

### MC2: Finding Anomalies from Geospatio-temporal Patterns

Honorable Mention for Effective Detailed Analysis

Georgia Tech

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### Overview

GPS coordinates (latitude, longitude)

### Goal:

Find unusual events/patterns Who, where, when, why?

e.g., Jack's Magical Beans Nationwide Refinery

Shops



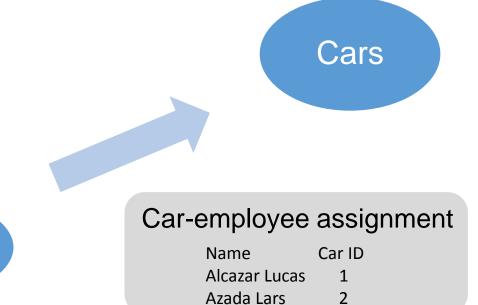
e.g., Car 1, 2 Truck 101



GPS coordinates

Employees





GPS coordinates

Employees

#### Car tracking data

Timestamp Car ID lat long 1/6/2014 6:28:01 35 36.076 24.875 1/6/2014 6:28:03 35 36.076 24.874





Cars

### Car-employee assignment

Name Car ID Alcazar Lucas 1 Azada Lars 2

GPS coordinates

#### Car tracking data

Timestamp Car ID lat long 1/6/2014 6:28:01 35 36.076 24.875 1/6/2014 6:28:03 35 36.076 24.874

Shops

Cars

### Card/loyalty spending data

Timestamp location price Name 1/6/2014 12:00 Jack's Beans 18.59 Elsa

Employees

#### Car-employee assignment

Name Car ID Alcazar Lucas 1 Azada Lars 2

**GPS** coordinates

#### Car tracking data

Timestamp Car ID lat long 1/6/2014 6:28:01 35 36.076 24.875 1/6/2014 6:28:03 35 36.076 24.874



Shops



Cars

### Card/loyalty spending data

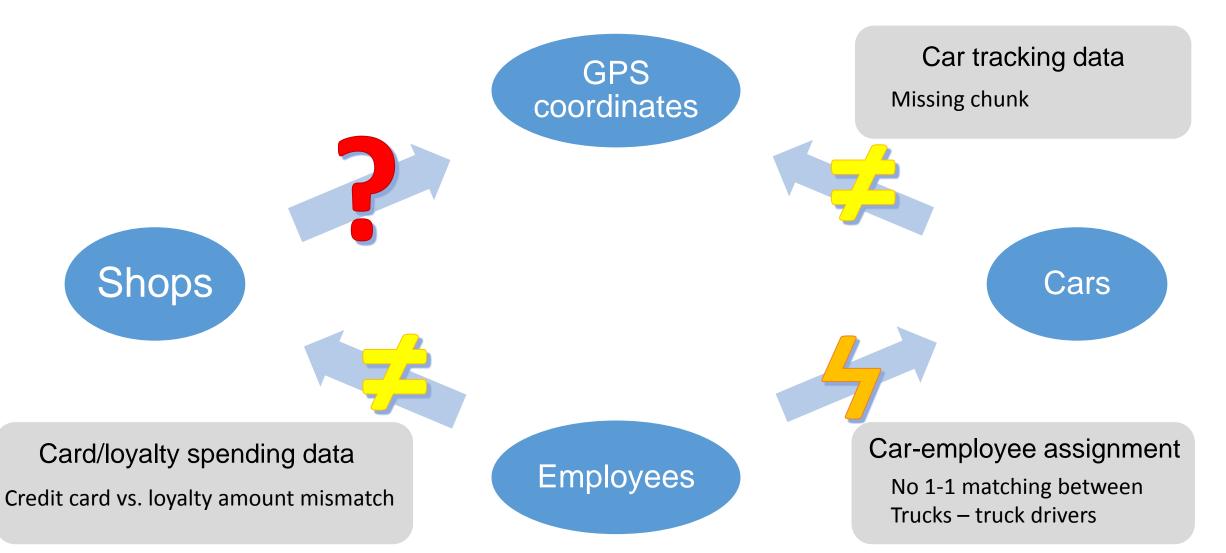
**Timestamp** location price Name 1/6/2014 12:00 Jack's Beans 18.59 Elsa

