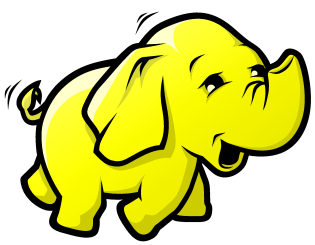
Crunching and visualizing Big Data

on a Computer Cluster

Joana Simões

March 30, 2015



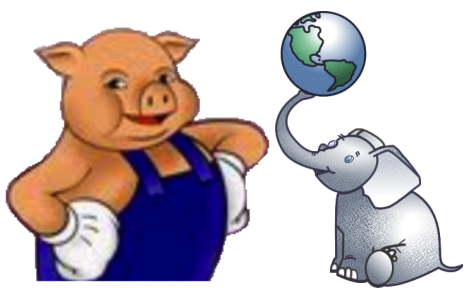


Table of Contents

Motivation

- Problem: the increasing volume of information, by explosion of traditional sources + new sources
- Target: fast query responses, which require a scalable architecture
- Possible solution: support clusters on a cost-effective architecture, such as commodity clusters or cloud environments

Cloud Services

Groups

A thought...

First the use case, then the tools.

Use Case

- Study spatial and temporal patterns of road traffic accidents.
- Relate target variable (accident) with context variables (e.g.: weather, proximity to SPI).

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- ETL: process responsible for pulling data out of the source systems and placing it into a data warehouse

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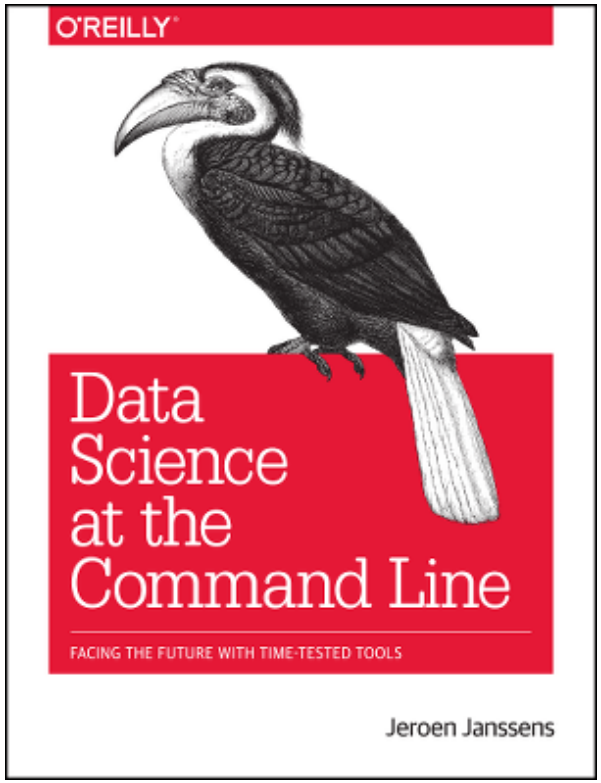
- ETL: process responsible for pulling data out of the source systems and placing it into a data warehouse
  - **Extract** data from different source systems and convert it into one consolidated data warehouse format which is ready for transformation processing
  - **Transform**: cleaning, filtering, splitting a column, joining data, apply validation, apply rules, etc
  - **Load**: into the data warehouse, repository or reporting applications

Another thought...

There are no free lunches.

Scalable ML Platforms

- ML platforms may provide high-level data import tools:



Scalable ML Platforms

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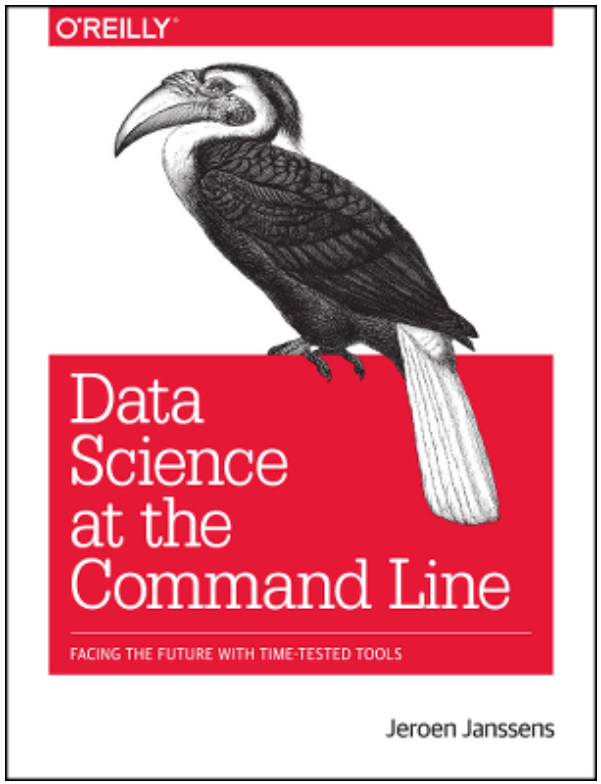

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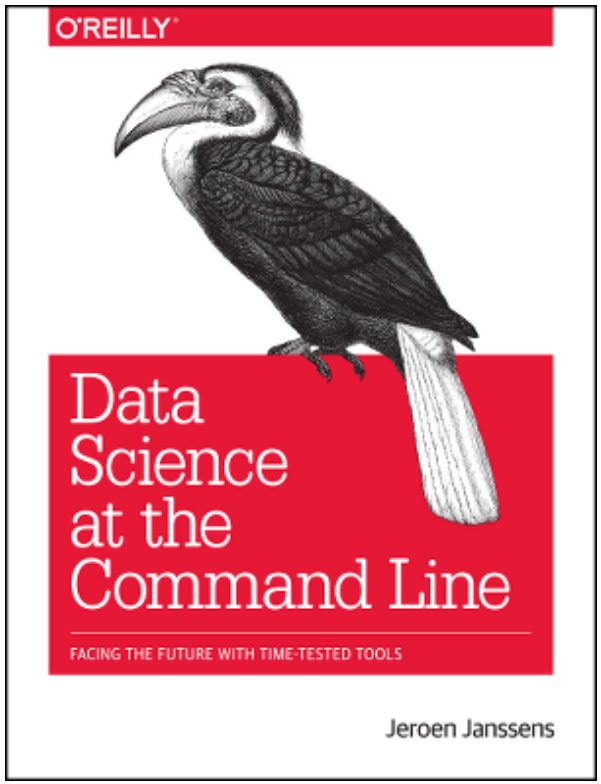

