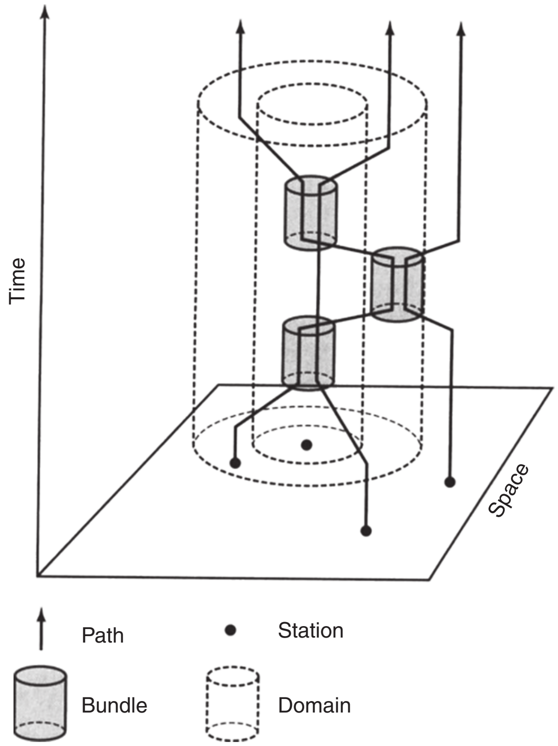

Figure 1 Hägerstrand's time-geographical diagram. Reproduced from Neutens, Schwanen, and Witlox (2001). Reprinted by permission of the publisher (Taylor & Francis Ltd, www.tandfonline.com).

Geography, like many other research and application fields, has moved in recent decades from being a data-poor field to being a data-rich field. This transition happened with the development of fields such GIS and remote sensing, and today public and private sector agencies are creating larger and larger datasets. This change made it imperative to develop new data mining tools to extract and construct knowledge from the huge databases that otherwise will remain undeciphered. The introduction of location devices, such as cellular phones, has created databases of human activities in space–time in great detail, but due to their large size there is need for new techniques in order to be able to extract patterns of behavior from within those large databases.

Quantitative analysis of trajectories

Attempts to aggregate behaviors into patterns and to analyze behaviors have mostly been descriptive; only a handful of studies introduced analytic methods to tackle the new type of high-resolution data available. The realm of trajectory pattern analysis offers many tools that can contribute to the analysis of spatial behavior. Research in this field grows out of the increasing availability of spatiotemporal data and the lack of techniques to analyze it (D'Urso and Massari 2013). The basic entities in this line of research are moving objects' trajectories that have a defined beginning and end time, and are divided into movement segments by stops – pauses in movement, identified in accordance with the scale of analysis. Yet, when considering semantic trajectories, one must consider background geographic information in order to understand and model trajectory patterns.

Trajectory pattern analysis attempts to resolve three major issues: how to measure similarities between trajectories, how to recognize clusters of similar trajectories, and how to treat the sequential element of a trajectory (Grinberger *et al.* 2014). Many measures have been developed to identify the similarity of trajectories – distance-based measures, dynamic time wrapping, and longest common subsequence being some of the most frequently used (Chen, Özsu, and Oria 2005). A variety of clustering methods are also used in pattern analysis, following the methods used for clustering of static data: direct methods that create clusters according to a central value or entity (*k*-means, *k*-medoids, fuzzy *c* means); agglomerative methods, which use a hierarchical tree to cluster trajectories together until a certain threshold is reached