

First-Order Logic = FOL = $\mathcal{L}_1$ and the First (Logic) Programmer

Selmer Bringsjord

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Troy, New York 12180 USA

Intro to Logic-based AI
10/2/2025



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Who is it?



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Who is it?

Leibniz
Aristotle
Gödel

...



MiniMaxularity-Related Logic-&AI In The News (2024)

Beneath the Potential Strike at U.S. Ports: Tensions Over Innovation

Port operators have long embraced automation, while dockworkers view it as a threat to their livelihoods.

▶ Listen to this article · 8:20 min [Learn more](#)



The Port of Savannah in Georgia. Dockworkers on the East and Gulf Coasts of the United States are threatening to go on strike beginning Tuesday. Erin Schaff/The New York Times



By **Peter S. Goodman**

Peter S. Goodman has reported on shipping and ports around the world for more than two decades.

Throughout the centuries, as ships have navigated oceans bearing all manner of freight, the companies that operate ports have pressed to limit what they spend on the people who load and unload cargo.

Dockworkers, for their part, have mobilized to pursue a greater share of the bounty through a familiar tactic: They have threatened to disrupt international commerce by going on strike.

Confronted by the militancy of longshore unions, port operators have deployed automation, in part to limit their vulnerability to labor troubles. Not coincidentally, [dockworkers tend to look suspiciously](#) at robots and other forms of innovation, divining threats to their livelihoods.

That, in a nutshell, is the history of labor relations on docks from Australia to Britain. And that dynamic is at the center of a contractual impasse now threatening to produce a [debilitating strike](#) starting Tuesday at ports on the East and Gulf Coasts of the United States.

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companies that operate ports have not what they spend on the people to unload cargo.

For their part, have mobilized to get their share of the bounty through force: They have threatened to disrupt international commerce by going on

the militancy of longshore operators have deployed force in part to limit their vulnerability to automation. Not coincidentally, they tend to look suspiciously at new forms of innovation, divining threats to their livelihoods.

Well, is the history of labor wars, from Australia to Britain. The Luddite is at the center of a

contractual impasse now threatening to produce a [debilitating strike](#) starting Tuesday at ports on the East and Gulf Coasts of the United States.

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Why did the Luddites protest?

Political reform in 19th century Britain

- [Tasks](#)
- [Background](#)
- [Teachers' notes](#)
- [External links](#)
- [Connections to curriculum](#)

The machine-breaking disturbances that rocked the wool and cotton industries were known as the 'Luddite riots'. The Luddites were named after 'General Ned Ludd' or 'King Ludd', a mythical figure who lived in Sherwood Forest and supposedly led the movement.

They began in Nottinghamshire in 1811 and quickly spread throughout the country, especially to the West Riding of Yorkshire and Lancashire in 1812, and also to Leicestershire and Derbyshire. In Yorkshire, they wanted to get rid of the new machinery that was causing unemployment among workers. Hand loom weavers did not want the introduction of power looms. In Nottinghamshire, they protested against wage reductions.

Workers sent threatening letters to employers and broke into factories to destroy the new machines, such as the new wide weaving frames. They also attacked employers, magistrates and food merchants. There were fights between Luddites and government soldiers.

Using the original documents in this lesson, find out how the Luddites protested against changes affecting their working conditions. How did the government respond?

[View lesson as PDF](#)[View full image](#)

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MiniMaxularity-Related Logic-&AI In The News (2025)

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Accenture Makes Room for AI With Thousands of Layoffs

The IT consulting firm plans to let go of more staff over the next few months if they can't adapt to the demands of AI.

