Motivating Paradoxes, Puzzles, and R,

Part II

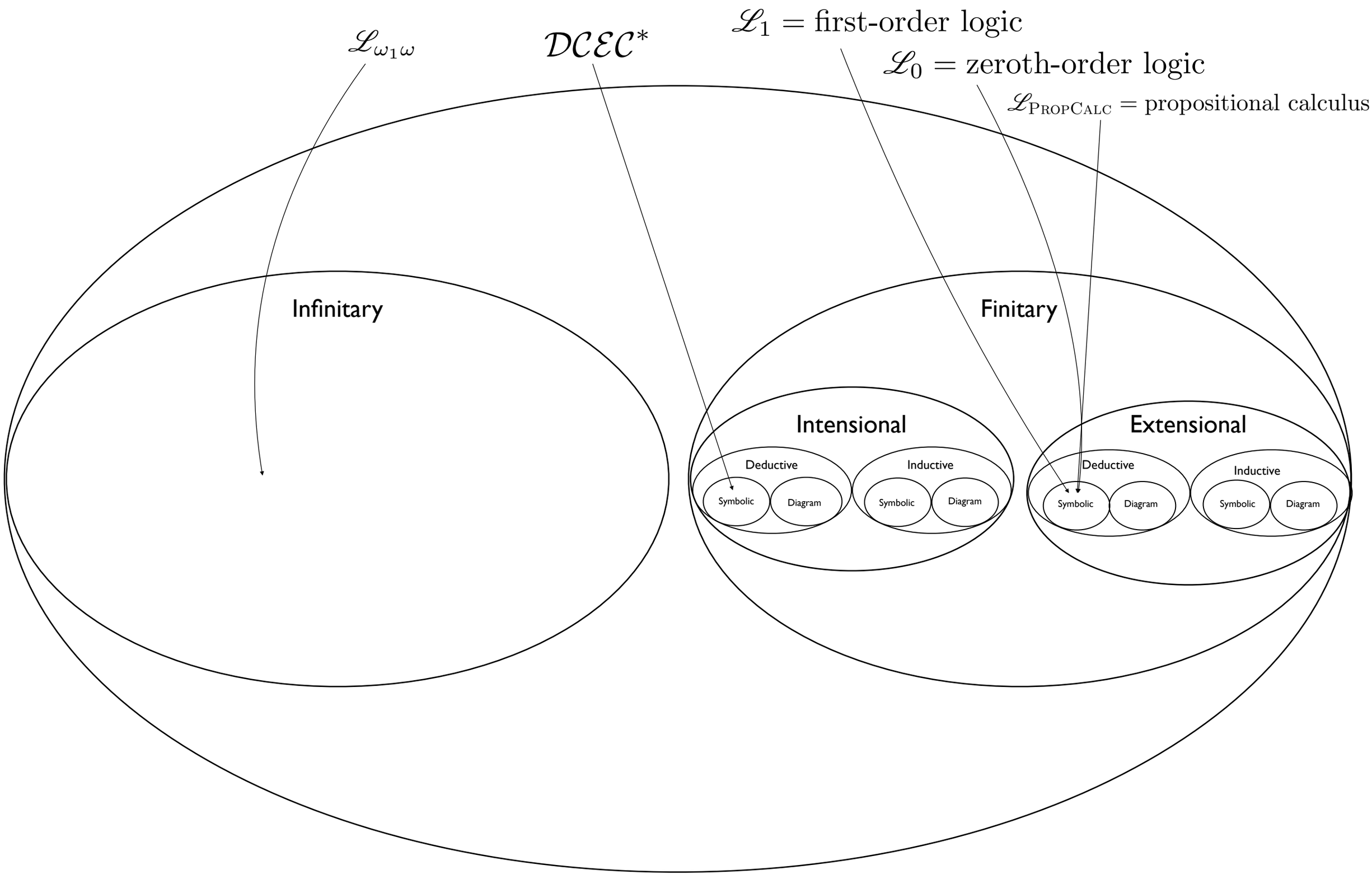
Selmer Bringsjord

Intro to (Formal) Logic (and AI)

1/23/20

Selmer.Bringsjord@gmail.com

The Universe of Logics



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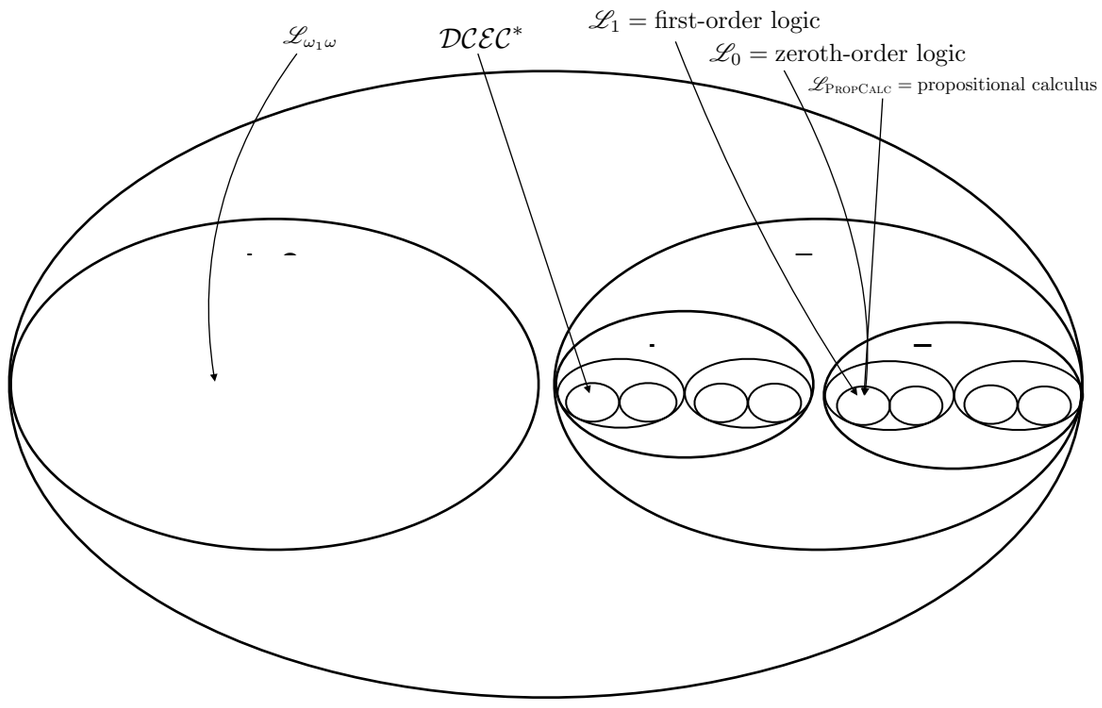

