhancement

Social Development: 10,000 BC to 2000



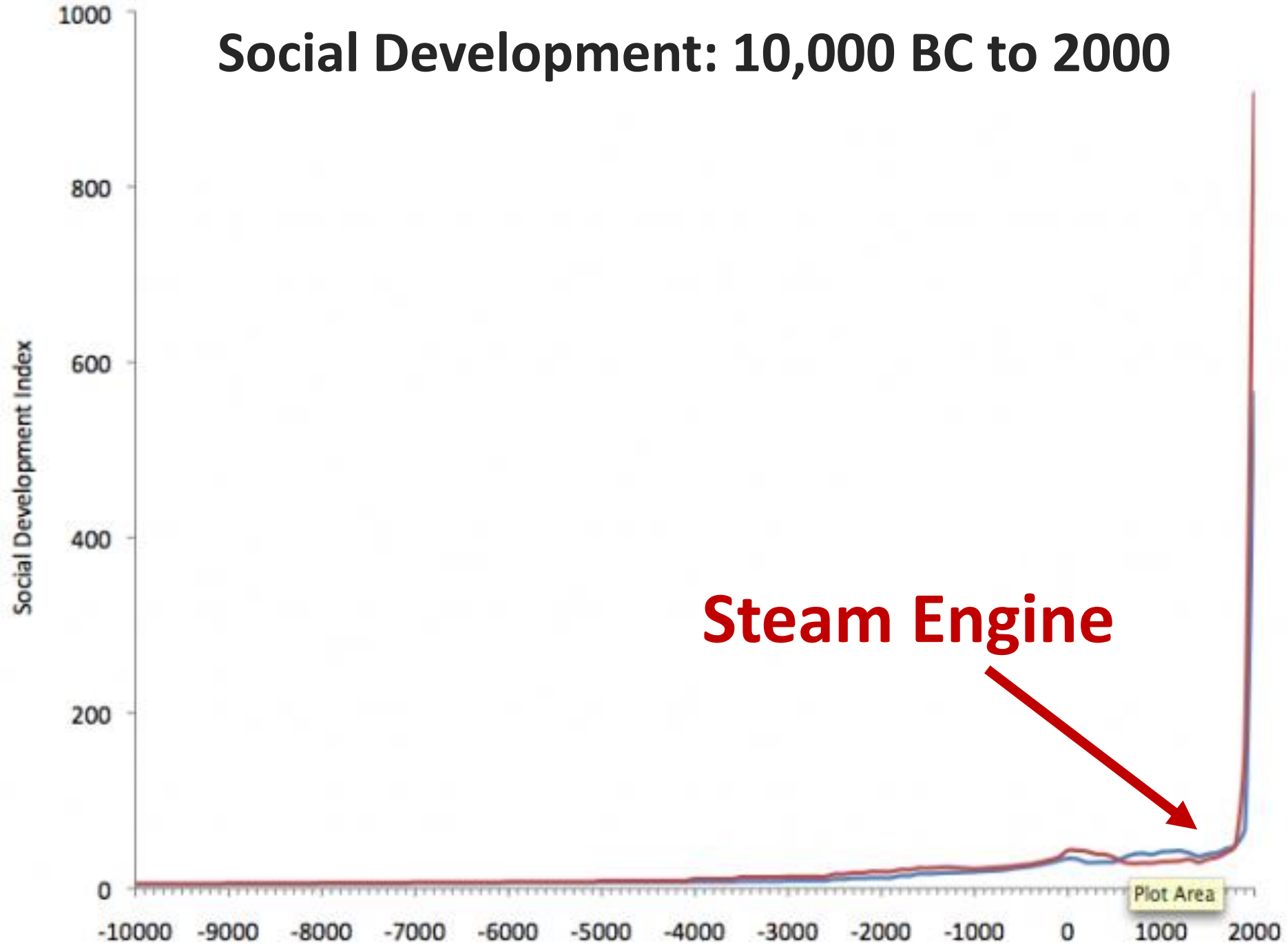
Milestones

- Domesticated oxen, horses
- Written language, numbers
- Printing press
- Coffee ☺
- …

I. Morris, Why The West Rules, 2010

http://andrewmcafee.org/2011/06/mcafee-industrial-revolution-computerization-human-development/

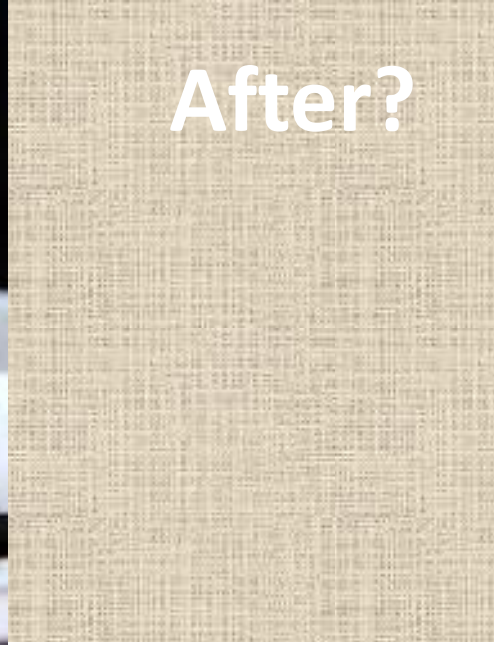
Social Development: 10,000 BC to 2000



I. Morris, Why The West Rules, 2010

Machines augmenting muscles
= Industrial Revolution
= First Machine Age

Everything changed.



Machines augmenting brains

= Second Machine Age

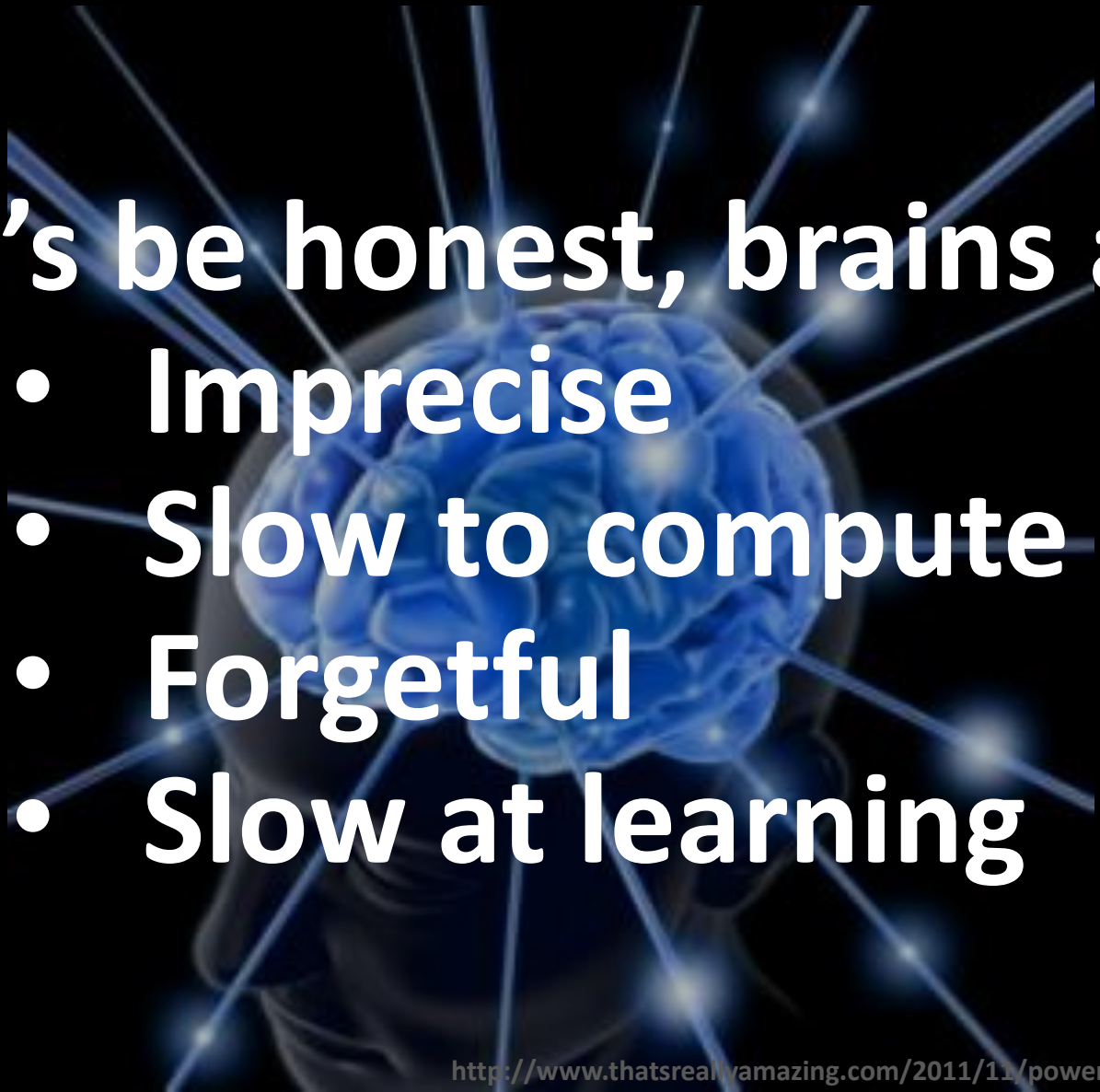
=*Cognitive Enhancement*

Intro to Cognitive Enhancement (CogE)

Sometimes, our brains fail us.

Sometimes, our brains fail us.

