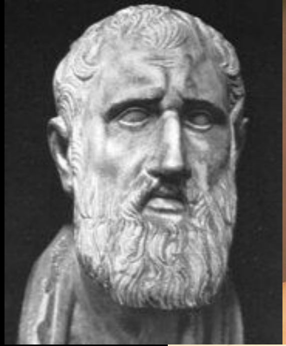
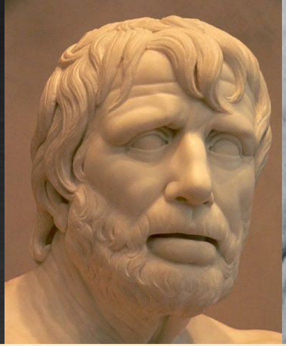
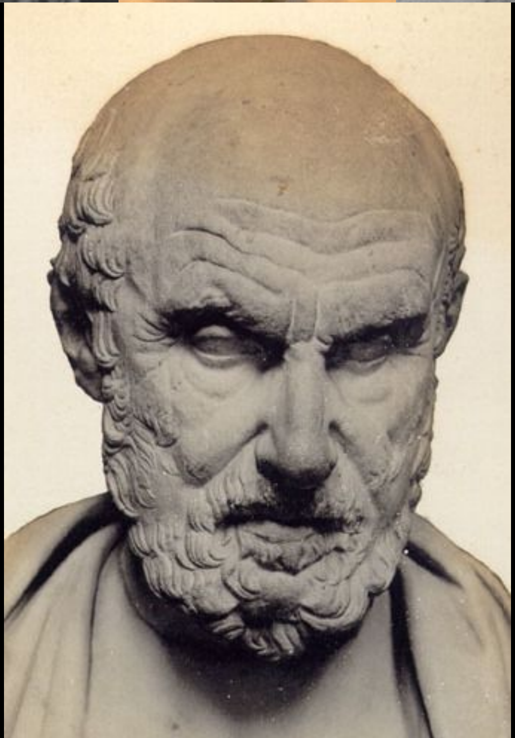
Inference Rules (Pt. I)

VS



Questions yet to be answered:

- ❑ Aristotle or the Stoics?
- ❑ Can we symbolize Aristotle and Boole?
- ❑ Is Logicism true?
- ❑ How do we know Stoic argument forms are actually valid?

Note:
We now have the tools to assess whether or not the Stoic argument forms are actually valid.

Modus Ponens

VALID

P	⊃	Q		P	/	Q
T	T	T		T		T
T	F	F		T		F
F	T	T		F		T
F	T	F		F		F

Use truth-table analysis to assess the following for validity…

1. P ⊃ Q; ~P; ∴ ~Q
2. P ⊃ Q; Q; ∴ P
3. ~(P & Q); P; ∴ ~Q
4. P ⊃ Q; P; ∴ Q
5. P v Q; ~P; ∴ Q
6. P ⊃ Q; ~Q; ∴ ~P

1. Fallacy of Denying the Antecedent
2. Fallacy of Affirming the Consequent
3. "Not Both" Form
4. Modus Ponens
5. Disjunctive Syllogism
6. Modus Tollens

1. $P \supset Q; \sim P; \therefore \sim Q$
2. $P \supset Q; Q; \therefore P$
3. $\sim(P \,\&\, Q); P; \therefore \sim Q$
4. $P \supset Q; P; \therefore Q$
5. $P \vee Q; \sim P; \therefore Q$
6. $P \supset Q; \sim Q; \therefore \sim P$

Questions yet to be answered:

- ☐ Aristotle or the Stoics?
- ☐ Aristotle or Boole?
- ☐ Is Logicism true?
- ☑ How do we know Stoic argument forms are actually valid?

Notice...

In modern categorical logic, we draw a Venn diagram for an argument and then populate it with information from the argument.

In modern truth-functional logic, we draw a truth-table for an argument, then we populate it with information from the argument.

Only then do we decide if the argument is valid or invalid.