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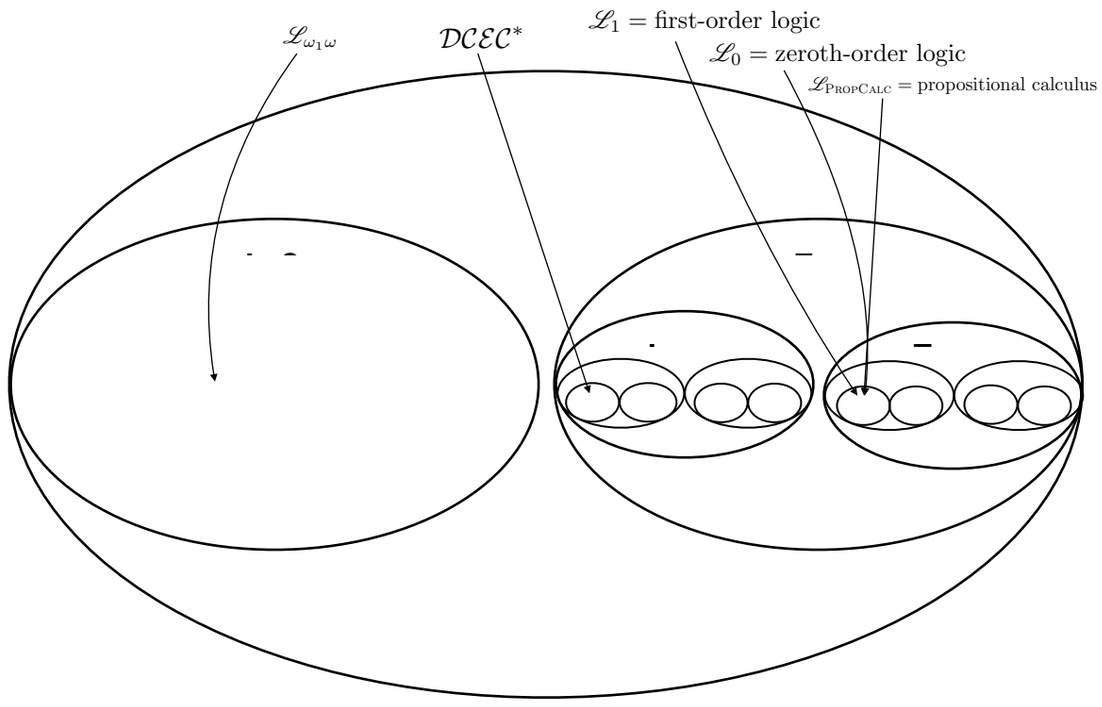

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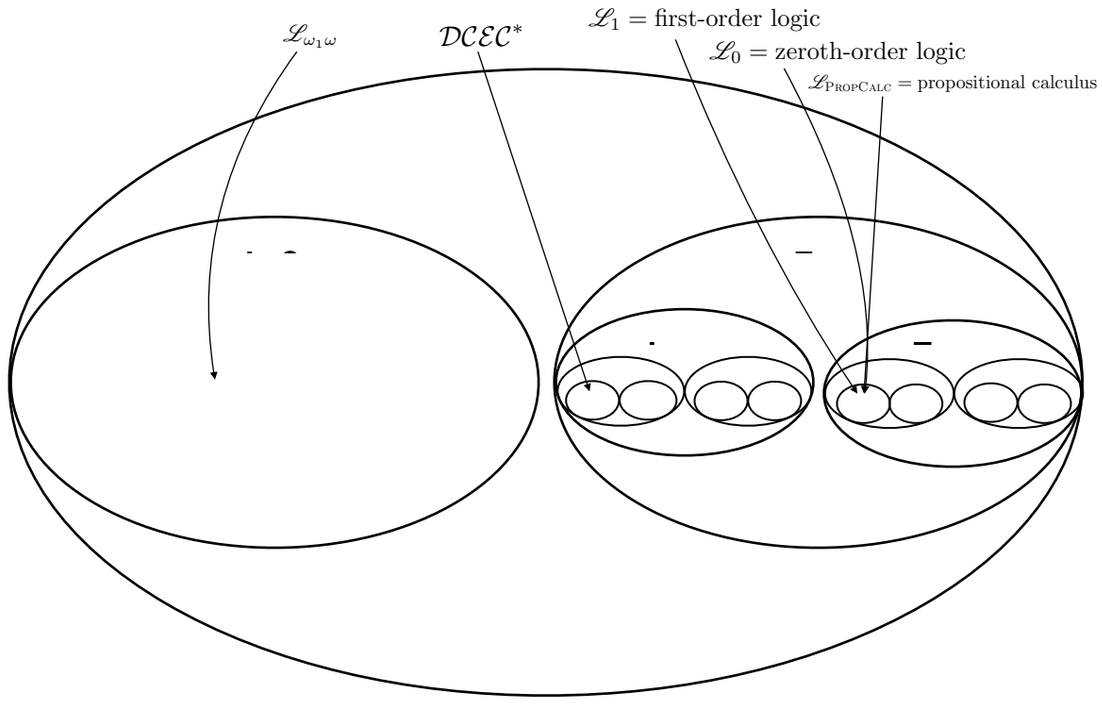

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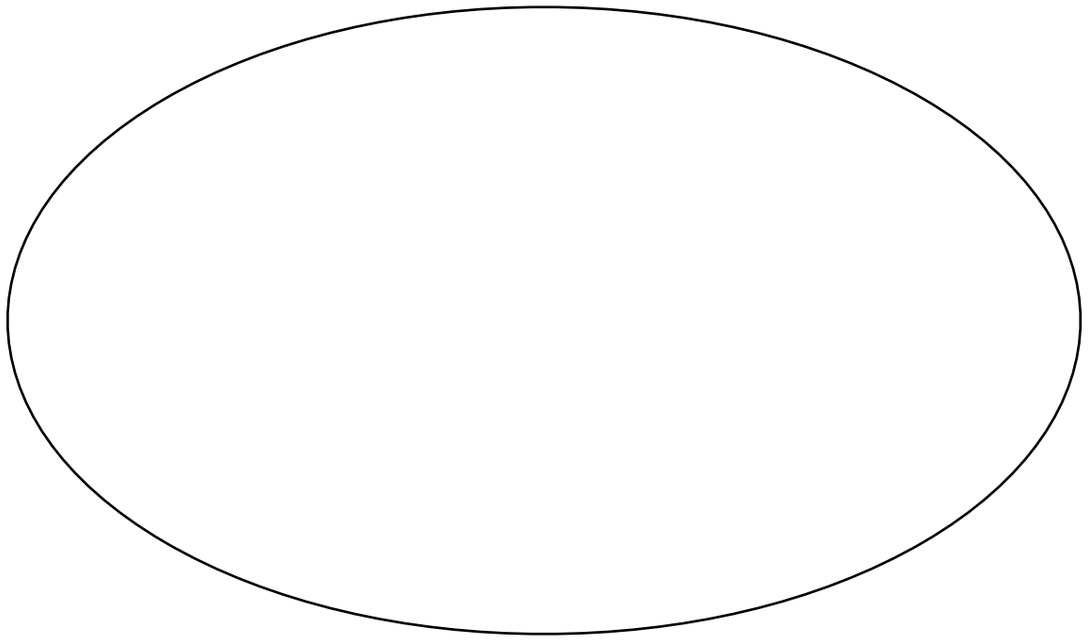

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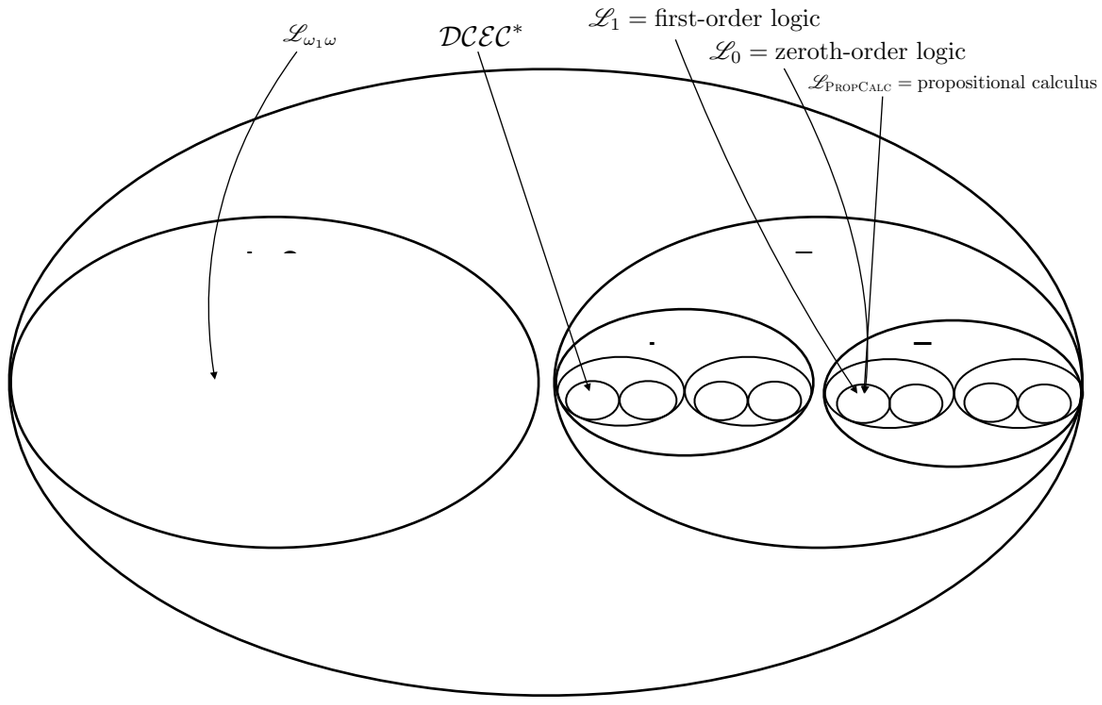