~~OMG, brains are AMAZING!~~

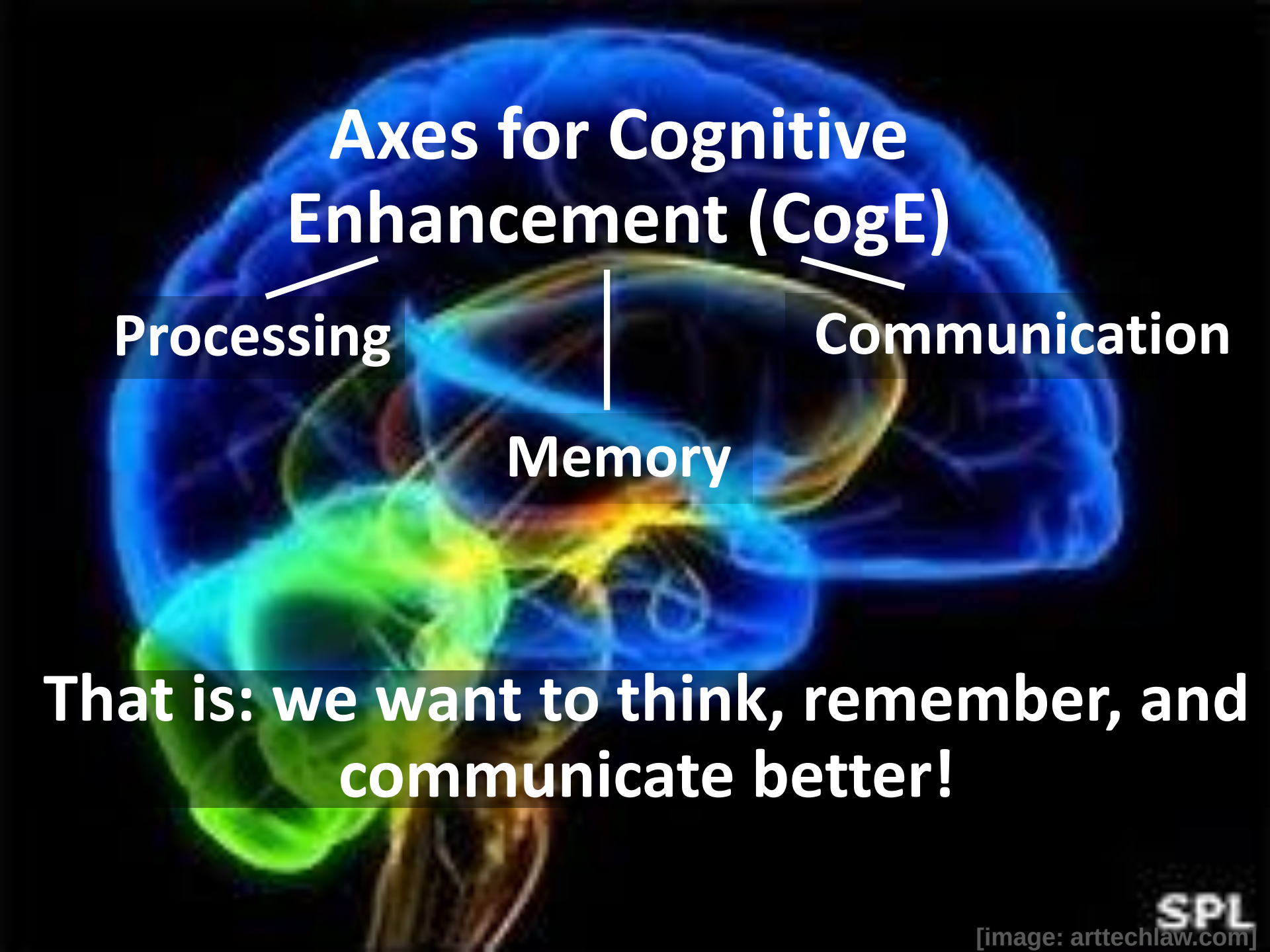


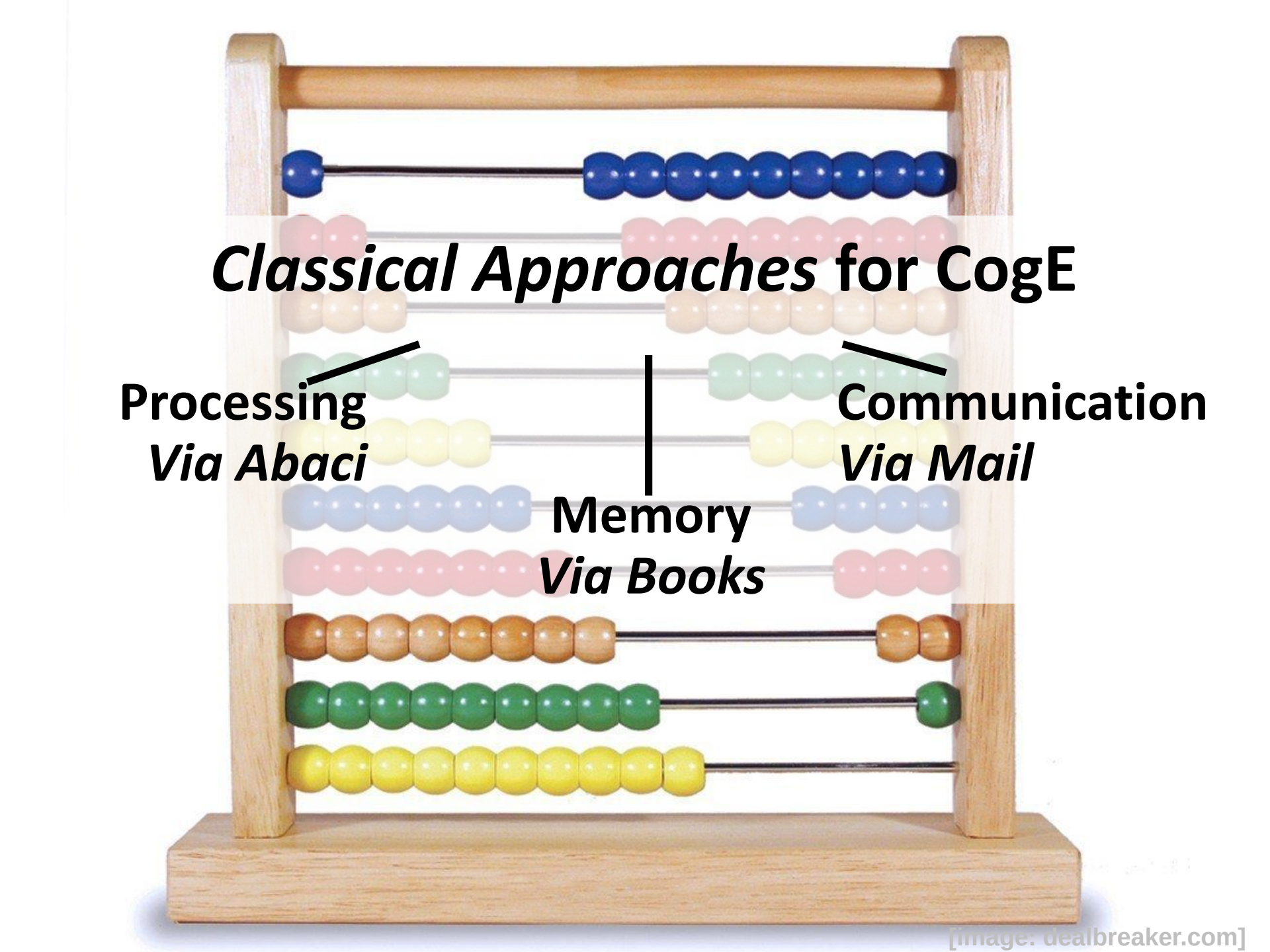
Let's be honest, brains are:

- Imprecise
- Slow to compute
- Forgetful
- Slow at learning

http://www.thatsreallyamazing.com/2011/11/power-of-human-mind-amazing/

Simple Cognitive Enhancement


Axes for Cognitive Enhancement (CogE)
Processing
Communication
Memory
That is: we want to think, remember, and communicate better!
SPL
[image: arttechlaw.com]


Classical Approaches for CogE
Processing
Via Abaci
Memory
Via Books
Communication
Via Mail
[image: dealbreaker.com]

Computing for CogE

Processing Via Calculators

Memory Via Online Calendars

Communication Via Texting

State-of-the-Art: *Computing + AI* for CogE:

Processing
Via Computer-Aided Design (CAD)

Memory
Via Google
Eg "What's the capital of China?"

Communication
Via Facebook

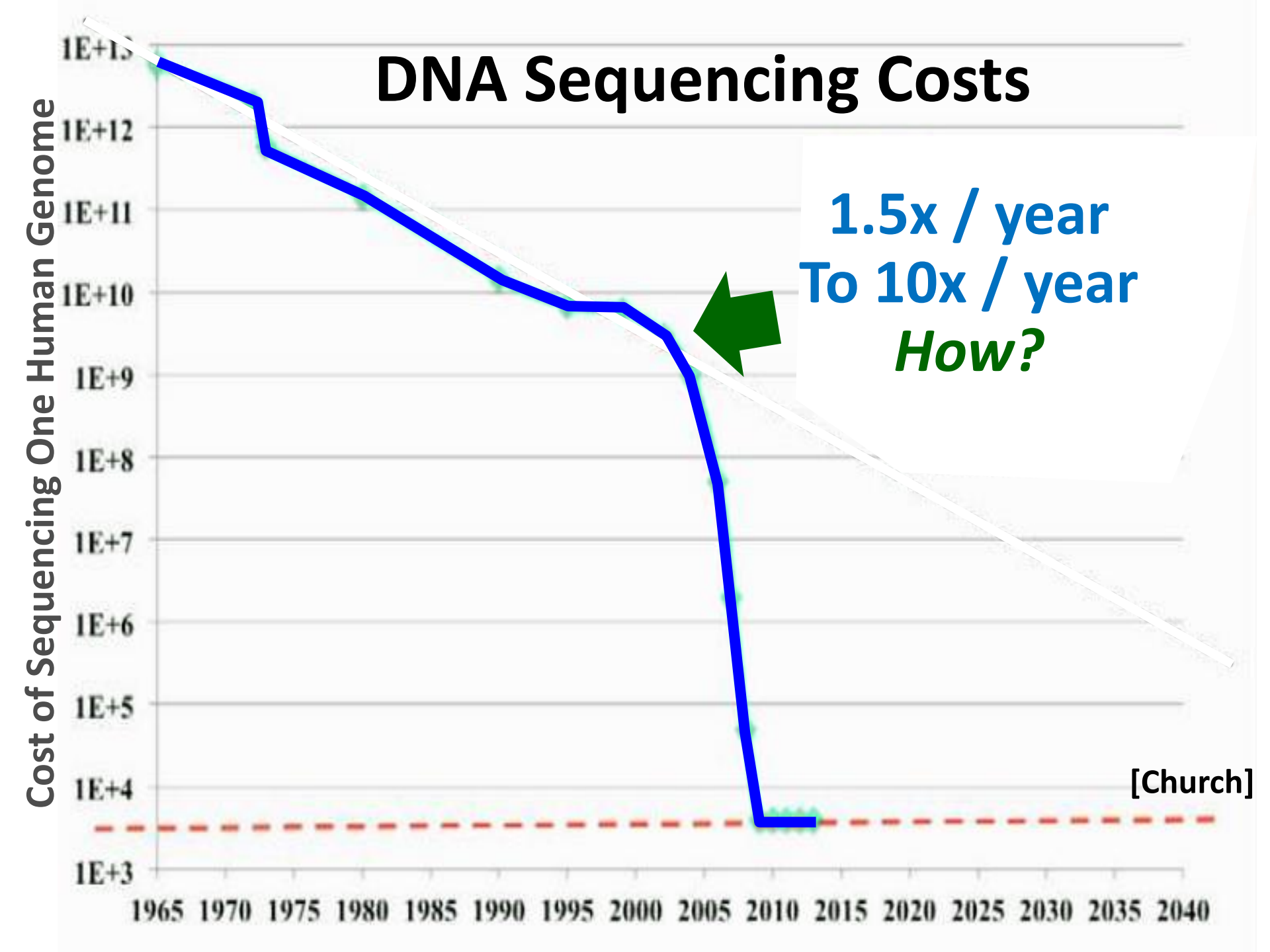
Future of CogE?