Are categorical logic and truth-functional logic similar enough to unify?

One similarity is that the validity tests for both are visual.

Both validity tests are also <u>mechanical</u>.

They are algorithmic.

There are steps one must follow.

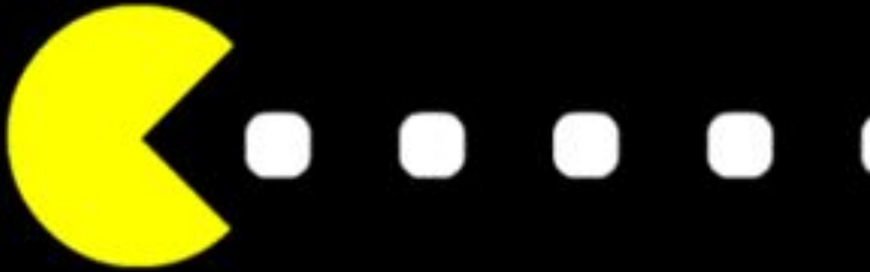
In other words...
When assessing for validity, we become like
human computers.

It seems at least *possible* that we can unify categorical logic and truth-functional logic…

PS

When we follow algorithmic processes to assess for validity, we are doing what modern computers do when they read parameters for customized programs.

These are also known as “arguments.”



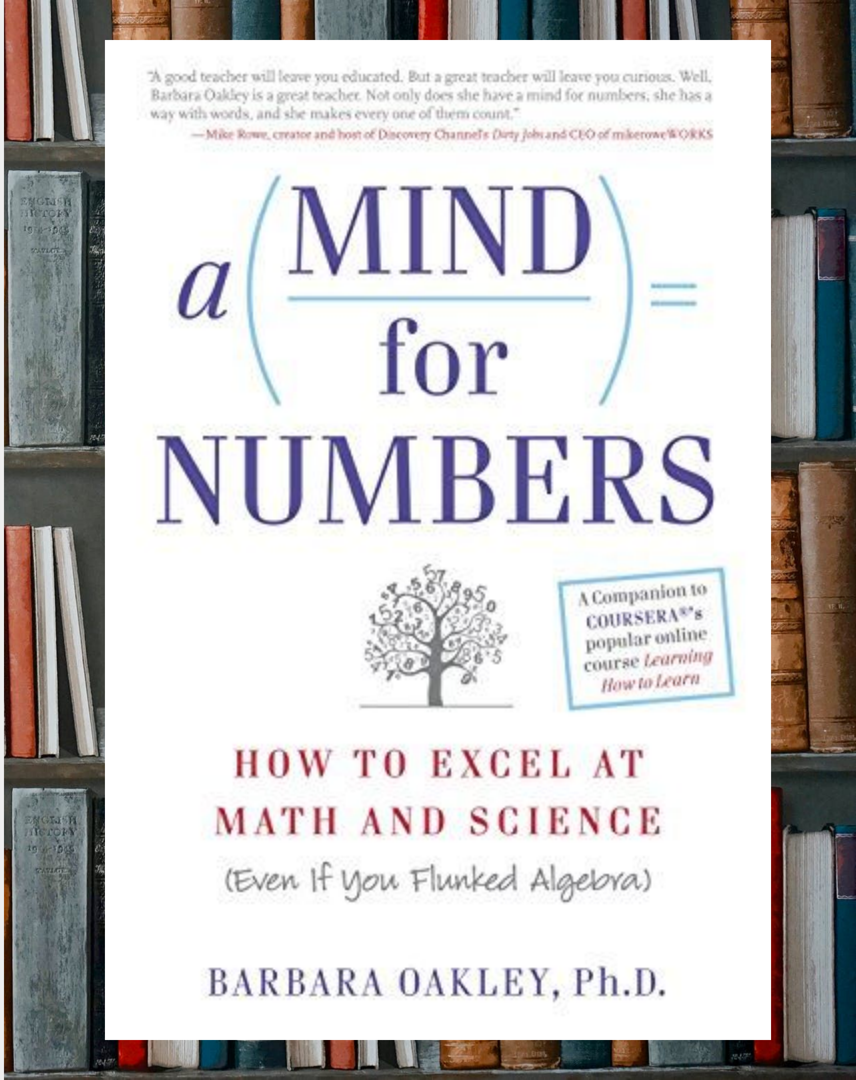
Food for thought...

