Cloud-Based Text Analytics: Harvesting, Cleaning and Analyzing Corporate Earnings Conference Calls

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Thanks!

- Jim Griffioen - Director of Center for Computational Science
- Gatton College of Business - $
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- Vikram Gazula – IT manager - Center for Computational Science
- My coauthors

The research problem

- Corporate earnings conference calls convey information to financial markets
- Existing analysis of conference calls = “bag of words” analysis
  - Simple, short word lists
  - No analysis of sentences, paragraphs, context, or meaning
- Our goal: analyze conference call data using emerging “holistic” text analytics (i.e., Coh-Metrix)
- Research question: Does call “cohesion” matter to markets?
  - Cohesion = relations among words, types of words, sentences and paragraphs in a document (8 dimensions)

The practical problem

- Cohmetrix Software
  - Good news:
    - Linguistically state of the art, includes lexicons (complete dictionaries), syntax, domain knowledge (i.e., Latent Semantic Analysis), rhetorical structure
  - Bad news:
    - Not open-source (can’t reverse engineer)
    - Computationally slow
- Conference call data
  - Available, “big” and dirty (~ 200,000 files)

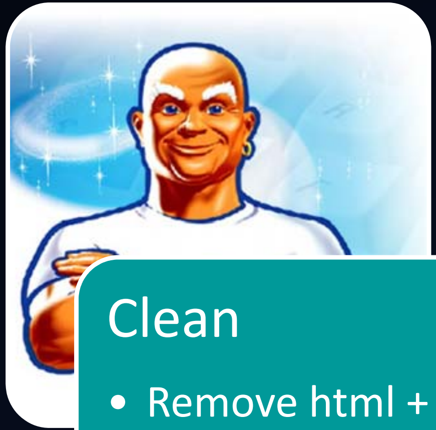
The race

- First-year research papers → due in 4 months (i.e., 120 days)
- Scope:
  - ~ 200,000 data files
- The PhD student…… was nervous

