Tackling The Challenges of Big Data

Big Data Collection

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Big Data Collection

Data Cleaning & Integration

Introduction

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Data Curation

- Ingest
- Validate
- Transform
- Correct
- Consolidate (dedup)
- And visualize information to be integrated

Data Warehouse Roots

- Retail sector started integrating sales data into a data warehouse in the early 1990's
- Average system was 2X budget and 2X late
- Because of data integration headaches
- However, warehouse paid for itself within 6 months with smarter buying decisions!

Issues

- sold $100K of widgets to IBM, Inc.
- sold 800K Euros of m-widgets to IBM, SA

- Translate currencies
- Is IBM, SA the same as IBM, Inc?
- Are m-widgets the same as widgets?

The Pile-On

- Essentially all enterprises followed suit and built warehouses of customer facing data
- Serviced by so-called Extract-Transform-and Load (ETL) tools

Architecture

- http://en.wikipedia.org/wiki/Data_integration

Traditional Wisdom - ETL

- **Human defines a global schema**
- **Assign a programmer to each data source to:**
  - Understand it
  - Write local to global mapping (in a scripting language)
  - Write cleaning routine
  - Run the ETL
- **Scales to (maybe) 25 data sources**

Traditional ETL Methodology – Schema Mapping

http://www.google.com/imgres?imgurl=http://www.xmlschema.info/images/shots/map_xml_thumb.gif&imgrefurl=http://www.xmlschema.info/xml_schema_mapping.html&h=469&w=600&sz=63&tbnid=70oECAvg0TMwkM:&tbnh=102&tbnw=131&zoom=1&usg=__AsYa-CEcZeR6MX9IV8JqvdpX9RM=&docid=MbKKOGXt3LED1M&sa=X&ei=XDGJUpi9OYevsQT5lYGAAg&ved=0CDQQ9QEwAg

Traditional ETL Methodology – Data Transformation

http://www.informatica.com/us/products/enterprise-data-integration/powercenter/

Current Situation

- **Enterprises want to integrate more and more data sources**
  - Miller beer example
  - Novartis example
  - Goby example (we will see this again)
- **Traditional ETL won't scale!!!!**
- **Point-projects in departments -- Staffed by a data scientist**
  - Brand manager deciding marketing spend
  - Augmenting demographic customer data for department use
- **Traditional ETL way too heavy-weight**

The Rest of This Module

- Curation example
- Low end (individual data scientist) support
- Enterprise support

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Issues

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The Problem

Demo of Goby.com

In Summary

- Data is dirty!!!!!
- Sometimes not clear how to clean it
  - 2 restaurants at the same address: food court or one went out of business??
- Transformations may be a big problem

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Issues

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New Ideas - 1

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Startups in This Space (probably a bunch more)

- Paxata
- Trifacta (commercial Data Wrangler)
- Cambridge Semantics
- Data Tamer
- ClearStory
- Attivio

At Least Two Foci

- Support for the individual data scientist
- Enterprise data integration

Support for the Data Scientist

- Wrangler video
- http://vis.stanford.edu/wrangler/

Summary

- Expect more systems in this space
- At low prices
- Market will be gated by the availability of data scientists
  – Insurance example

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New Ideas - 1

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New Ideas - 2

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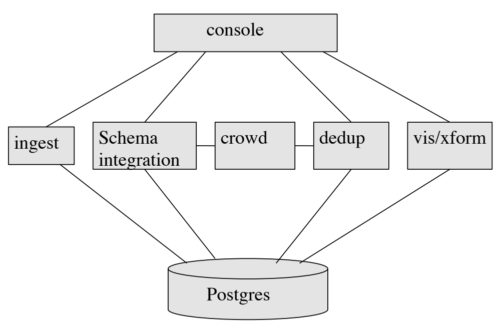
Data Tamer Goals

- Do the "long tail"
  - Better/cheaper/faster than the ad-hoc techniques being used currently
- By inverting the normal ETL architecture
  - Machine learning and statistics
  - Ask for human help only when automatic algorithms are unsure

Data Tamer Architecture



Data Tamer -- Ingest

- Assumes (for now) a data source is a collection of records, each a collection of (attribute-name, value) pairs.
- Loaded into Postgres