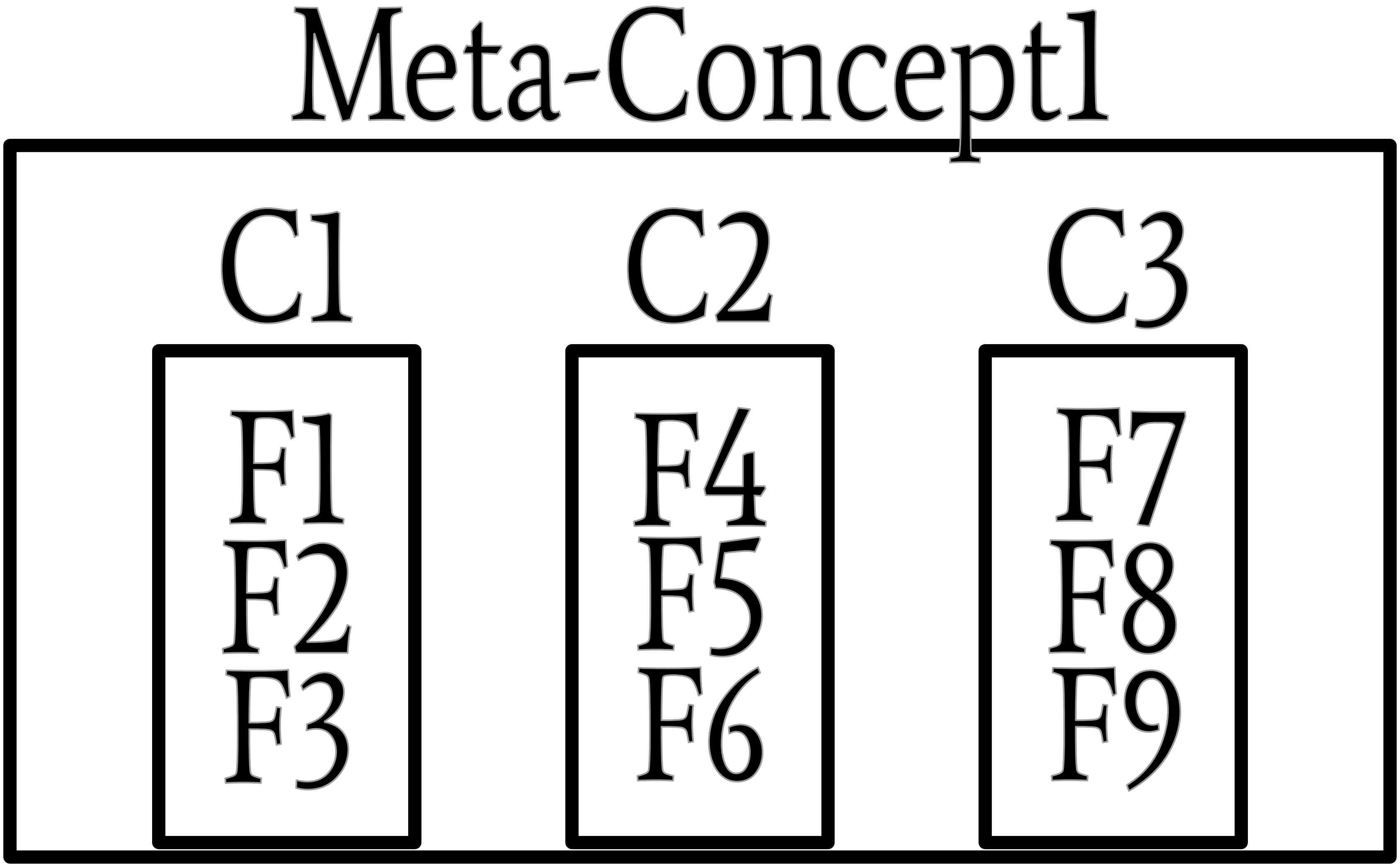
Chunking

Chunking is the mental process of grouping together connected items, words, or even whole declarative sentences so that they can be stored or processed as single concepts.

