Weighted Graphs to Model Causality

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Abstract –*In this paper we explore the role of weighted graphs to evaluate the degree in which a sentence is direct or indirect cause of an effect, to obtain the path with a highest causality degree between two concepts, and in the inverse way, given a context, the two concepts with a strongest causal relationship.*

Keywords: Weighted causal graphs, causality, causal model, causal representation.

1 Introduction

Causality is an important notion in every field of science. In empirical sciences, causality is a useful way to generate knowledge and provide for explanations. When a quantum physicist calculates the probability of an atom absorbing a photon, he analyses this event as the cause of the atom's jump to an excited energy level; that is, he tries to establish a cause-effect relationship [1]

Causation is a type of relationship between two entities: cause and effect. The cause provokes an effect, and the effect is a consequence of the cause. Causality can be a direct process when A causes B and B is a direct effect of A, or an indirect one when A causes C through B, and C is an indirect effect of A.

According to Sowa [2], three assumptions described by Born [3] have to be fulfilled to consider a relationship as causal:

1. "Causality postulates that there are laws by which the occurrence of an entity B of certain class depends on the occurrence of an entity A of another class, where the world entity means any physical object, phenomenon, situation, or event. A is called the cause, B the effect".

2. "Antecedence postulates that the cause must be prior to, or at least simultaneous with the effect".

3. "Contiguity postulates that cause and effect must be in spatial contact or connected by a chain of intermediate things in contact".

These three postulates are the base to differentiate causal statements form conditional ones, although causality and conditionality are strongly related.

To represent causation, there have been many approaches, though we will focus in this paper in the representation of causality through causal graphs. The use of causal graphs as a way to represent information has been very present in literature, as Pearl [4], [5], Spirtes [6] or Sobrino [7], exemplifies. But these representations lack of ponderations in the edges to represent causality degrees. On the other hand, there are studies about causality like [8] where degrees are assigned to quantify the impact in which a cause provokes an effect, but no causal representation is used. It seems them a novelty proposal to mix the two approaches: use weighted graphs as a way to calculate degrees of direct or indirect causality between two concepts.