Note IV

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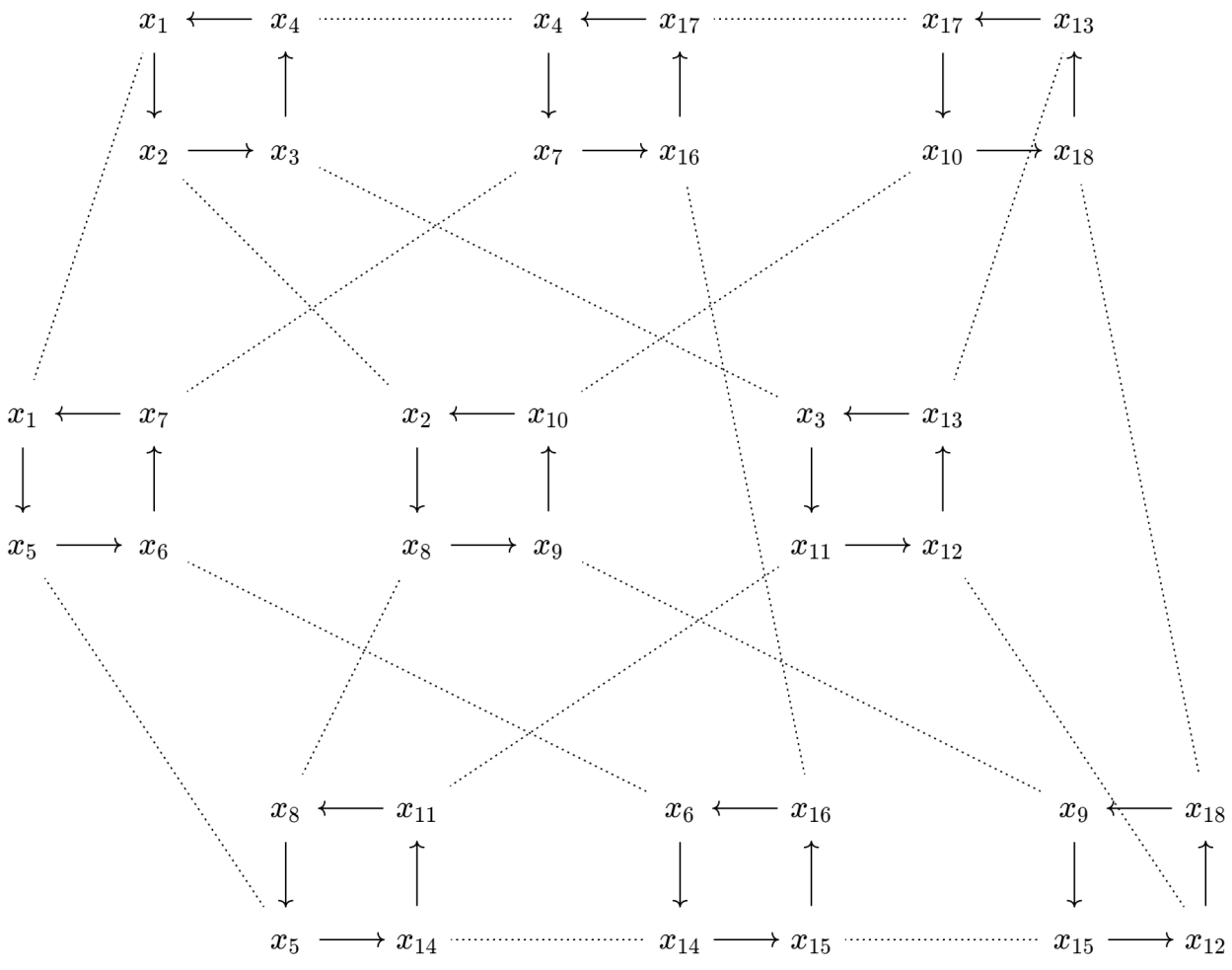