In Chapter 6 of *A Mind for Numbers*, Barbara Oakley reminds us that "choking" occurs when we have overloaded our working memory.

To prevent this, we must take enough time to "chunk", or integrate one or more concepts into a smoothly connected working thought pattern.




Meta-Concept1
C1
C2
C3
F1
F2
F3
F4
F5
F6
F7
F8
F9

Natural Deduction:
Important Concepts

Natural Deduction

Natural deduction is a method of proof in which the conclusion of an argument is deduced from its premises, step by step, through a set of specified *rules of inference*.

Inference

An inference is a fully-supported statement deduced from another statement or statements.

Rule for Validity:

If…

a. a natural deduction proof exists for an argument, and
b. all the deductions are made with valid **rules of inference**,

then the argument must be valid.

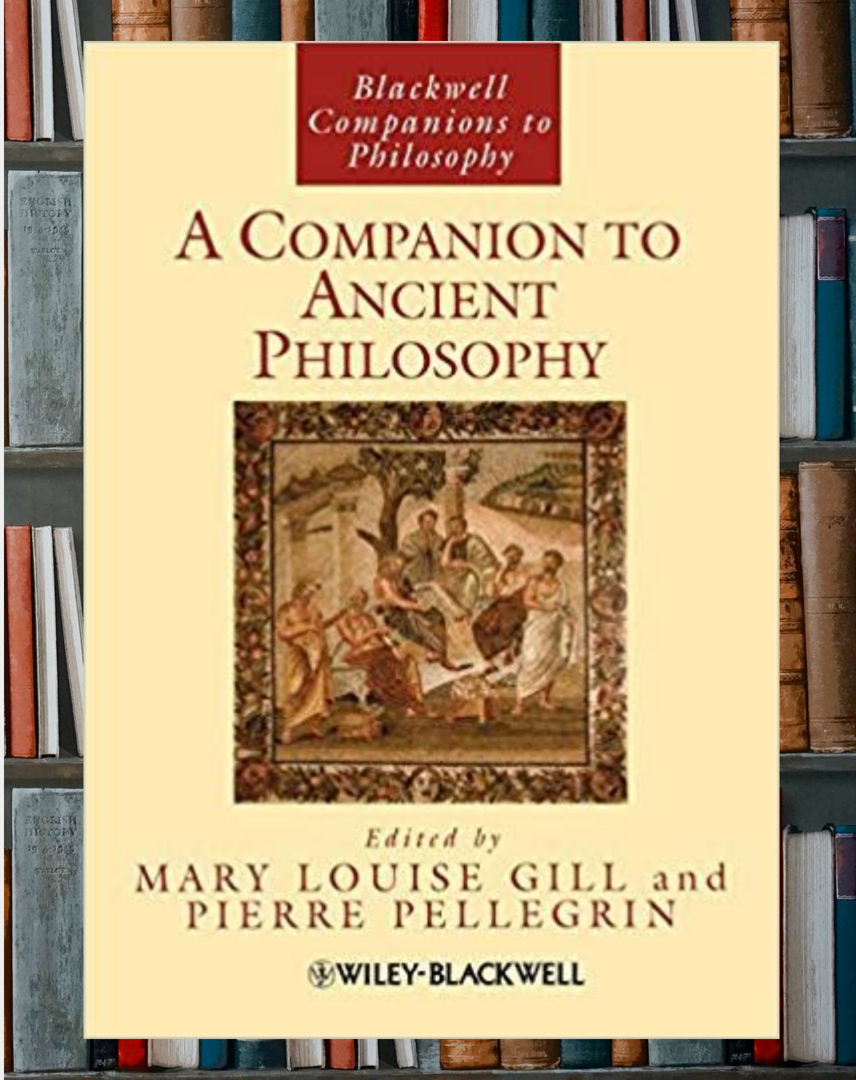
SD

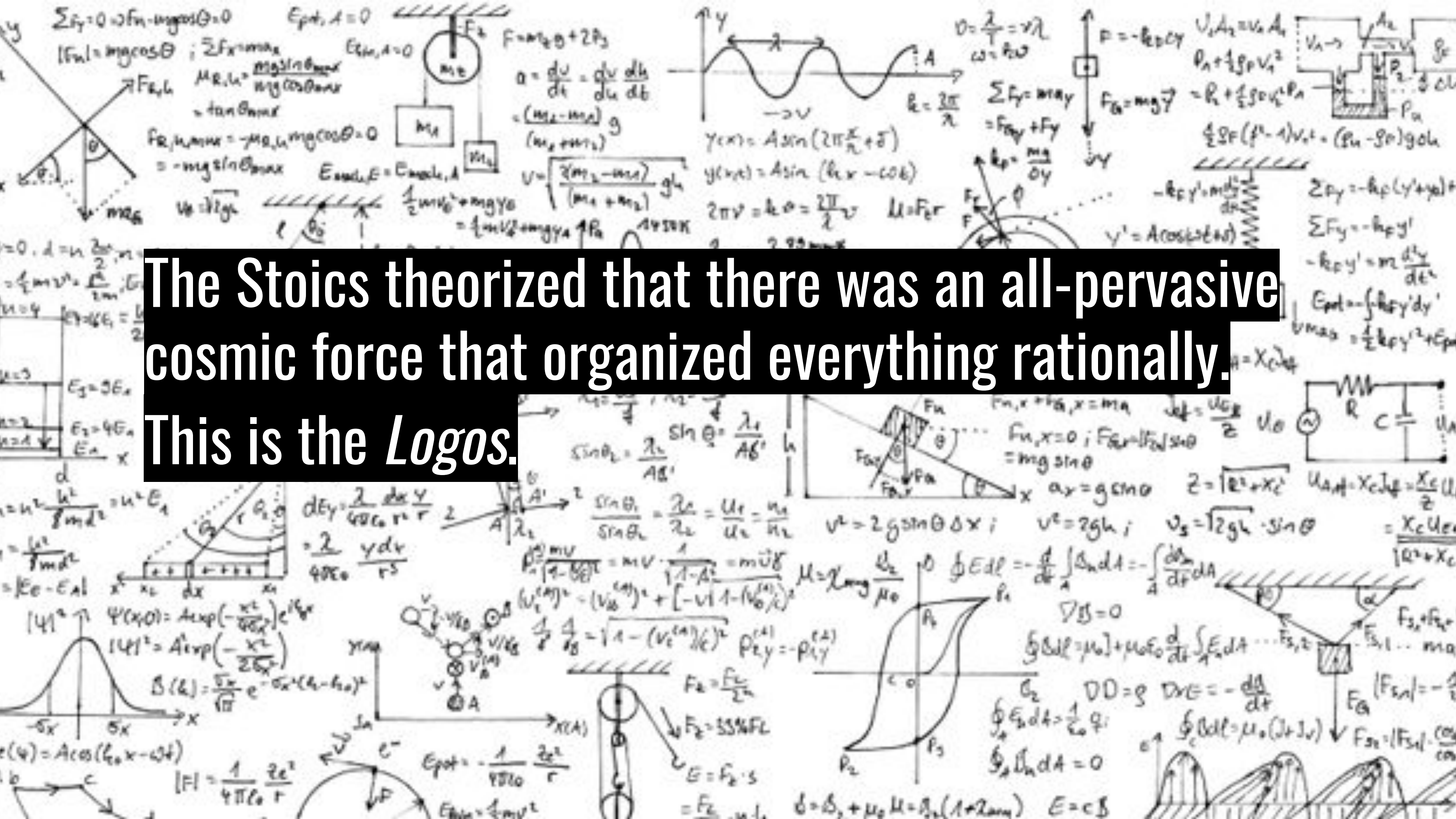
SD (which stands for *sentential derivation*) will be the name of our derivation system.