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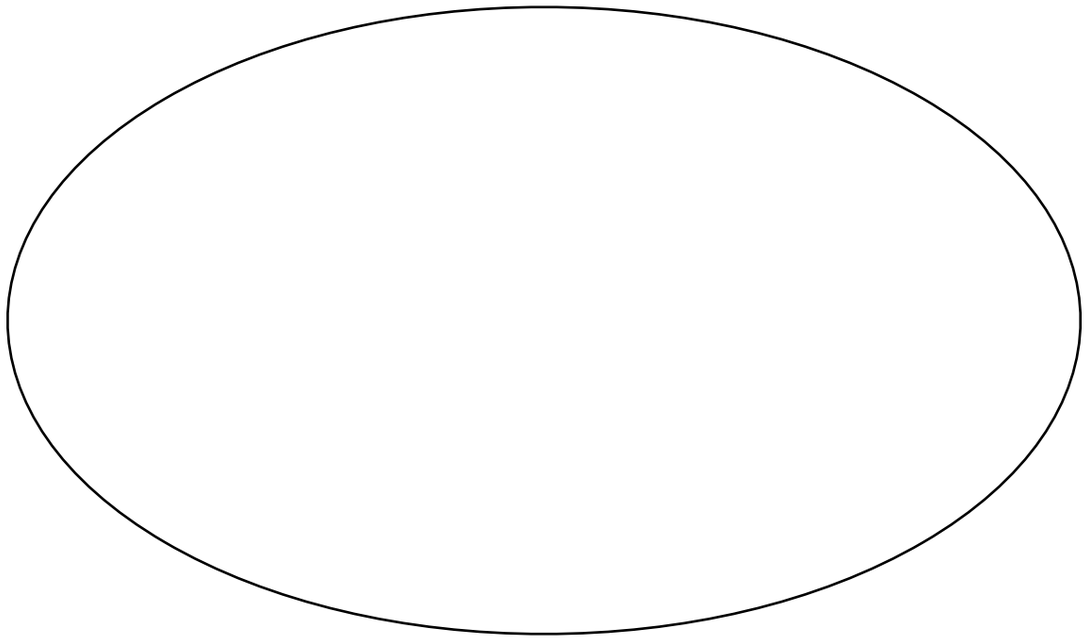

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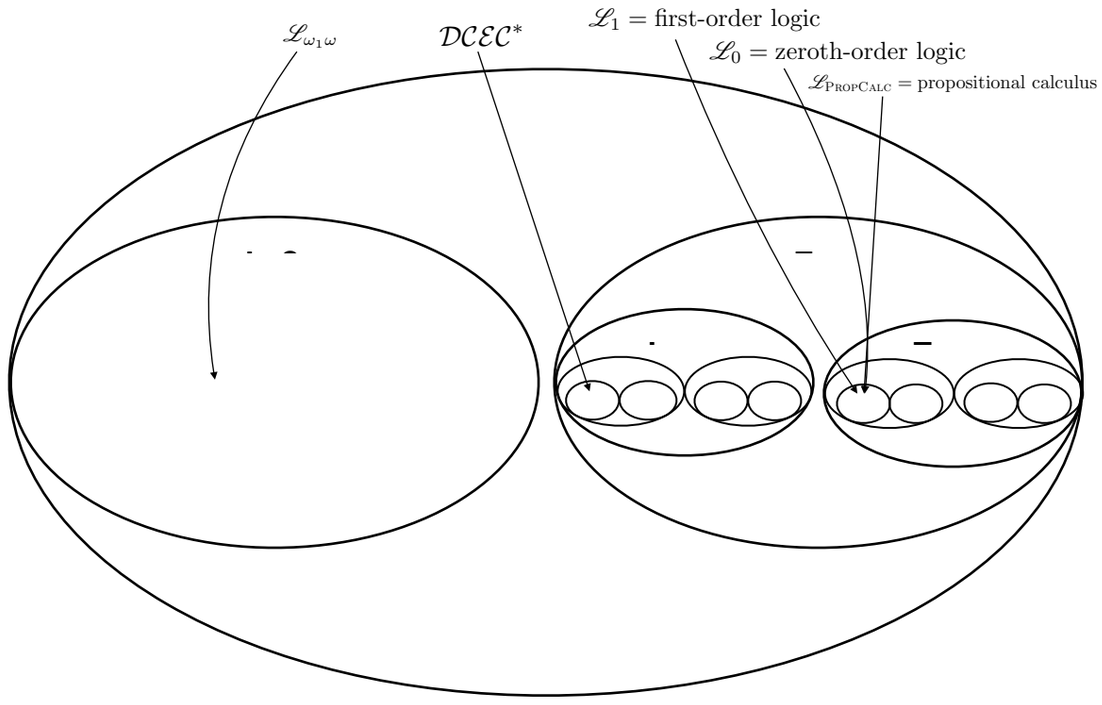

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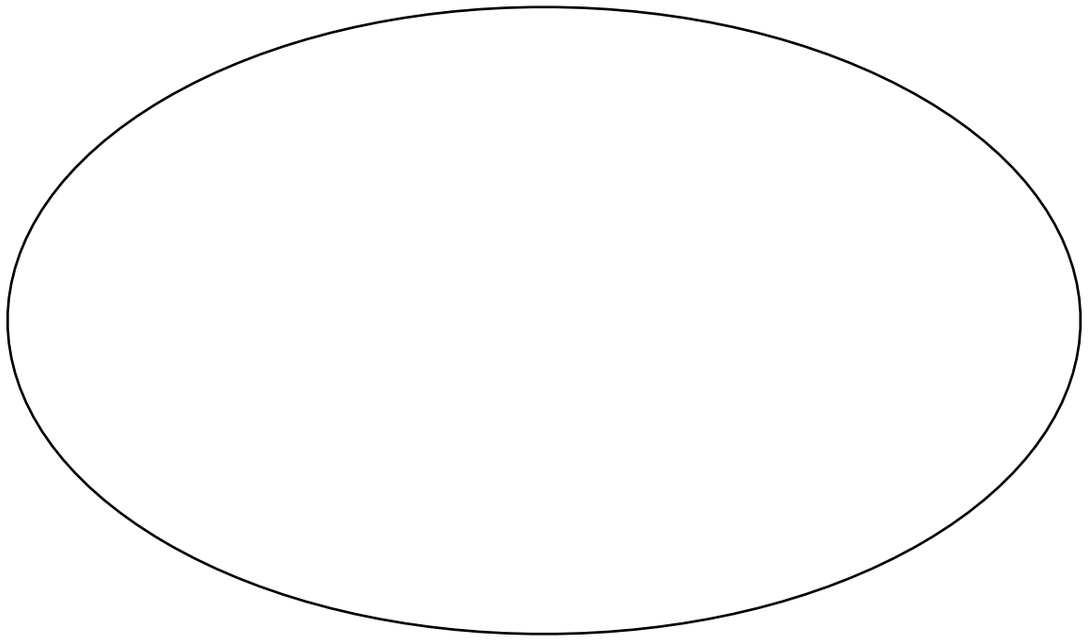