Scalable ML Platforms

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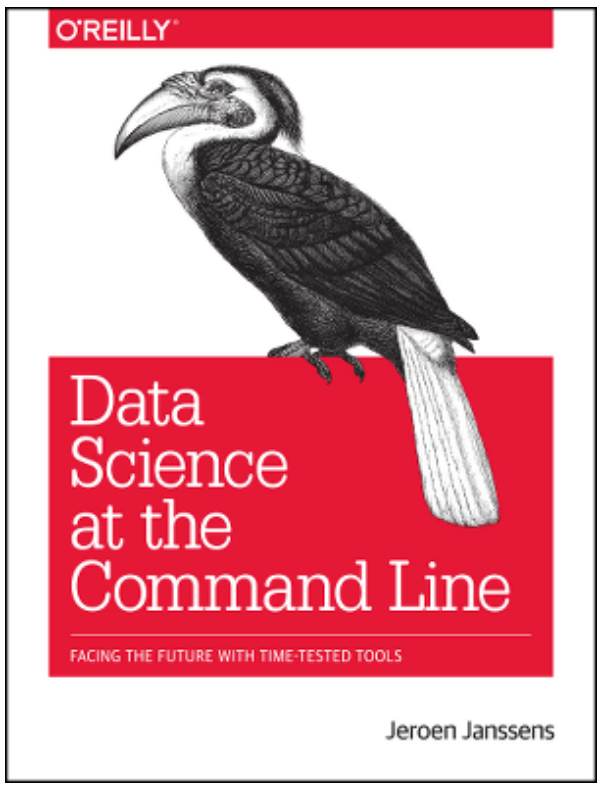
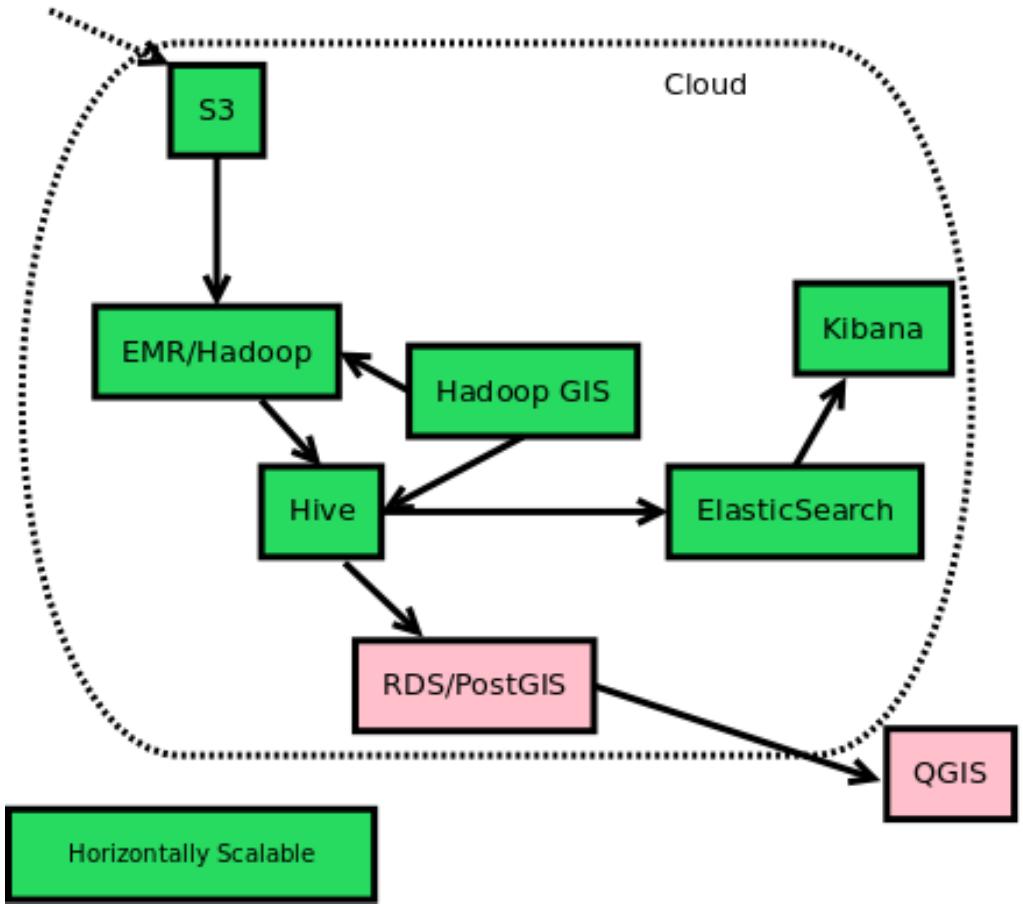
- To ensure maximum flexibility, we should be able to link together many tools, often using the command line.



Stack


Cloud
S3
EMR/Hadoop
Hadoop GIS
Kibana
Hive
ElasticSearch
RDS/PostGIS
QGIS
Horizontally Scalable

Hadoop

Hive

Hadoop GIS

Pig

PostgreSQL + PostGIS

E(L)K

From S3 to HDFS

- Micro-task: Understand the dataset structure
  - A sample dataset is stored on an S3 bucket: `s3n://workshop-bdsd/accidents/`

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  - Download and view dataset

From S3 to HDFS (cont.)