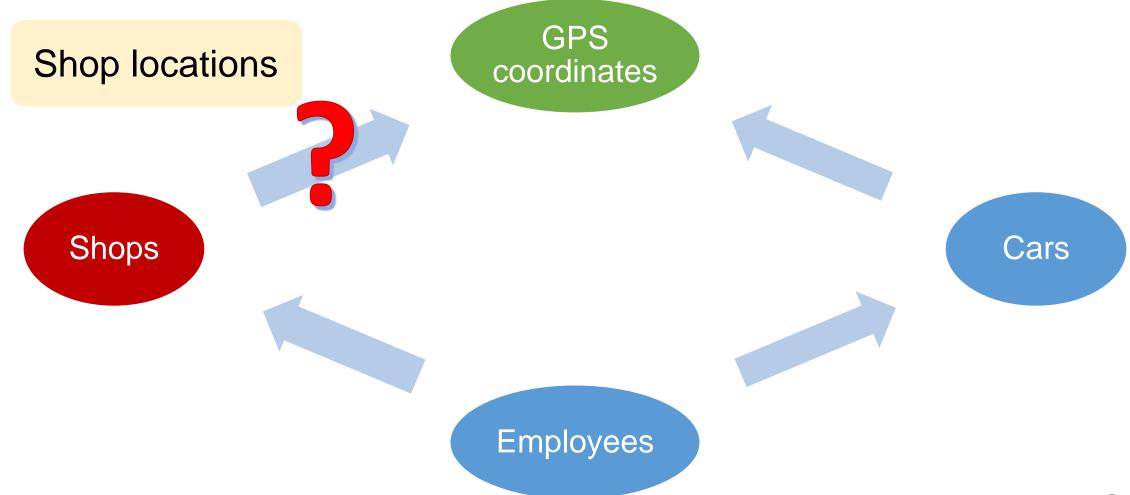
**Employees** 

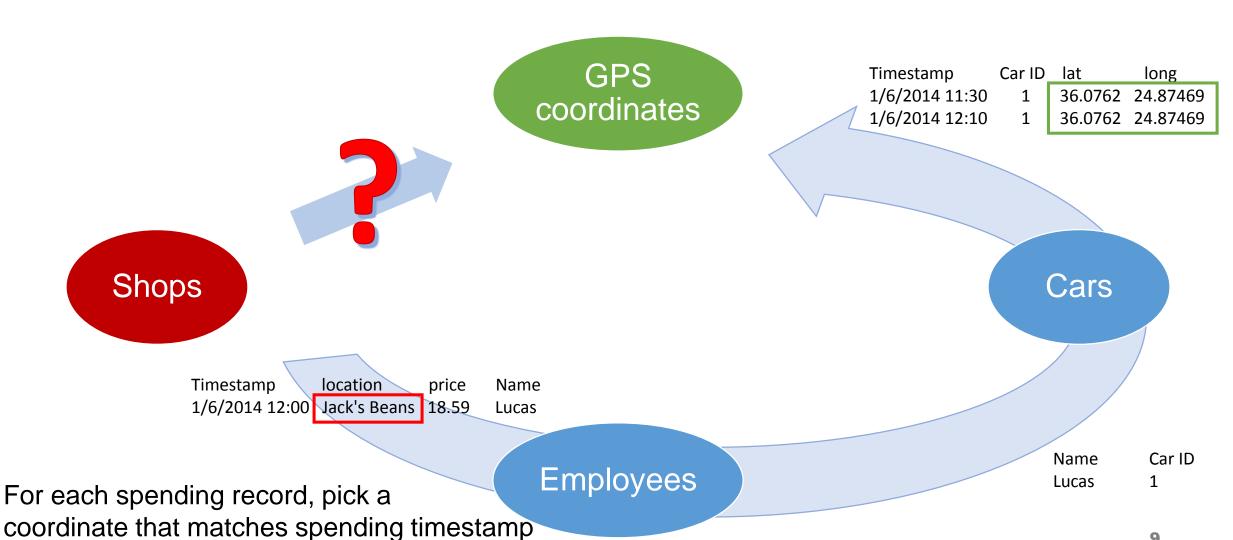
#### Car-employee assignment

Name Car ID Alcazar Lucas 1 Azada Lars 2

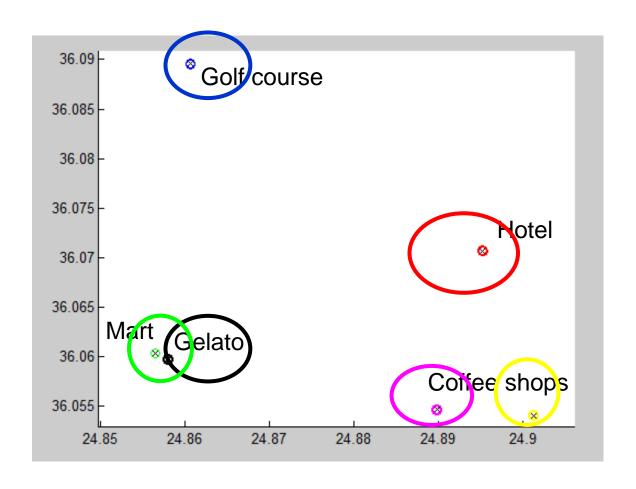
# Missing/Conflicting Data

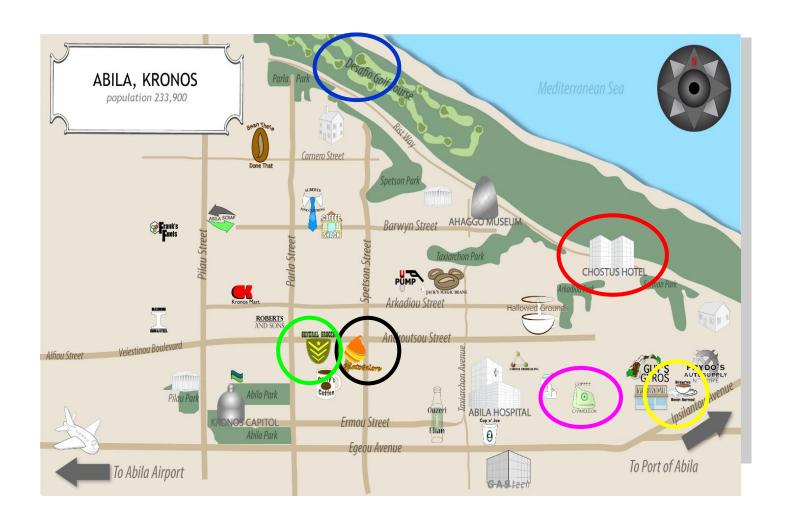




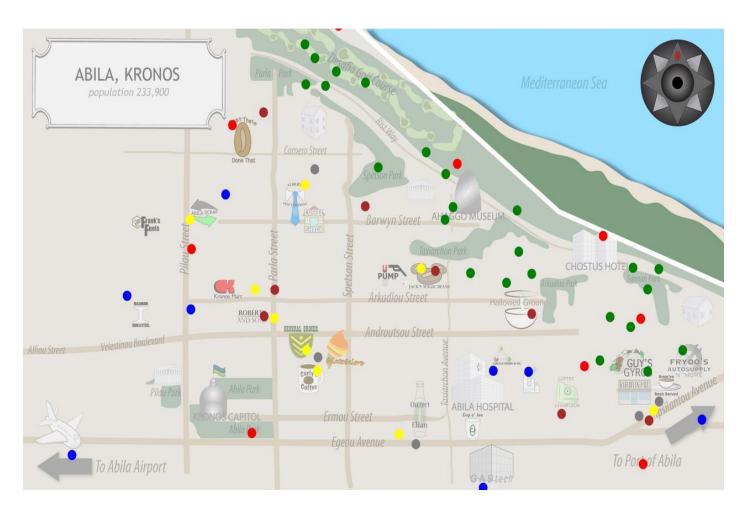


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### Other Locations Identified



- Coffee
- Food
- Shopping
- Work-related
- Employee home
- Other locations