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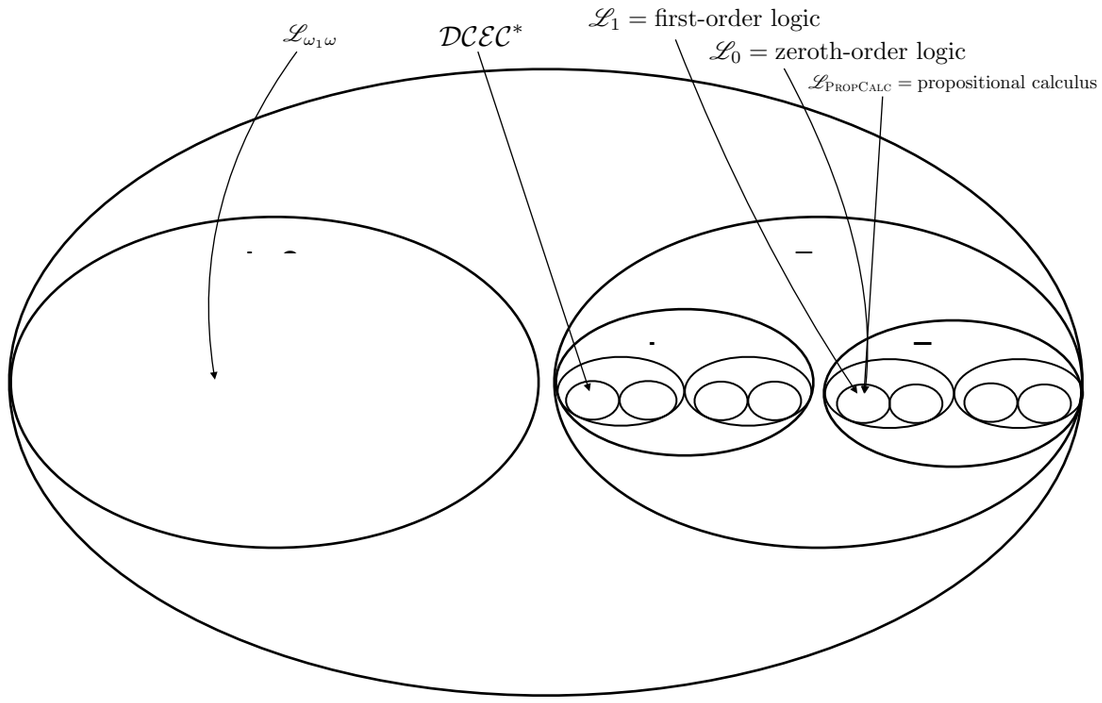

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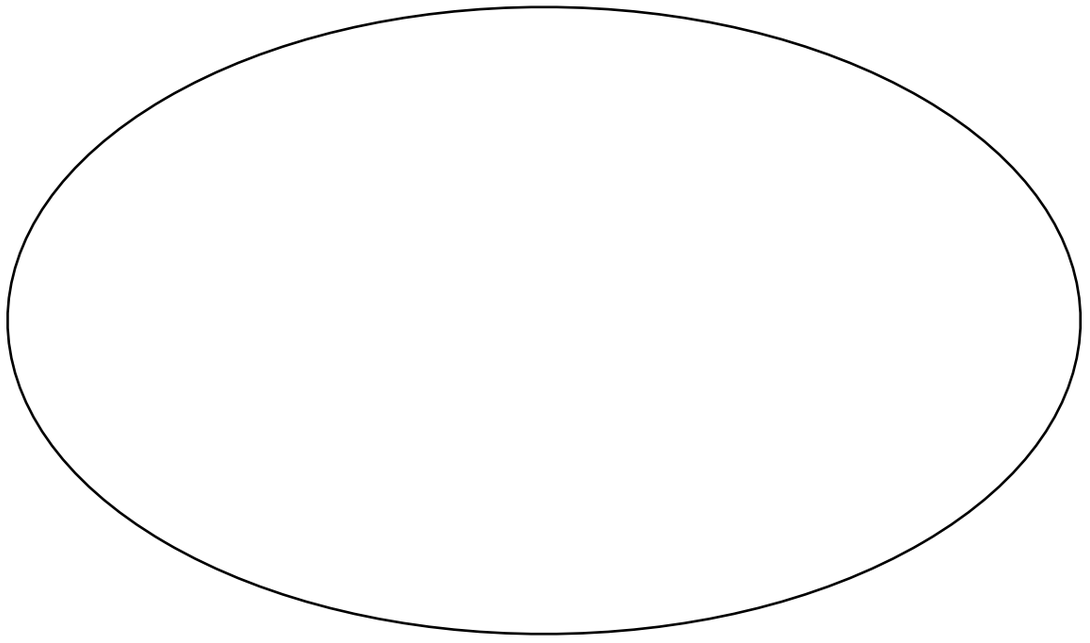

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Ross, J. (1992) "Immaterial Aspects of Thought" *Journal of Philosophy* ***89.3***: 136–150.

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Background Claim

$\mathcal{R}$ Humans, at least neurobiologically normal ones, are fundamentally rational, where rationality is constituted by certain logico-mathematically based reasoning and decision-making in response to real-world stimuli, including stimuli given in the form of focused tests; but mere animals are not fundamentally rational, since, *contra* Darwin, their minds are fundamentally qualitatively inferior to the human mind. As to whether computing machines/robots are fundamentally rational, the answer is "No." For starters, if x can't read, write, and create, x can't be rational; computing machines/robots can neither read nor write nor create; ergo, they aren't fundamentally rational.

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self-reference

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recursion

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intensional reasoning

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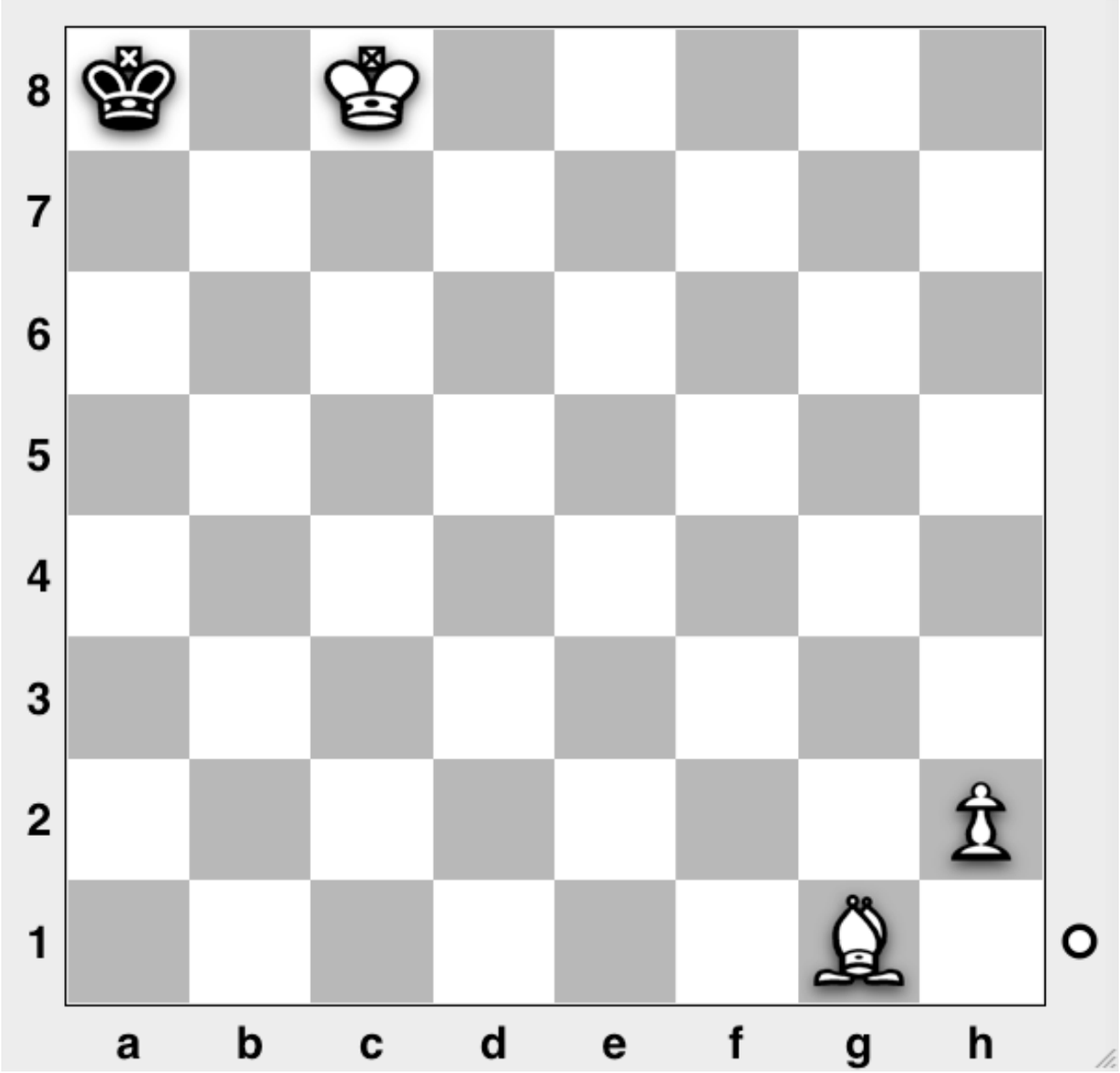
It's White's turn. What move did Black just make?



