Ontological Thought Experiment

The Nature of Spacetime

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1 The Nature of Spacetime: Ontological Thought Experiment

Premises

- **Premise 1 (N=1 Universe):** In a universe containing only one object (e.g., Anton), the concepts of *space*, *time*, and *motion* are **undefined**.
  - No reference frame exists to measure distance, motion, or time.
  - Spacetime, as a Smooth Differentiable Manifold (SDM) or any mathematical structure, **cannot be empirically grounded** in this scenario.
  - There's no physical experiment or observation Anton can preform to empirically detect "spacetime".
- **Premise 2 (N=2 Universe):** Introducing a second object (e.g., Bob) enables **relative relationships** (e.g., distance between Anton and Bob).
  - No continuity, differentiability, or geometry (e.g., angles, curvature) is required to describe the system.
  - Spacetime as an SDM remains **unnecessary and speculative**.
- **Premise 3 (N3 Universe):** With three or more objects, **geometry emerges** as a useful abstraction.
  - Triangles, angles, and planar relationships can be defined.
  - The sum of angles in a triangle may deviate from 180° (non-Euclidean geometry), suggesting curvature.
  - However, this curvature is a property of the **abstraction** (the model of spacetime), not an ontological feature of the universe itself.
- **Premise 4 (General Relativity as a Meta-Theory):** General Relativity (GR) describes the **curvature of spacetime** as a response to mass and energy.
  - If spacetime is an abstraction (a model to describe relationships between objects), then GR is a theory about the **curvature of the abstraction**.
  - GR does not describe an underlying, independent reality but rather **how our model (spacetime) must behave** to predict observations within limits of this abstraction applicability.

Argument

1. In a universe with **N=1 or N=2**, spacetime (as an SDM or any background structure) **cannot exist ontologically** because it lacks empirical or operational grounding. It is a **meaningless construct** in these cases.
2. For **N3**, spacetime emerges as a **useful abstraction** to describe the relationships between objects. However, it remains a **mathematical tool**, not a fundamental entity.
3. General Relativity (GR) is a theory that describes the **curvature of this abstraction**. It does not have an **ontological basis** because it operates on a model (spacetime) that is itself a human construct to organize and predict observations.
4. Therefore, **GR cannot claim to describe an independent, fundamental reality**. It is an **instrumental tool** for predicting the behaviour of objects within the framework of the abstraction.

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Conclusion

Spacetime is not an ontological feature of the universe but an abstraction that emerges when the number of objects and their interactions reach a complexity requiring optional and arbitrary formalism aka a continuous, differentiable framework. General Relativity, as a theory of the curvature of this abstraction, **lacks ontological foundation** and is instead a **predictive and organizational tool** for describing the relationships between objects within limits of this abstraction applicability.

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