## **Processed Data**

Shop locations

GPS coordinates

Car tracking data

Shops

Tracking + Spending data
Vis → meaningful info

e.g. The executives play golf together at weekends

Cars

Card/loyalty transaction

Employees

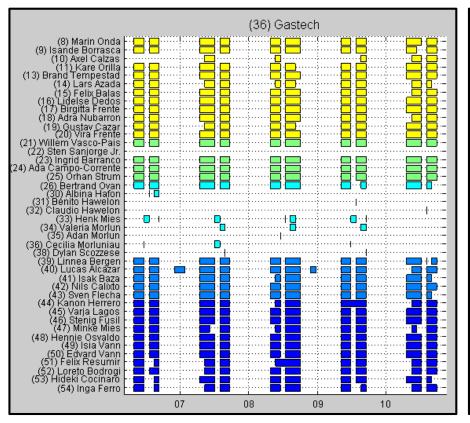
Car-employee assignment

# Our Tool

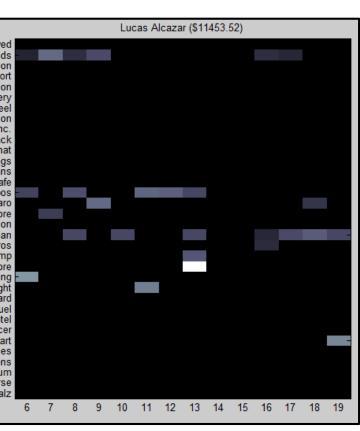
### **Space-time cube view**

### Jan 14, Tue Isande Borrasca **Brand Tempestad** Hippokampos !! Brewed Awakenings Chostus Hotel 24.84 Bre₩ve Been Served 36.08 24.88 36.07 36.06 36.05