Aha! (Beyond Deep Blue?)

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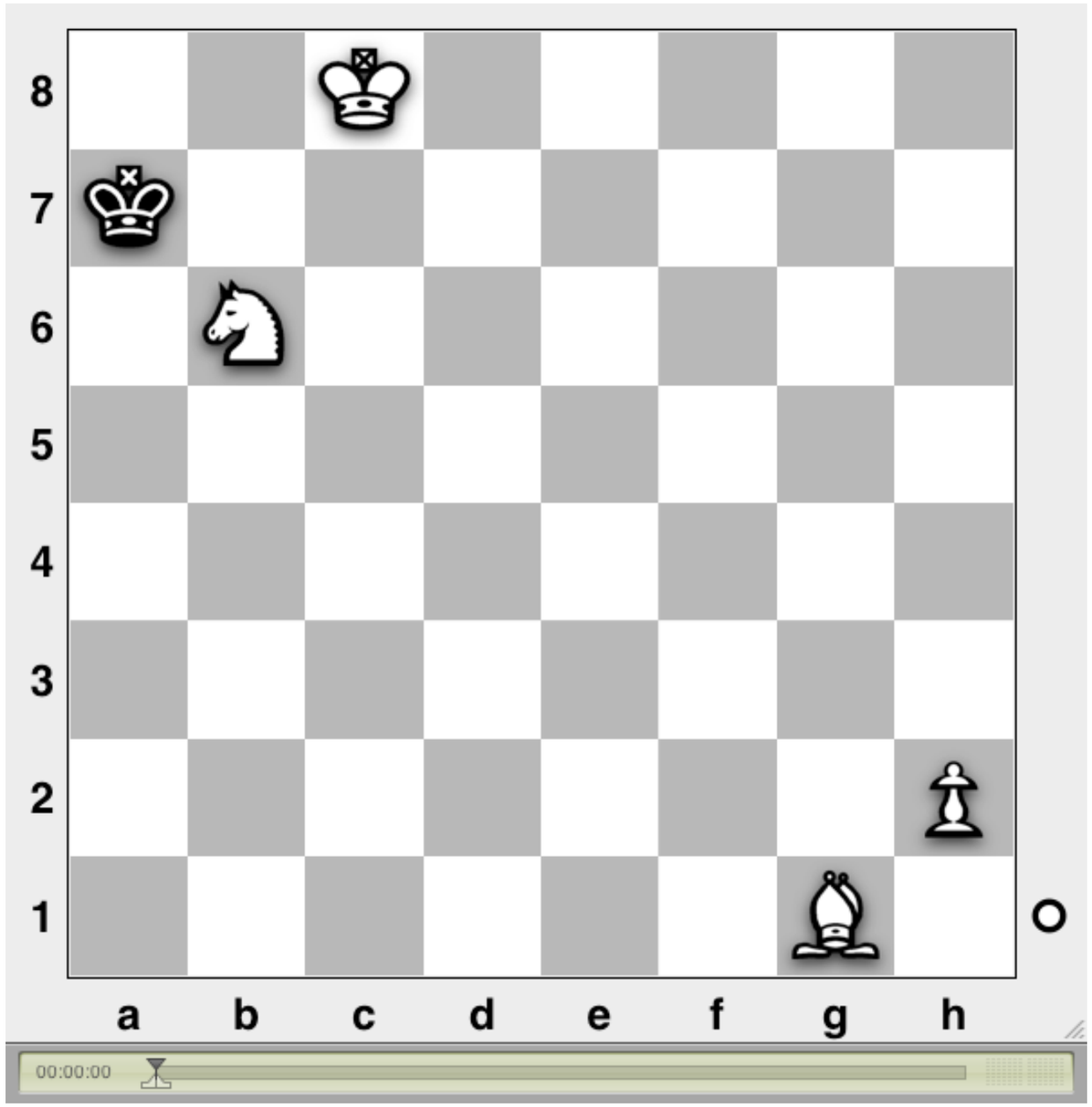

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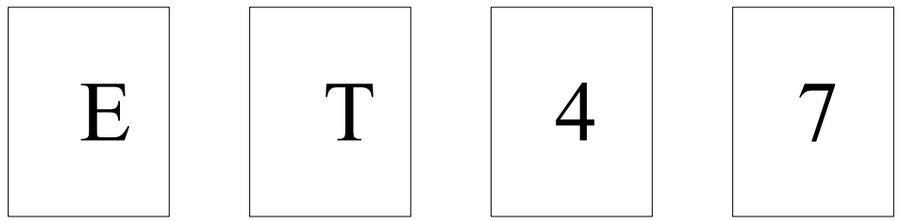

Suppose I claim that the following rule is true.

> If a card has a vowel on one side, it has an even number on the other side.

Which card or cards, if any, should you turn over in order to try to efficiently decide whether the rule is true or false?

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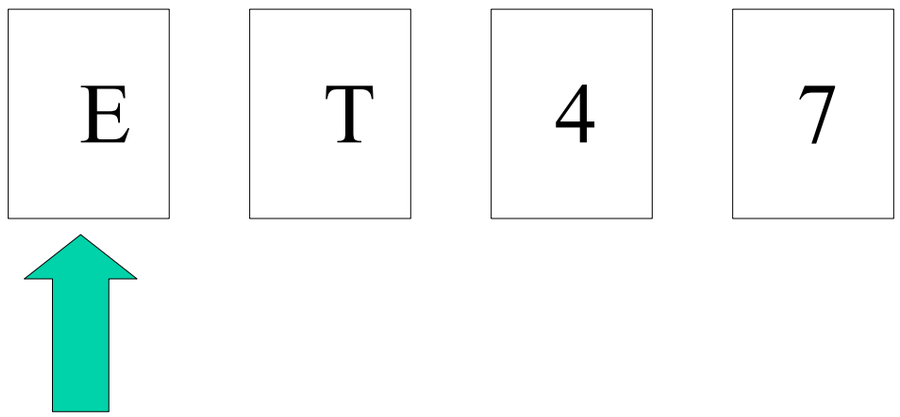

