

ABSTRACT

With the rapid growth in the field of mobile GIS, applications dealing with spatial data are proliferating. Cache management in such applications is critical and poses several research challenges. Important issues include storage, retrieval and efficient management of spatial data. Traditional caching schemes like page caching and tuple caching do not scale well in this new domain. Their failure is caused by their inherent assumption of spatial locality of reference, inability to support content based reasoning or sometimes simply due to the dynamics of the spatial data and mobile environments.

We need an altogether different approach to manage and efficiently utilize cache while dealing with spatial data in mobile GIS applications. Spatial queries in these applications tend to exhibit semantic locality due to the inherent location attribute associated with spatial data. We exploit this fact for caching purpose and this is where semantic caching comes into picture. We use semantic cache descriptors to determine and manipulate the contents of the cache. In this thesis we propose an infrastructure that supports semantic caching of data in mobile environments. We build a prototype system as a “proof of concept” that captures the essential elements of semantic caching and demonstrates its working. Our system uses the existing relational database framework to efficiently manage semantic cache. We devise and implement a new cache replacement algorithm that takes advantage of schema knowledge in determining the replacement victims. We formulate the problem as an integer linear program and then solve a relaxation to obtain fractional optimal solution. We also implement a solver that, for restricted cases, determines if a query can be answered from local cache. Finally we propose a variety of techniques for semantic query processing and cache management.