



Project Proposal for Ph.D.

Project Details	
Project Title	Causal Representation Learning: Learning Latent Causal Structures from Data
Project Summary (Minimum 500 and maximum 2000 characters)	Many machine learning models, especially deep learning, excel at predicting outcomes but lack understanding of the underlying causal mechanisms that drive these outcomes. This often leads to models that are not interpretable and fail to generalize well to new data distributions (e.g., domain shifts). Traditional causal inference techniques, such as causal graphs and structural equation models (SEMs), require domain expertise to construct, which limits their scalability in data-rich environments. In response to these challenge, the proposed project aims to develop novel algorithms for causal discovery. In particular, the project will investigate the interplay between machine learning and causal discovery and how one can benefit from the other. The project seeks to tackle key challenges, such as dealing with unobserved variables and confounding factors, thereby enhancing the robustness and scalability of causal inference models. These advancements are expected to have a significant impact on fields requiring complex decision-making, from scientific research to applied AI systems.

Ph.D. Supervisors			
Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Souvik Chakraborty	Applied Mechanics	souvik@am.iitd.ac.in
Supervisor 2	Sandeep Kumar	Electrical Engineering	ksandeep@ee.iitd.ac.in

Project requirements (Student qualifications, experience required, etc)
*The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)
- B.E./B.Tech. /M.E./ M.Tech./M.Sc or equivalent degree in Applied Mathematics/ Electrical Engineering/ Computer Science or related field. - Candidates should have sound knowledge of Probability theory and programming. Knowledge of graph is preferable.

Source of fellowship/funding (CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)
Institute Fellowship/ Project Fellowship

Role of Faculty Members involved:	
Supervisor-1	The first supervisor Souvik Chakraborty works on scientific machine learning and will look into discovery of causality using machine learning
Supervisor-2	The second supervisor Sandeep Kumar is an expert in graph learning and will lead the same.