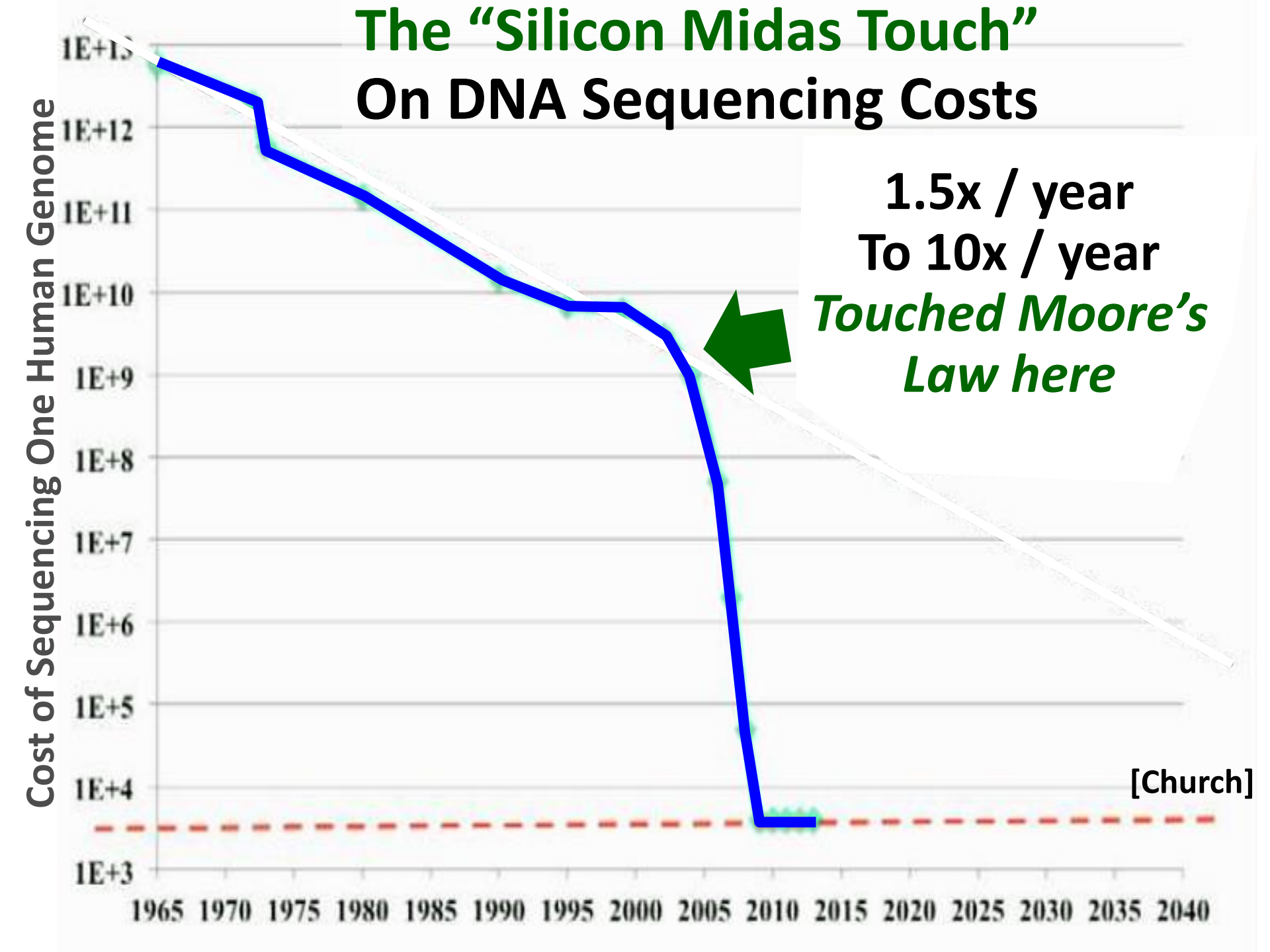
Prediction frameworks:

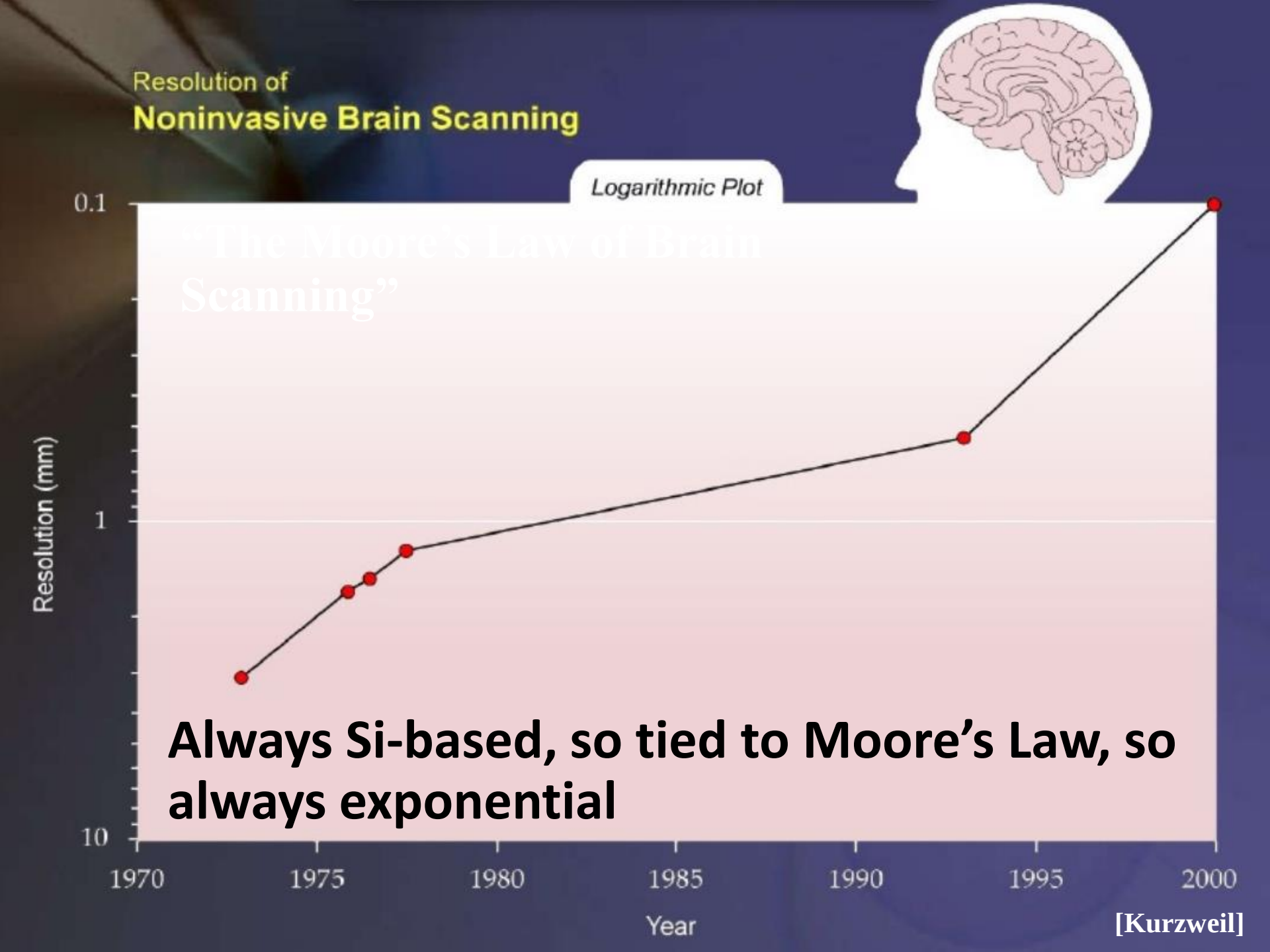
1. **Extrapolate, with Si**
2. **Identify future CogE artifacts**

