We Are Modelers, Pressing Our Models

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How do we model?

We Are Modelers, Pressing Our Models

How do we model?

To what extent

can we model?

We Are Modelers, Pressing Our Models

How do we model?

To what extent can we model?

Why do we model?

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

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Goal: Food!

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- Where will deer be given current conditions?

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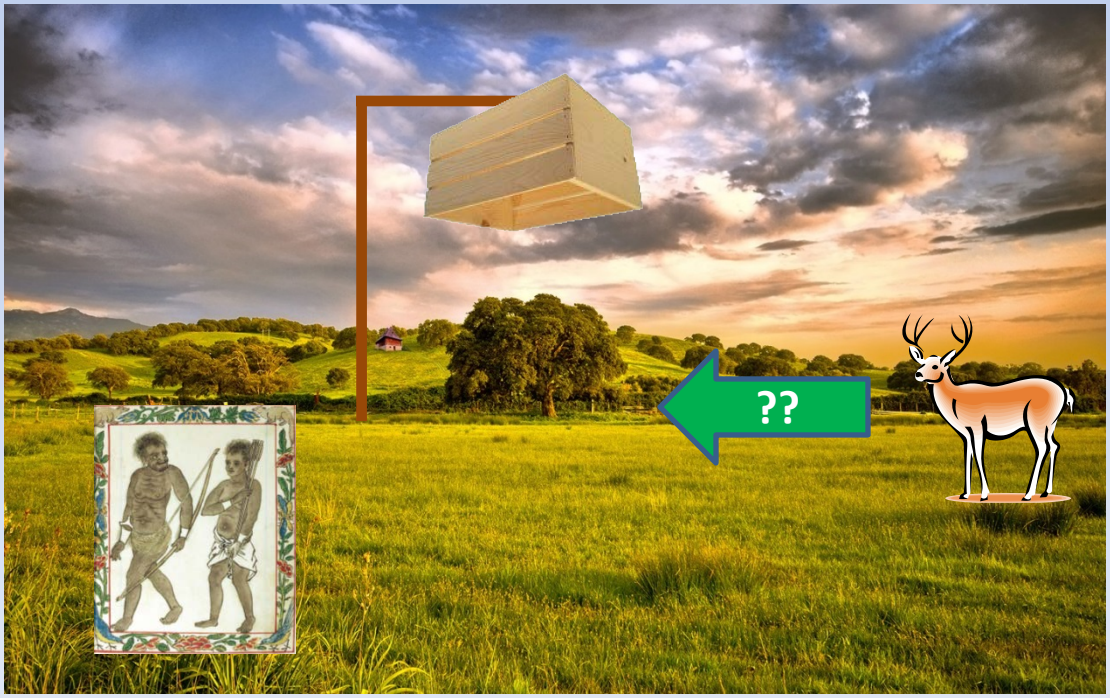

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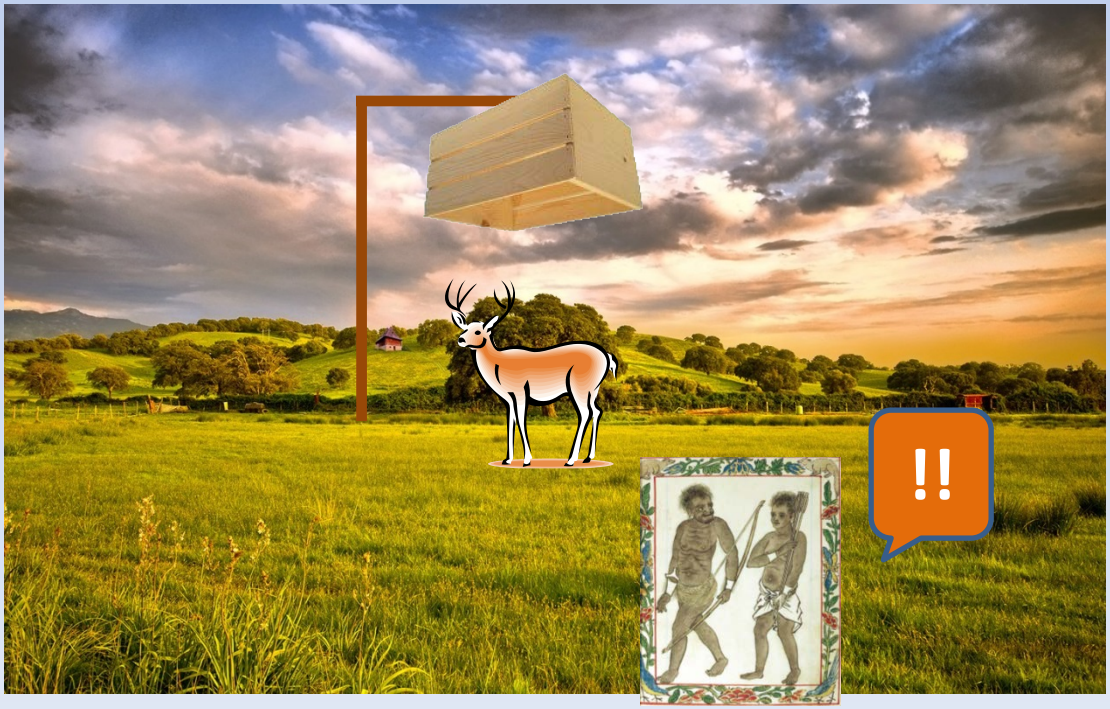

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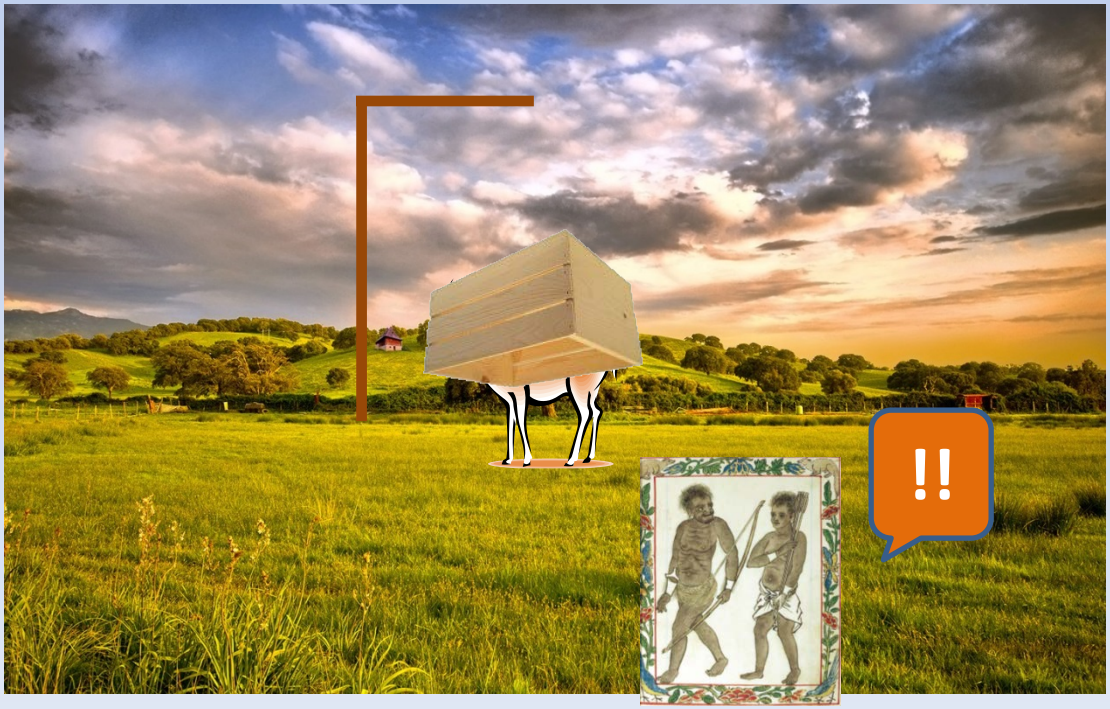

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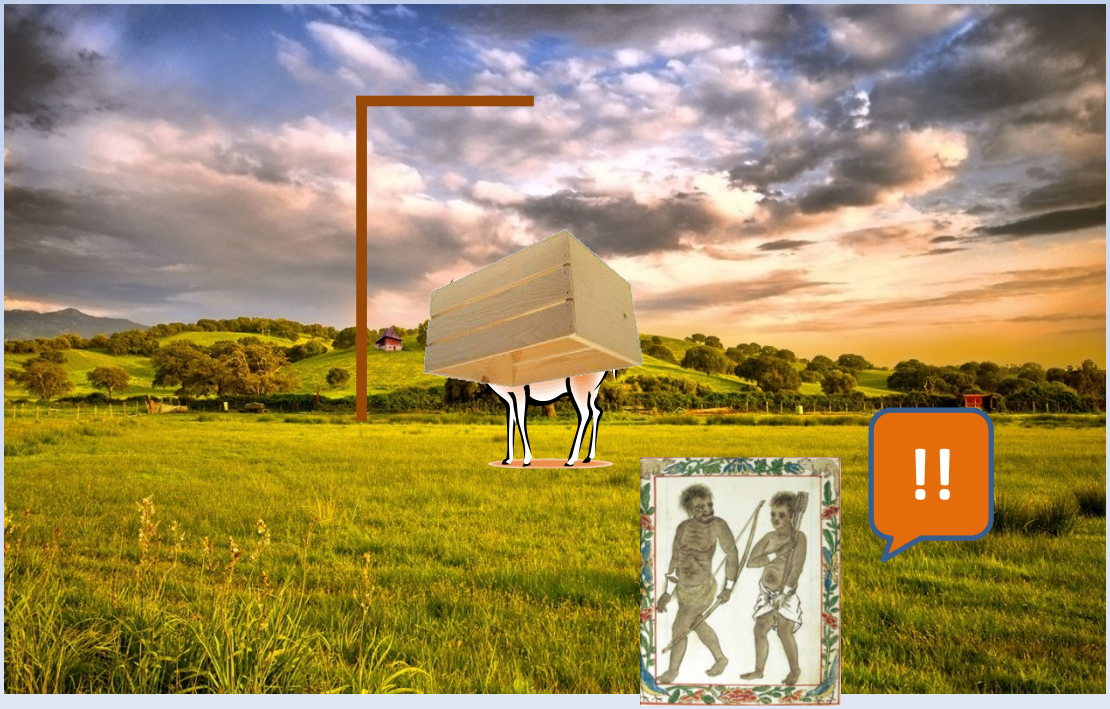
➢ **Prediction**