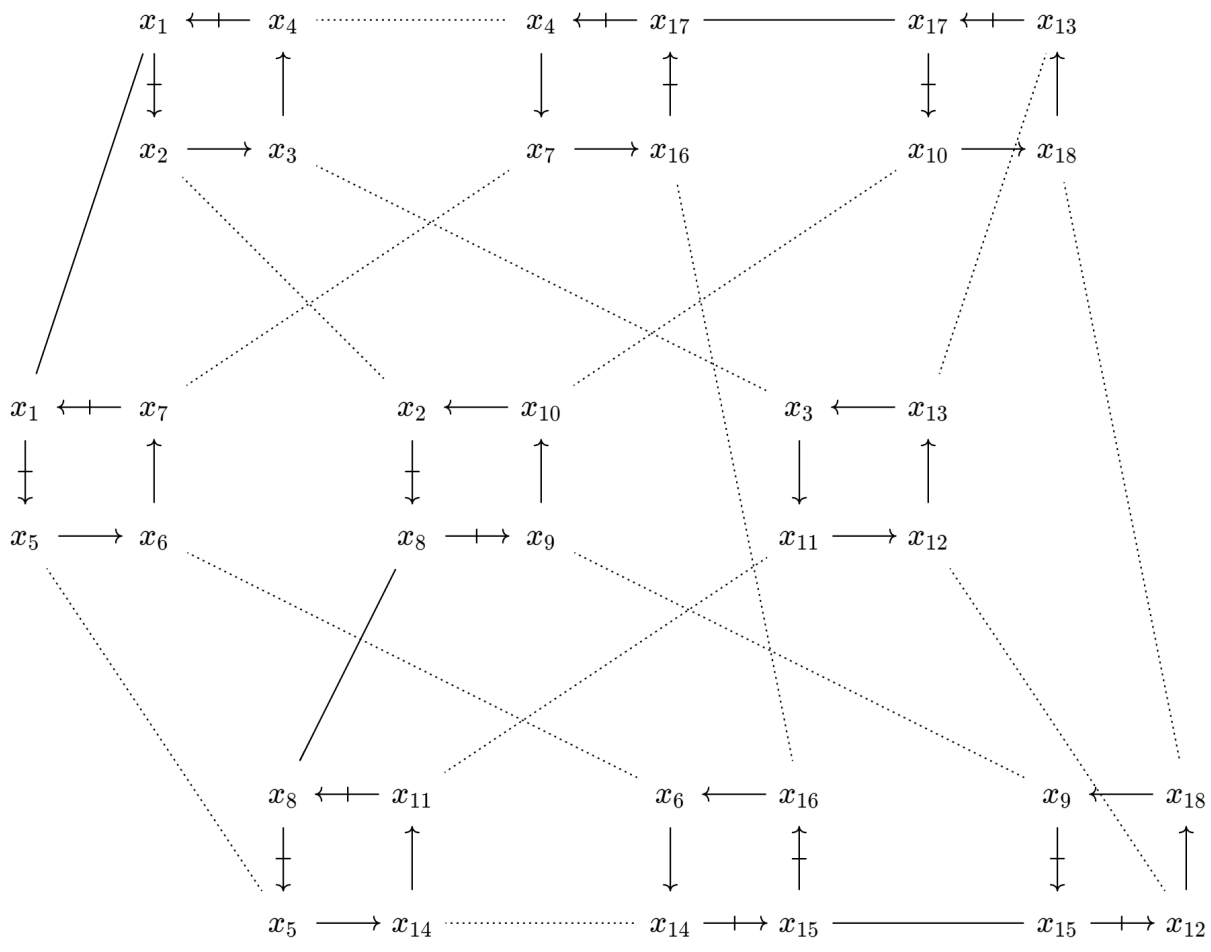
Kochen-Specker Theorem



