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# TURBO: The Swiss Knife of Auto-Encoders

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In this study, we present a novel information-theoretic framework, termed as TURBO, designed to systematically analyse and generalise auto-encoding methods. We examine the principles of information bottleneck and bottleneck-based networks in the auto-encoding setting and identify their inherent limitations, which become more prominent for data with multiple relevant, physics-related representations. The TURBO framework is introduced, its core concept consisting in the maximisation of mutual information between various data representations expressed in two directions reflecting the information flows. We illustrate that numerous prevalent neural network models are encompassed within this framework. The study underscores the insufficiency of the information bottleneck concept in elucidating all such models, thereby establishing TURBO as a preferable theoretical reference. The introduction of TURBO contributes to a richer understanding of data representation and the structure of neural network models, enabling more efficient and versatile applications.

## Brainstorming idea [title]

Stochasticity in the TURBO framework

## Brainstorming idea [abstract]

Finding the best methods for introducing stochasticity in neural network is a challenging, yet necessary task. It is, for example, a crucial aspect in HEP-related studies, where almost every processes contain randomness. TURBO being a versatile generalised framework for auto-encoder-like models, extending it to handle stochasticity in a meaningful way would be another notable step towards interpretable machine learning.

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