It will consist of 11 derivation rules.

Storytime!

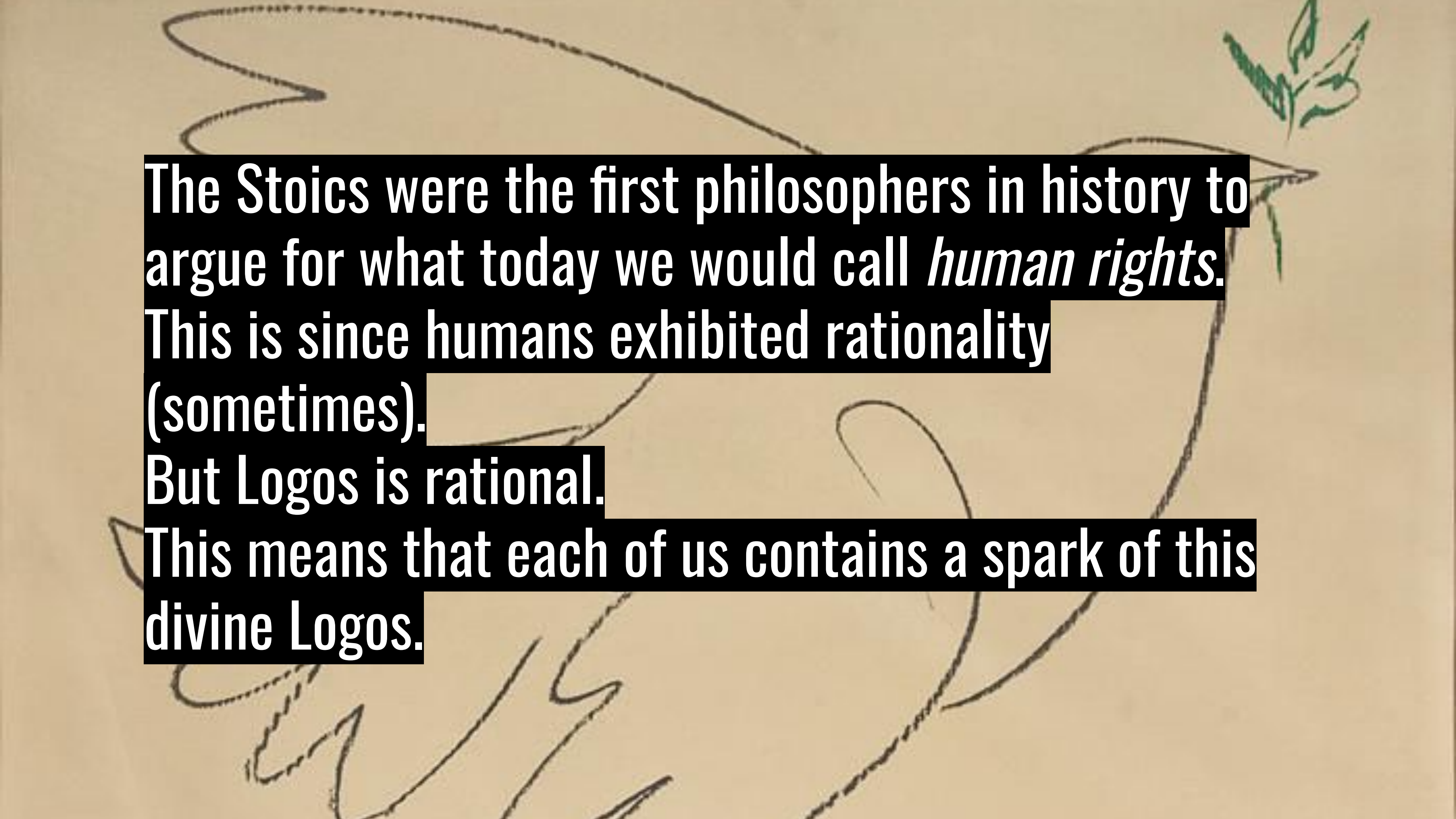
Richard Bett discusses Stoic Ethics in chapter 27 of Gill and Pellegrin (2009).





