Proactive Caching for Spatial Queries in Mobile Environments & Cache Invalidation and Replacement Strategies for Location-Dependent Data in Mobile Environments

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Overview

Introduction

Published in IEEE Transactions on Computers

by

Baihua Zheng, Jianliang Xu, and Kik L. Lee

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Motivation

Doing location based queries from a mobile phone, with a cache, the user could:

- Save Money
- Reduce Network Traffic
- Conserve battery

Existing cache replacement policies too simple. Does not consider valid scopes of cached items

Related Work

Temporal-dependent invalidation

- server sends *invalidation reports* to clients

Location-dependent invalidation

- Depending on users location or area after movement, data might be invalidated.

Semantic data caching

- cached items saved with locations associated with query

Problem

Mobile, cache enabled, clients communicate with fixed hosts, requesting location based service from fixed hosts.
A Geometric model is used, with identifying their location via e.g. GPS.

- Mobile clients
- Fixed hosts
- Geometric model

- Perceived Problem

Given a cache enabled client and a LBS server, which cache replacement technique performs best, and does data distribution have an effect.

Invalidation Strategies

Location-Dependent Invalidation Strategies

- **PE** Polygonal Endpoints
- **AC** Approximate Circle
- **CEB** Cache Efficientcy Based

Methods to support invalidation of cache items based on the valid scope of each items

CEB - Cache Efficientcy Based

$$E(v_i^{'}) = \frac{A(v_i^{'})/A(v)}{(D+O(v_i^{'}))/D} = \frac{A(v_i^{'})D}{A(v)(D+O(v_i^{'}))}$$

- $v_i^{'}$ - subregion of v
- $A(v_i^{'})$ - area of $v_i^{'}$
- $O(v_i^{'})$ - overhead to record scope of $v_i^{'}$
- D - Data size
- $A(v_i^{'})/A(v)$ - Cache hit ratio (assuming uniform probability of queries from all locations)
- $(D + O(v_i^{'}))/D$ - Cost ratio to archive hit ratio
- $E(v_i^{'})$ - Caching efficiency of data item with respect to scope of $v_i^{'}$

Cache Replacement Policies

Eject cache items furthest away from user

Favor cache items with larger valid scope

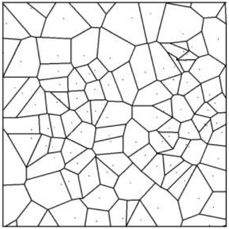
PA Probability Area $c_{i,j} = P_i * A(v'_{i,j})$

PAID Probability Area Inverse Distance $c_{i,j} = \frac{P_i * A(v'_{i,j})}{D(v'_{i,j})}$

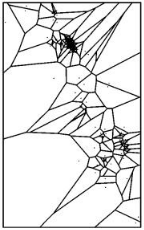
- $c_{i,j}$ - Cost function of data value j of cache item i
- P_i - Access probability of cache item
- $A(v'_{i,j})$ - Area of attached valid scope $v'_{i,j}$
- $D(v'_i)$ - Distance between user and valid scope $A(v'_{i,j})$

Setting

2 datasets, modeled as Voronoi Diagrams (110/185 Points)



(a)



(b)

- 2 datasets, modeled as Voronoi Diagrams (110/185 Points)

Conclusion

Impression

Paper too long, with very little content

Experimental section almost 2/3 of paper.

Paper does not state problem to be solved, is a rather just a description of methods

Introduction

Published at: ICDE '05: Proceedings of the 21st International Conference on Data Engineering

by

Haibo Hu, Jianliang Xu, Wing Sing Wong, Baihua Zheng, Dik Lun Lee, and Wang-Chien Lee

April 2005

Related Work

Introduction

Published at IEEE Trans. Comput., 2002

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Published at IEEE Trans. Comput., 2002

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Published at IEEE Trans. Comput., 2002

Related Work