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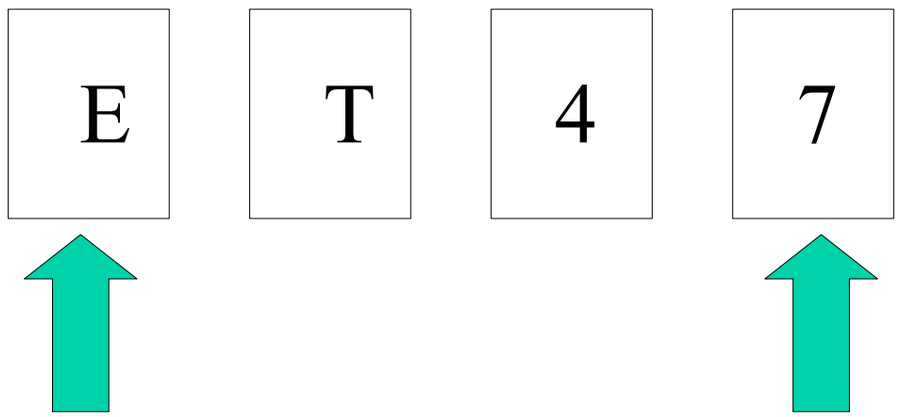

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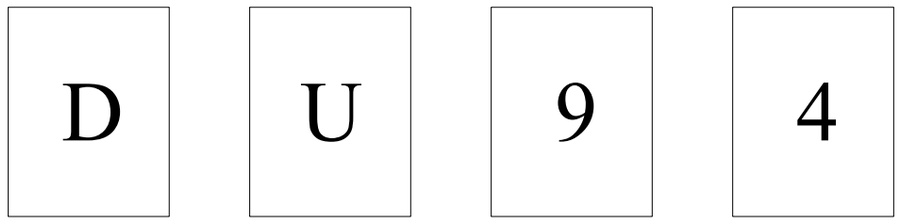

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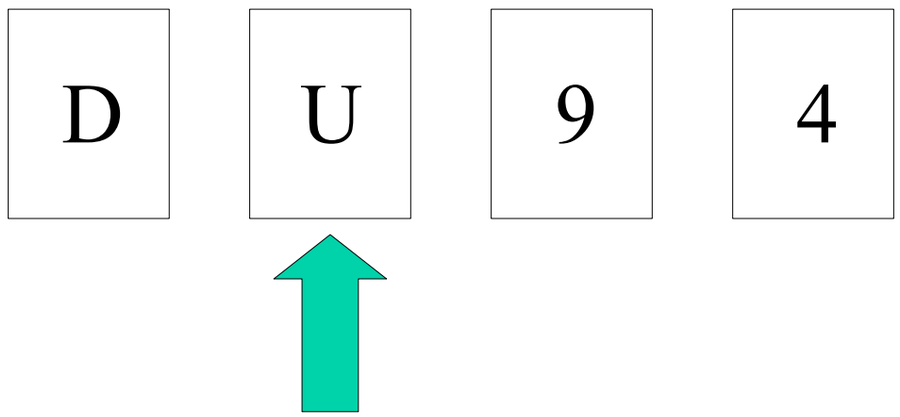

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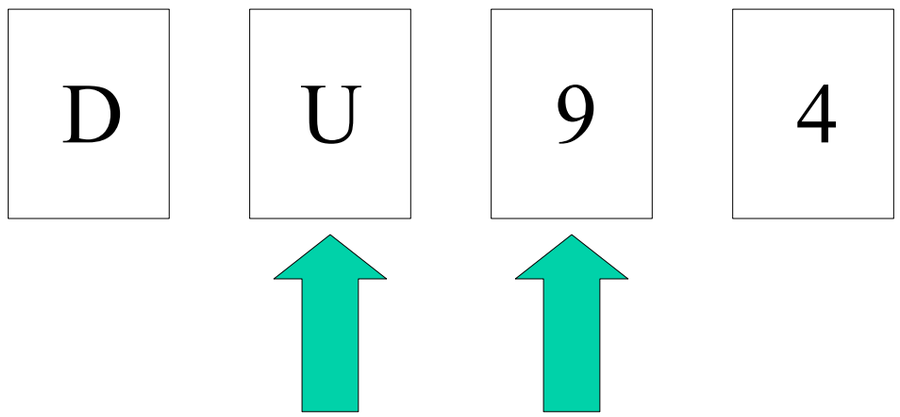

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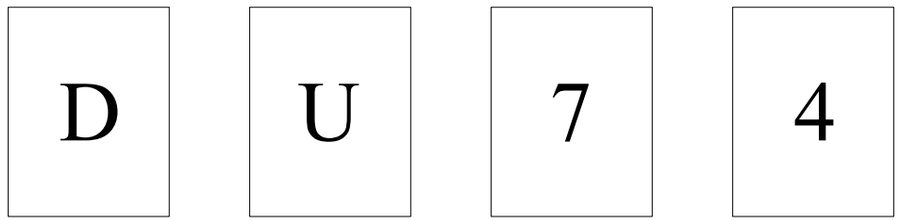

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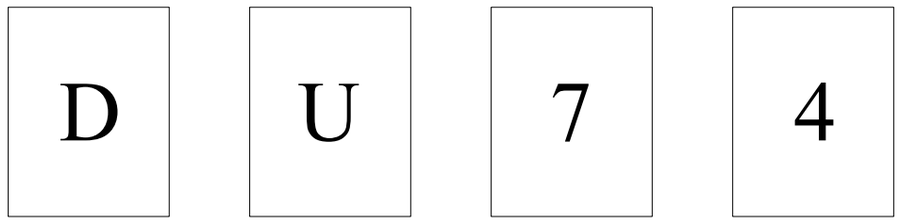

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The Original King-Ace

Suppose that the following premise is true:

> If there is a king in the hand, then there is an ace in the hand, or else if there isn't a king in the hand, then there is an ace.

What can you infer from this premise?

The Original King-Ace

Suppose that the following premise is true:

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> There is an ace in the hand.

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The Original King-Ace

Suppose that the following premise is true:

> If there is a king in the hand, then there is an ace in the hand, or else if there isn't a king in the hand, then there is an ace.

What can you infer from this premise?

NO! ~~There is an ace in the hand.~~

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In fact, what you *can* infer is that there *isn't* an ace in the hand!

King-Ace 2

Suppose that the following premise is true:

If there is a king in the hand, then there is an ace in the hand; or if there isn't a king in the hand, then there is an ace; but not both of these if-then statements are true.

What can you infer from this premise?

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(e.g. English or Chinese)

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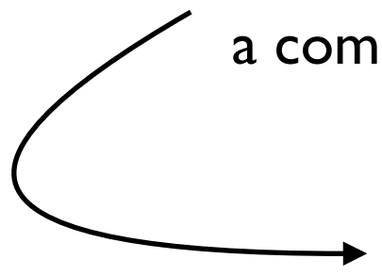

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HyperSlate™

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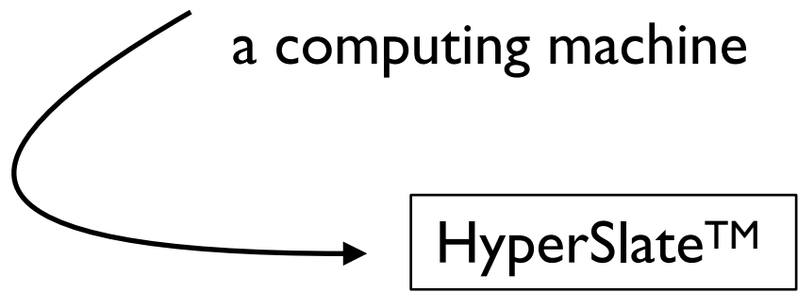

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STARTING 1/30

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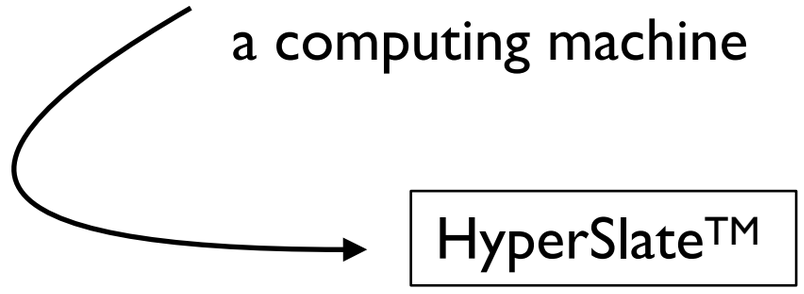

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King-Ace Solved

(informal proof)

Proposition: There is *not* an ace in the hand.

