



# COLLEGE of ENGINEERING AND PHYSICAL SCIENCES

SCHOOL OF COMPUTER SCIENCE

## MSc Defence

**Tuesday April 18, 2023 at 10am via Zoom [Remote]**

**Shiqi Gu**

*Characterizing Qualitative Causal Dependency for  
NAT-modeled Bayesian Networks*

**Chair:** Dr. Gary Grewal

**Co-Advisor:** Dr. Yang Xiang

**Advisory:** Dr. Mark Wineberg

**Non-Advisory:** Dr. Deb Stacey

### **Abstract:**

The Non-impeding noisy-AND Tree (NAT) model is a local model we focus on in Bayesian networks (BNs). In order to improve algorithms for learning structures of NAT-modeled BNs, further understanding of dependency between a cause and the effect within a NAT model is required. For example, how does the dependence vary with the location of a causal event and values of single-causals? Although dependence between them can be measured by mutual information computed using algorithms for NAT conditional probability distributions (CPDs), it does not address directly what conditions of NAT models render the dependence stronger or weaker at the macro level.

A computational framework is developed in this research for analyzing qualitative dependency in the NAT-modeled BNs. The framework involves reducing the exponential space of NAT structures to a tractable subspace through chain NATs, converting NATs to equivalent chain NATs exactly and qualitatively, and conducting a qualitative dependency analysis for chain NATs by the approach with imprecise probabilities. Our experiment demonstrates the feasibility of qualitative estimation of dependency through this framework. The qualitative analysis helps identify the most influential aspects of causal dependency in the NAT models.