Kochen-Specker Theorem



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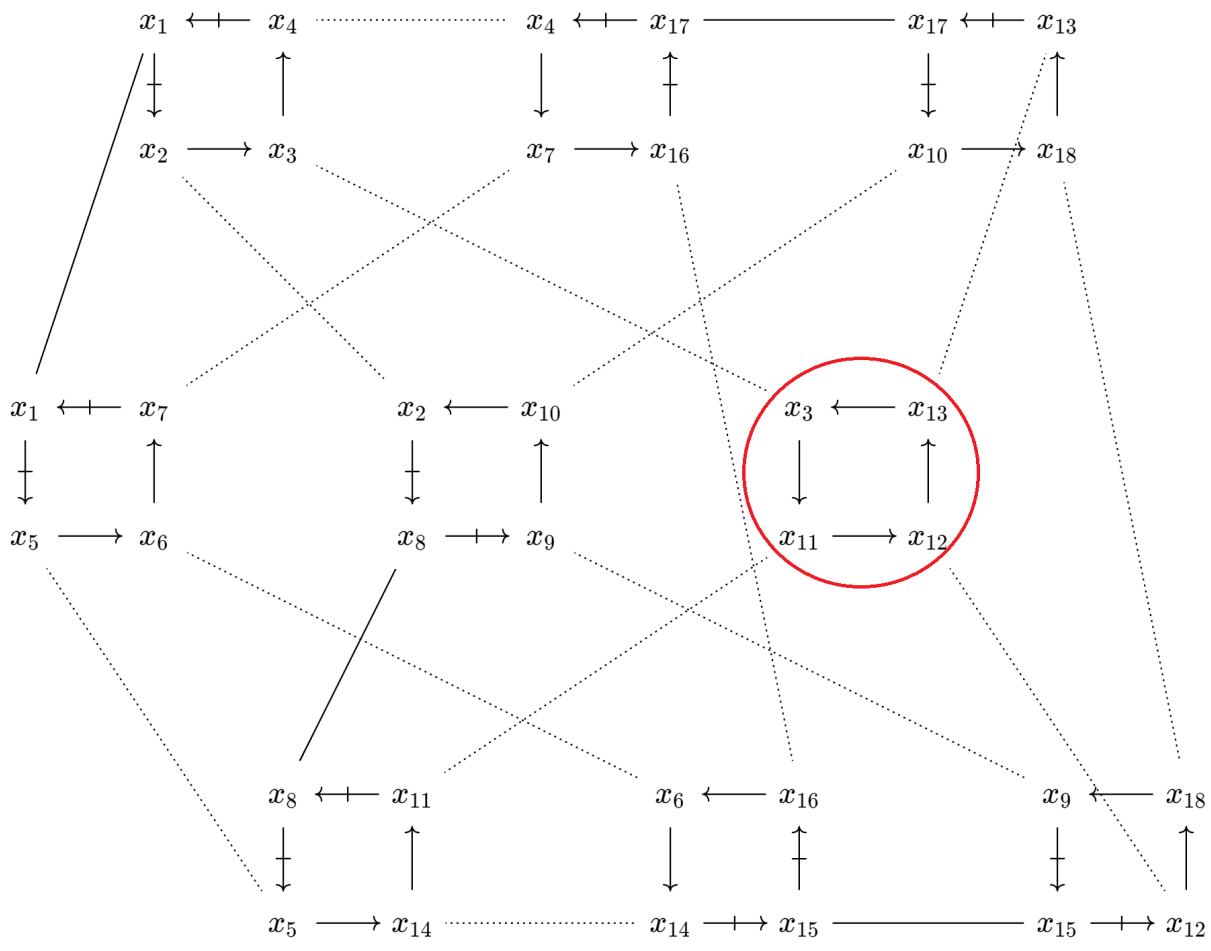