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



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➢ **Prediction**

➢ **Explanation**

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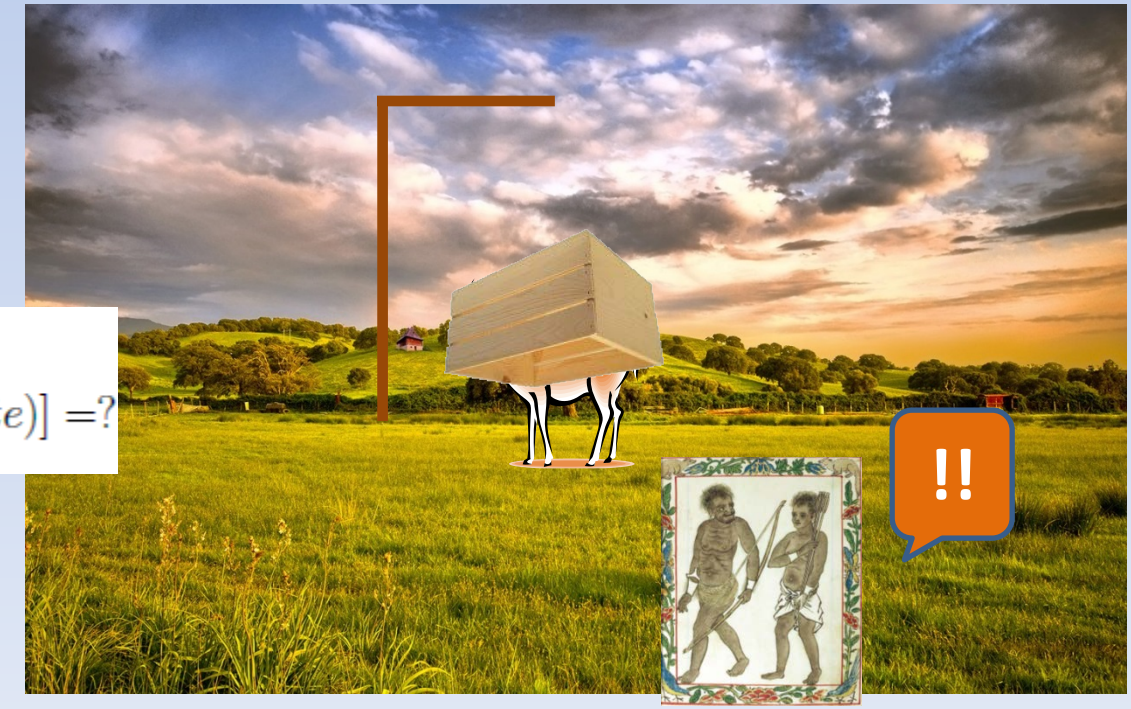

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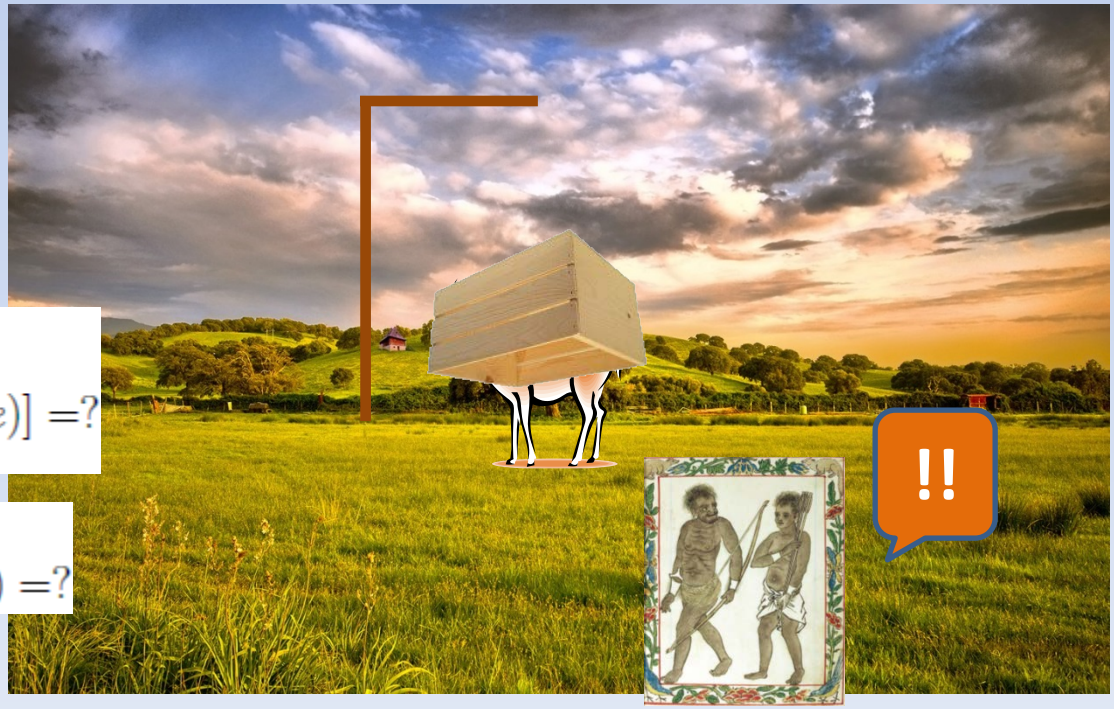