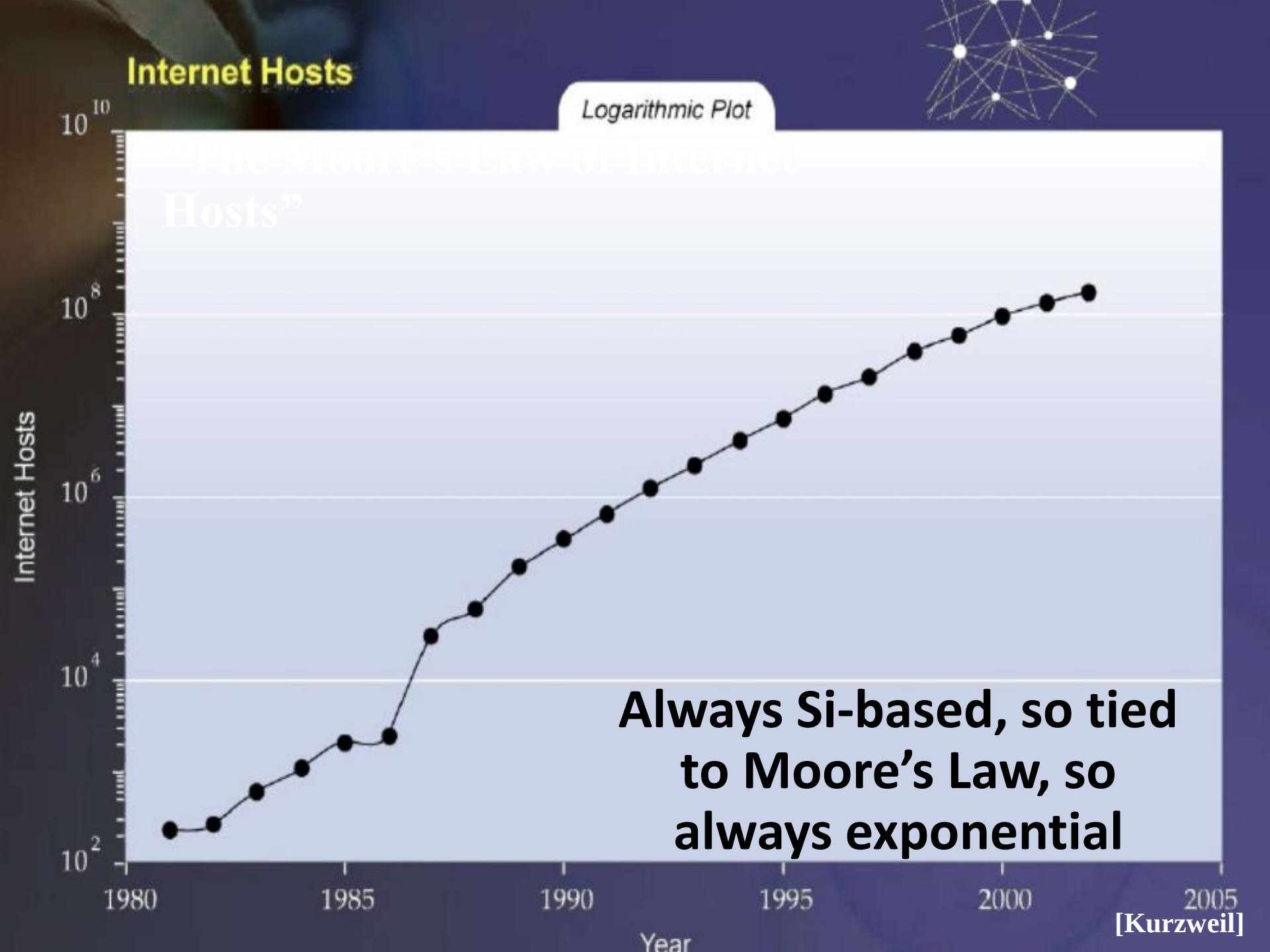
Future of CogE?

Prediction framework #1: Extrapolate, with Si


DNA Sequencing Costs
Cost of Sequencing One Human Genome
1E+12
1E+11
1E+10
1E+9
1E+8
1E+7
1E+6
1E+5
1E+4
1E+3
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040
1.5x / year
To 10x / year
How?
[Church]

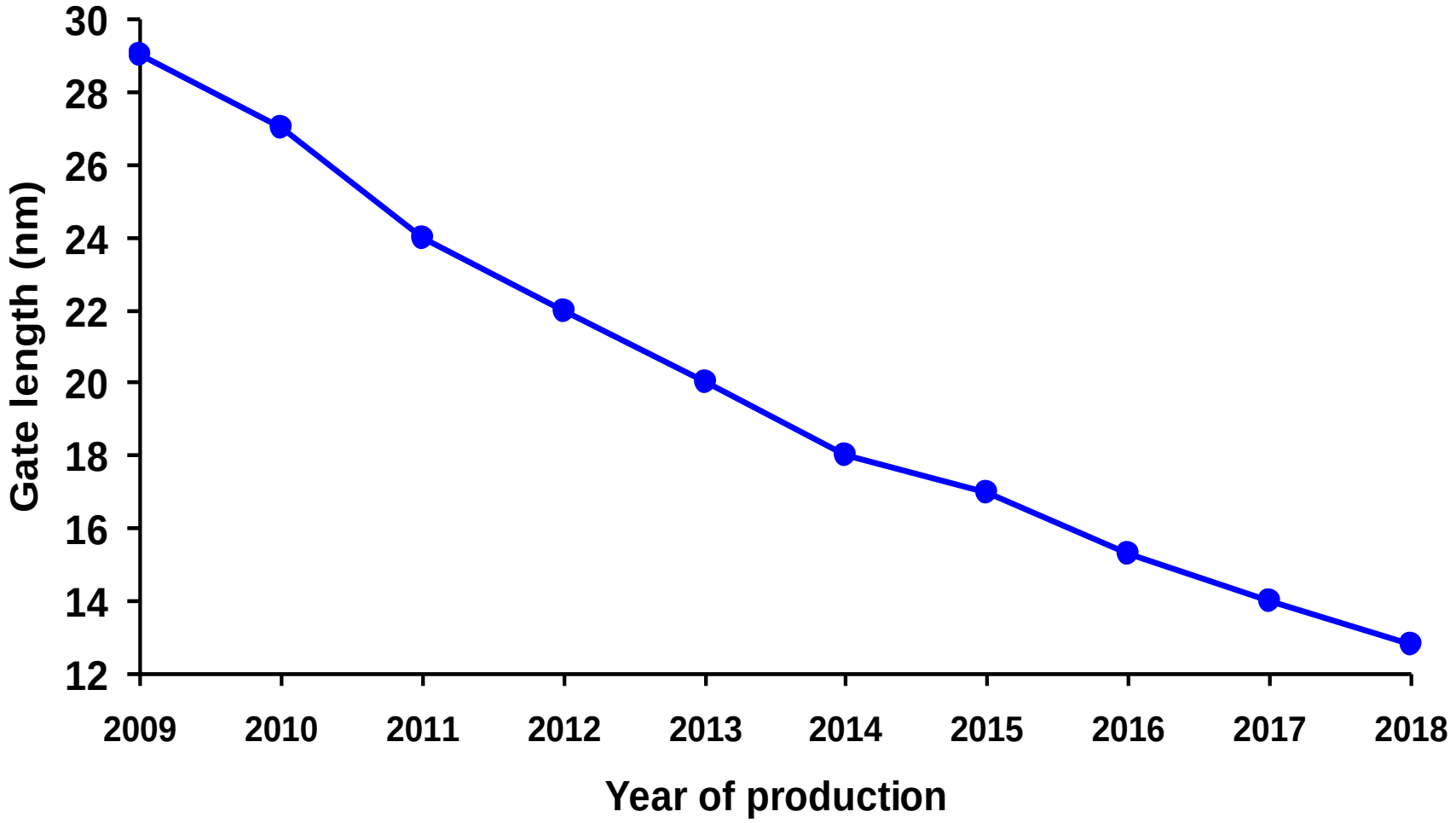

The "Silicon Midas Touch"
On DNA Sequencing Costs
1.5x / year
To 10x / year
Touched Moore's Law here
[Church]
Cost of Sequencing One Human Genome
1E+12
1E+11
1E+10
1E+9
1E+8
1E+7
1E+6
1E+5
1E+4
1E+3
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040


Resolution of
Noninvasive Brain Scanning
Logarithmic Plot
"The Moore's Law of Brain Scanning"
0.1
1
10
Resolution (mm)
1970
1975
1980
1985
1990
1995
2000
Year
Always Si-based, so tied to Moore's Law, so always exponential
[Kurzweil]


Internet Hosts
Logarithmic Plot
"The Moore's Law of Internet Hosts"
Internet Hosts
10^{10}
10^{8}
10^{6}
10^{4}
10^{2}
1980
1985
1990
1995
2000
2005
Year
Always Si-based, so tied to Moore's Law, so always exponential
[Kurzweil]