- Micro-task: Create a table linking to the data
  - Enter hive and create an external table linking to the S3 bucket

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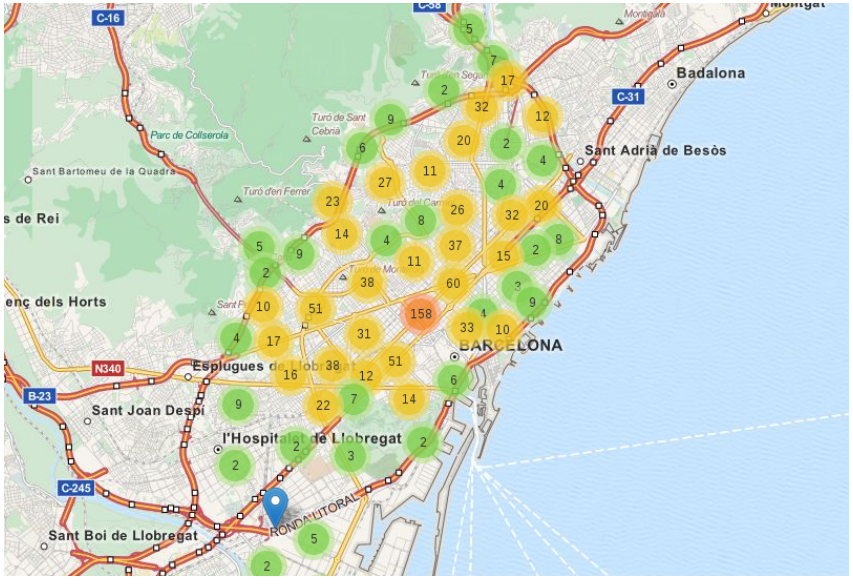
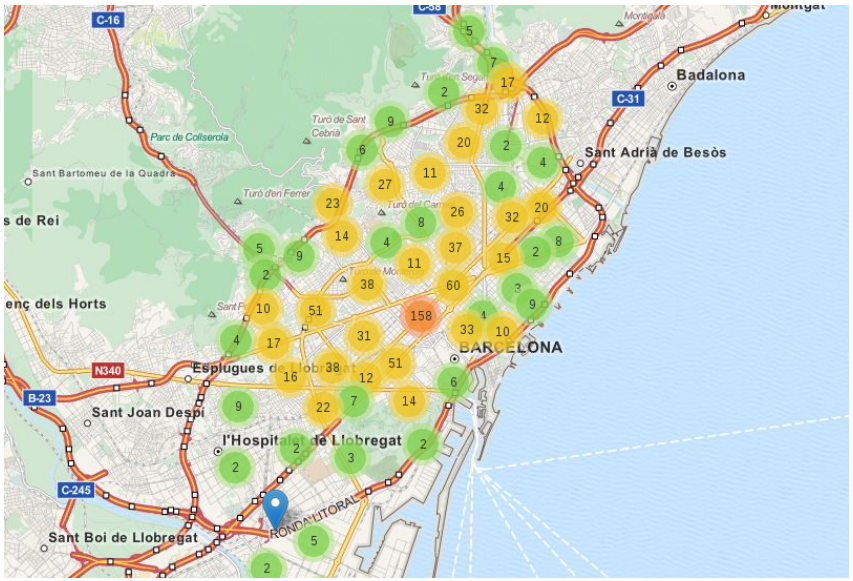
  - View table

What is so "Special" about Spatial



What is so "Special" about Spatial

- Location attributes allow us to detect spatial patterns
- Location also works as a "key", allowing us to connect with other datasets



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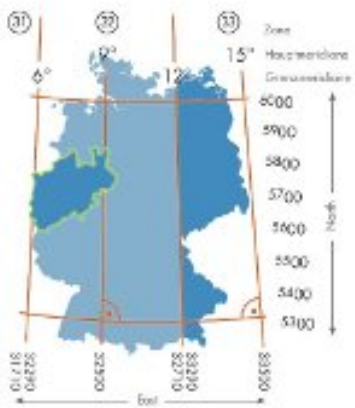
    - $lon = y/1000 + 400000$
    - $lat = y/1000 + 4500000$

CRS

World Geodetic System (WGS84, EPSG:4326): standard for use in cartography, geodesy, and navigation; reference CRS for GPS.