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Inference Queries

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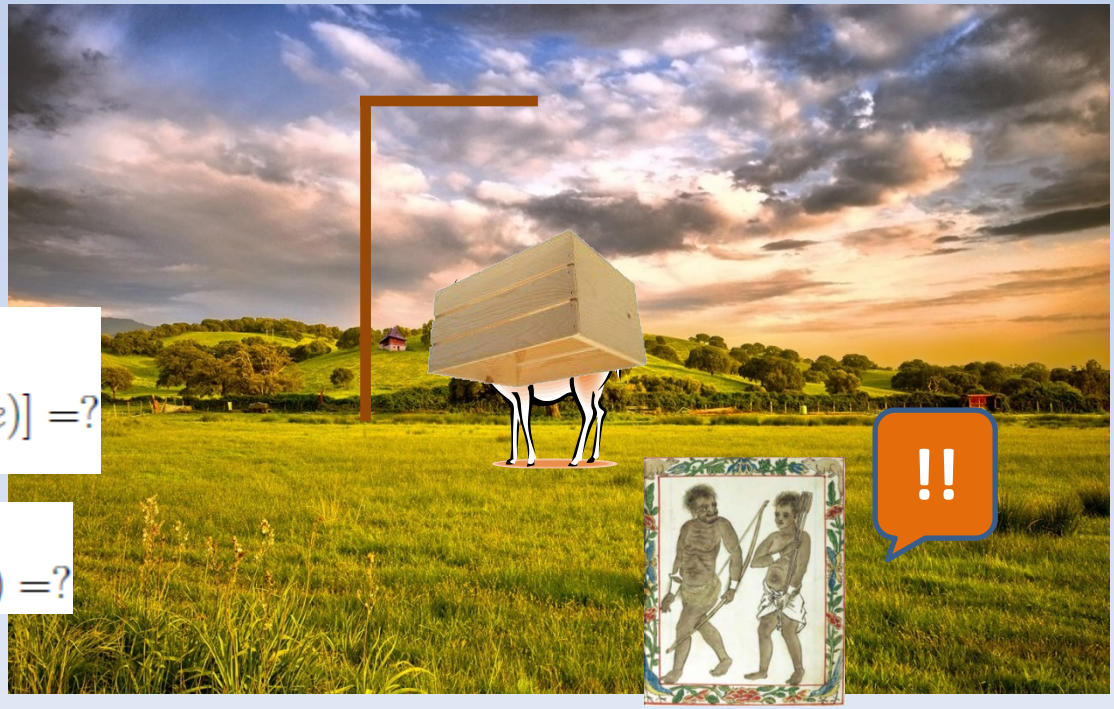

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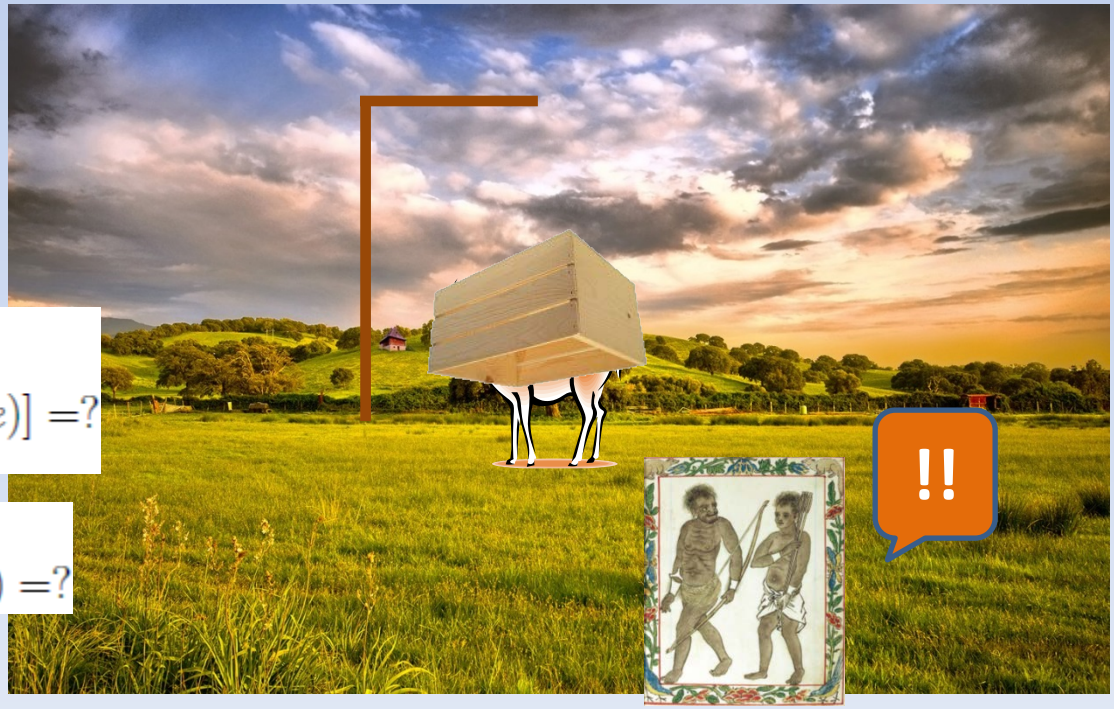

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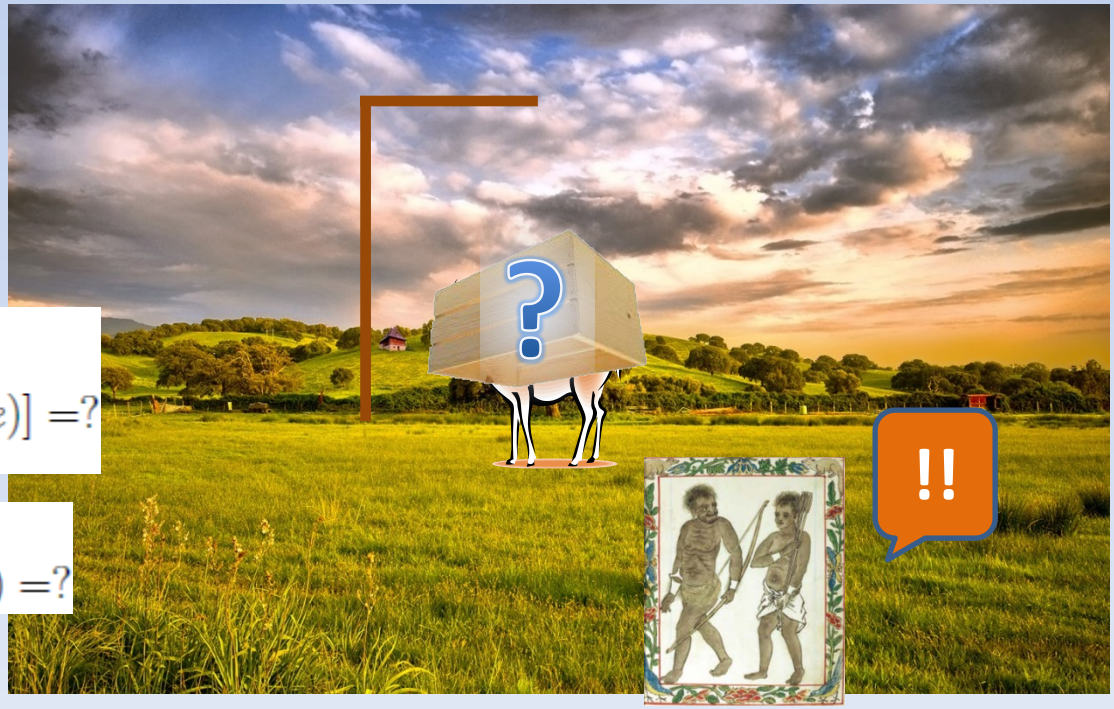