Moore's Law : Definition

Silicon transistor size 2x smaller every 18 months. *An exponential over time.*

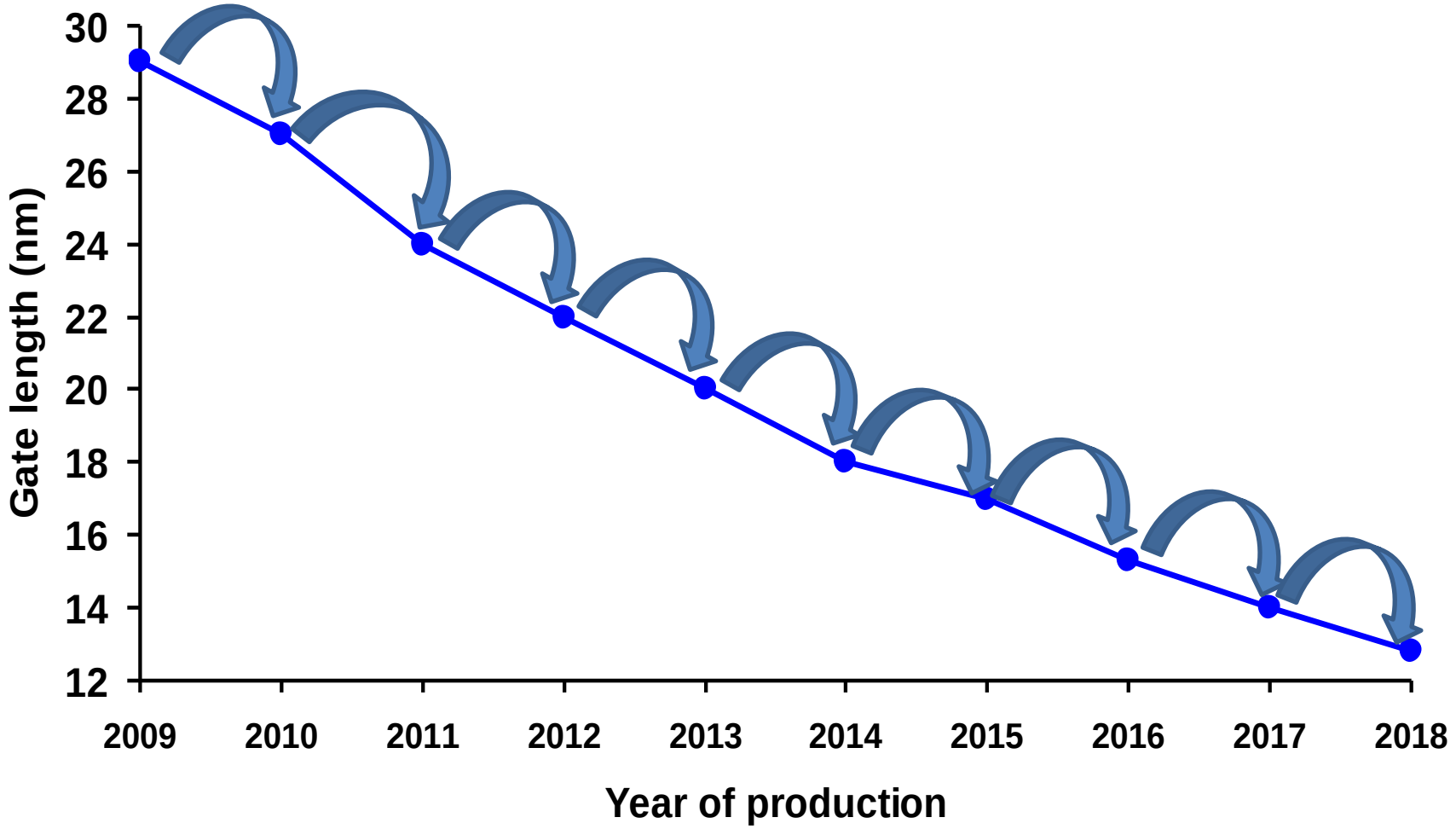


[International Technology Roadmap for Semiconductors, 2011]

Moore's Law: *How?*

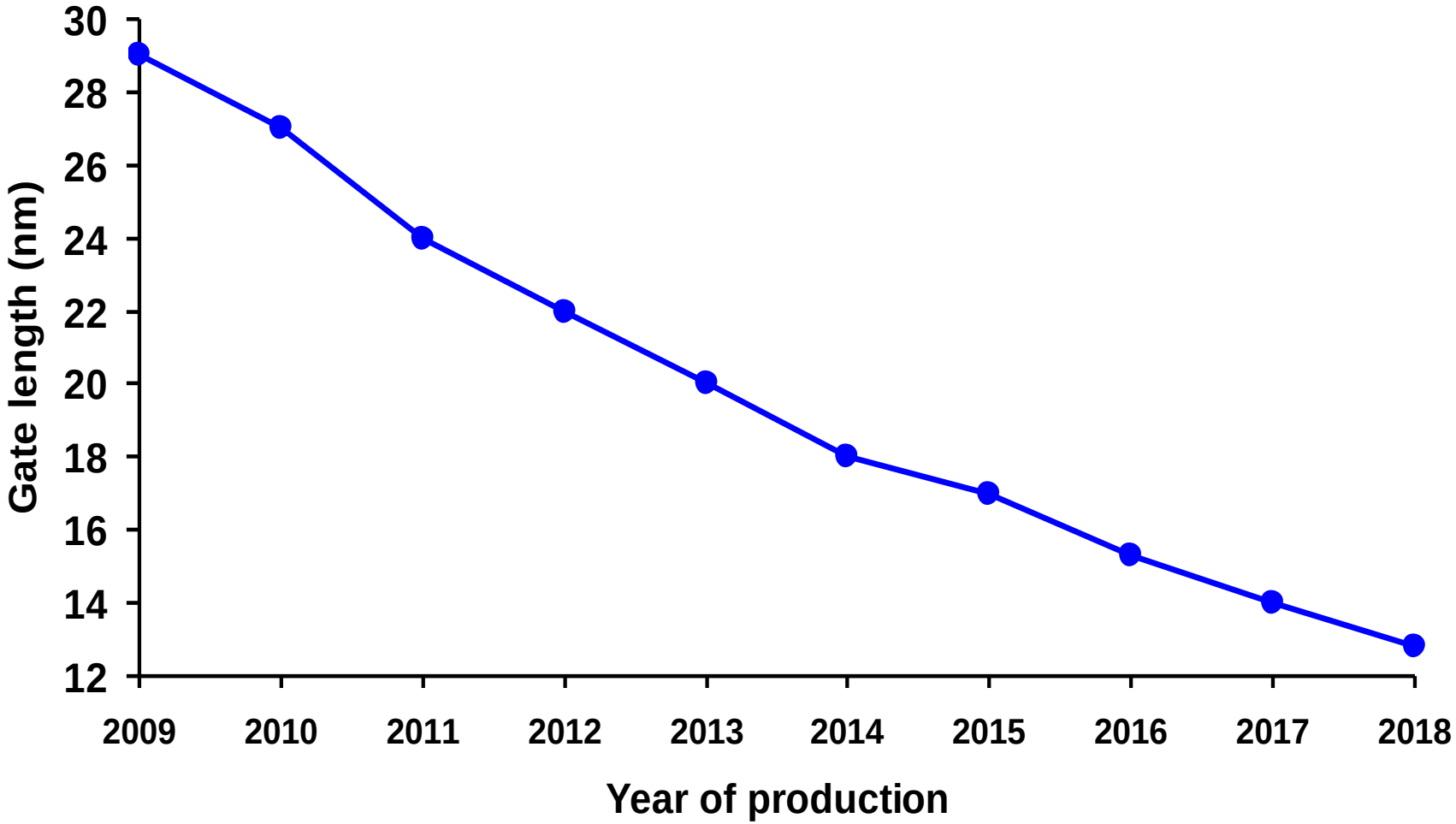
A: Silicon Midas touch *applied to itself*

AI-powered CogE (*CAD*). One generation of machines to design the next generation. The ultimate bootstrap!



In Predicting the Future of CogE:
Simply, use Moore's ~~Law~~ Schedule

Improving chips for communication, processing, memory



[International Technology Roadmap for Semiconductors, 2011]

Future of CogE
Prediction framework #1: Extrapolate, with Si

Takeaways:

- **"Si Midas Touch" causes exponentials**
- **Most notably, on Si itself**
  - **=Moore's Law**
  - **AI-powered CogE (CAD) closes the bootstrap loop**

Future of CogE
Prediction framework #1: Extrapolate, with Si

Takeaways:

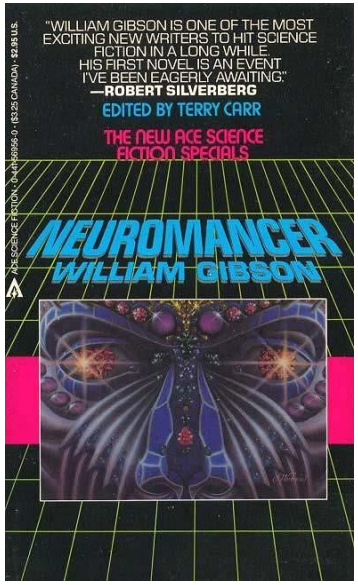
- **"Si Midas Touch" causes exponentials**
- **Most notably, on Si itself**
  - **=Moore's Law**
  - **AI-powered CogE (CAD) closes the bootstrap loop**

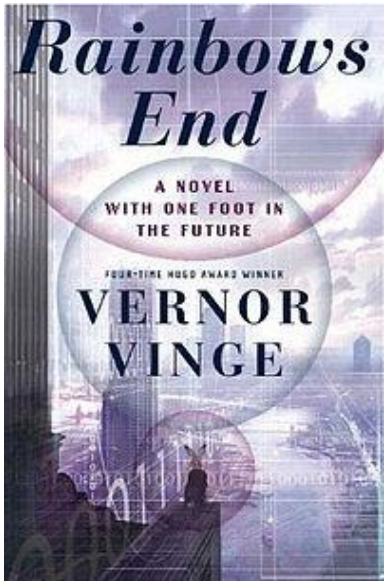
- **But extrapolation doesn't paint a picture of the future..**

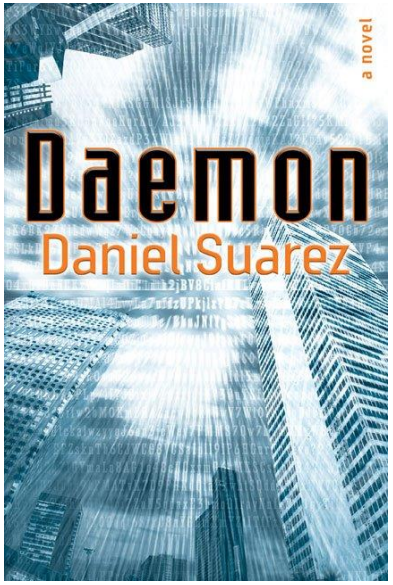
Future of CogE

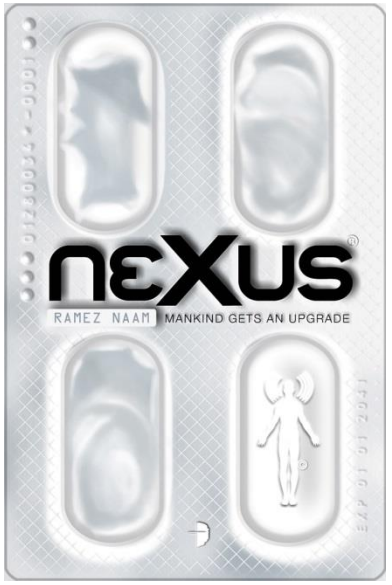
Prediction Framework #2: *Future Artifacts*

