Tiny Location Fingerprints Uniquely Identify Individuals

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ABSTRACT

Every time a cellular mobile communication subscriber makes a call, their network operator registers a so-called CDR record, which includes their current location at cell-level accuracy. Moreover, smartphones can estimate their current location at fine or coarse grain resolution using a variety of technologies such as GPS and wifi fingerprinting or Bluetooth beaconing correspondingly, thus generating a trail of location data. Over the past decade numerous data sets representing the movements of large human populations have been collected across the globe from London and Los Angeles to Beijing and Dakar, and studied with a view to discover key characteristics of the underlying human dynamics. Despite the diverse characteristics of these data sets, significant commonalities have been identified.

Specifically, these studies revealed the answers to: how to infer meaningful (semantic) locations such as home and work from raw location observations; how to predict algorithmically spatial patterns of individual movement for example, whether it is possible to employ a temporally ordered sequence of one's most frequent places of presence to predict subsequent movements; how to model the temporal evolution of these patterns; how to assess the uniqueness of trails associated with particular individuals; how these features scale with location data accuracy; and, how to relate mobility patterns to the demographics of the population monitored.

Considering these studies as a whole, we extrapolate that presence along a sequence of seven (plus or minus two) significant places is adequate to uniquely identify a particular individual from a population of several hundred million users.

BODY

A sequence of 7 (± 2) significant places reconstructed from smartphone data, distinguishes an individual amongst a large human population.

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