Limits

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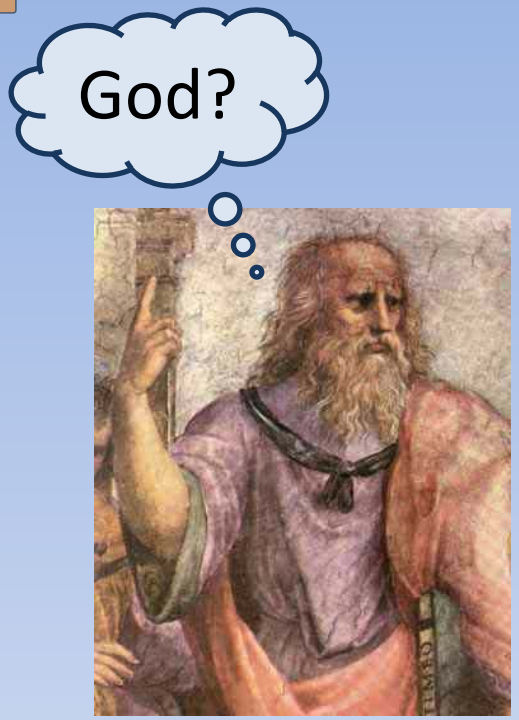

Limits

"What are the limits of our models?"

Limits

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→ *Epistemology*

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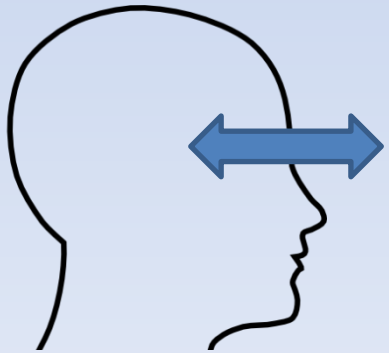
<u>Empiricists</u>

Senses
Knowledge ← **Environment**



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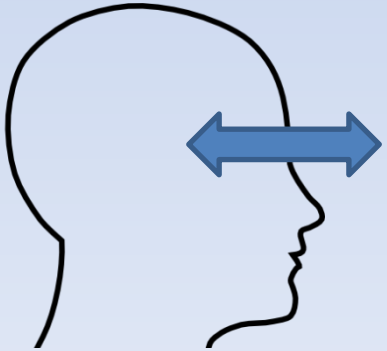
Observe Everything → Know Everything



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<u>Rationalists</u>

Thinking

Knowledge ← **Logic**

<u>Empiricists</u>

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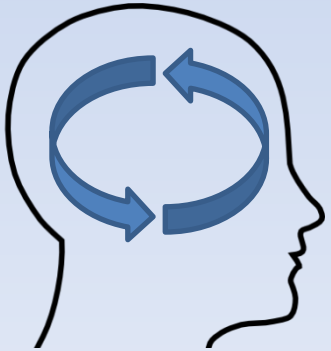

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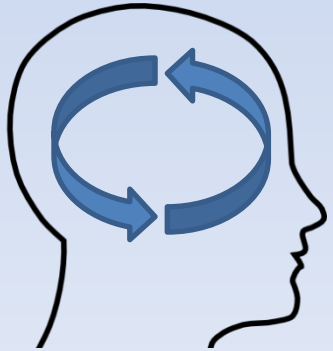

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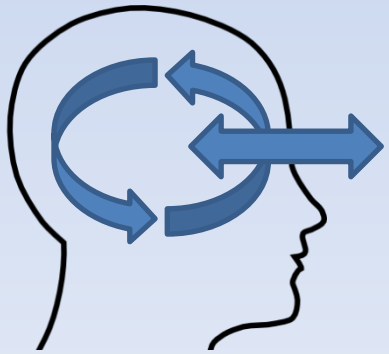
God-Machine?

∞ processing

∞ memory

∞ bandwidth



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∞ memory
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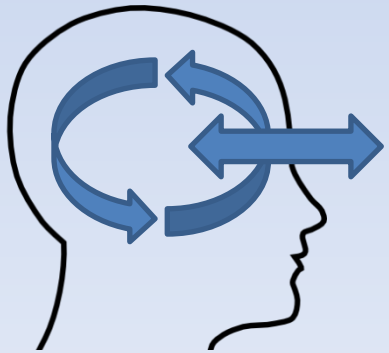
Can we reach the God Machine?