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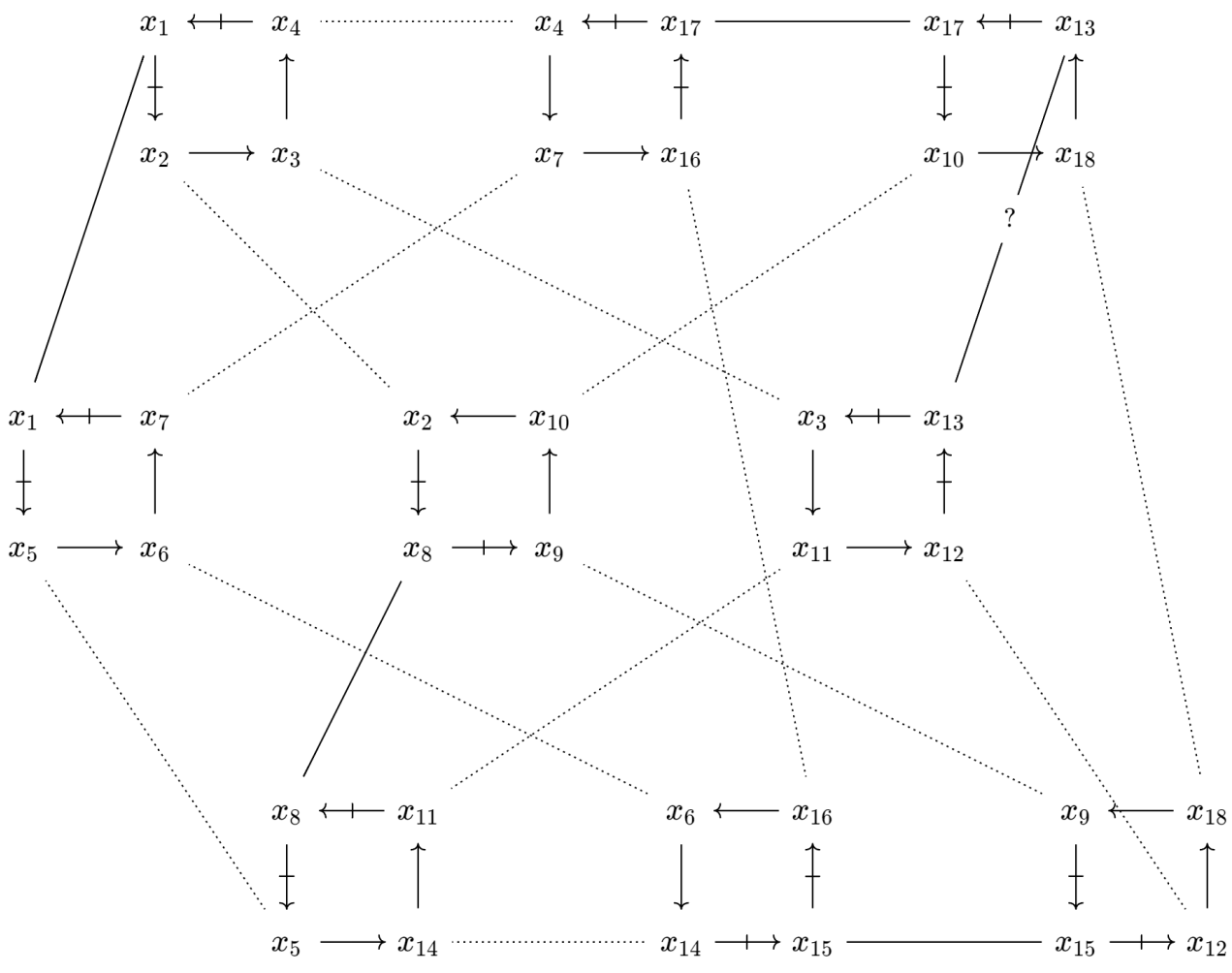

