Which causal structures might not support a classical explanation based on any underlying physical theory.

***Shashaank Khanna** (University of York), Matthew Pusey (University of York)*

A causal relationship can be described using the formalism of Generalised Bayesian Networks. This framework allows the depiction of cause-and-effect relations (causal scenarios) effectively using generalised directed acyclic graphs (GDAGs). A GDAG is **" not interesting "** if the causal relations existing can be explained classically regardless of the underlying physical theory. The problem of identifying **" interesting "** causal scenarios for GDAGs of 7 nodes is still open which we deal in this work.

We propose a new graphical theorem, the-

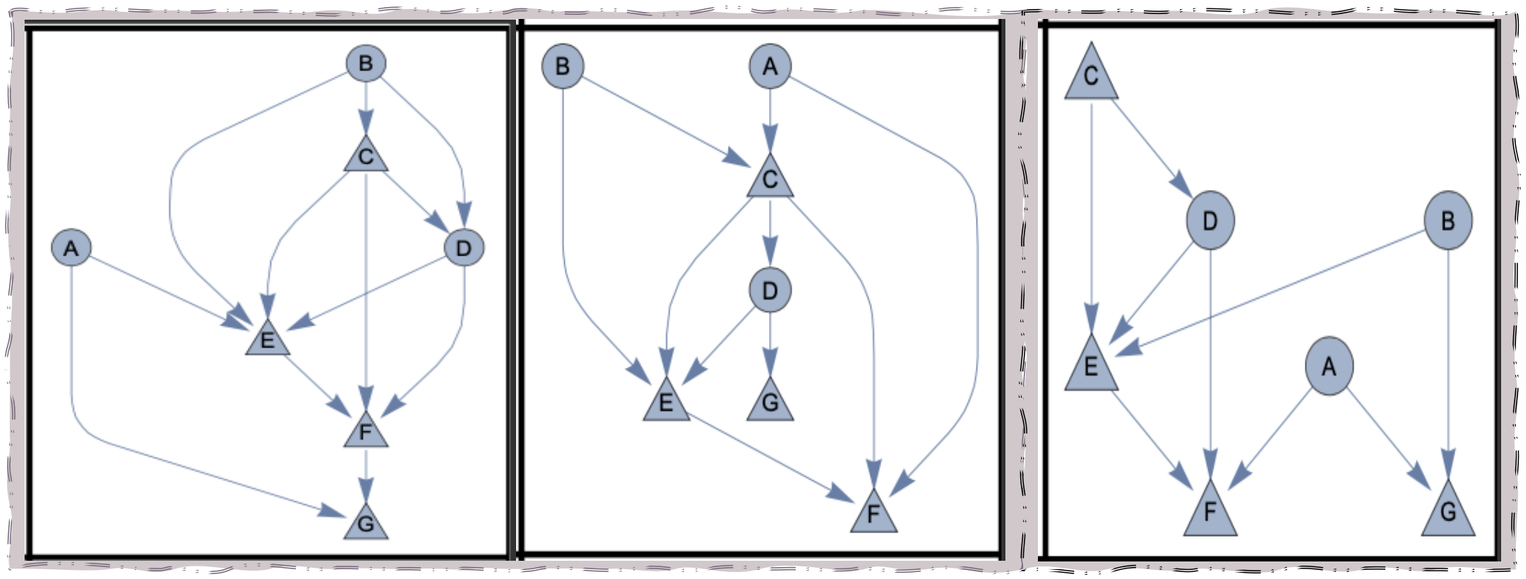
" Research ≈ :): .....(Schrodinger's Smiley)

E-Separation Theorem—:

$X \perp Y \mid Z$ after deletion of W .....just extended d-separation

The conditions of our theorem help in checking when a probability distribution is in $\mathcal{I}$ but not in $\mathcal{C}$ and thus check when a causal scenario might be **"interesting".**

Some 7 nodes GDAGs (Causal Scenarios) returned as **"Interesting"** by our code based on our theorem which thus CANNOT BE explained CLASSICALLY based on any theory-:



Only 20 GDAGs of 7 nodes remain unchecked by our E- Separation theorem. Our theorem can check the rest of the 7 nodes GDAGs for " interestingness ".

Employing our code for entropic and fine grained entropic inequalities we check these 20 left 7 nodes

Causal Scenarios for a classical explanation-: