We Are Modelers, Pressing Our Models

How do we model?

To what extent
can we model?

Why do we model?

What are the ***long-term consequences***
of our modeling?

The First Modelers

Goal: Food!

- Where will deer be given current conditions?
- What conditions will make deer most likely move under the trap?
- If I make a noise, will deer move under the trap?

➢ **Prediction**

➢ **Explanation**

➢ **Intervention**

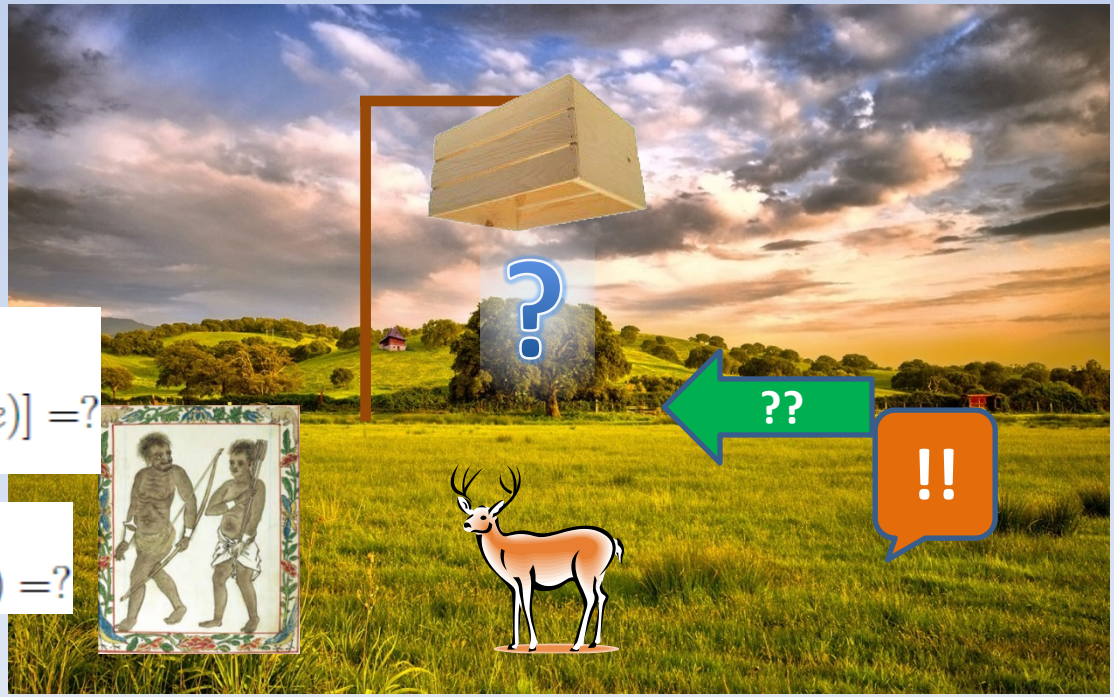
Inference Queries

Computable!

$$P(y|x) = ?$$
$$P(DeerPos_{t+1}|state_t) = ?$$

$$\underset{x}{\text{argmax}}\,[P(y|x) = z] = ?$$
$$\underset{state}{\text{argmax}}[P(DeerPos = \text{UnderTrap}|state)] = ?$$

$$P(y|\mathbf{do}(x)) = ?$$
$$P(DeerPos = \text{UnderTrap}|\mathbf{do}(noise)) = ?$$



Limits

God?

"What are the limits of our models?"
"How do we acquire knowledge?"

→ *Epistemology*

Rationalists

Thinking

Knowledge ← **Logic**

Empiricists

Senses

Knowledge ← **Environment**

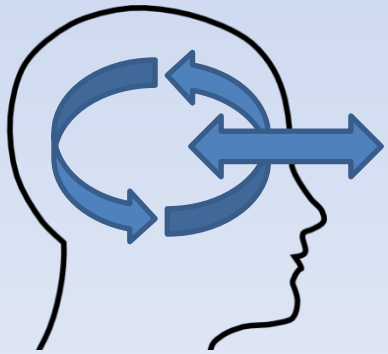
Compute Everything → Know Everything

Observe Everything → Know Everything

God-Machine?