Reality Check: Hard Limits

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

Reality Check: Hard Limits

Physical Measurements	lim	lim
Heisenberg $\sigma_x \sigma_p \geq \frac{\hbar}{2}$		

Reality Check: Hard Limits

Physical Measurements		Knowledge
Heisenberg	$\lim$	**Gödel Incompleteness**
$\sigma_x \sigma_p \geq \frac{\hbar}{2}$		$\text{Complete} \oplus \text{Consistent}$

Reality Check: Hard Limits

Physical Measurements	Physical Manipulation	Knowledge
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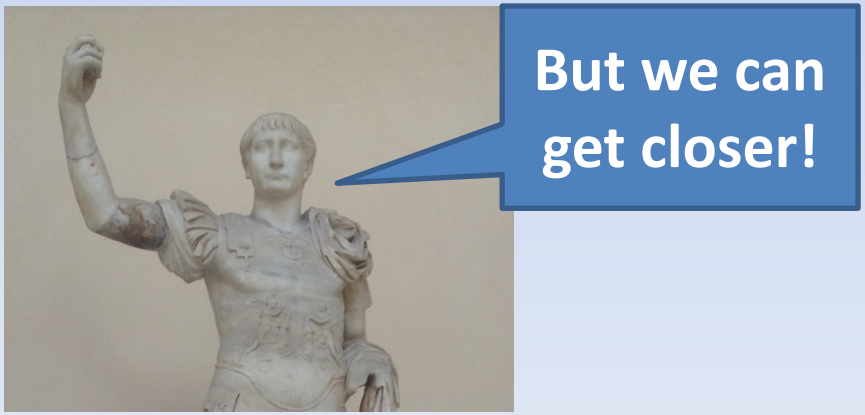

Push the Limits

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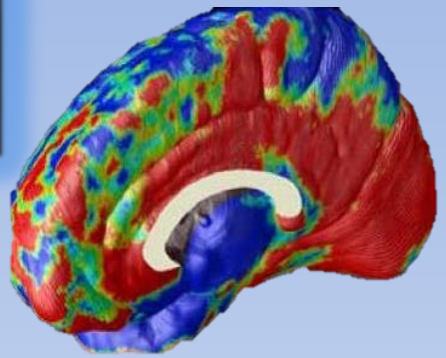
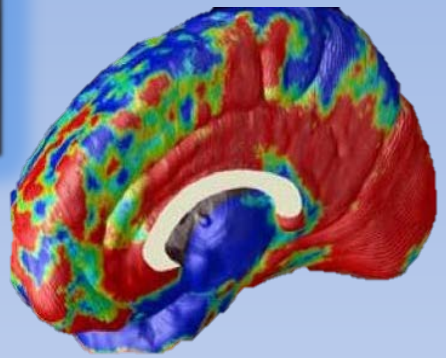


- Push bandwidth (I/O)
  - More Data, More *Relevant* Data

Push the Limits



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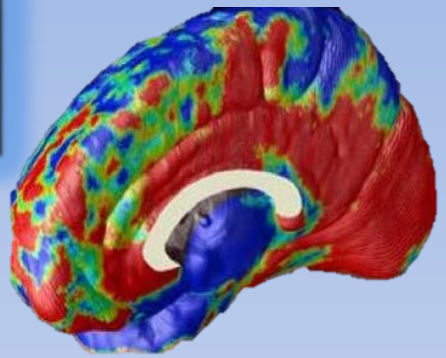

- Push bandwidth (I/O)
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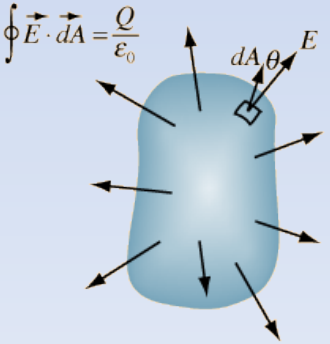
- Push Computation (Processor)
  - New ways of thinking → Theories
    - Classical to Probabilistic



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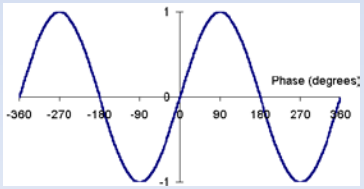

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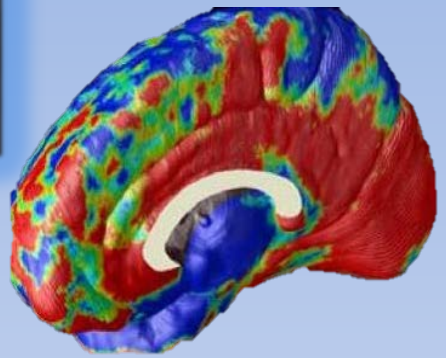
Push the Limits



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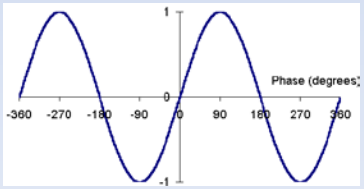
- Push Computation (Processor)
  - New ways of thinking → Theories
    - Classical to Probabilistic
  - Increase thinking efficiency

123



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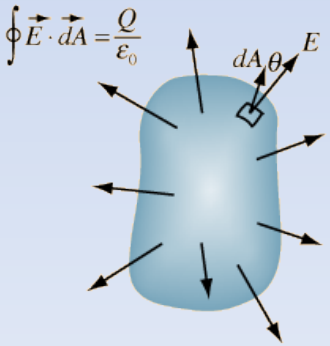

Taking Models to the Next Level

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

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Scientists: expand knowledge via ↗ models

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<u>The Bottom Line</u>:

Within limitations, make *most likely* inferences

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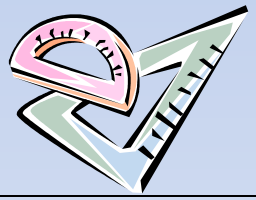

Engineering: leverage all knowledge & Solve problems

<u>The Bottom Line</u>:

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For what purpose?