Data Tamer – Schema Integration

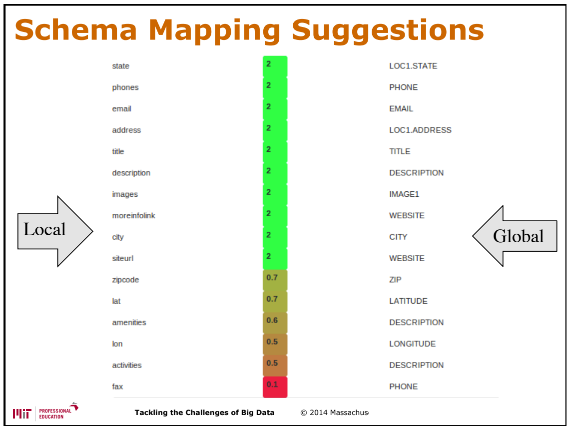
- Must be told whether there is a predefined partial or complete global schema or nothing
- Starts integrating data sources
  - Using synonyms, templates, and authoritative tables for help
  - 1st couple of sources require asking the crowd for answers
  - System gets better and better over time

Data Tamer – Schema Integration

- Inner loop is a collection of experts
  - T-test on the data
  - Cosine similarity on attribute names
  - Cosine similarity on the data
- Scores combined heuristically
- After modest training, get 90% of the matching attributes on Goby and Novartis automatically
  - Cuts human cost dramatically

Data Tamer – Crowd Sourcing

- Hierarchy of experts
- With specializations
- With algorithms to adjust the “expertness” of experts
- And a marketplace to perform load balancing
- Currently doing a large scale evaluation at Novartis
  - Late flash: it works!!!!


Schema Mapping Suggestions
Local
Global
state 2 LOC1.STATE
phones 2 PHONE
email 2 EMAIL
address 2 LOC1.ADDRESS
title 2 TITLE
description 2 DESCRIPTION
images 2 IMAGE1
moreinfolink 2 WEBSITE
city 2 CITY
siteurl 2 WEBSITE
zipcode 0.7 ZIP
lat 0.7 LATITUDE
amenities 0.6 DESCRIPTION
lon 0.5 LONGITUDE
activities 0.5 DESCRIPTION
fax 0.1 PHONE
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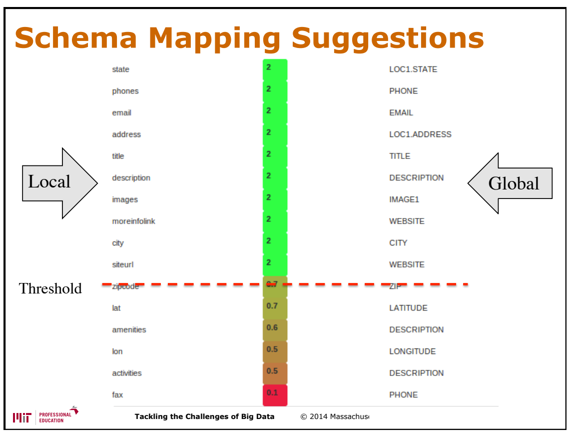
Schema Mapping Suggestions
Local
Global
Threshold
state 2 LOC1.STATE
phones 2 PHONE
email 2 EMAIL
address 2 LOC1.ADDRESS
title 2 TITLE
description 2 DESCRIPTION
images 2 IMAGE1
moreinfolink 2 WEBSITE
city 2 CITY
siteurl 2 WEBSITE
zipcode 0.7 ZIP
lat 0.7 LATITUDE
amenities 0.6 DESCRIPTION
lon 0.5 LONGITUDE
activities 0.5 DESCRIPTION
fax 0.1 PHONE
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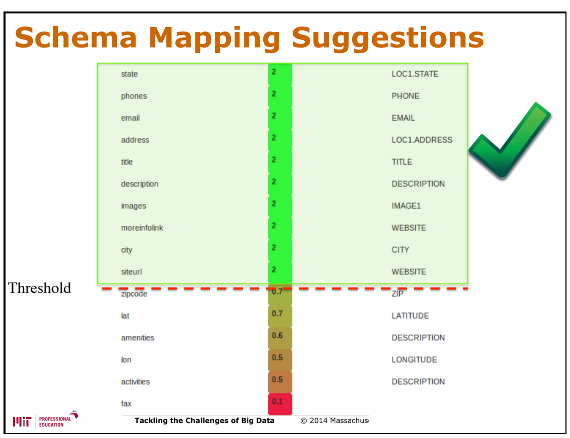
Schema Mapping Suggestions
Threshold
state 2 LOC1.STATE
phones 2 PHONE
email 2 EMAIL
address 2 LOC1.ADDRESS
title 2 TITLE
description 2 DESCRIPTION
images 2 IMAGE1
moreinfolink 2 WEBSITE
city 2 CITY
siteurl 2 WEBSITE
zipcode 0.7 ZIP
lat 0.7 LATITUDE
amenities 0.6 DESCRIPTION
lon 0.5 LONGITUDE
activities 0.5 DESCRIPTION
fax 0.1
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Schema Mapping Suggestions

