Copernican turn in temporal logic

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Although temporal logic can be also applied in information science or quantum physics, its origin comes from the investigation of time, truth, and the rules of time dependent deduction that was started by Prior (Prior, 1968). We return to this original aim in this contribution.

These investigations can have multiple foundations. A philosophical origin of our work is found in McTaggart's work (McTaggart, 1908). He distinguishes three different time series called A, B, and C series. The A series speaks about time as the 'future','present' and 'past'. On the other hand, the B series uses only the terms 'earlier than' and 'later than'. The last, C series, is completely atemporal and describes only the non-oriented relationship between events. He then argues that there is no objective time, only subjective time.

Yet, McTaggart's view gained support in physics quite recently. Barbour's approach advocates timeless physics too (Barbour, 2000) (Barbour, 2009). The foundation of his approach is a structure similar to a C series. Barbour builds up the world from so called 'configurations' and connects them with a specific measure. Although these configurations can be realized in multiple ways (for example as relative configurations of particles in Euclidean space), they form the 'primary ontological elements' for this theory. The measure then connects these configurations and gives the world a C series-like form. This approach, based on physics, therefore replaces the classical linear idea of time with a multidimensional structure.

Nevertheless we have already seen a similar structure in temporal logic. Namely the branching temporal logic based on Belnap's work (Belnap, 1992). This temporal logic uses a structure composed of ordered events. The building blocks of these structures can vary among approaches from so called 'histories' in the original Branching Space-times (Belnap, 1992) to the looser 'continuations' in Branching Continuations (Placek, 2011). A history represents the whole possible succession of events (one could say from the Big Bang until the Big Crunch) as opposed to a continuation which focuses only on localized successions of events (i.e. from Monday until Friday).

Following the recent contribution to this study by Dieks (2016), we attempt to present a formal model for an observer based temporal logic that encompasses also concepts from physics thanks to its inspiration by Belnapian branching logic. We use this logic to highlight formal differences between classical Branching space-times and Barbourian temporal logic. In particular, we introduce to both systems the role of an observer. Through this observer we investigate the truth and falsity of different temporal statements. This allows us to demonstrate a weak Copernican revolution in time - formally showing that the present and its observers do not need to be in the center of it all.

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