For what purpose?

1) Advance humanity toward ***your future vision***
   ➔ Your meaning of life

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2) **FUN!** Enjoy everything…
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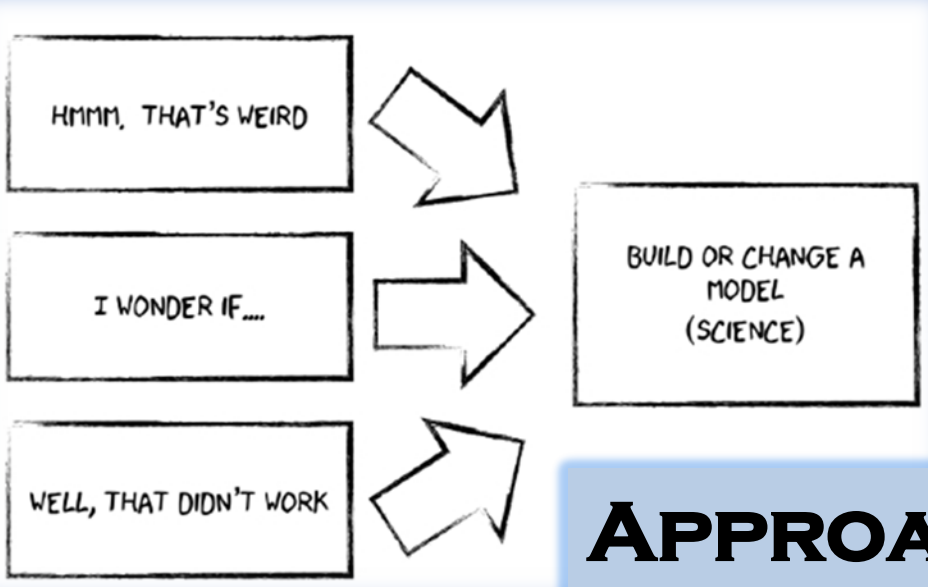
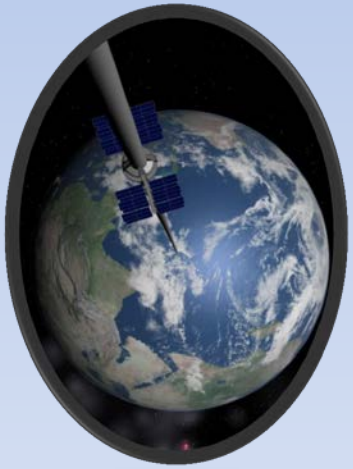


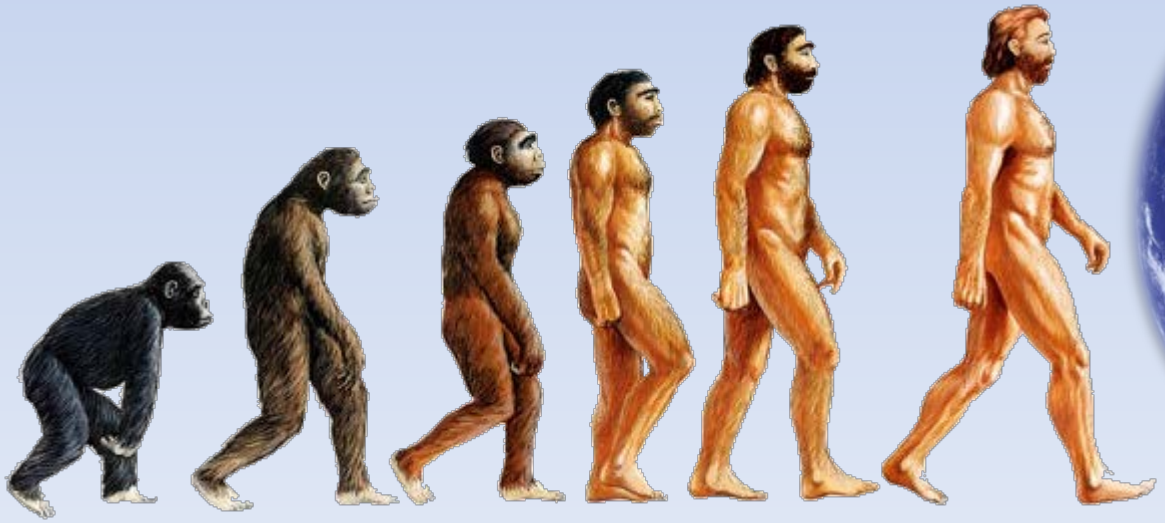
Better…

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

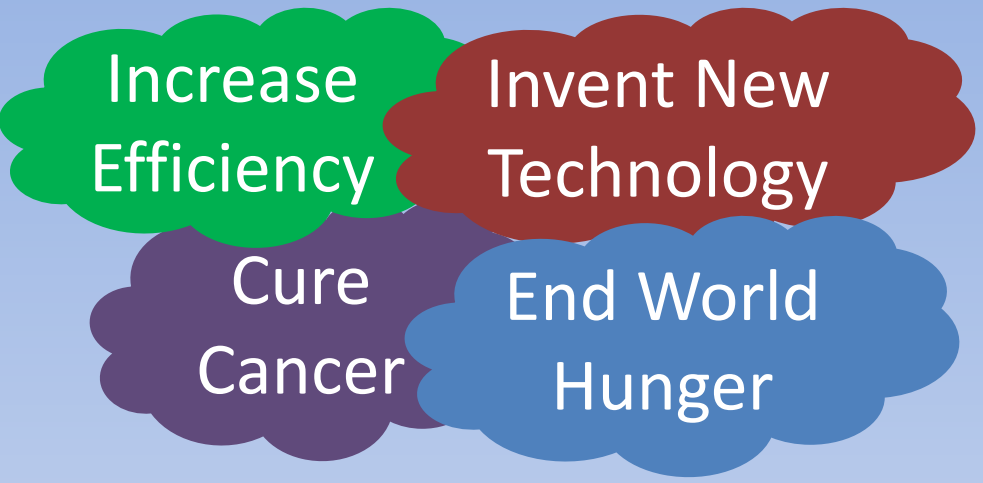


APPROACH OUR LIMITS AND PROSPER!