The Stoics theorized that there was an all-pervasive cosmic force that organized everything rationally.

This is the *Logos*.



The Stoics were the first philosophers in history to argue for what today we would call *human rights*.
This is since humans exhibited rationality (sometimes).
But Logos is rational.
This means that each of us contains a spark of this divine Logos.

They stressed the moral life,
guided by reason,
making sure that one is not consumed by material possessions.
The best way to train oneself?
Logic.

LIVE LONG & PROSPER

Rules of Inference

Conditional Elimination
(⊃E)

Where **P** and **Q** are meta-variables ranging over declarative sentences…

1. Given: **P** ⊃ **Q**
2. Given: **P**
3. You may infer: **Q**

⊃E can take many forms...

A ⊃ B; A; ∴ B

⊃E can take many forms...

A ⊃ B; A; ∴ B

J ⊃ L; J; ∴ L

⊃E can take many forms...

A ⊃ B; A; ∴ B

J ⊃ L; J; ∴ L

~I ⊃ ~O; ~I; ∴ ~O

⊃E can take many forms…

A ⊃ B; A; ∴ B

J ⊃ L; J; ∴ L

~I ⊃ ~O; ~I; ∴ ~O

(A v B) ⊃ (C & D); (A v B); ∴ (C & D)

Disjunction Introduction

(∨I)

Where **P** and **Q** are meta-variables ranging over declarative sentences…

1. Given: **P**
2. Inference: **P ∨ Q**

Or: **Q ∨ P**

∨I can take many forms...

A

A ∨ B

∨I can take many forms…

A

A v (B & D)

∨I can take many forms…

A

A v [(O ≡ P) ⊃ (H v M)]

∨I can take many forms...

A

A v ~~~~~~~~~~~~~~~~L

Conjunction Introduction

(&I)

Where **P** and **Q** are meta-variables ranging over declarative sentences…

1. Given: **P**
2. Given: **Q**
3. Inference: **P** & **Q**
   or: **Q** & **P**

&I can take many forms…

1. A
2. B
3. C

&I can take many forms...

1. A
2. B
3. C
4. A & B

&I can take many forms...