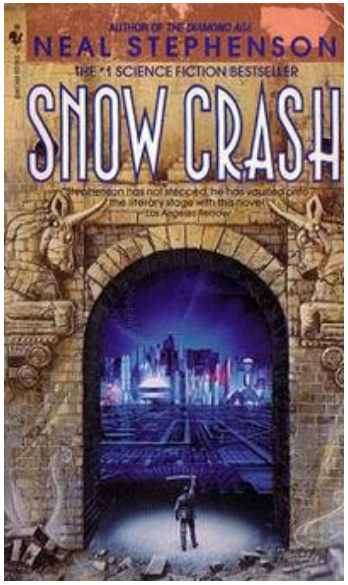
A Source for Artifacts:
Sci-fi: Choose Your Own ~~Adventure~~ Future

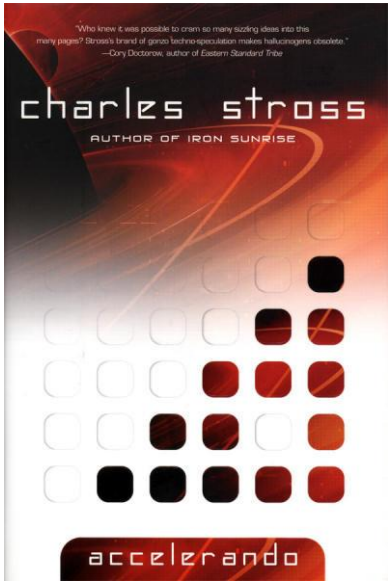


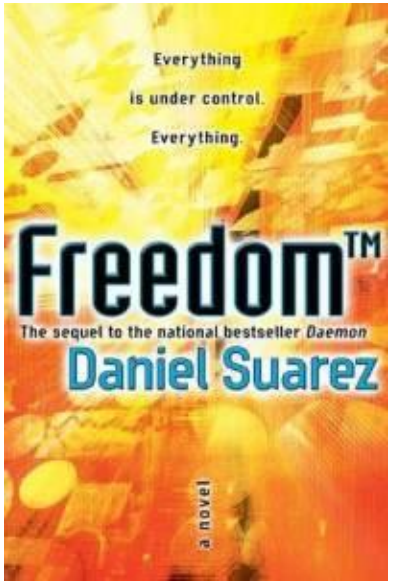


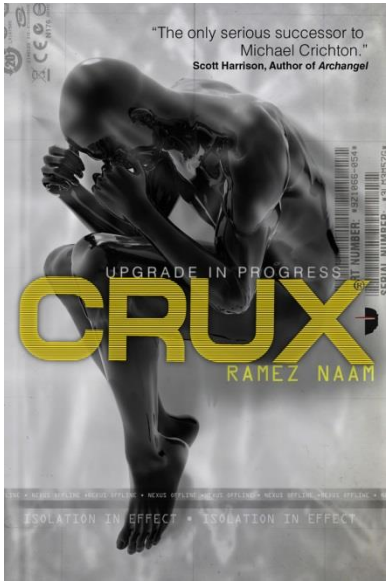












A Future Artifact from “Accelerando”

“… [His] glasses zoom in …”

“He pipes the image stream up to … his websites in real time.”

…he pulls [his glasses] on and is besieged by an urgent flurry of ideas demanding attention.

…[He] plunges into one of those unavoidable fits of deep interaction, fingers twitching on invisible keypads and eyeballs jiggling as his glasses funnel deep media straight into his skull through the highest bandwidth channel currently available.

[Photo: Shutterstock]

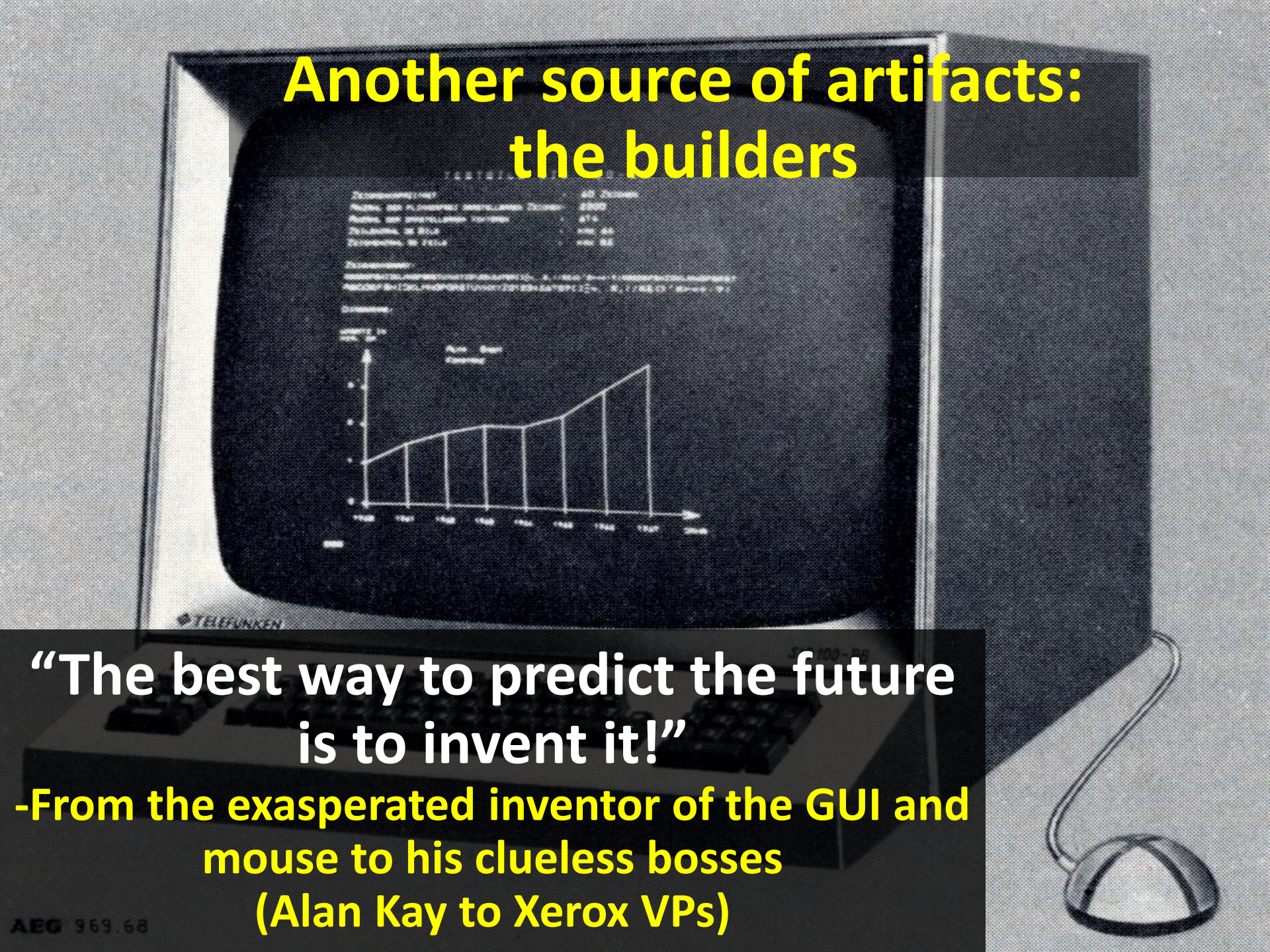
A Future Artifact From “Rainbows End”

sming
= silent messaging
= sending text or voice
by *thinking* about it

“…there was a glimmer of connectivity, enough for *sming*:
Miri --> Miri Gang: <sm>I think we're getting close.</sm>
Lena --> Miri Gang: <sm>…Get out of there.</sm>

…He *sminged* back, voice format: “…”

Another source of artifacts: the builders



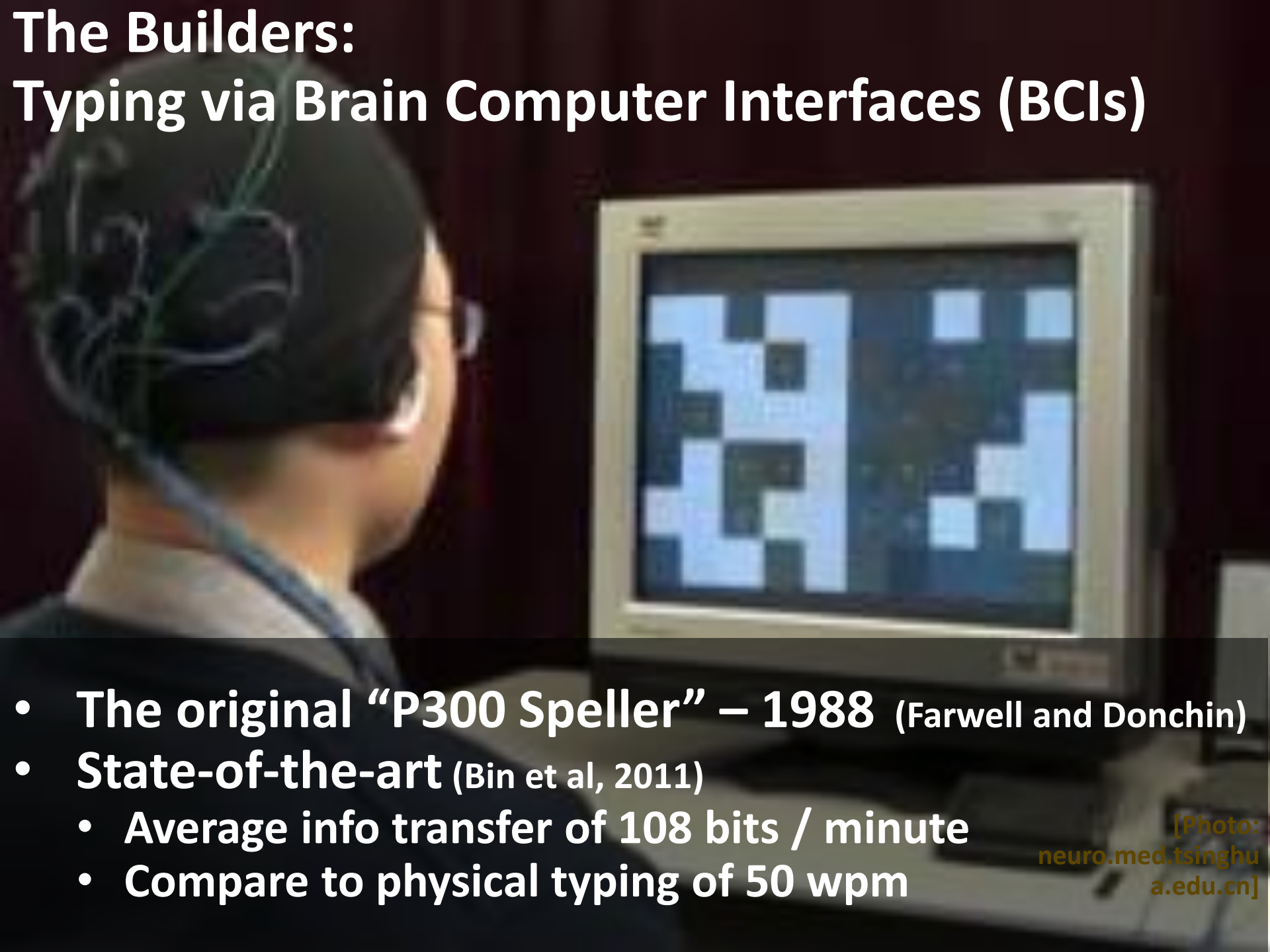
“The best way to predict the future is to invent it!”