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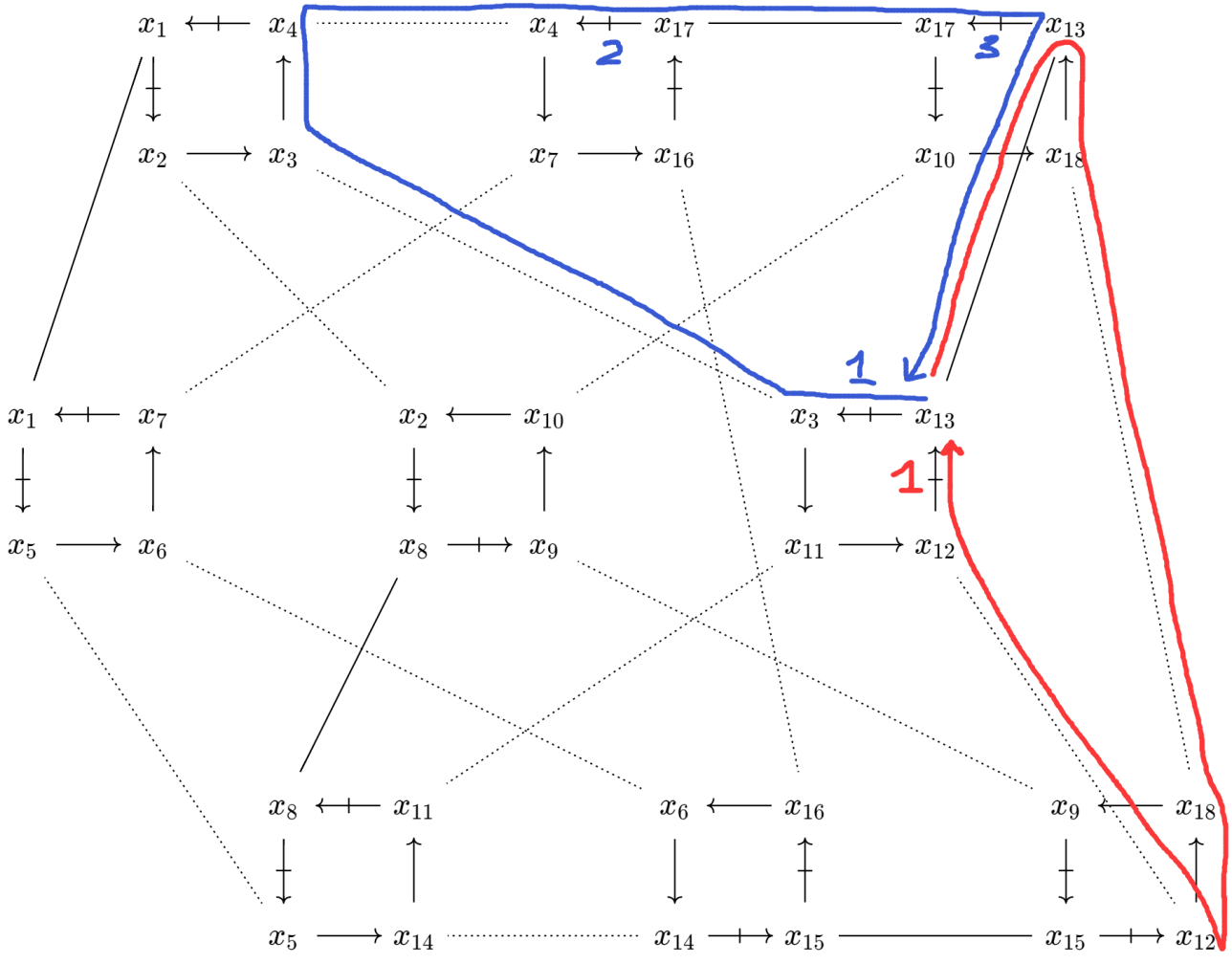