Proof: We know that at least one of the if-thens (i.e., at least one of the **conditionals**) is false. So we have two cases to consider, viz., that *K* => *A* is false, and that ¬*K* => *A* is false. Take first the first case; accordingly, suppose that *K* => *A* is false. Then it follows that *K* is true (since when a conditional is false, its antecedent holds but its consequent doesn't), and *A* is false. Now consider the second case, which consists in ¬*K* => *A* being false. Here, in a direct parallel, we know ¬*K* and, once again, ¬*A*. In both of our two cases, which are exhaustive, there is no ace in the hand. The proposition is established. **QED**

Bringsjord 1

(1) The following three assertions are either all true or all false:

If Billy helped, Doreen helped.

If Doreen helped, Frank did as well.

If Frank helped, so did Emma.

(2) The following assertion is definitely true: Billy helped.

Can it be inferred from (1) and (2) that Emma helped?

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YUP! — & now prove it!

Bringsjord 1: Proof

Proof: We have two cases to work from: when the conditionals in (1) are all true, and when they are all false. (In both cases, (2) remains true, and available.) So assume Case 1 first. In this case, we can simply chain through the conditionals by repeated application of *modus ponens* to arrive at the conclusion that Emma helped. Now assume Case 2 holds. This immediately implies that the first two conditionals are false; i.e., we have ~(B =>D) and ~(D => F). Recalling that a conditional fails to hold exactly when its antecedent if true while its consequent is false, we have, in turn: B & ~D, and D & ~F. But then we have a contradiction, viz. ~D & D. Since everything follows ("explosively"!) from a contradiction, we are done. **QED**

NEW …

A criminal genius nearly a match for Sherlock Holmes (Do you recognize the Dr?) has built a massive hydrogen bomb, and life on Earth is hanging in the balance, hinging on whether you make the logical prediction. Dr M gives you a sporting chance to: make the right prediction, snip or not snip accordingly, and prove that you're right …

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If one of the following assertions is true then so is the other:

(1) If the red wire runs to the bomb, then the blue wire runs to the bomb; and, if the blue wire runs to the bomb, then the red wire runs to the bomb.

(2) The red wire runs to the bomb.

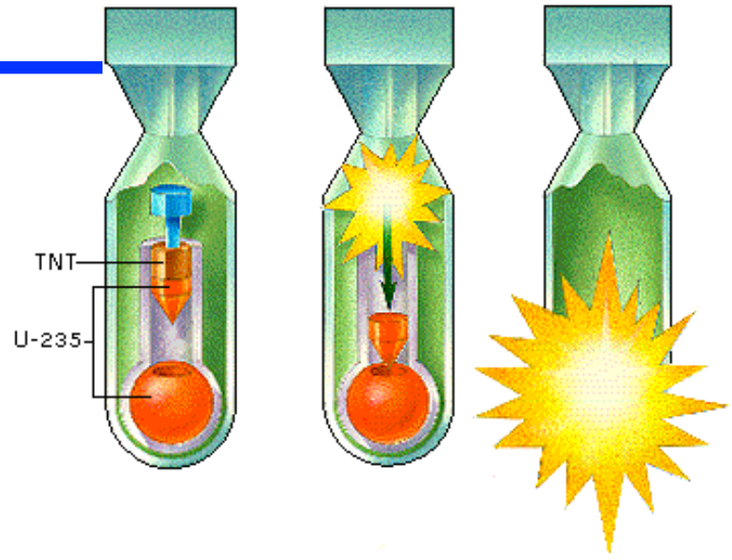
Given this perfectly reliable clue from Dr Moriarty, if either wire is more likely to run to the bomb, that wire *do*es run to the bomb, and the bomb is ticking, with only a minute left! If both are equiprobable, neither runs to the bomb, and you are powerless. Make your prediction as to what will happen when a wire is snipped, and then make your selected snip by clicking on the wire you want to snip! Or leave well enough alone!

Red more likely.

Blue more likely.

Equiprobable.

Snip



Life on Earth has ended.

advance one more slide to see a proof that you indeed made an irrational decision…

Proposition: The blue wire is more likely!

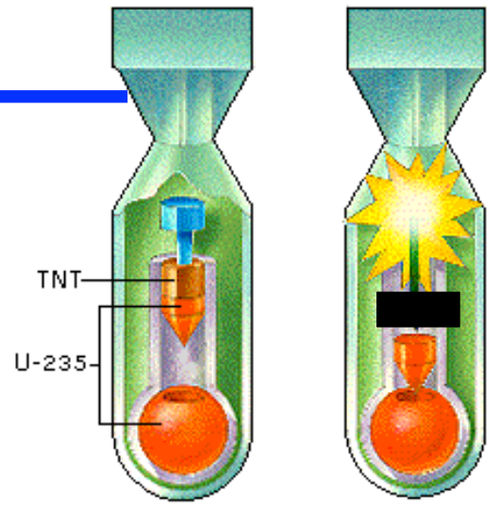
Proof: (1) can be treated as a biconditional, obviously (R <=> B).

There are two top-level cases to consider: (1) and (2) are both true; or both are false. In the case where they are both true, it's trivial to deduce both R and B. So far, then, R and B are equiprobable. What happens in the case where (1) and (2) are both false? We immediately have ~R from the denial of (2). But a biconditional is true just in case both sides are true, or both sides are false; so we have two sub-cases to consider.

Consider first the case where R is true and B is false. We have an immediate contradiction in this sub-case, so both R and B can both be deduced here, and we have not yet departed from equiprobable. So what about the case where R is false and B is true? The falsity of R is not new information (we already have that from the denial of (2)), but we can still derive B. Hence the blue wire is more likely. **QED**

STOP

Snip



Life on Earth is saved!

if you can now hand Dr M a proof that your decision was the rational one!

Advance one more slide to see a proof from Bringsjord that yours had better match up to …

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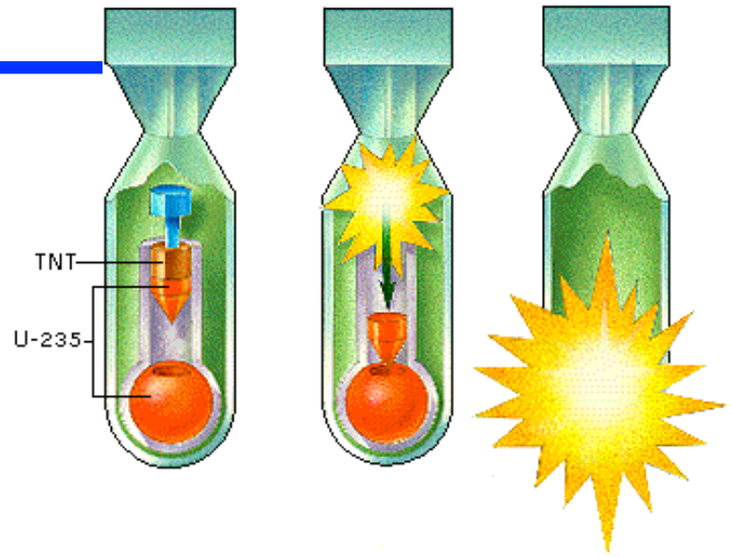