European Terrestrial Reference System 1989 (ETRS89, EPSG:5554): proposed, multipurpose Pan-European mapping standard; based on the ETRS89 Lambert Azimuthal Equal-Area projection coordinate reference system



Objective

- Separate lat, long fields and map them to correct types
- Remove invalid values
- Convert all coordinates into a single CRS (WGS84)

Exporting Data to Pig

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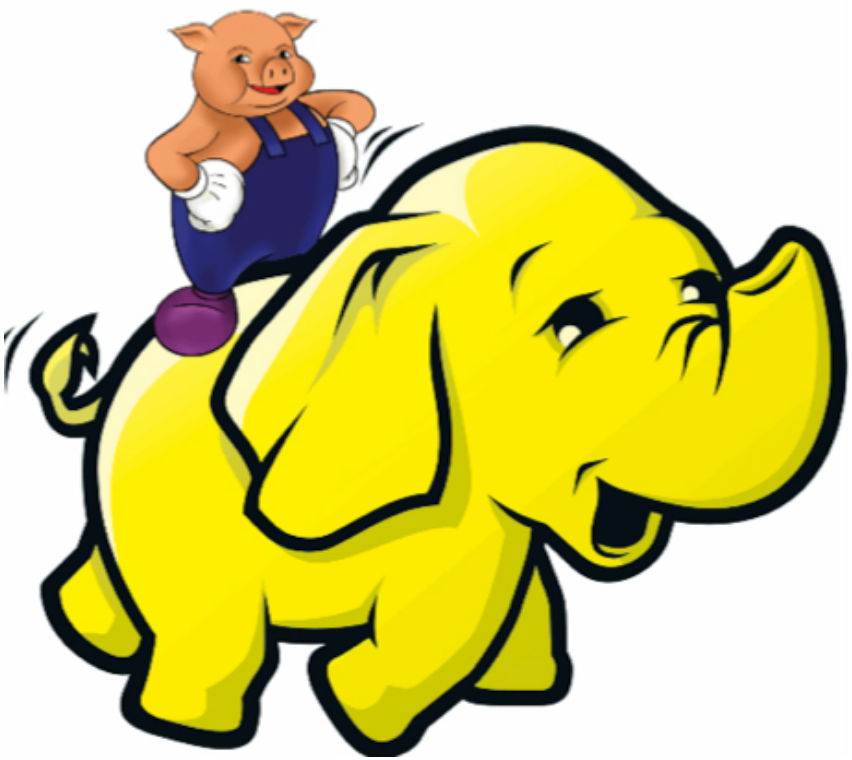
  - Create a copy of the accidents table, with an id field (joins).
  - Export this table into a tsv
  - Store it in HDFS (if needed)
  - View exported data