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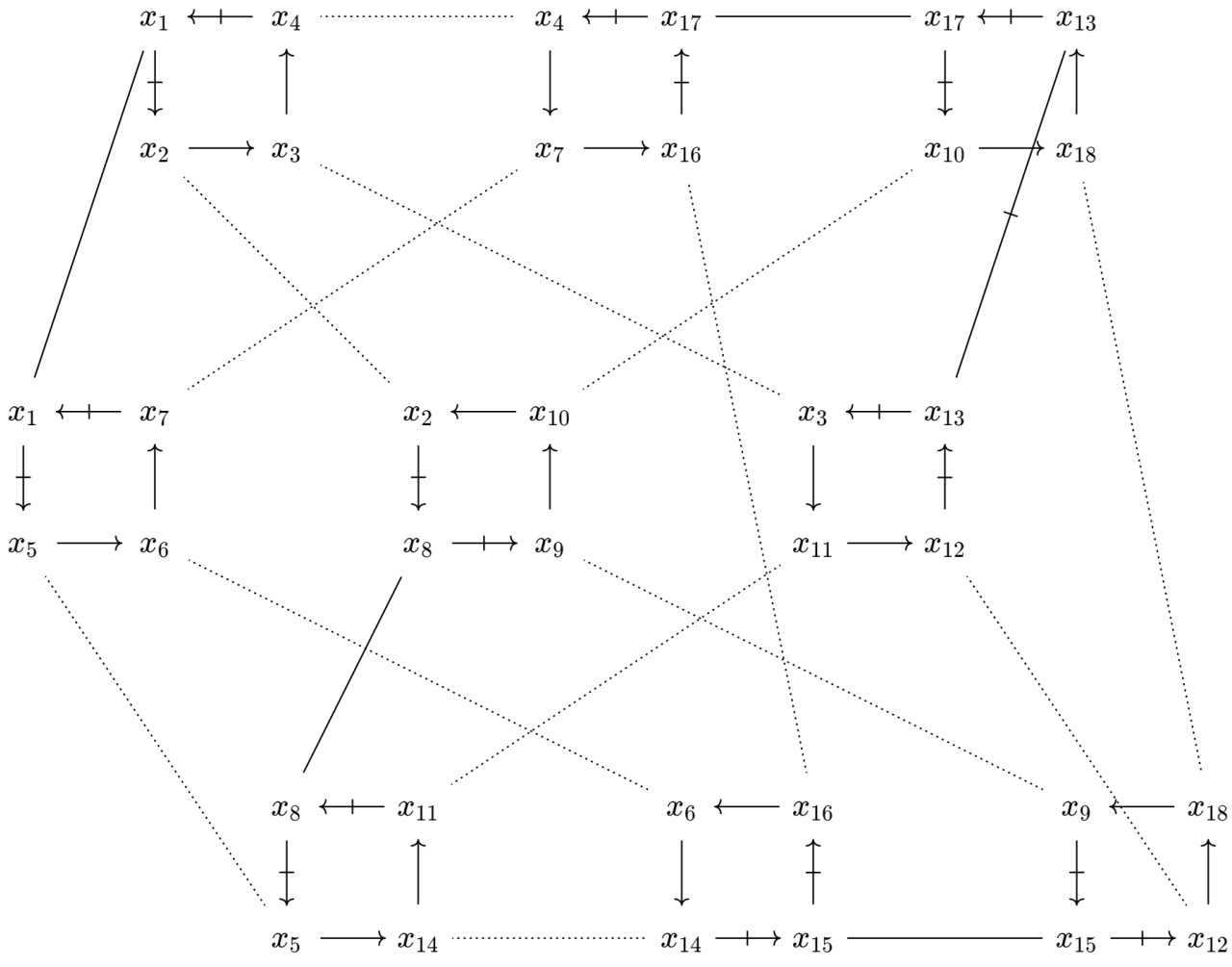


In essence, therefore, we experience time because of the interplay between our computational boundedness as observers, and the computational irreducibility of underlying processes in the universe. If we were not computationally bounded, we could "perceive the whole of the future in one gulp" and we wouldn't need a notion of time at all. And if there wasn't underlying computational irreducibility there wouldn't be the kind of "progressive revealing of the future" that we associate with our experience of time.

On the Nature of Time . (Stephen Walfram)

The stunning implication of this idea is that if we we were able to see things in wholes, not just the parts that are connected to us-if we were capable of perceiving every nuance of every interaction in the universe with perfect clarity as it happened-time would cease to exist in any meaningful sense.

The Order of Time . (Carlo Rovelli)

Metaphysics of Presence

Metaphysics of presence, as proposed by Jacques Derrida, has been the dominating paradigm of philosophizing since Ancient Greece. *Presence* implies a priority and fixation of the present, as if the time gets paused, or frozen, when the observer intervenes. To be more precise, "the present" becomes a violent synchronicity of all events involved, a contraction or a condensation of the historical temporality, so that every detail being observed can be carefully studied and analyzed in observer's logical temporality.

The Classical Logic since Aristotle is built upon such "metaphysics of presence":

- presence indicates "now".
- presence also indicates the opposite of absence.

From "Global Inconsistency"...