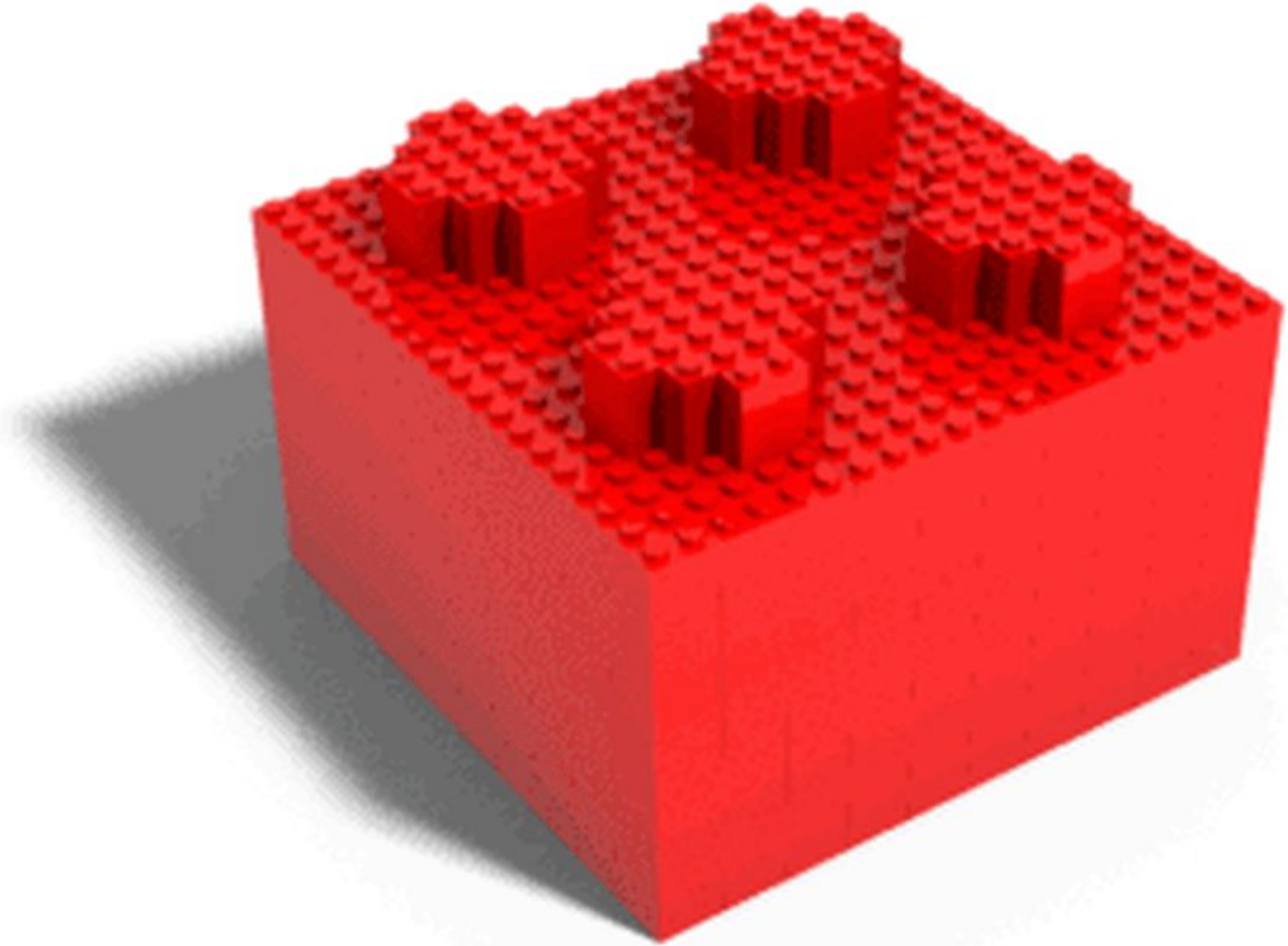
1. A
2. B
3. C
4. A & C

&I can take many forms...

1. A
2. B
3. C
4. C & A

&I can take many forms…

1. A
2. B
3. C
4. C & A
5. (C & A) & B



Conjunction Elimination (&E)

Where **P** and **Q** are meta-variables ranging over declarative sentences…

1. Given: **P & Q**
2. Inference: **P**

   or: **Q**

&I can take many forms...

1. (C & A) & B
2. C & A
3. B
4. C
5. A

Reiteration
(R)

Where **P** is a meta-variable ranging over a declarative sentence…

1. Given: **P**
2. Inference: **P**

Biconditional Elimination

(≡E)

Where **P** and **Q** are meta-variables ranging over declarative sentences…

1. Given: **P ≡ Q**
2. Given: **P**
3. Inference: **Q**

Biconditional Elimination (≡E)

Where **P** and **Q** are meta-variables ranging over declarative sentences...

1. Given: **P ≡ Q**
2. Given: **Q**
3. Inference: **P**

Memorize this!

Read this!

Also:

- Make your own mini-problems
    - Use the rules to make valid inferences:

1. (A & B) ☰ C (Premise)
2. C (Premise)
3. A & B (Inference)

    - Have a friend identify which rule of inference was used.

Answer: ☰E from 1 and 2