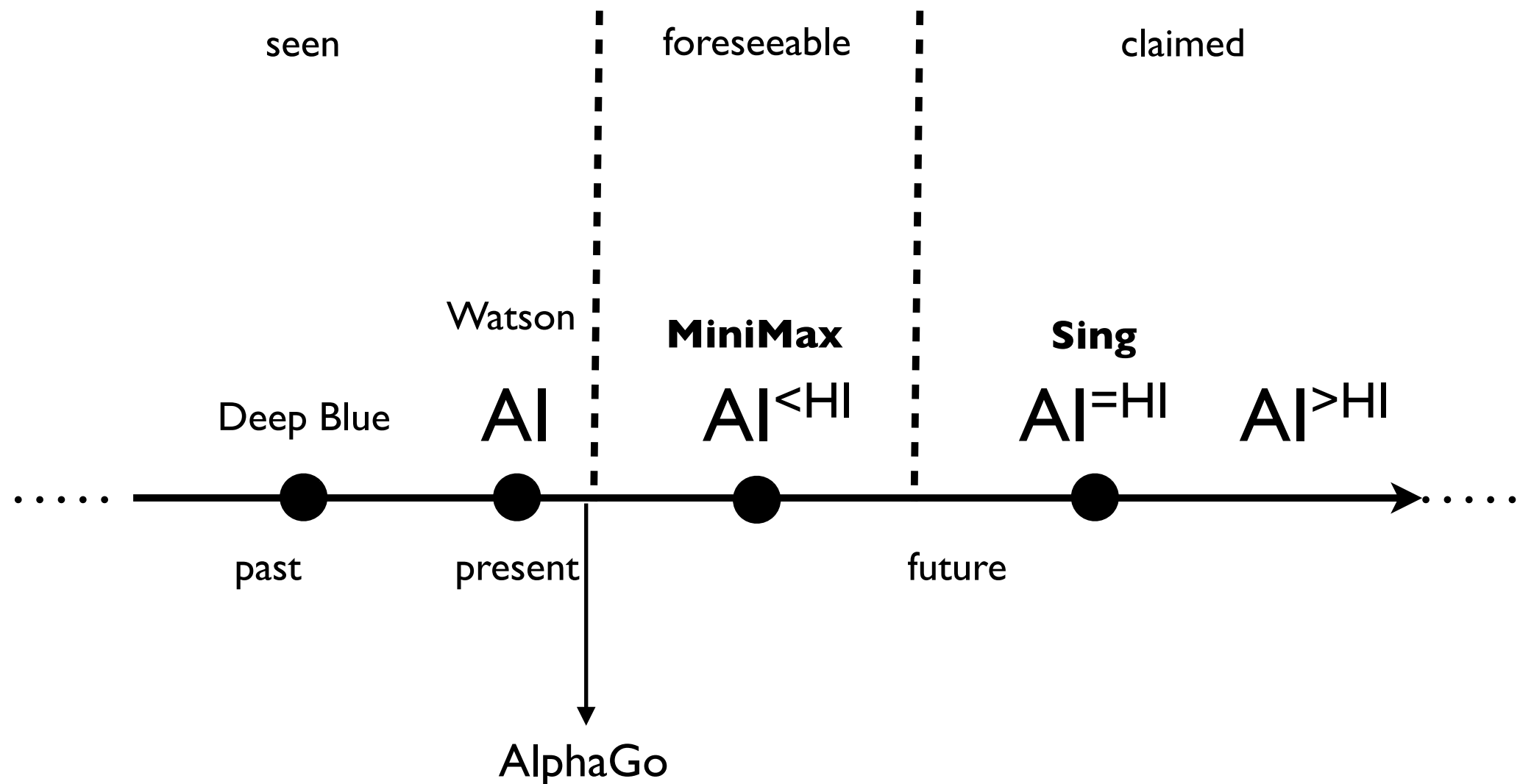


Written by
Gus Mallett

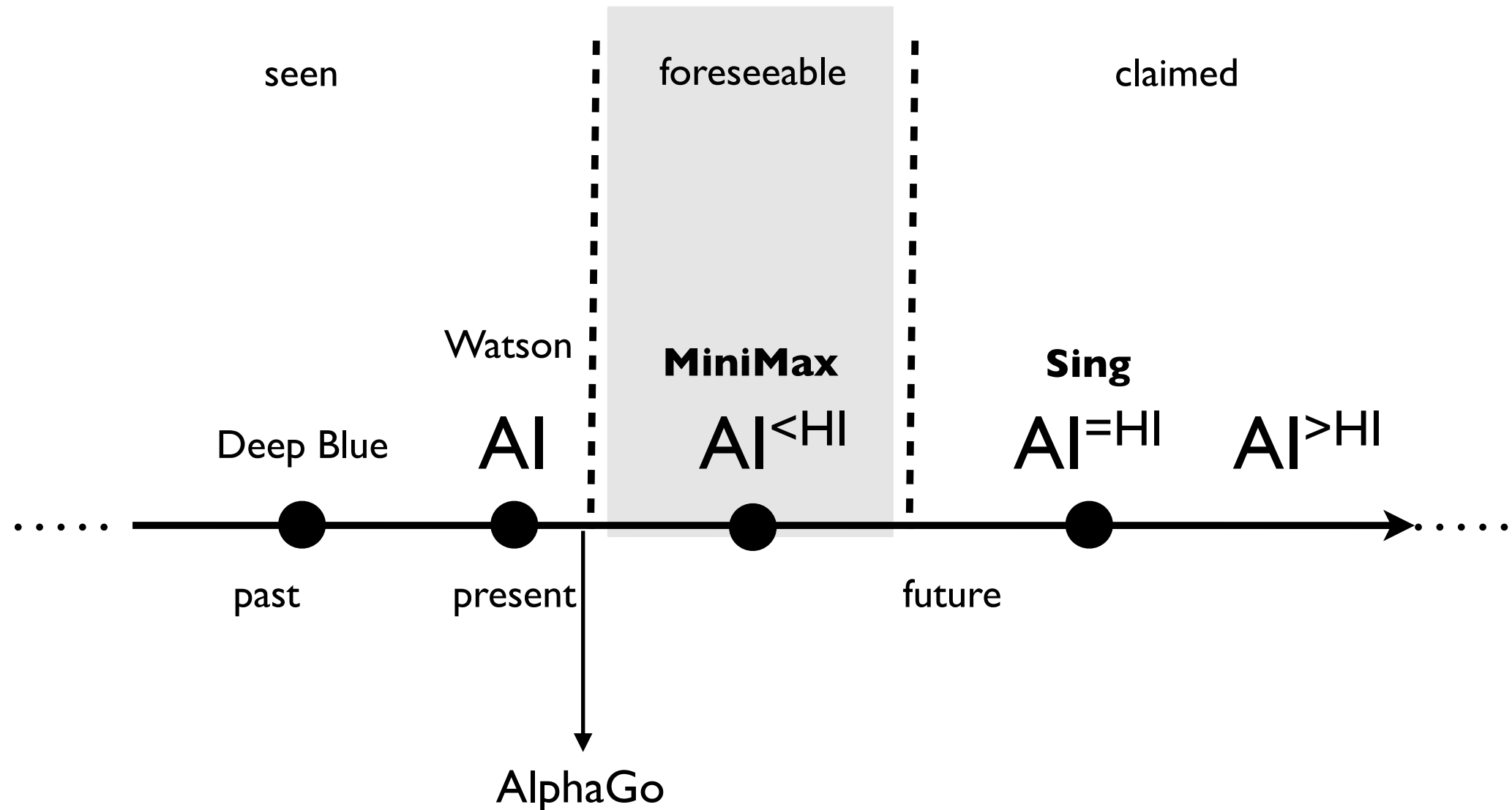
 Published on September 29, 2025

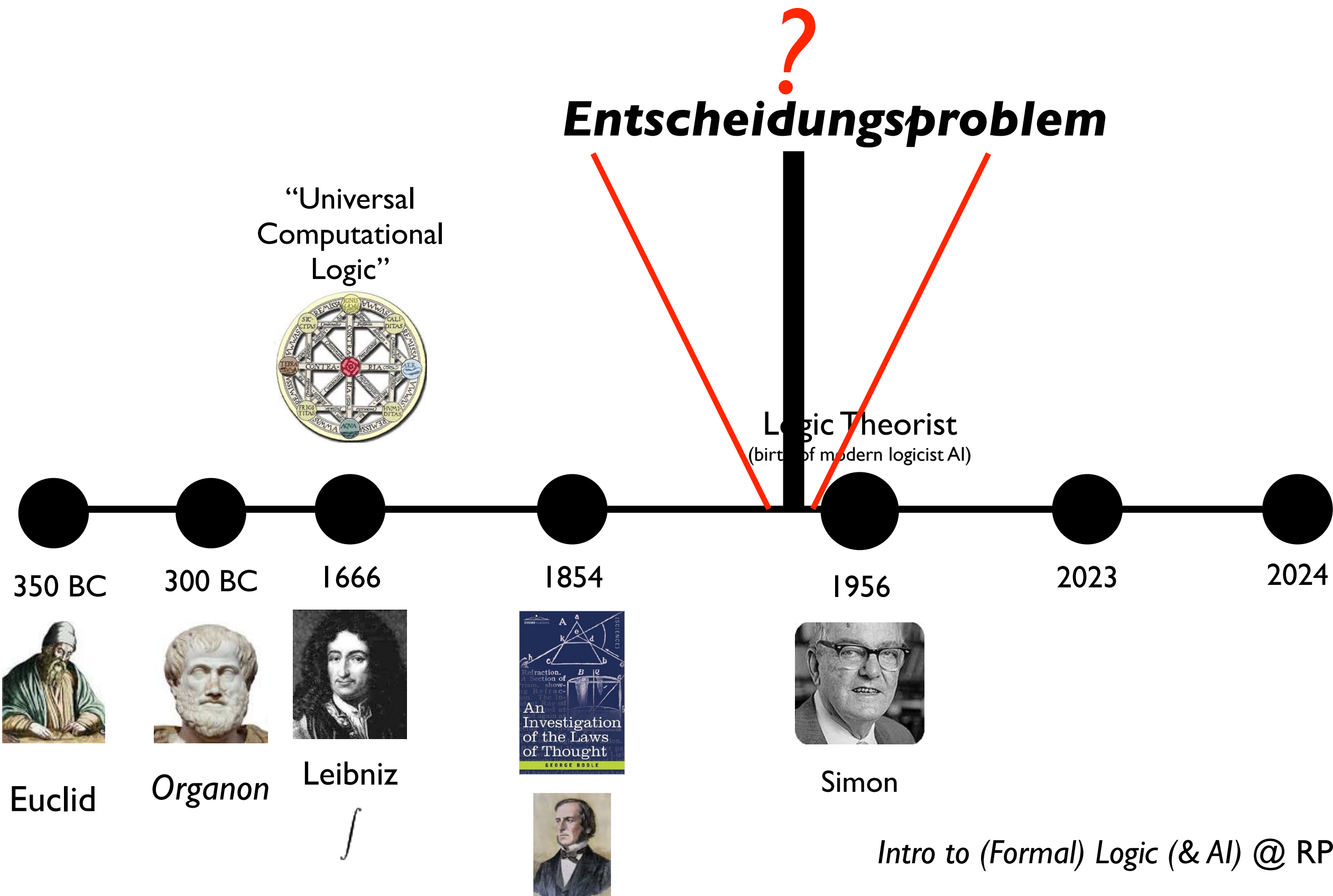


A Realistic Timeline (from last time)



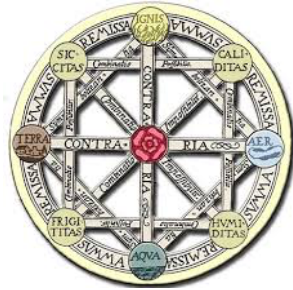
A Realistic Timeline (from last time)





Entscheidungsproblem

“Universal
Computational
Logic”



Logic Theorist
(birth of modern logicist AI)

350 BC

300 BC

1666

1854

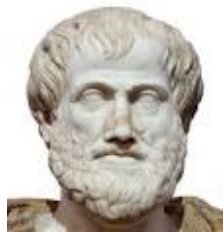
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2024



Euclid

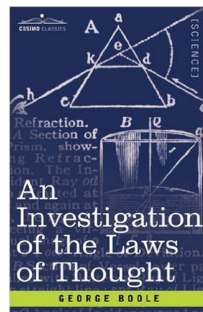


Organon



Leibniz

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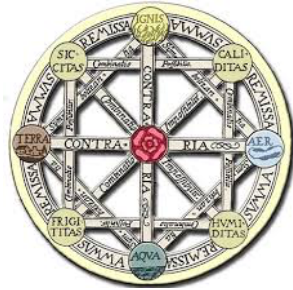
Simon