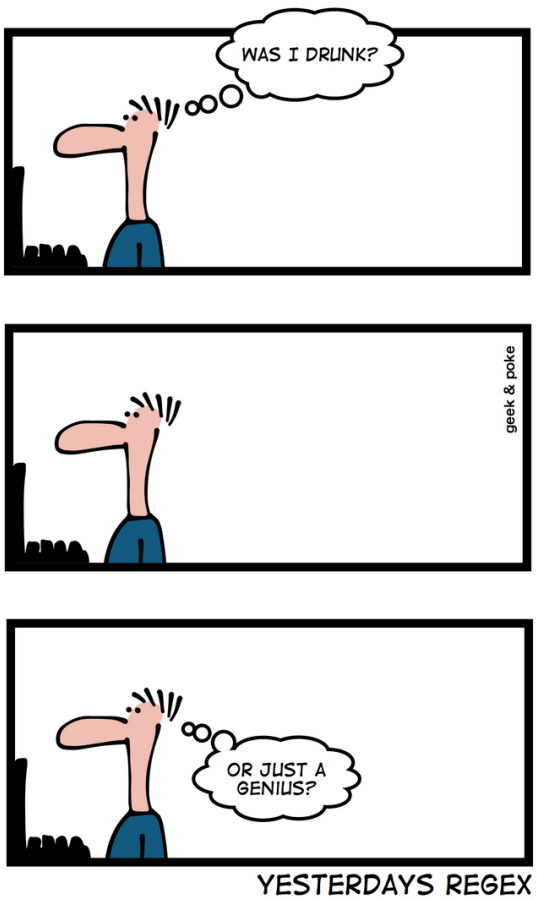
Presenting the Pig Script

- Subsets the coordinate list, using filters
- Detects each coordinate "type", using regular expressions
- In the case of grid encoded, it applies a formula to decode back into grid
- Stores the results into separate files, in HDFS



REGEX

- Sequence of characters that forms a search pattern, mainly for use in pattern matching with strings, or string matching



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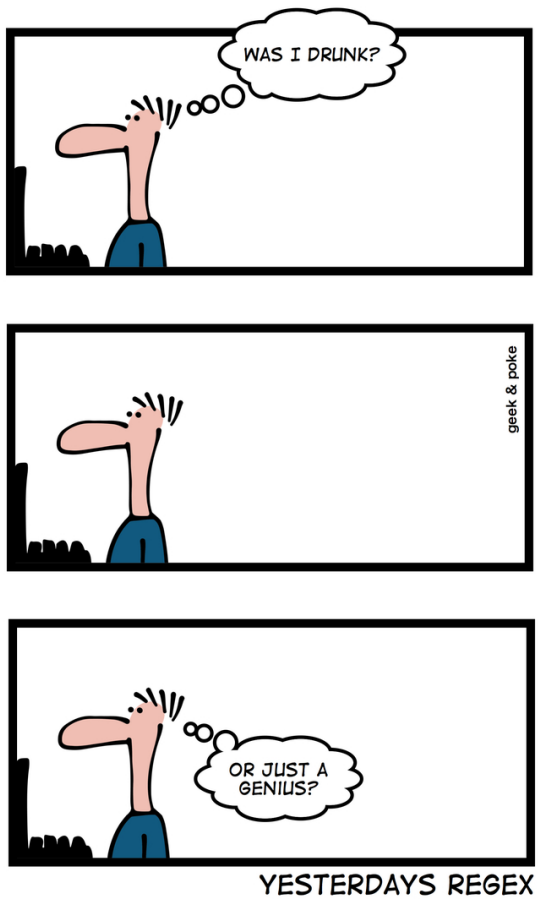

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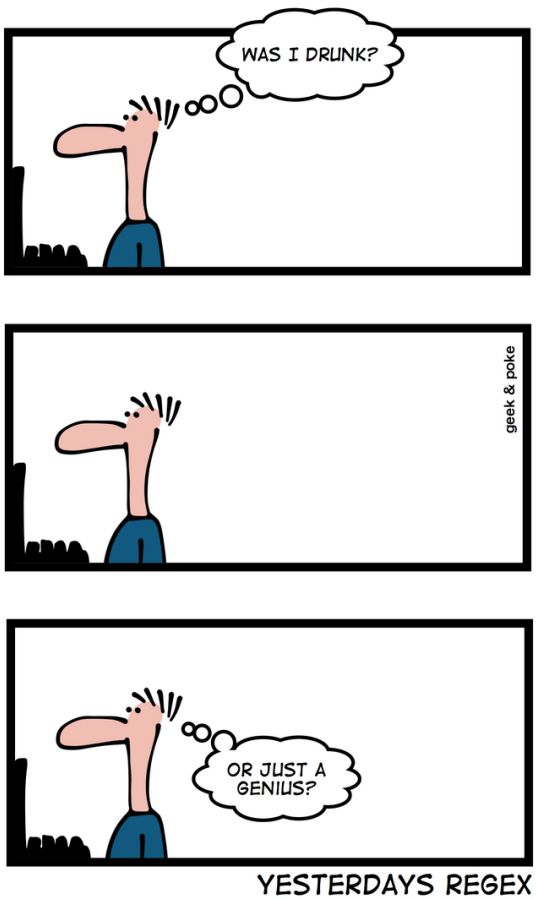