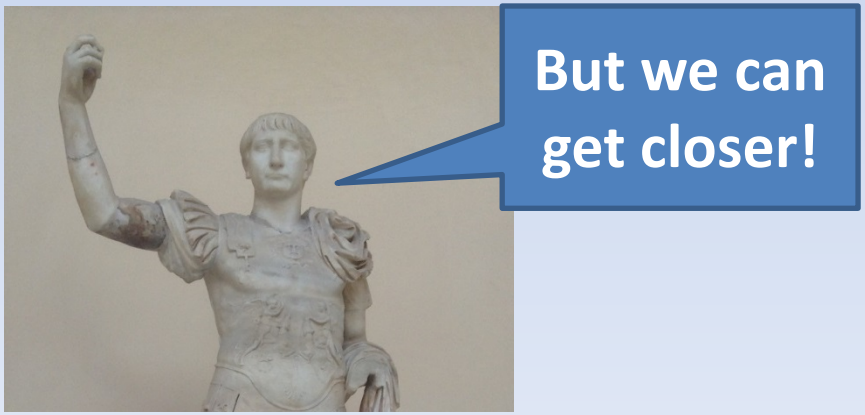
∞ processing
∞ memory
∞ bandwidth

Can we reach the God Machine?

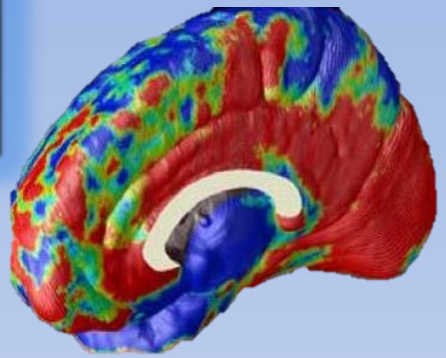


Reality Check: Hard Limits

$\lim$	$\lim$	$\lim$

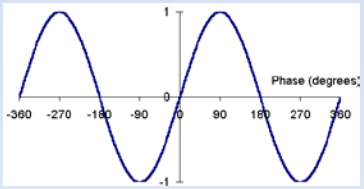


Push the Limits



- Push bandwidth (I/O)
  - More Data, More *Relevant* Data
- Push Memory (RAM, Storage)
  - Summarize and condense (Hash)
- Push Computation (Processor)
  - New ways of thinking → Theories
    - Classical to Probabilistic
  - Increase thinking efficiency

123



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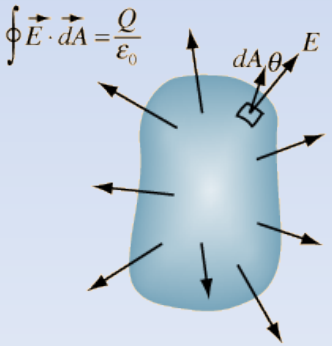
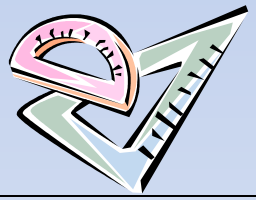


Taking Models to the Next Level

- Accuracy & Precision ↗
  - Assumptions ↘
  - Minimize error
- Compatibility w/ other models ↗ (Unification)
- Computability ↗
- Simplicity ↗ (*Language*)

Scientists: expand knowledge via ↗ models



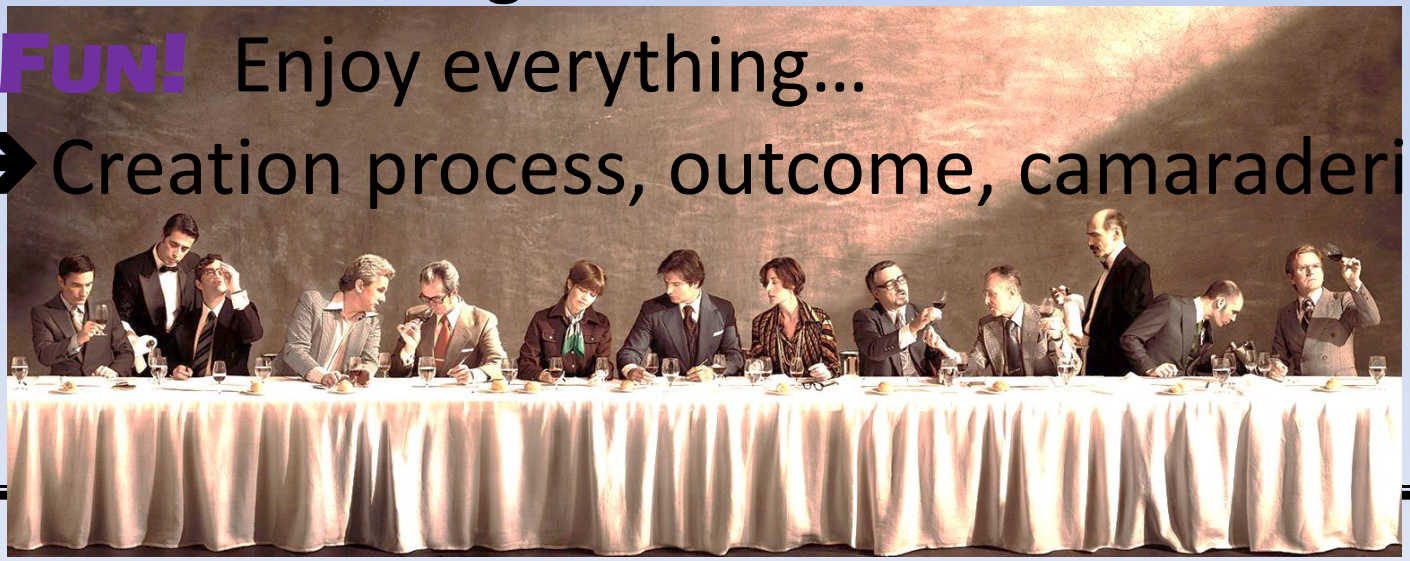
Engineering: leverage all knowledge & Solve problems

