Intelligent Transportation

Traffic Data Management

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Intelligent Transportation

PROBLEM

• Traffic congestion is a $87.2 billion annual drain on the U.S. economy\(^1\):
  • 4.2 billion lost hours (one work week for every traveler)\(^1\)
  • 2.8 billion gallons of wasted fuel (three weeks worth of gas for every traveler)\(^1\)

\(^1\) Texas Transportation Institute Urban Mobility Report, 2007 data
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GOAL

• To improve the performance of the surface transportation network through:
  • Capturing real-time data from infrastructure and vehicles
  • Developing data-driven solutions to improve mobility by leveraging optimization opportunities (e.g., path planning for commuter groups)
Intelligent Transportation

Facilitating an infrastructure for acquiring, processing, storing and querying real-time and historical transportation datasets
TransDec: Data-Driven Decision Making in Transportation Systems
Outline

• TransDec
• Accomplishments
• Projects
  • Stream Data Processing
  • Time-dependent Route Planning
  • Inferring Traffic from Video Feeds
• Future Plans
TransDec Team

• Government
  • LA-MTA: Los Angeles County Metropolitan Transportation Authority
  • RIITS: Regional Integrated Intelligent Transportation System

• USC
  • Annenberg Innovation Lab
  • Price School of Public Policy
  • Integrated Media Systems Center

• Industry
  • Microsoft
  • Intel
TransDec

Input Traffic Data
Data Processing
Storage
Query Retrieval & Visualization

46 MB/min
26 MB/min

Microsoft SQL Azure
Oracle Database

Big Data!

Highway
Traffic Monitoring Videos
Real-time Flow Data Extraction
CalTrans
Viewmont

Microsoft StreamInsight
15 TB/Year
26 MB/min

USC Viterbi
School of Engineering

Integrated Media Systems Center
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Accomplishments

• Unrivaled research
  • $1.8+ million funding in last 2 years

• Advanced development
  • Largest repository of SC traffic data (15+TB)
  • End-to-End system

• Intellectual property
  • Algorithms & Papers (Best paper award)
  • Filed and provisional two patents

• Technology Transfer
  • Incubator, Amplify.la
Outline

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Stream Data Processing

- **Traffic Data Lifecycle: Loop Detectors**
  - Loop Detector: most commonly used traffic sensors
  - The data is collected in Detector Cabinet and relayed to the service provider.
  - Provide two data fields: volume (count) and occupancy (% time a vehicle is over the sensor)
## Stream Data Processing

### A Data Management Problem

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Sample XML</th>
<th>Cycle</th>
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<th>Daily (in KB)</th>
<th>Annual (in KB)</th>
<th>3 Years (in KB)</th>
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</tbody>
</table>

**Continuous**

**Large**

**Heterogeneous (loop detector, gps, events)**
Stream Data Processing

- **Microsoft StreamInsight**
  - Efficient retrieval of high-rate streaming data
  - On the fly processing and analysis
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Time-dependent Route Planning

- Traffic patterns varies based on the time of the day, day of the week and season
Time-dependent Route Planning

• Existing FP Techniques
  • Based on the **constant** edge weights for each edge

• In Real-world
  • The weight of an edge is a function of time, i.e., **time-dependent**
  • Arrival-time to an edge determines the travel-time on that edge

8:30 AM  5:00 PM
Time-dependent Route Planning

Baseline Offerings

• Constant travel-time
• Current traffic conditions

Unused Variables

• Historical traffic averages
• Time of day
• Day of week
• Season of year
• Holidays or events
Time-dependent Route Planning

ClearPath

- Technology Transfer for commercialization

- Moving Forward Collaboration with courier companies
Time-dependent Route Planning

**FILED UNDER**  Cellphones, Mobile Software

Apple confirms it's working on a traffic service, moving away from Google Maps?

Apple is now collecting anonymous traffic data to build a crowd-sourced traffic database with the goal of providing iPhone users an improved traffic service in the next couple of years.

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Ford Motor Company Expands Collaboration with INRIX on Traffic and Routing

Global Partnership Enhances Ford SYNC and Powers Next-Generation Navigation Systems on All Ford, Lincoln and Mercury Vehicles

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NAVTEQ Launches Enhanced Traffic Patterns™

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TomTom Provides Historical Traffic Data to City of Zürich

Press Release: TomTom – Mon, Oct 17, 2011 8:00 AM EDT
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Inferring Traffic from Video Feeds

• Today technology: Inductive loop detectors

• Major drawbacks
  – Expensive to install and maintain
  – Traffic must be interrupted for installation and repair
  – Can not detect slow or stationary vehicle
Inferring Traffic from Video Feeds

• Infer traffic flow using Intel Viewmont co-processor and its SDK
• Compare traffic flow with loop detector data
TransDec

- Input Traffic Data
- Data Processing
- Storage
- Query Retrieval & Visualization

- 46 MB/min
- 15 TB/Year

- Traffic Monitoring Videos
- Real-time Flow Data Extraction

- CalTrans
- Viewmont

Microsoft SQL Azure
Oracle Database 11g

RIITS
Los Angeles County

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Future Plans

• Develop spatio-temporal analytical and data mining techniques to discover

  Tipping-points  Butterfly Effects  Black Swans
Questions?

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