Intro to (Formal) Logic (& AI) @ RPI

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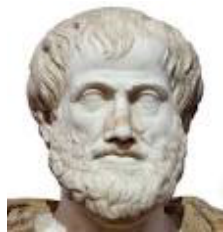
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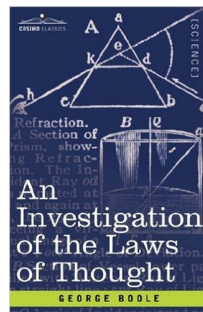


Organon



Leibniz

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Simon



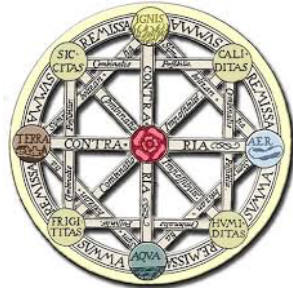
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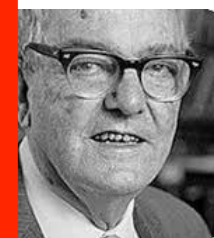
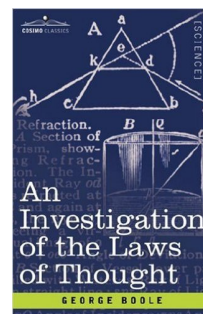


Organon



Leibniz

$\int$



Simon



Frege

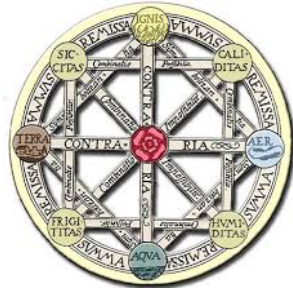
Exceeds Leibniz & de-mystifies Euclid: the “compellingness” of these proofs consists in their being, at bottom, formal proofs in first-order logic (FOL).

Intro to (Formal) Logic (& AI) @ RPI

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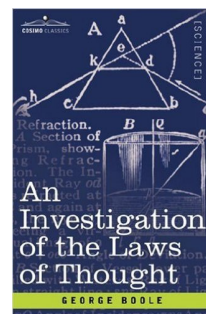


Organon



Leibniz

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Church



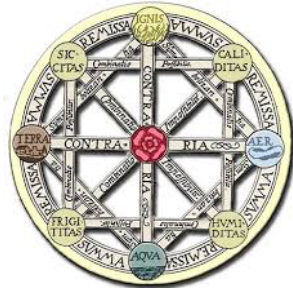
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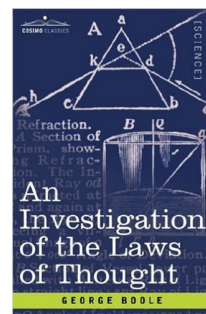


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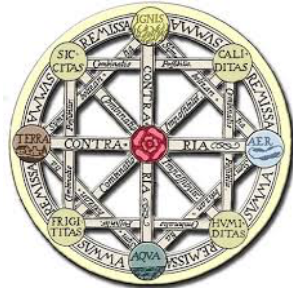
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Entscheidungsproblem

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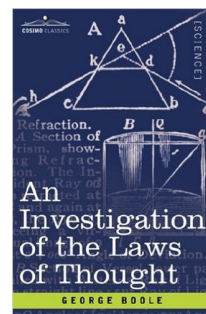


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Church



Turing



Post



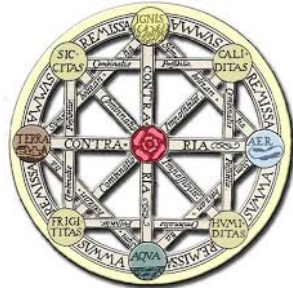
Simon

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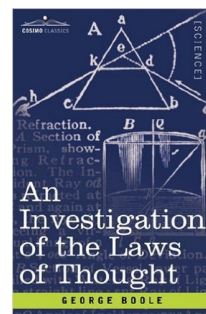


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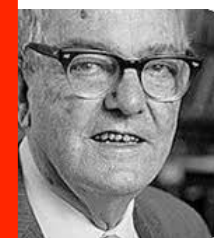
Church



Turing



Post



Simon

Intro to (Formal) Logic (& AI) @ RPI

Here’s what a computer is, and given that, sorry, the *Entscheidungsproblem* can’t be solved by such a machine!

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Two HyperGrader®
Required Prop-Calc Problems for **A**
(+ one coming AI-generated
personalized one) ...

TertiumNonDaturILBAI24

TertiumNonDaturILBAI24

DisjunctiveSyllogismILBAIF24

Quantifiers (etc) ...

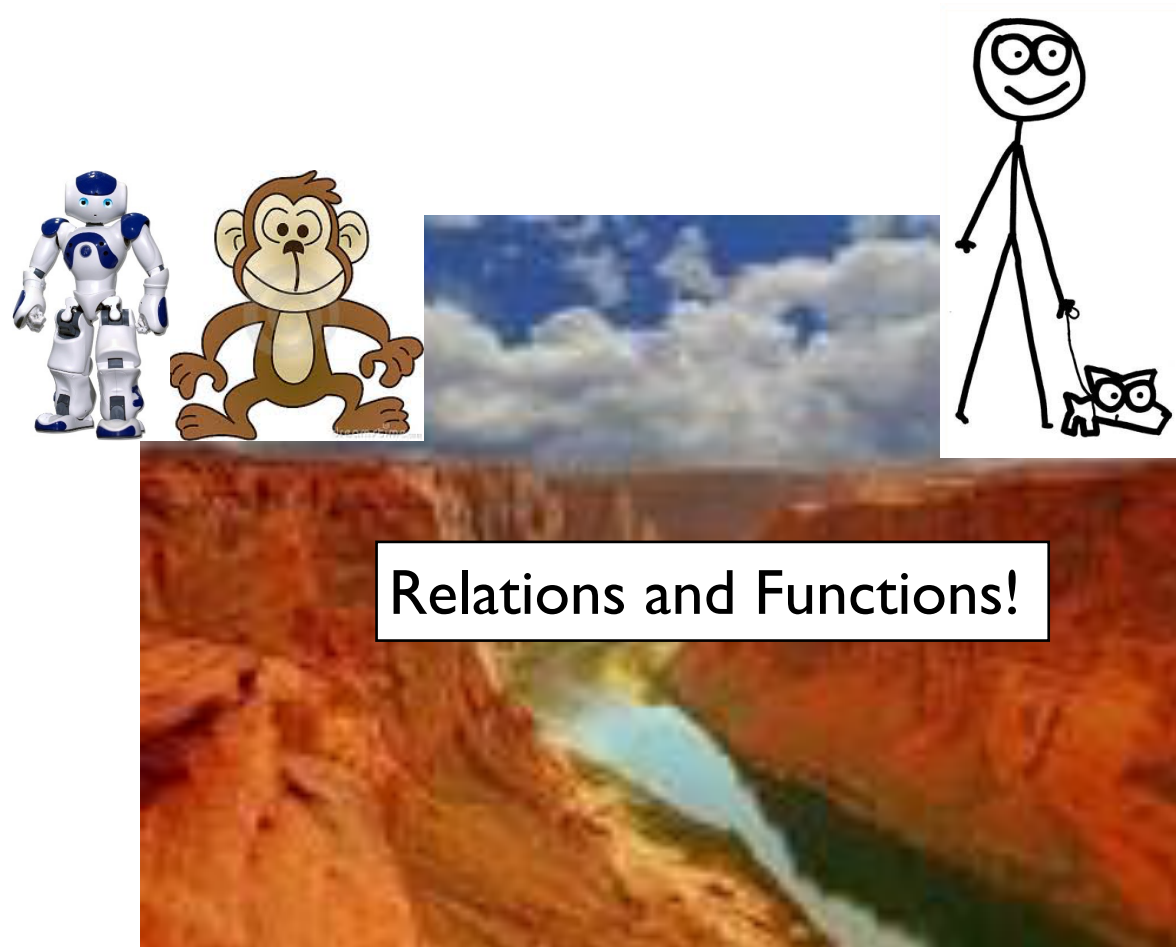
The Canyon of Discontinuity (or Darwin's Dread)



