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Cryptographic tests of complexity conjectures in holography

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In the AdS/CFT correspondence, a spatial subregion of a conformal field theory allows for the recovery of a corresponding subregion of the bulk known as its *entanglement wedge*. In some cases, an entanglement wedge contains a locally but not globally minimal surface homologous to the CFT subregion, in which case it is said to contain a *python's lunch*. It has been proposed that python's lunch geometries should be modelled by tensor networks that feature projective operations where the wedge narrows. This model leads to the *python's lunch (PL) conjecture*, which asserts that reconstructing information from past the locally minimal surface is computationally difficult. In this work, we invoke cryptographic tools pertaining to a primitive known as the *conditional disclosure of secrets (CDS)* to develop consequences of the projective tensor network model that can be checked directly in AdS/CFT. We argue from the tensor network picture that the mutual information between appropriate CFT subregions is lower bounded linearly by an area difference associated with the geometry of the lunch. Recalling that the mutual information is also computed by bulk extremal surfaces, this gives a checkable geometrical consequence of the tensor network model. We prove weakened versions of this geometrical statement in asymptotically AdS_{2+1} spacetimes satisfying the null energy condition, and confirm it in some example geometries, supporting the tensor network model and by proxy the PL conjecture. On the other hand, we point out a tension between the PL conjecture and a plausible cryptographically inspired lower bound on the mutual information involving the complexity of reconstructing operators inside the lunch; this suggests the existence of protocols for computationally secure CDS requiring unexpectedly small entanglement.

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quantum gravity

Keyword-2

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Keyword-3

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Author: WADDELL, Chris (Perimeter Institute)

Co-authors: MAY, Alex (Perimeter Institute); XU, Michelle (Stanford University); PASTERSKI, Sabrina (Perimeter Institute)

Presenter: WADDELL, Chris (Perimeter Institute)

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