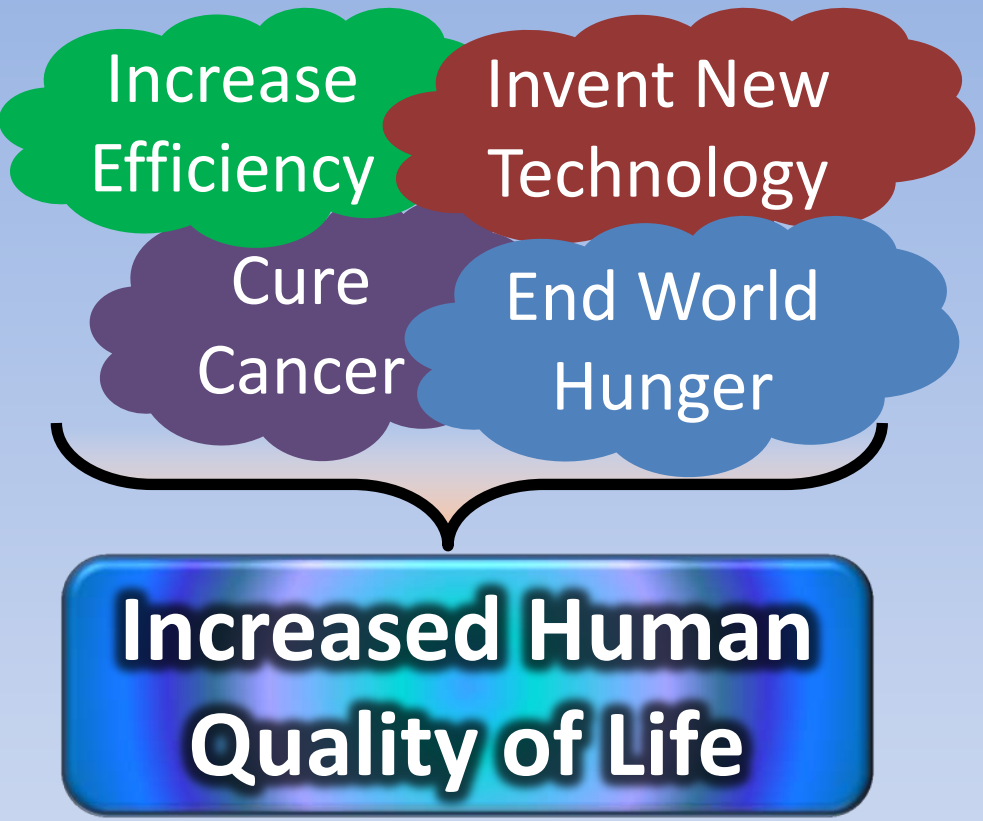
PART II: CONSEQUENCES



Majority's Future Vision: "*Progress*"



Majority's Future Vision: "*Progress*"



Majority's Future Vision: "*Progress*"

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Increase Efficiency

Invent New Technology

Cure Cancer

End World Hunger

Increased Human Quality of Life

Human Population Growth

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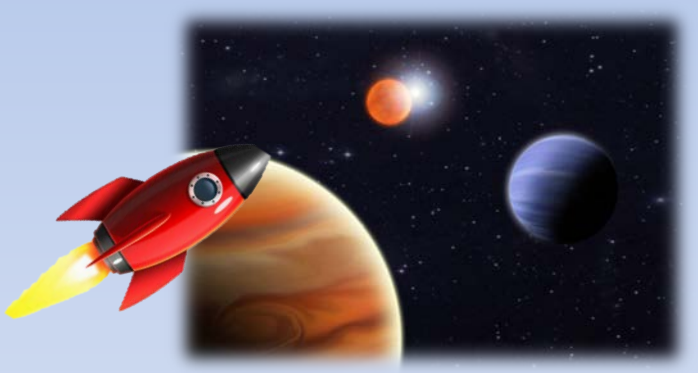
Progress Cycle → …?

1. Stop human population growth
   - Redefine society's notions of ethics and "progress"
2. 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, no one else directly
2. Continue infinite growth – to Space!
   - Direct Action; Science & Engineering

Remark: Progress Cycle's Breakpoint

- Trend: increasing QualityOfLife—

  e.g. Education, Food & Financial Stability, Medicine, …

Increased Human Quality of Life

Remark: Progress Cycle's Breakpoint

- Trend: increasing QualityOfLife—

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  —Correlates with *Decreasing Birth Rates*

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- Developed nations vs. Developing nations

Remark: Progress Cycle's Breakpoint

- Trend: increasing QualityOfLife—

  e.g. Education, Food & Financial Stability, Medicine, …

  —Correlates with *Decreasing Birth Rates*
- Developed nations vs. Developing nations

Will population problems resolve *naturally*, as a side effect of technological progress and addressing societal issues?

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, …….