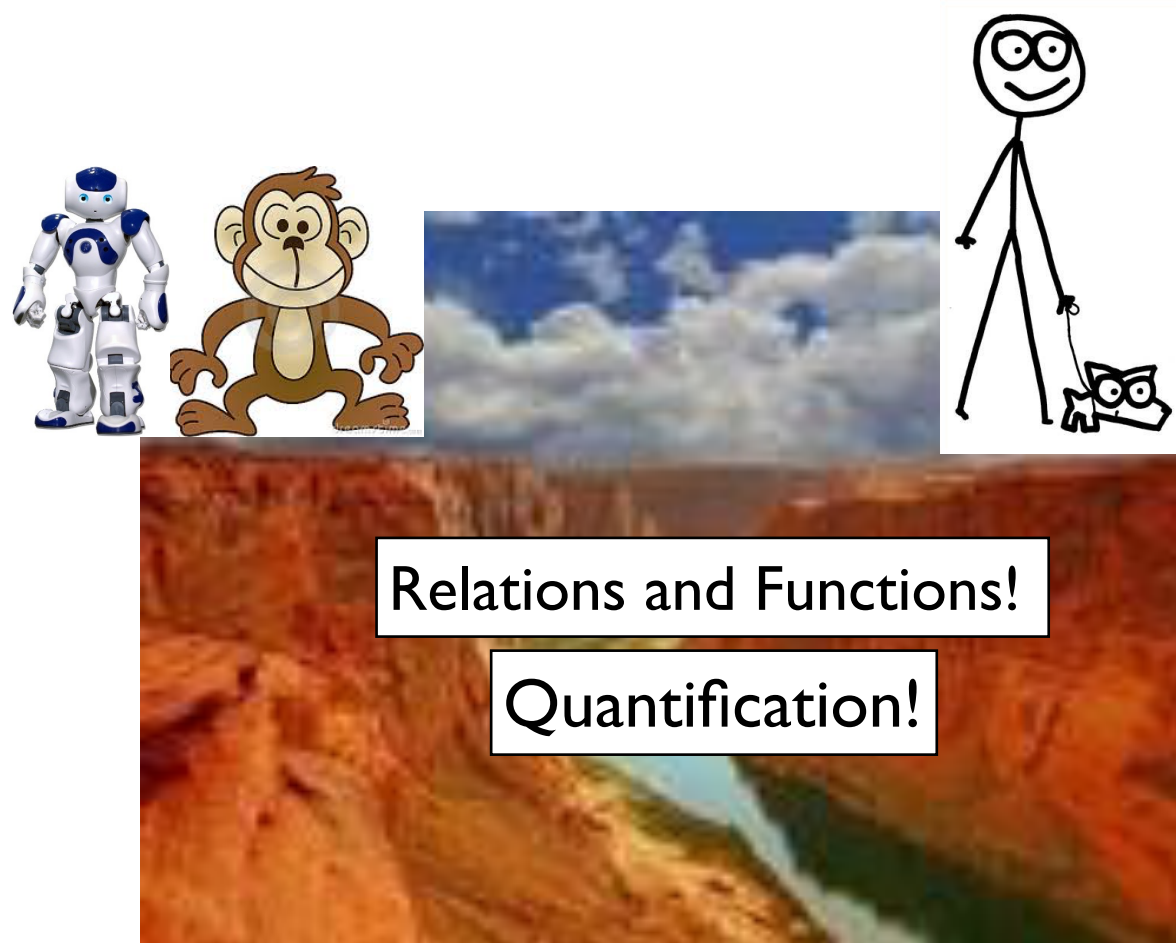
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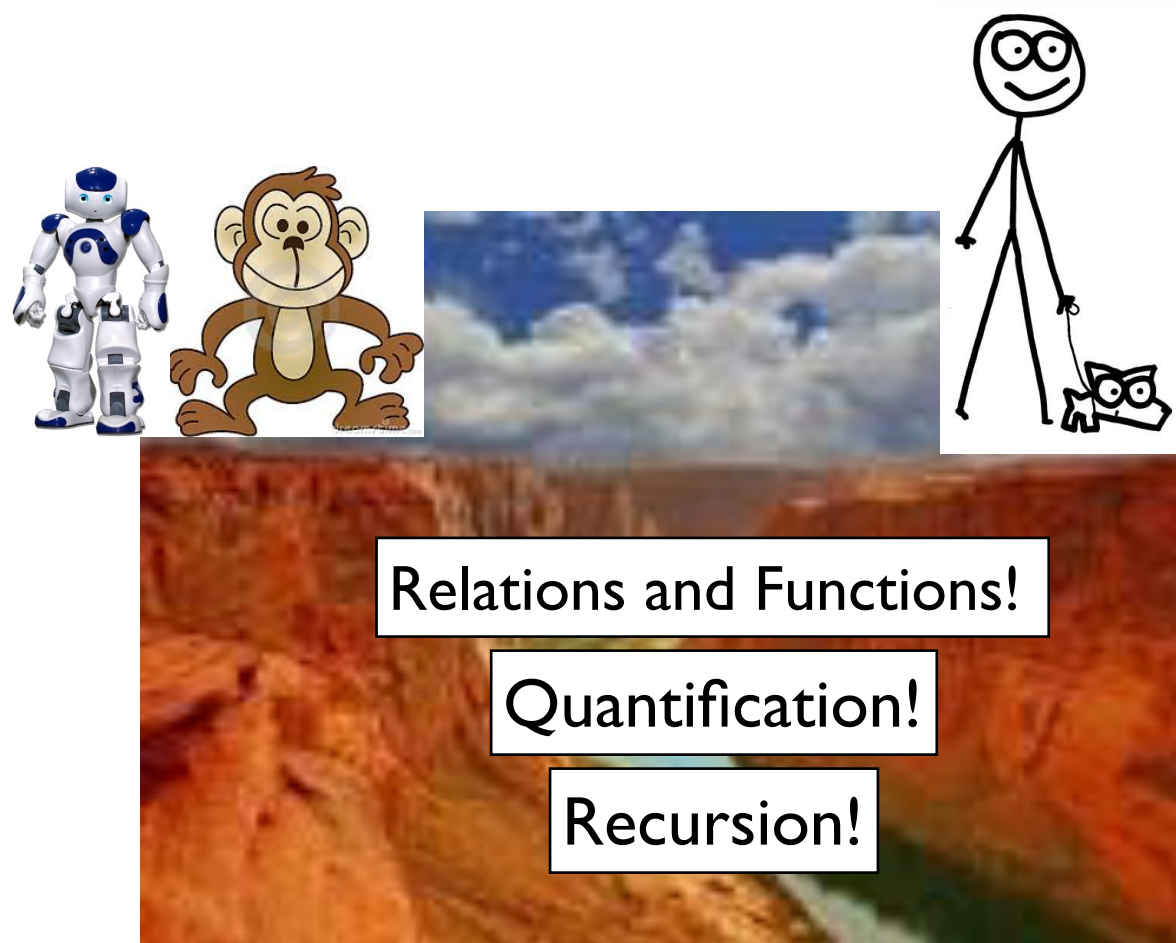
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Quantification!

Relations and Functions

Recursion!

Karkooking Problem ...

Everyone karkooks anyone who karkooks someone.

Alvin karkooks Bill.

Can you infer that everyone karkooks Bill?