Revisit 3 Laws of Classical Logic since Aristotle:

- Law of Identity $A \rightarrow A$
- Law of Non-Contradiction $\neg(A \wedge \neg A)$
- Law of Excluded-Middle $A \vee \neg A$

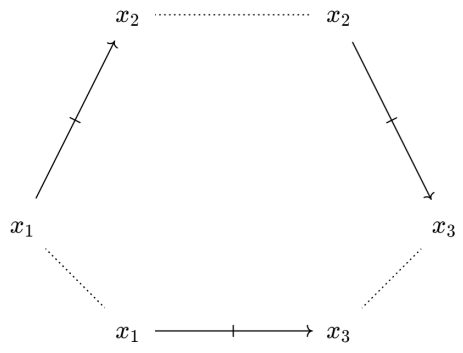
A non-classical logic is obtained if one law is no longer "universally admitted":

- Paraconsistent Logic (drop LNC)
- Intuitionistic Logic (drop LEM)

Any meaningful logic(s) if we consider dropping the Law of Identity?

...To "Delayed Contradiction"

Consider the Specker Triangle scenario (not realizable in QM):



One of $\{x_1, x_2, x_3\}$ is forced to arrive self-contradiction (in two different contexts).

The minimal scenario, however, should be something like this:

$$x \quad \cdots\cdots \quad x$$

where observable x is always in delay with itself, splitted by "different contexts".

The slogan for dialectics is "Two divides into One".

Ontic vs. Epistemic

The slogan for dialectics is "Two divides into One":

> The contradiction between two externally opposite contexts can be "inscribed back into" the contradiction immanent to one-in-itself.

This implies an interesting atomism as well as monism:

- atoms (dens) are not ontologically fully constituted "ones".
- in terms of Democritus, void is not among atoms, but immanent to atoms.

The proposal of clarification between ψ-ontic and ψ-epistemic by Harrigan and Spekken:

- ψ-ontic state = the state of reality-in-itself (not fully inaccessible)
- ψ-epistemic state = reflects the knowledge of reality (always incomplete)

A much more radical stance is implied by such dialectical approach:

The incomplete knowledge (epistemic incompleteness) can be inscribed back into the "incomplete reality" (ontological incompleteness). In other words, our intellectual finitude and limitation is a "positive feature" instead of a "negative bug".

Although, as we show in [1], determinism may formally be shown to be consistent, there is no longer any evidence that supports it, in view of the fact that classical physics has been superseded by quantum mechanics, a non-deterministic theory. The import of the free will theorem is that it is not only current quantum theory, but the world itself that is non-deterministic, so that no future theory can return us to a clockwork universe.

Appendix. Can There Be a Mechanism for Wave Function Collapse?

Granted our three axioms, the FWT shows that nature itself is non-deterministic. It follows that there can be no correct relativistic deterministic

The Strong Free Will Theorem . (Conway and Kochen)

The "Game Analogy"

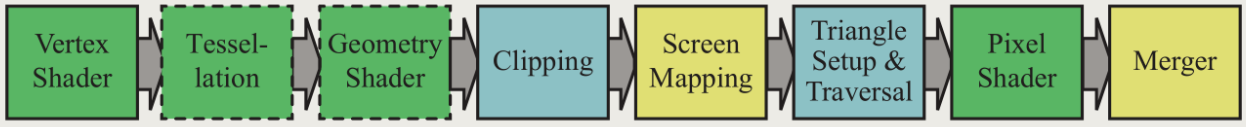


Figure 3.2. GPU implementation of the rendering pipeline. The stages are color coded according to the degree of user control over their operation. Green stages are fully programmable. Dashed lines show optional stages. Yellow stages are configurable but not programmable, e.g., various blend modes can be set for the merge stage. Blue stages are completely fixed in their function.

In analogy to 3D 1st perspective game with real-time rendering:

- a player is always located, with finite perspective ("computational boundedness").
- a player is always embodied, with a faculty of interaction with environments.

Risk extending the analogy a bit far:

- classical (logic, mechanics) means everything is "rendered" all at once without delay.
- quantum means things are rendered "economically" and with a minimal delay.