<u>The Bottom Line</u>:

Within limitations, make *most likely* inferences

For what purpose?

1) Advance humanity toward ***your future vision***
   ➔Your meaning of life
2) **FUN!** Enjoy everything…
   ➔Creation process, outcome, camaraderie



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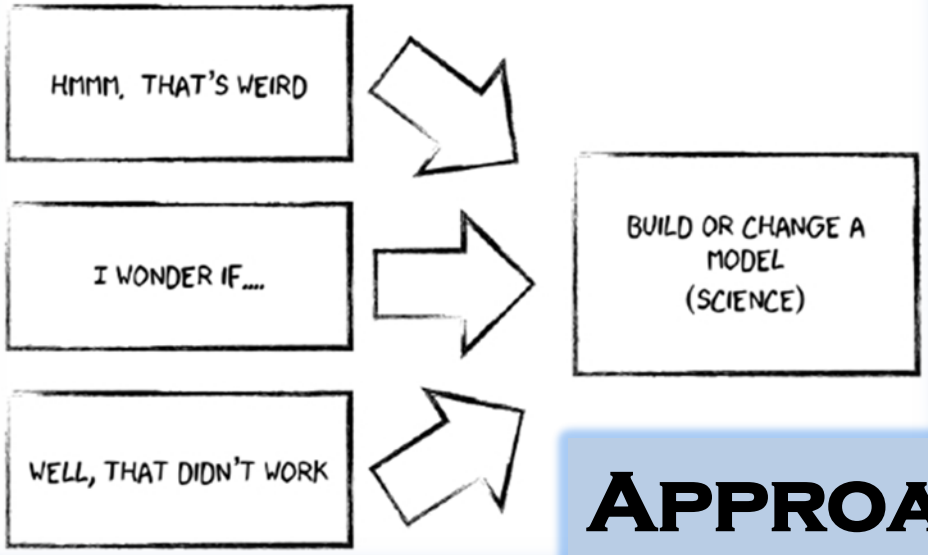
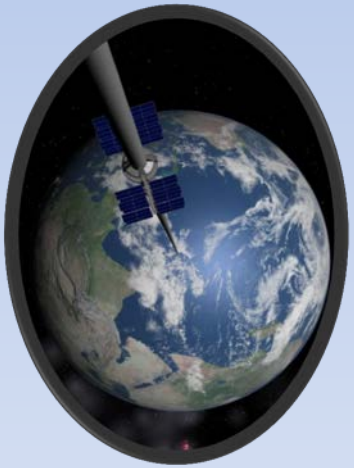