ANSWER:

JUSTIFICATION:

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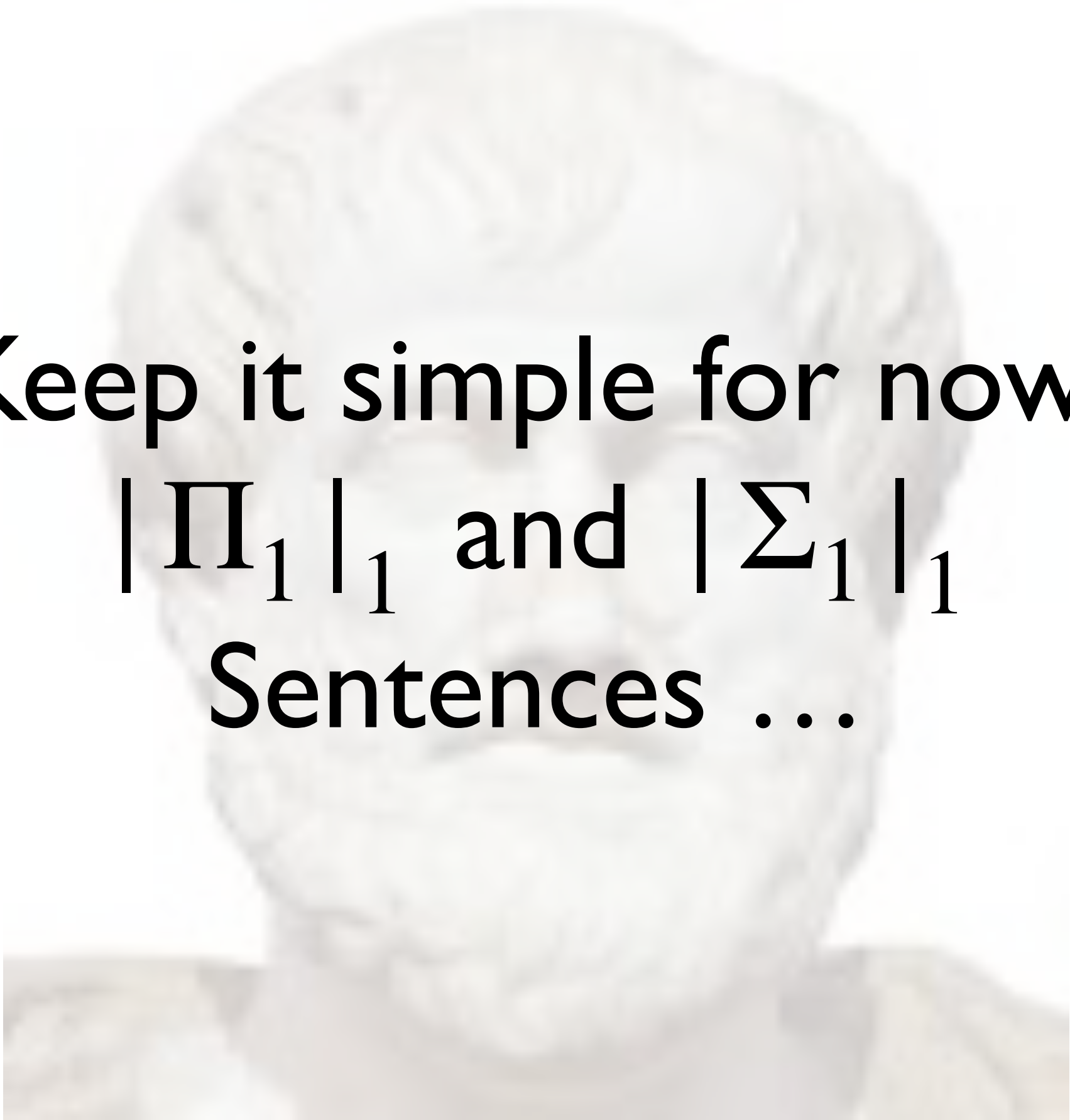
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JUSTIFICATION:

Relations and Functions!

Quantification!

Recursion!

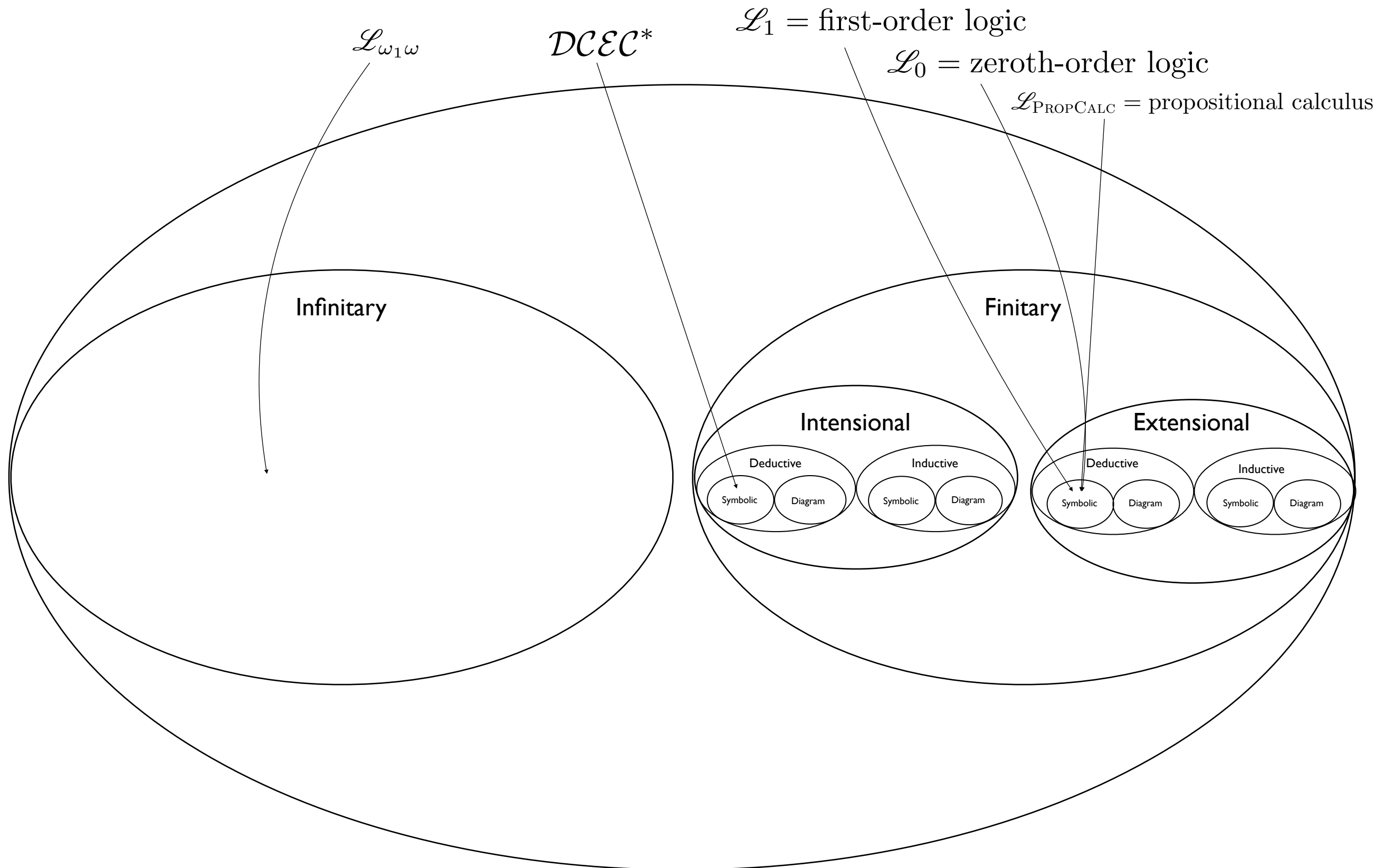


Keep it simple for now!