-From the exasperated inventor of the GUI and mouse to his clueless bosses (Alan Kay to Xerox VPs)

The builders:
Virtual Reality-based CogE

The Builders:
Augmented Reality-based CogE

The Builders:
Typing via Brain Computer Interfaces (BCIs)



- The original "P300 Speller" – 1988 (Farwell and Donchin)
- State-of-the-art (Bin et al, 2011)
  - Average info transfer of 108 bits / minute
  - Compare to physical typing of 50 wpm

[Photo: neuro.med.tsinghua.edu.cn]

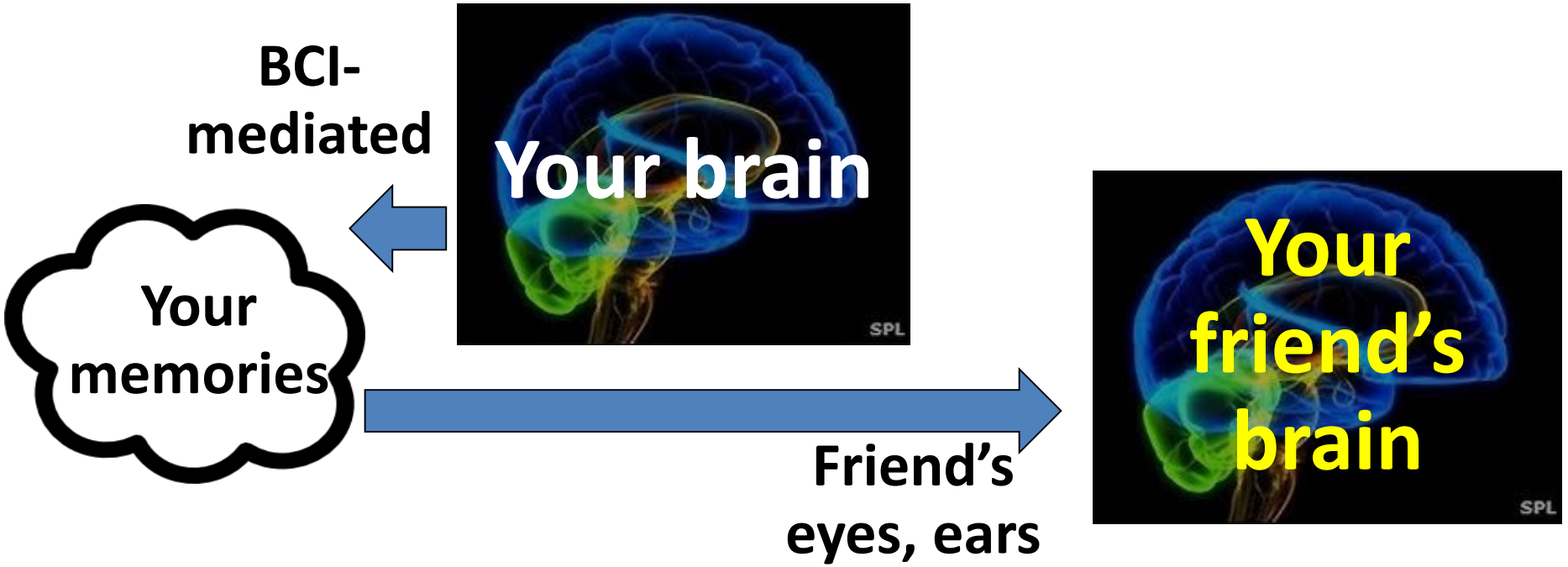
Dropbox Your Brain:
AR / BCI Goggles For CogE of Memory

- Everything you see and hear goes to the cloud
- Use EEG interface to browse past memories
- Re-view past sights & sounds into goggles

Perfect memory in the cloud (or locally)

BCI-mediated

YouTube Your Brain:
AR / BCI Goggles to Stream Memories



Supercompute Your Brain:
AR / BCI Goggles for CogE of Processing

Cloud-scale computing

BCI-mediated

CogE – Artifact Predictions

Now:

- Prototype Low-Latency VR (Oculus)
- Prototype AR (Google Glass, annotated reality)

<1 Year:

- Production Ultra-Low Latency VR (Oculus / FB)
- Prototype next-gen virtual worlds (FB)

5-12 Years:

- "Real" AR (repainted reality)
- Production SR sming
- DropBox your brain (perfect memory)
- YouTube your brain (talk in pictures)
- BW+, +, +, …
- Then, where does "self" end? And other Q's…

CogE - Opportunities

1. **Anything that increases communication, BW, or memory between brain and computer.**
2. **Anything that drives Moore's Law**
3. **Infrastructure / ecosystem around this**

1. Includes
   - VR, AR, AR/BCI. AI-powered. Think iPhone 15.
   - 10x+ ML algorithms, ML co-processors, ML-opt'd chips
   - Mobile-worthy brain-scanning tech (fast, low power, high-res, non-invasive)
2. Includes
   - Cheaper, higher-performing devices -> fabs
   - AI to design better devices, chips, fabs
3. Includes
   - Knowledge economy -> how to monetize -> tracking intellectual assets

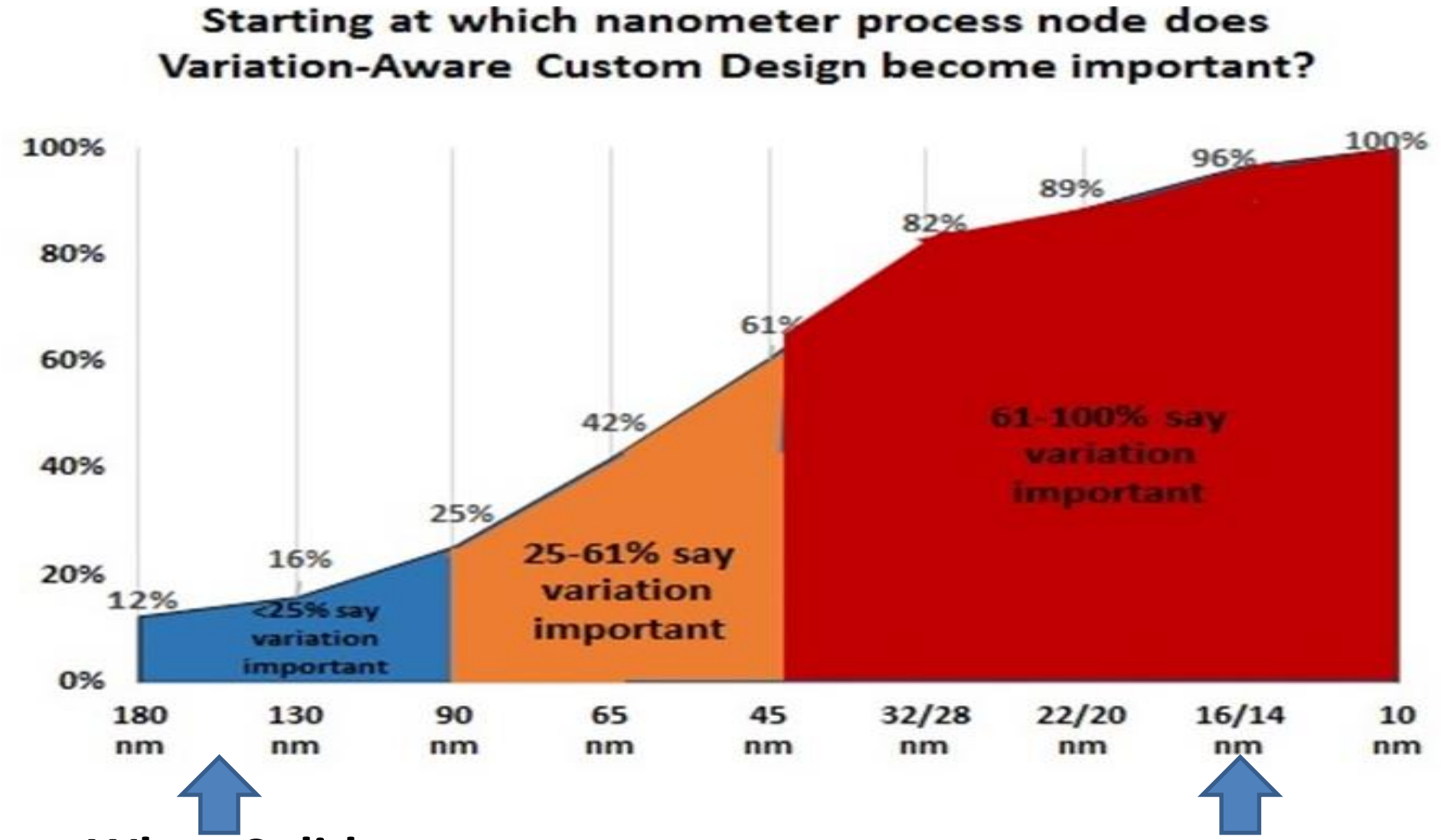

How do you reconcile
the future
with your career?
Step 1: Have a model of the future
Step 2: Insert yourself into it