#### **Timeline view**



**Matrix view** 

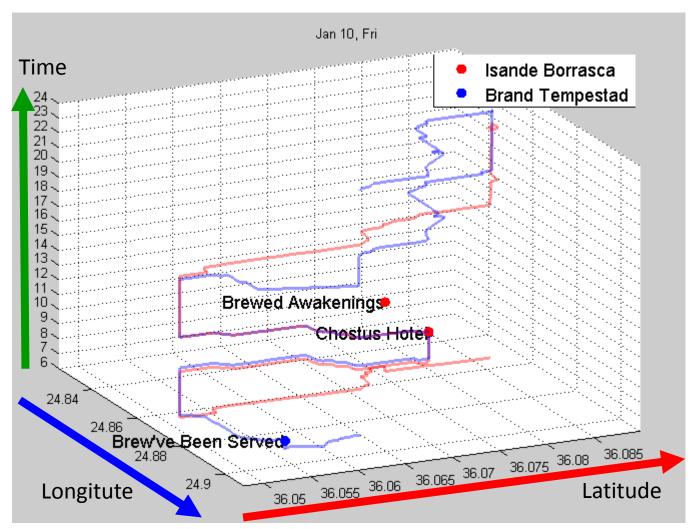


Staying (+spending) pattern at a particular location

Geospatial trajectory over time

Spending amount (Shop or Employee) x Day

# Our Tool Space-time cube view

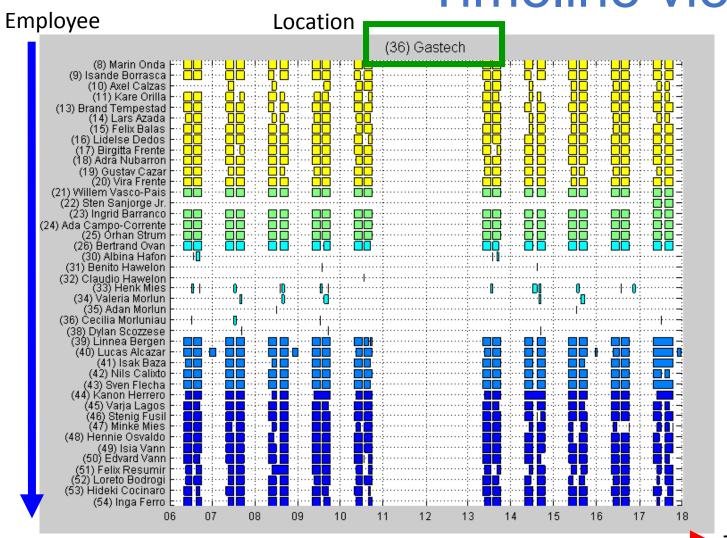


- Employees' trajectory over space and time
- Employee-focused

# Demo

Brand and Isande at Chostus Hotel

# Our Tool Timeline view



 Staying pattern (duration) for a particular location

Location-focused

## Demo

Suspicious visits on Gastech executives

# **Our Tool** Matrix view

2.5

1.5

0.5

Date

**Employee** Shops Lucas Alcazar (\$11453.52) Brew've Been Served Hallowed Grounds Coffee Cameleon Abila Airport Kronos Pipe and Irrigation 3.5 Nationwide Refinery Maximum Iron and Steel Stewart and Sons Fabrication Carlyle Chemical Inc. Coffee Shack Bean There Done That Brewed Awakenings Jack's Magical Beans Katerina's Cafe

10 11 12 13 14 15 16 17 18 19

Hippokampos Abila Zacharo

Gelatogalore Kalami Kafenion Ouzeri Elian

> Guy's Gyros U-Pump

Shoppers' Delight Abila Scrapyard Frank's Fuel

> Chostus Hotel General Grocer Kronos Mart

Frydos Autosupply n' More Albert's Fine Clothing

Octavio's Office Supplies Roberts and Sons Ahaggo Museum

Desafio Golf Course

Daily Dealz

Spending amount heatmap

- (Shop x Day) for a particular employee
- (Employee x Day) at a particular shop

### Demo

### Flexible interactions between three views

Lucas's unusual spending at Frydos Autosupply

# Thank you!



Summary
MATLAB's built-in interaction capabilities

Future Work
Interactive Visual MATLAB

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