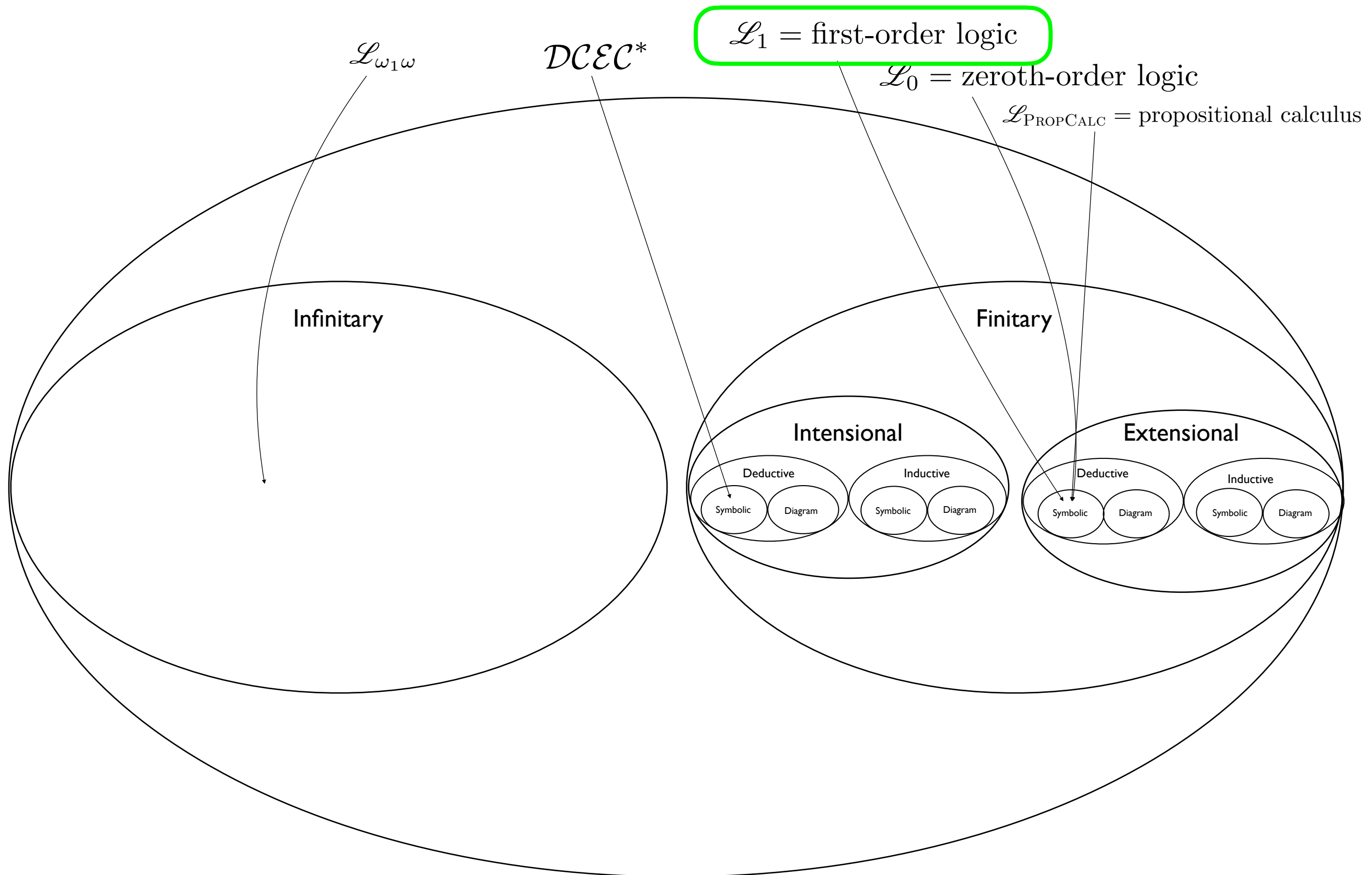
$|\Pi_1|_1$ and $|\Sigma_1|_1$

Sentences ...

The Universe of Logics



The Universe of Logics



Two Proposed Arguments; Valid?

- All mammals walk.
- Whales are mammals.
- Therefore:
- Whales walk.
- All of the Frenchmen in the room are wine-drinkers.
- Some of the wine-drinkers in the room are gourmets.
- Therefore:
- Some of the Frenchmen in the room are gourmets.



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We can of course easily symbolize and settle the matter in HyperSlate® (PC oracle permitted now)! (You should do this now & save the problem in your library.) Doing so is *impossible* in the prop calc, and likewise impossible in zeroth-order logic!

Two Proposed Arguments; Valid?

- All mammals walk. $\forall x[M(x) \rightarrow W(x)]$
- Whales are mammals. $\forall x(Wh(x) \rightarrow M(x))$
- Therefore:
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 $\forall x(Wh(x) \rightarrow W(x))$
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- All of the Frenchmen in the room are wine-drinkers. $\forall x(F(x) \rightarrow W(x))$
- Some of the wine-drinkers in the room are gourmets. $\exists x(W(x) \wedge G(x))$
- Therefore:
- Some of the Frenchmen in the room are gourmets. $\exists x(F(x) \wedge G(x))$

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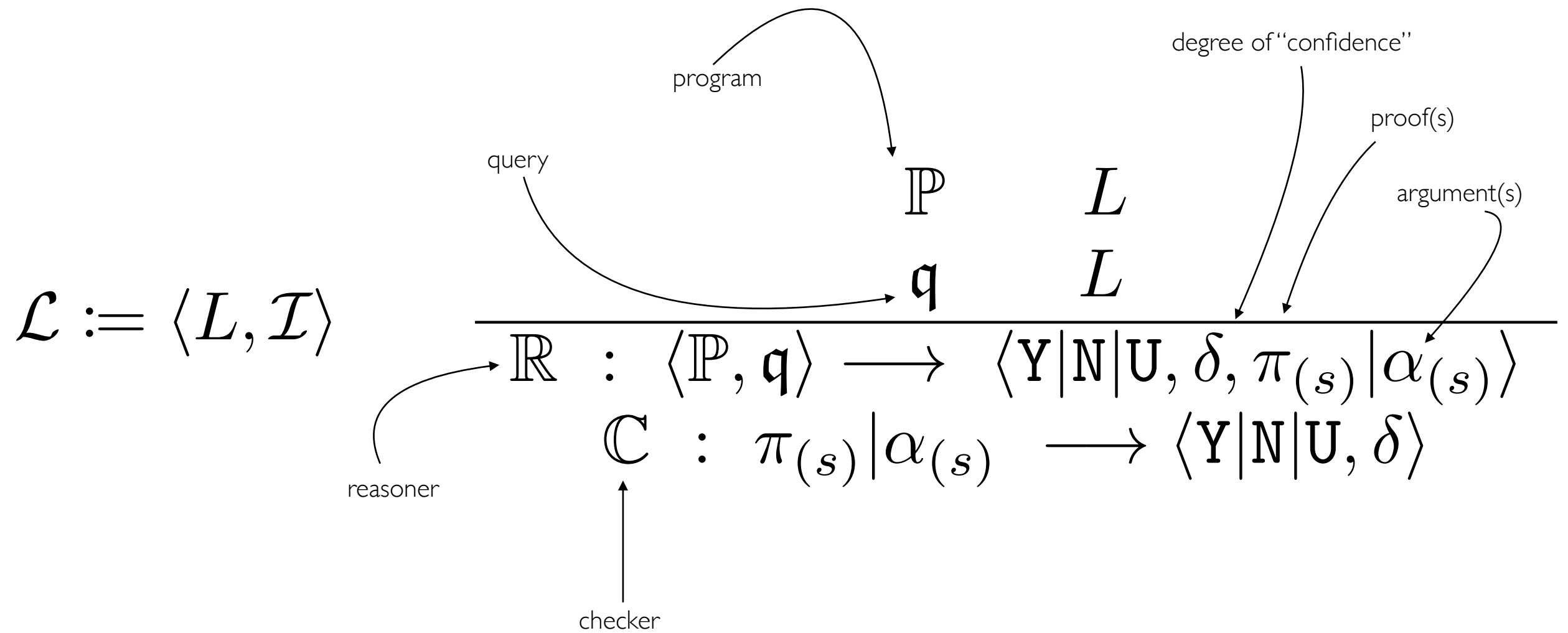
(Pure General) Logic Programming ...