state	2	LOC1.STATE
phones	2	PHONE
email	2	EMAIL
address	2	LOC1.ADDRESS
title	2	TITLE
description	2	DESCRIPTION
images	2	IMAGE1
moreinfolink	2	WEBSITE
city	2	CITY
siteurl	2	WEBSITE
zipcode	0.7	ZIP
lat	0.7	LATITUDE
amenities	0.6	DESCRIPTION
lon	0.5	LONGITUDE
activities	0.5	DESCRIPTION
fax	0.1	

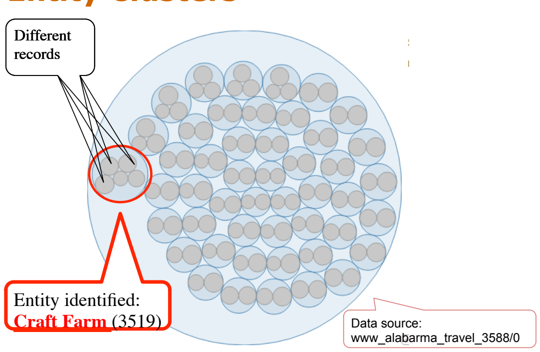
Threshold

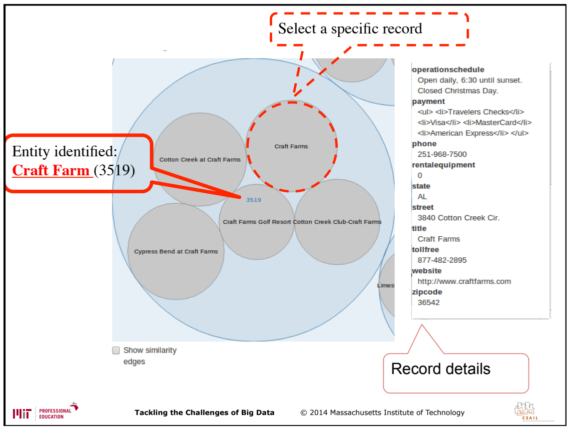
Crowd

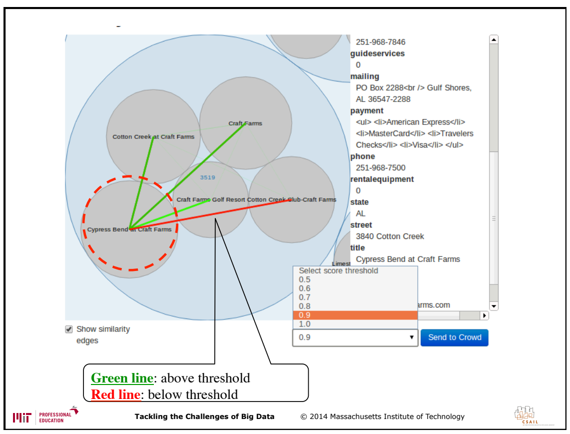
Data Tamer – Entity Consolidation

- On tables defined by schema integration module
- Entity matching on all attributes, weighted by value presence and distribution
- Basically a data clustering problem
- With a first pass to try to identify "blocks" of records
  - Otherwise N ** 2 in the number of records
- Wildly better than Goby; a bit better than domain-specific Verisk module

Entity Clusters







Data Tamer Future

- Text
- Relationships
- Hierarchical data (maybe)
- Adaptors
- Better algorithms
- User-defined operations

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New Ideas - 2

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The Way Forward

- Enterprises will want to integrate more and more data sources
  - This is the number one headache of most of them
  - Too expensive to do manually with a programmer
- Remains to be seen what fraction of the market can be aided by Data Tamer-style tools
  - Initial results are encouraging

The Way Forward

- Cleaning will be a big issue forever
  - How clean does your data need to be?
- I imagine a big database of transformations
  - Pick the one that you need
- Data scientists will have to familiar with this stuff
  - Not just stat and data management

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