

Trees and Decisions

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ABSTRACT

The traditional model of sequential decision making, for instance, in extensive form games, is a tree. Most texts define a tree as a connected directed graph without loops and a distinguished node, called the root. But an abstract graph is not a domain for decision theory. Decision theory perceives of acts as functions from states to consequences. Sequential decisions, accordingly, get conceptualized by mappings from sets of states to sets of consequences. Thus, the question arises whether a natural definition of a tree can be given, where nodes are sets of states. We show that, indeed, trees can be defined as specific collections of sets. Without loss of generality the elements of these sets can be interpreted as representing plays. Therefore, the elements can serve as states and consequences at the same time.

Using this formalization, we provide a general definition of extensive form games which encompasses all classical examples plus more complicated objects like e.g. decision problems in continuous time. An interesting consequence is that the existence of immediate predecessors is not a requirement to be able to define games.