$$\mathcal{L} := \langle L, \mathcal{I} \rangle$$

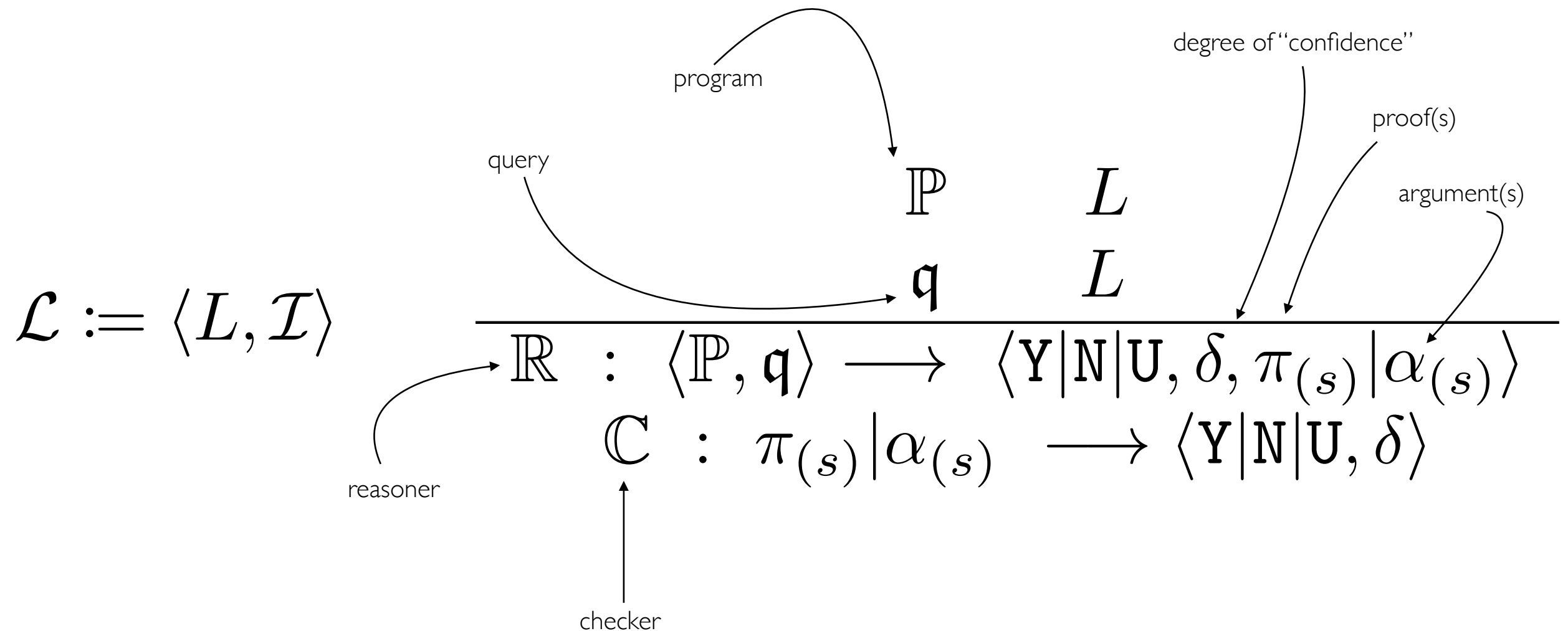
$$\begin{array}{c}
 \mathbb{P} \qquad L \\
 \mathfrak{q} \qquad L \\
 \hline
 \mathbb{R} : \langle \mathbb{P}, \mathfrak{q} \rangle \longrightarrow \langle \mathbf{Y} | \mathbf{N} | \mathbf{U}, \delta, \pi_{(s)} | \alpha_{(s)} \rangle \\
 \mathbb{C} : \pi_{(s)} | \alpha_{(s)} \longrightarrow \langle \mathbf{Y} | \mathbf{N} | \mathbf{U}, \delta \rangle
 \end{array}$$

$$\mathcal{L} := \langle L, \mathcal{I} \rangle$$

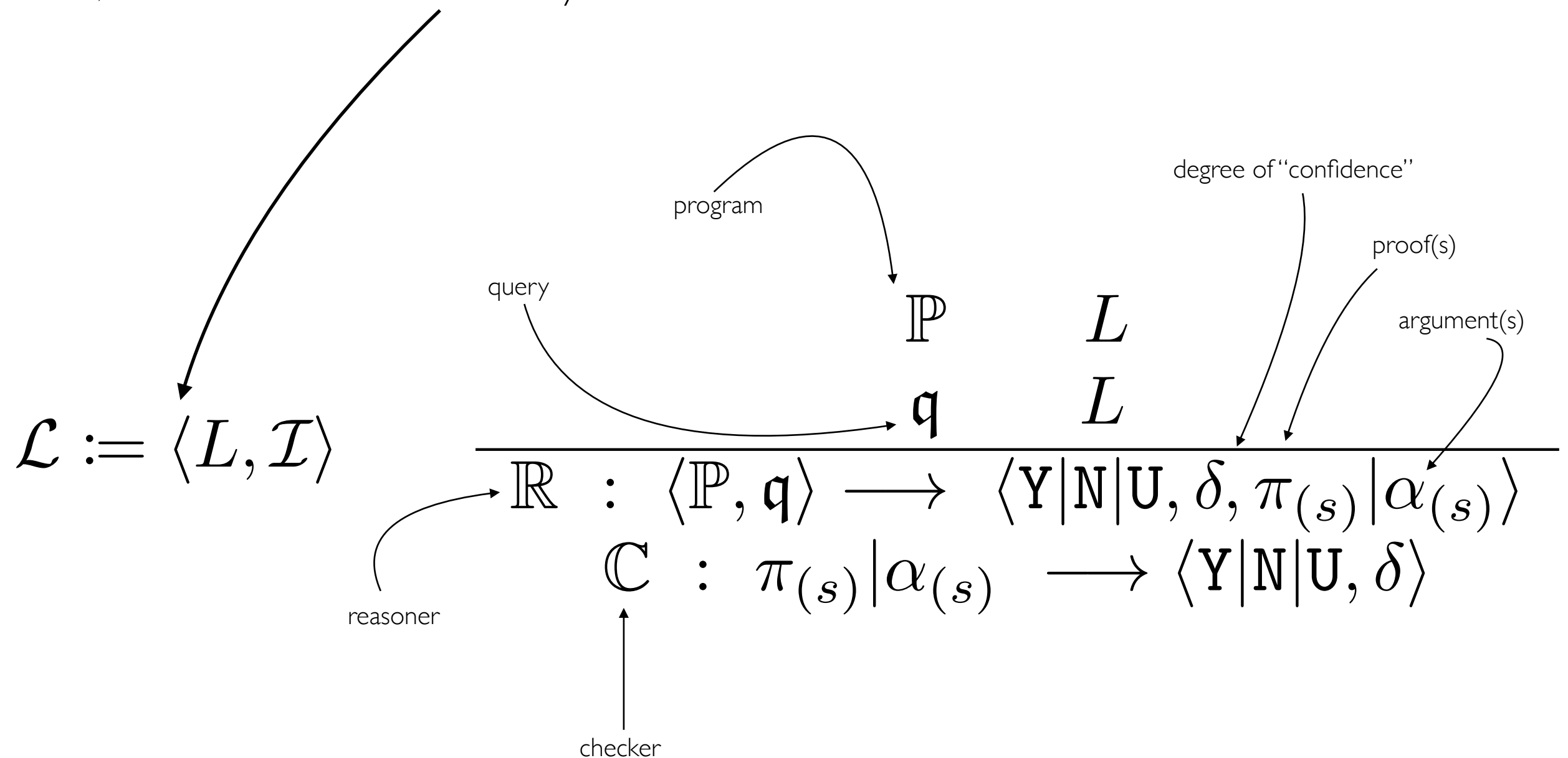
	$\mathbb{P}$	L
	$\mathfrak{q}$	L
$\mathbb{R} : \langle \mathbb{P}, \mathfrak{q} \rangle \longrightarrow \langle \mathbf{Y} \mathbf{N} \mathbf{U}, \delta, \pi_{(s)} \alpha_{(s)} \rangle$		
	$\mathbb{C} : \pi_{(s)} \alpha_{(s)} \longrightarrow \langle \mathbf{Y} \mathbf{N} \mathbf{U}, \delta \rangle$	