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  - Check output files

Importing Data Back into Hive

- Micro-task: Create tables linking to pig output

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  - Create table with wgs84 data
  - Create table with grid data
  - Create table with police-decoded data

Exporting data into PostGIS

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- We need to rely on another tool: PostGIS on RDS
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  - Exported merged table into TSV

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  - Copy data into table

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  - Transform grid geometry into another CRS

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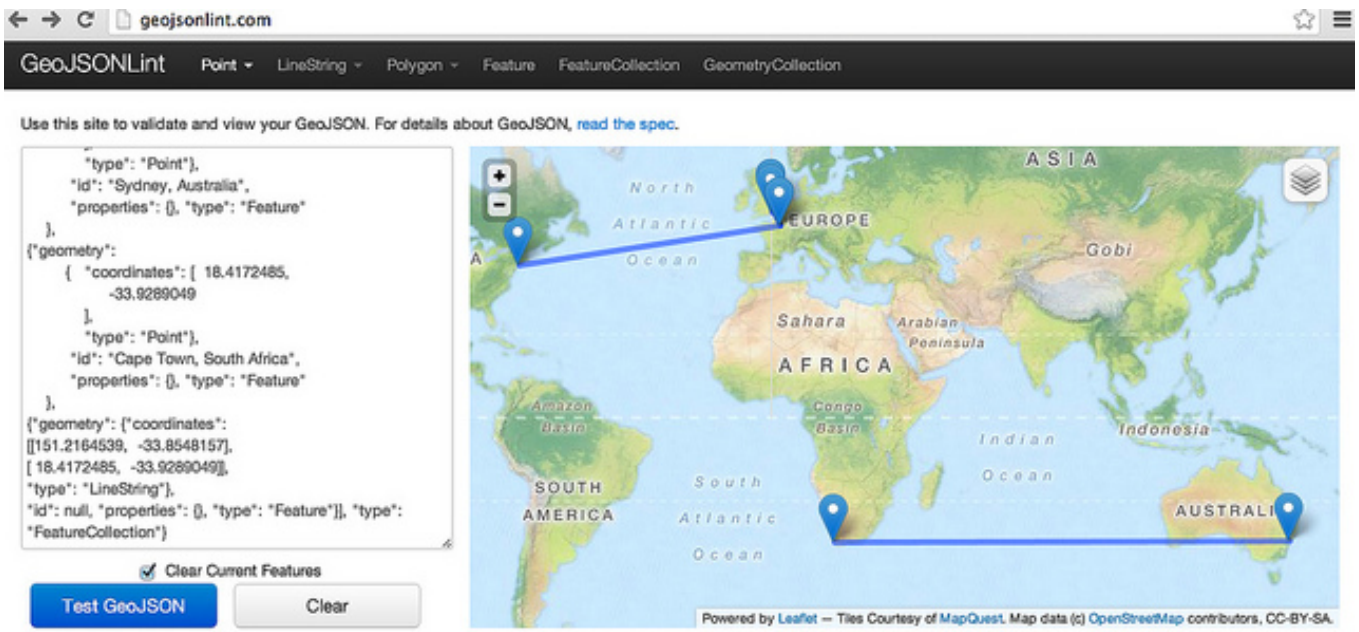
  - Transform grid geometry into another CRS
  - Export grid geometry in GeoJSON

GeoJSON

GeoJSON: is an open standard format for encoding collections of simple geographical features along with their non-spatial attributes using JavaScript Object Notation.



Importing Data back into Hive

- Micro-task: Import transformed data

Importing Data back into Hive

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  - Enter Hive

Importing Data back into Hive

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  - Create table linking to the PostGIS export

Importing Data back into Hive

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  - Create new table and instantiate geometry from GeoJSON

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  - Join imported records with original table with all fields
  - Merge imported records with WGS84 records, for a single table with unified geometry

Understanding Indexes

Generating Indexes

References

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Thank you for Listening!