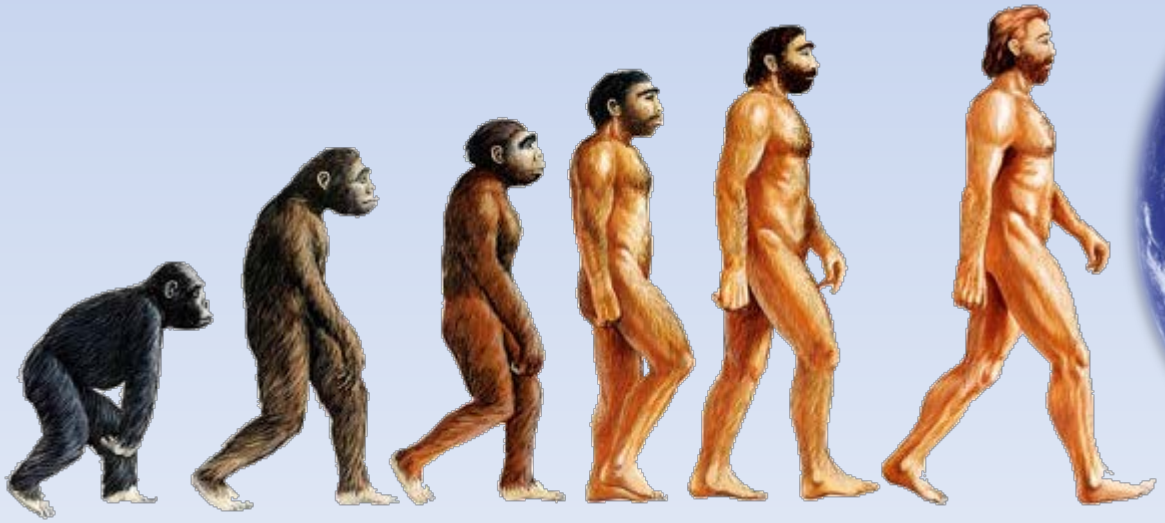
Better…

- **Predictions**
- **Explanations**
- **Interventions**



APPROACH OUR LIMITS AND PROSPER!

PART II: CONSEQUENCES



Majority's Future Vision: "*Progress*"

Increase Efficiency

Invent New Technology

Cure Cancer

End World Hunger

Increased Human Quality of Life

Human Population Growth

Decreased Human Quality of Life

Crime & Disease

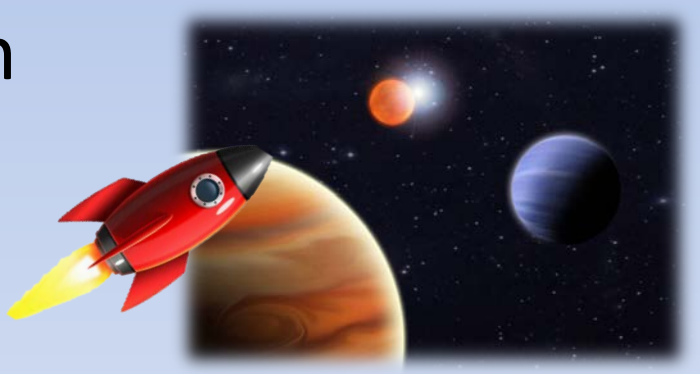
Species Elimination

Environmental Terraforming

Resource Scarcity

Progress Cycle Resolution

1. Accept finite human population
   - Redefine society's notions of ethics and "progress"
2. Continue infinite growth
   - Colonize Space!
   - Infinite growth ok in the infinite universe



3. Perish
   - Humans kill themselves or Earth?
   - Black swan event?

Solution: 1 + 2

1. Accept finite human population
   - Political/Cultural Problem
   - Better limit human pop. growth → limit rate of QoL ↘
2. Continue infinite growth – to Space!
   - Technological/Engineering Problem
   - Defines rate of QoL ↗

Utopia: Hard finite human population, tech. advances ↗QoL indefinitely

Goal: #2 Rate of QoL↗ **>** #1 Rate of QoL↘

My Proposal: 2 + 1

1. Accept finite human population
   - Indirect action – be the role model and inspire value change among others *locally*
   - Overt mass convincing is hard
     - I can only control myself, not anyone else directly
2. Continue infinite growth – to Space!
   - Direct Action; Science & Engineering

Backup!

Modern Models

- Physics
  - Prediction: What is the path of an electron?
  - Explanation: What causes gravity?
  - Intervention: If we build a rocket and ignite it, will it launch into orbit?
- Finance
  - What will the value of Apple be in 3 months?
  - What circumstances led to the 2008 crash?
  - If the Federal Reserve repurchases treasury bonds, will inflation decrease?
- Music
  - How will it sound if a violin plays A, a Flute plays B, a Cello plays C, …
  - What leads an audience to most appreciate a sound? [psychology]
  - If we change the increase a tune's time signature, will it appear faster?
- Love, History, Biology, Mathematics, Engineering, Health, …….

- Luddite anti-technology
  - Without tech. progress, will hit the hard Earth resource limit → stops human growth, at great cost of minimum QoL (crime, overcrowding, …)