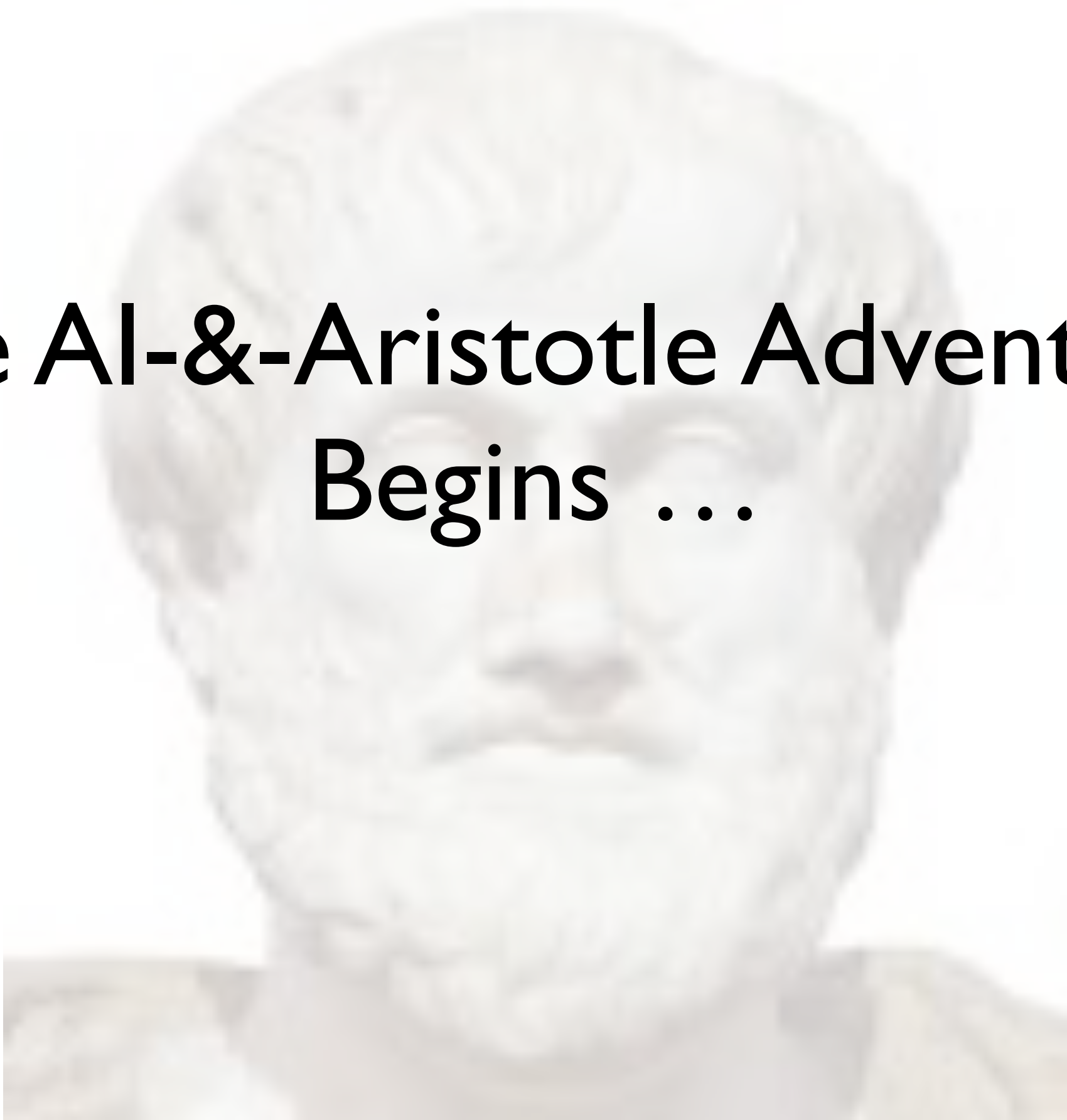
For just “logic programming,” and a vintage approach that goes back to circa 1970, restrict this to FOL or a fragment thereof, and use resolution as the only inference schema.



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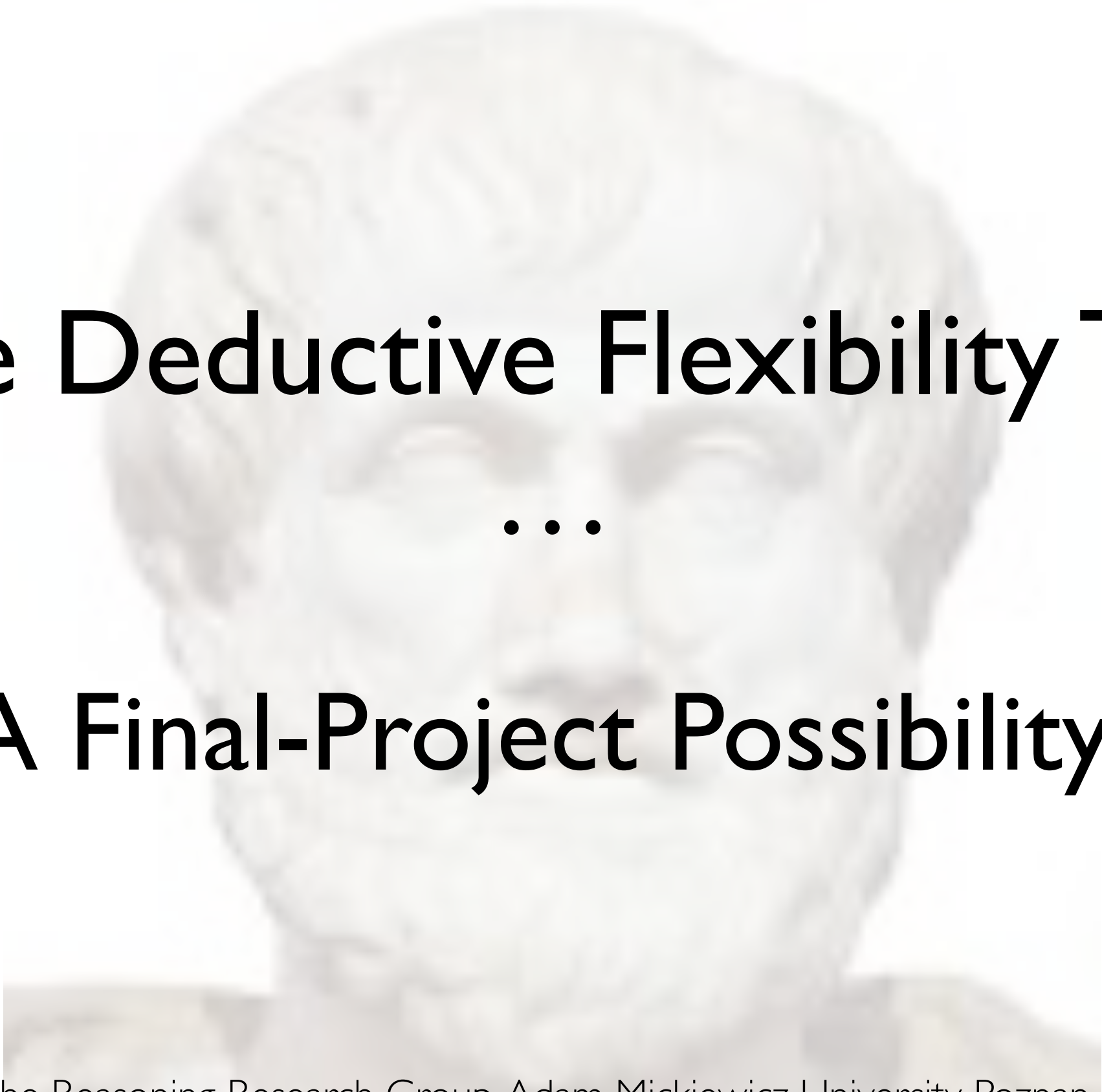
The AI-&-Aristotle Adventure Begins ...



The Deductive Flexibility Test

...

From the Reasoning Research Group, Adam Mickiewicz University, Poznan, Poland
<http://murbansk-rrg.home.amu.edu.pl/research-projects/deductive-flexibility-test>



The Deductive Flexibility Test

...

(A Final-Project Possibility!)

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Example with correct answer:

- (1) Some nedges are dwens.
- (2) Some strimes are dwens.
- (3) Every nedge is a strime.
- (4) Every nedge is a dwen.
- (5) This is not the case, that no dwen is a strime.
Some dwens are strimes.

Answer: (2); (5); (3 and 4); (1 and 4)

Correct? To HyperSlate® ...

- I (1) Every faub is a non-veece.
 (2) No phodd is a veece.
 (3) No veece is a phodd.
 (4) Every veece is a non-faub.
 (5) Every faub is a phodd.
 No faub is a veece.

Answer:_____

*Den rasjonelle delen av
menneskesinnet er
basert på logikk.*