Dissertation Defense

Protecting Locations of Individual Movement under Temporal Correlations

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Abstract: Concerns on location privacy frequently arise with the rapid development of GPS enabled devices and location-based applications. In this dissertation, we study how to protect the locations of individual movement under temporal correlations. First, we propose three types of privacy notions, location privacy, customizable privacy, and the privacy for spatiotemporal events. Location privacy is used to protect the true location of a user at each timestamp; Customizable privacy means the user can configure personalized privacy notions depending different demand; Privacy for spatiotemporal events needs to be specially preserved because even if location privacy is guaranteed at each timestamp the spatiotemporal events can still be exposed. Second, we investigate how to preserve these privacy notions. We show that the traditional ℓ_1-norm sensitivity in differential privacy exaggerates the real sensitivity, and thus leads to too much noise in the released data. Hence we study the real sensitivity, called sensitivity hull, for the data release mechanism. Then we design the optimal location release mechanism for location privacy. We show that the data release mechanism has to be dynamically updated for the customizable privacy to guarantee the privacy is protectable, which is measured by a notion of degree of protection. To protect the spatiotemporal events we study how to derive the probability of the spatiotemporal events for arbitrary initial probabilities of adversaries. Then we check whether to release the location at each timestamp to bound the risk of the spatiotemporal events. Third, we implement these algorithms on real-world datasets to demonstrate the efficiency and effectiveness.

Wednesday, March 29, 2017, 11:30 am
Chemistry 320

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