Insert Yourself Into The Future

1. **Anything that increases communication, BW, or memory between brain and computer.**
2. **Anything that drives Moore's Law**
3. **Infrastructure / ecosystem around this**

1. Includes
   - VR, AR, AR/BCI. AI-powered. Think iPhone 15.
   - 10x+ ML algorithms, ML co-processors, ML-opt'd chips
   - Mobile-worthy brain-scanning tech (fast, low power, high-res, non-invasive)
2. Includes
   - Cheaper, higher-performing devices -> fabs
   - AI to design better devices, chips, fabs **(ADA, Solido)**
3. Includes
   - Knowledge economy -> how to monetize -> tracking intellectual assets **(ascribe)**

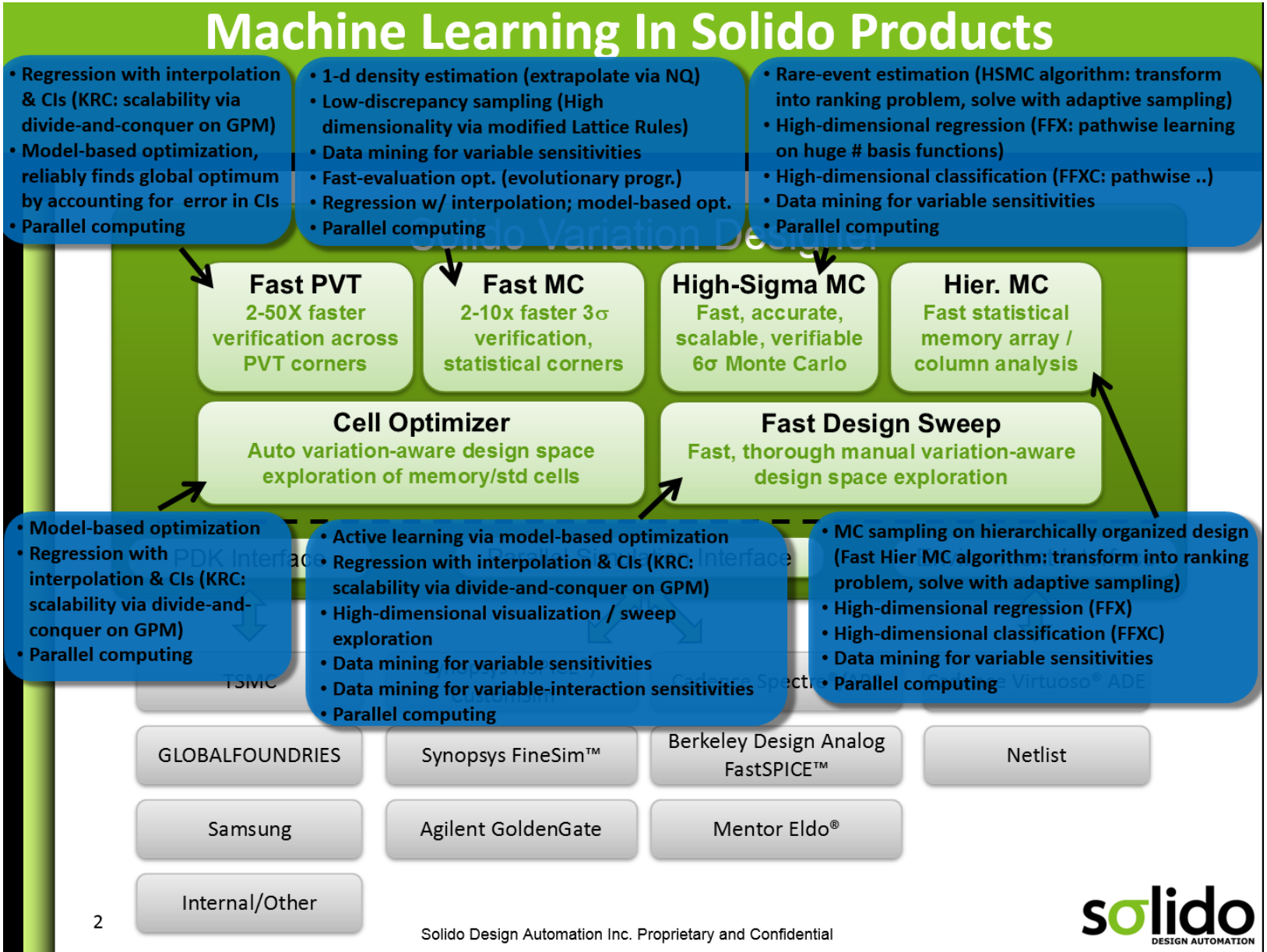
Example 1 (Solido) - Problem: Variation vs. Moore's Law



When Solido started (2005)

Now (2015)

Example 1 (Solido) - Solution: AI/ML solves variation to help drive Moore's Law



Example 1 (Solido) - Solution 2:

Example of cognitive enhancement by raising abstraction level for engineer, leaving details to AI/ML

Impacts On Margin

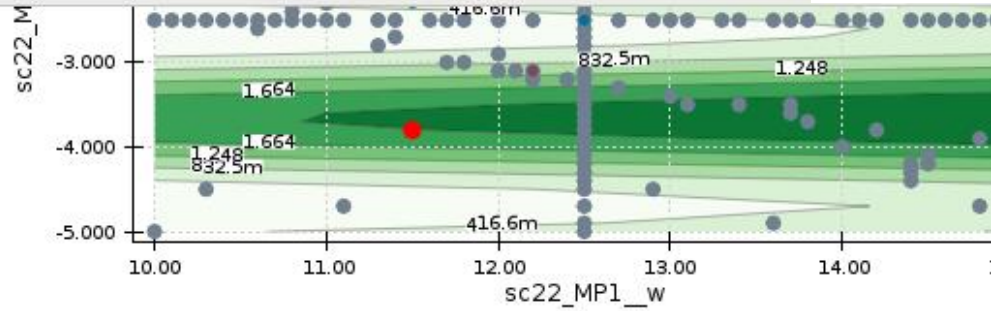
Impact	Variables	Initial	Current	Best	Exp ID=3
54.73%	sc22_MP1__l	-2.500	-3.800	-3.100	-2.300
30.94%	sc22_MP1__l, sc22_MP1__w	-2.500, 12.50	-3.800, 11.50	-3.100, 12.20	-2.300, 11.50
14.33%	sc22_MP1__w	12.50	11.50	12.20	11.50

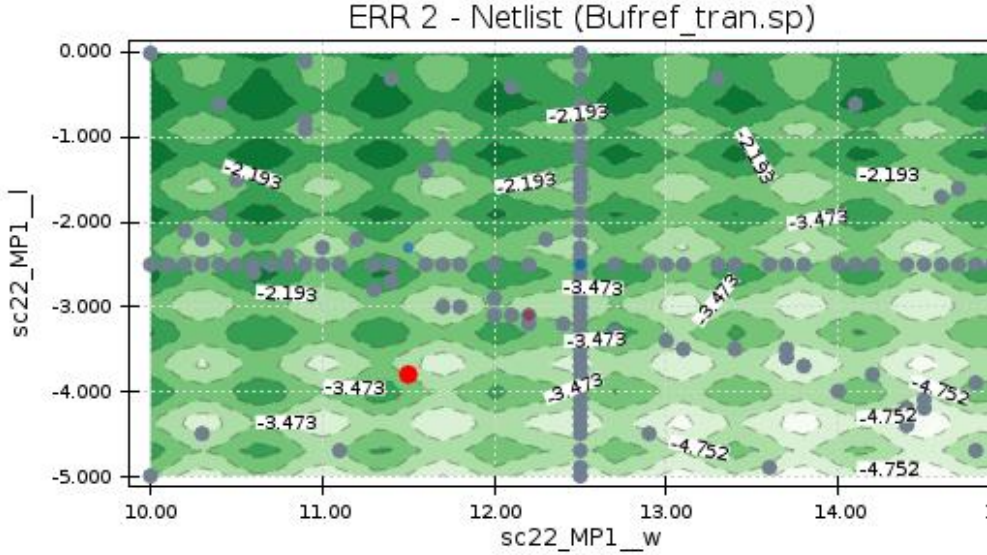
Candidates Table

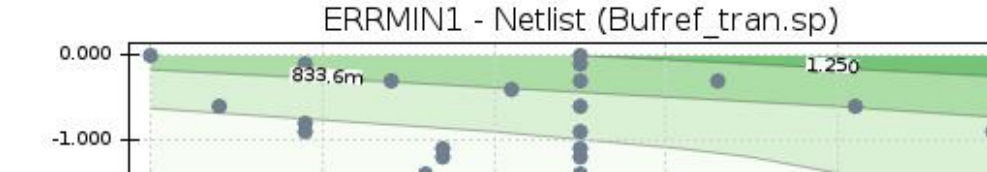
	Initial	Current	Best	Exp ID=3
Simulated	False	N/A	N/A	False
Margin	-52.13m	-83.04m	-4.044m	-49.17m
END1	5.244	8.354	406.8m	4.947
END2	-738.3m	-861.0m	-812.8m	-638.3m
IVDD	-2.500	-3.800	-3.100	-2.300

Sweeps on Netlist (Bufref_tran.sp)

solido DESIGN AUTOMATION







Example 2 (ascribe) - Problem: Monetization in the knowledge economy How do you share your creations securely?

"my conclusion is that **whatever you put on the internet you lose it**. Maybe keep the rights, but lose the power over it."

-typical creator

Example 2 (ascribe): Solution:
Share securely via blockchain (security) + analytics (visibility)

Conclusion

- Q: How do you reconcile the future with your career?
- A: Model the future & insert yourself into it

- My model: Future is CogE, powered by Moore's Law & surrounding infrastructure
- I've inserted myself into Moore's Law (ADA, Solido) and infrastructure (ascribe)