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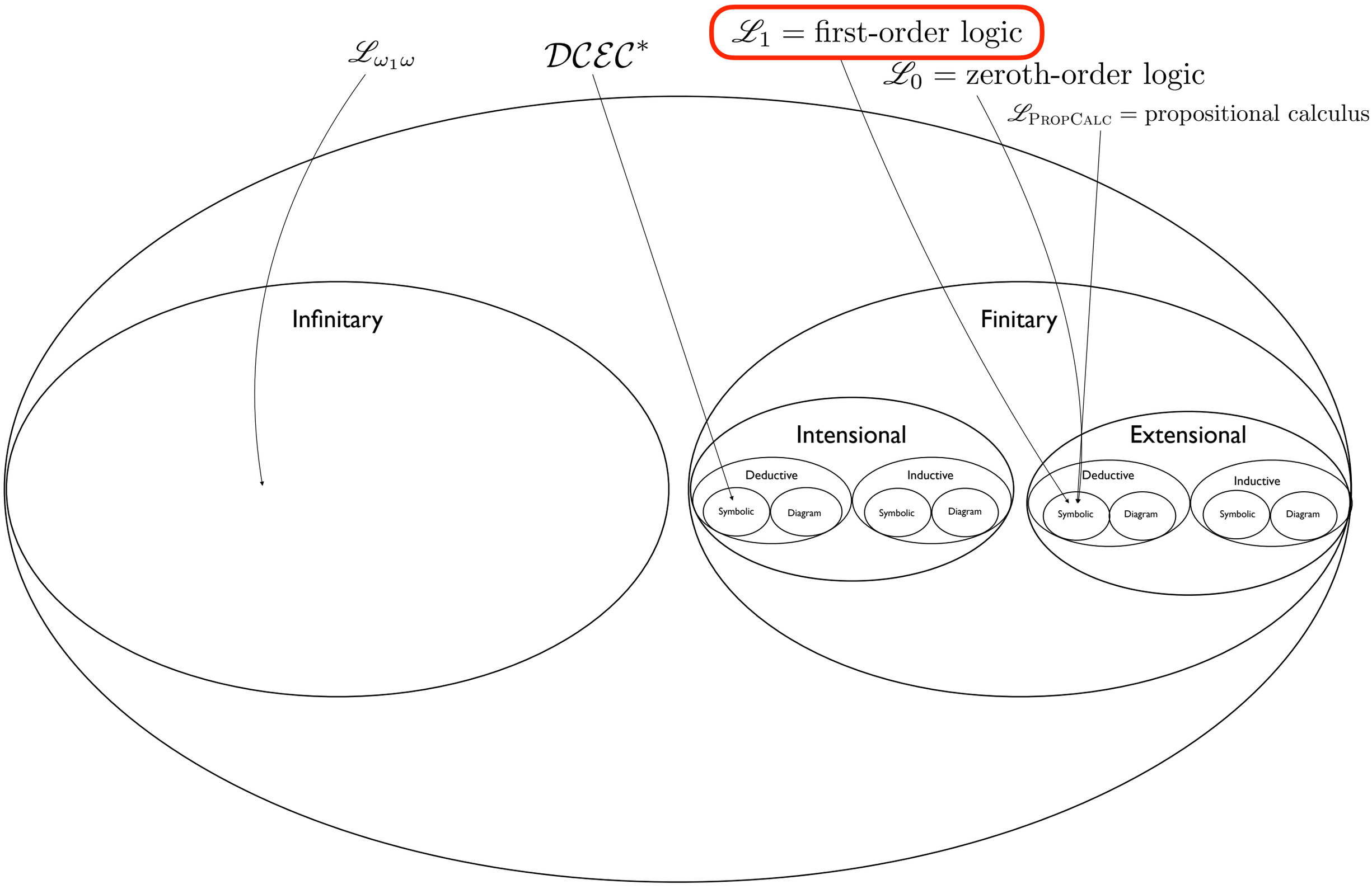
The Universe of Logics



Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;
or
there's a thing such that if it's a llama, everything is a llama;
or
there's a thing such that every llama is a non-llama.

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Is this disjunction TRUE, FALSE, or UNKNOWN?

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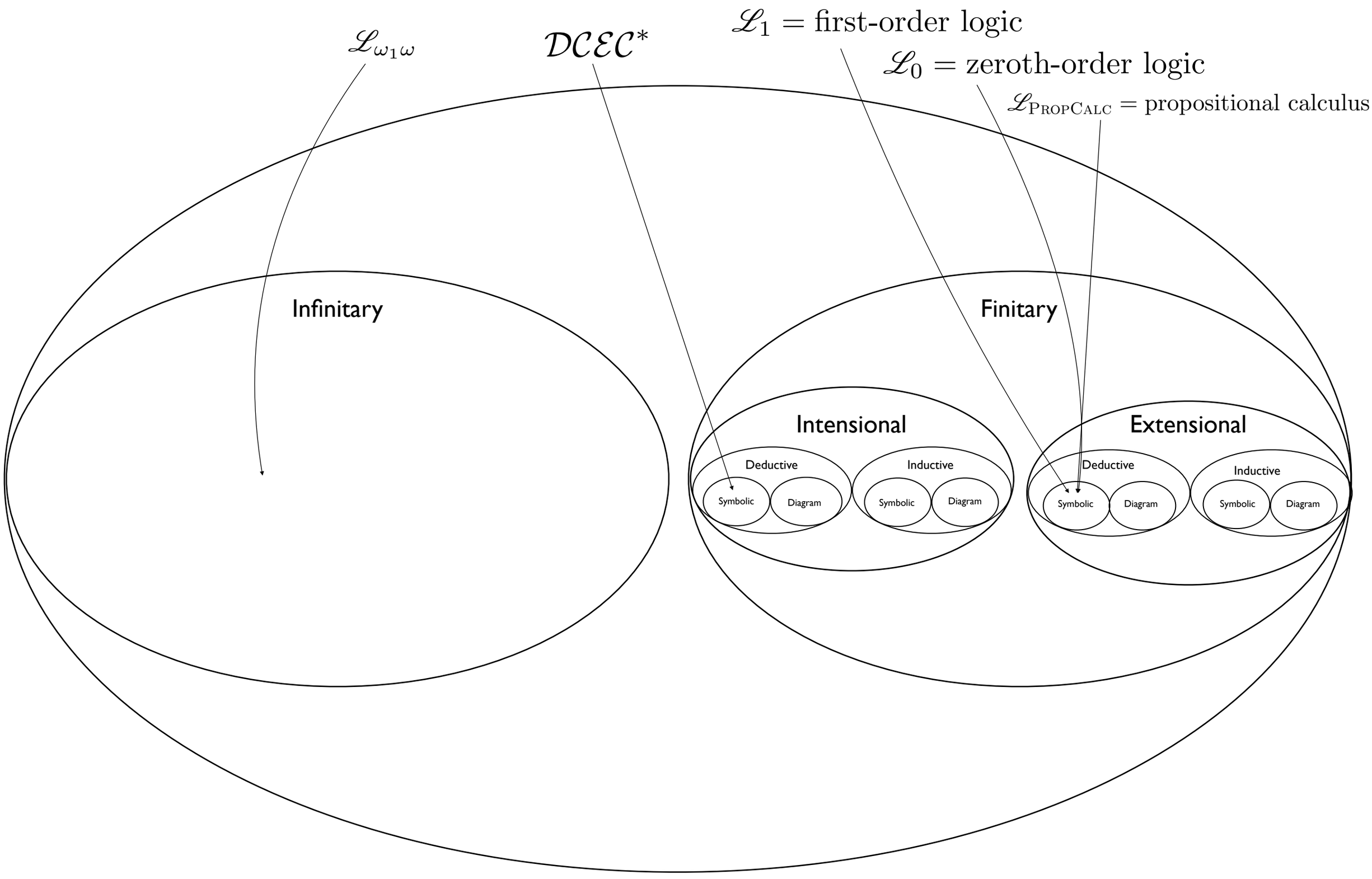
Supply a formal proof!

The Universe of Logics



The Universe of Logics