The process - conceptually

Harvest (dirty) files

- Download, open, select, copy, paste, save



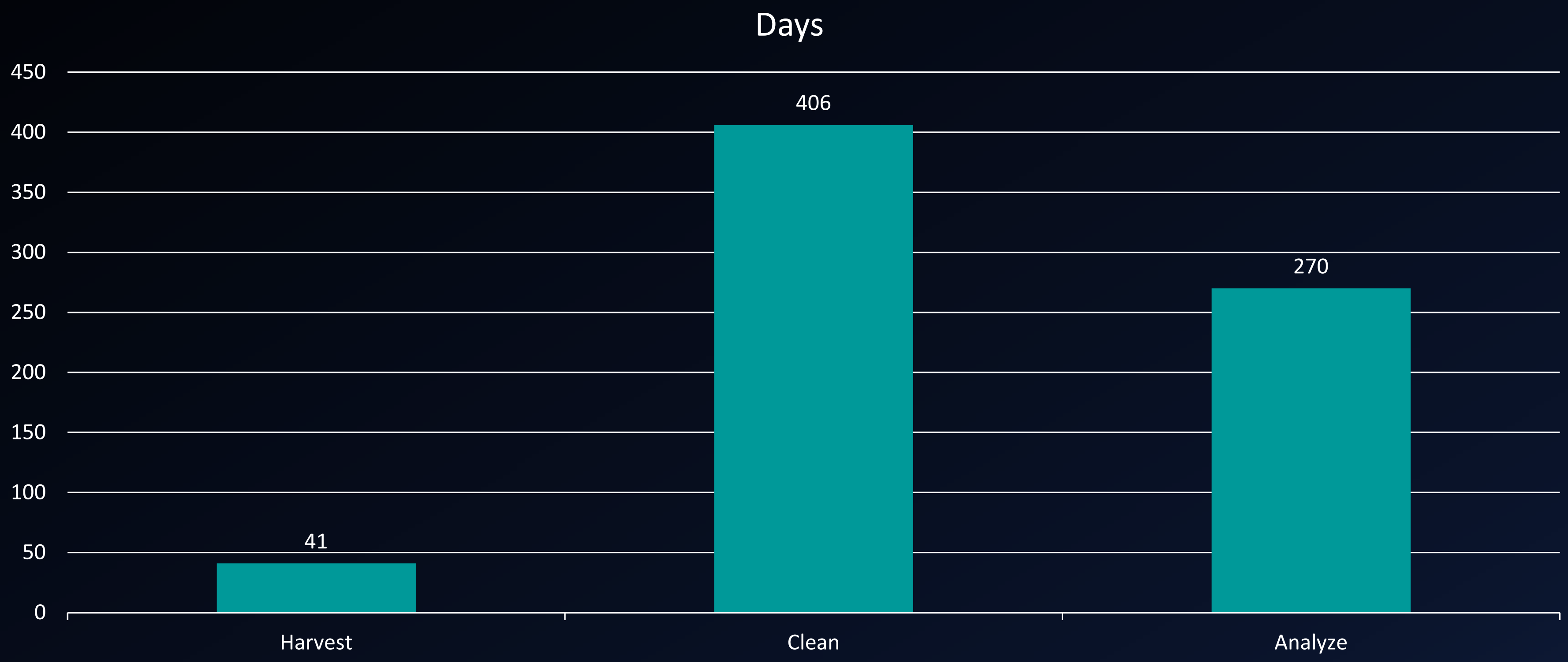
Clean

- Remove html + all non-English

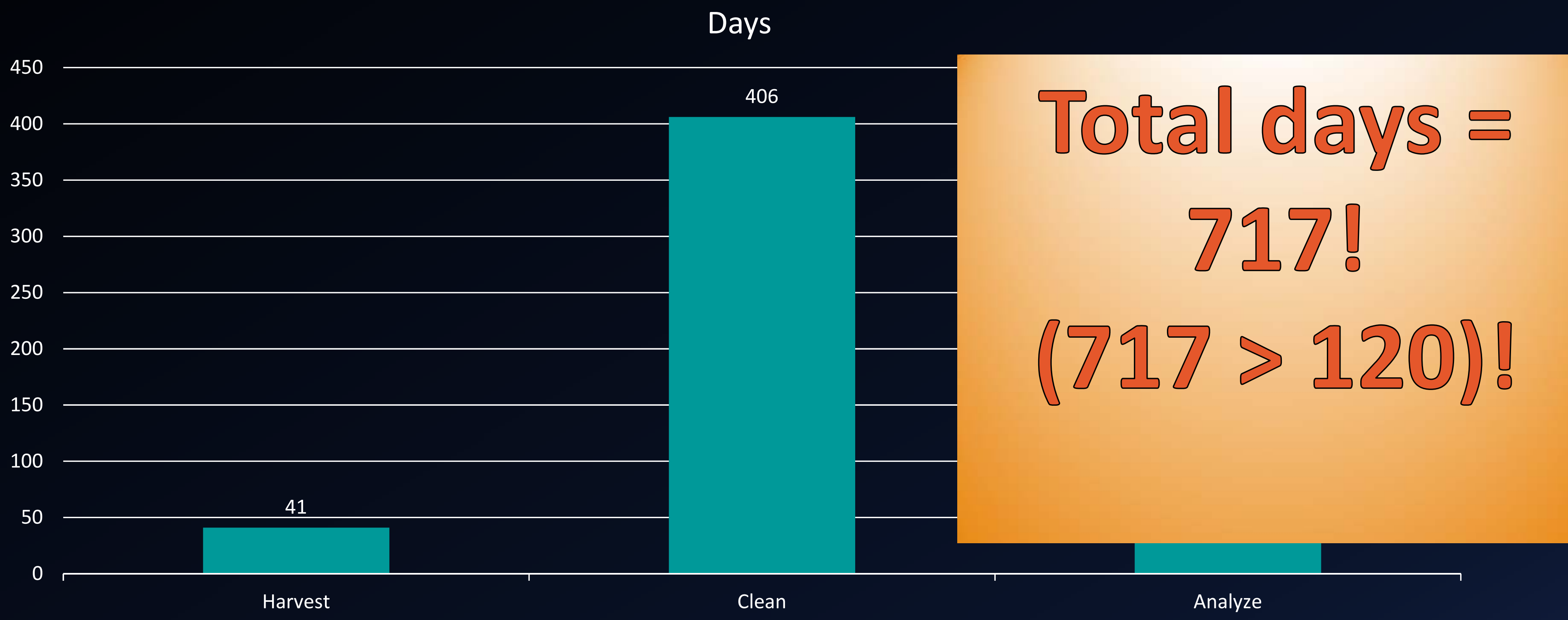
Analyze

- Run Coh-Metrix

Project: Manual & Local Resources – Estimated Days to Completion



Project: Manual – Estimated Days to Completion



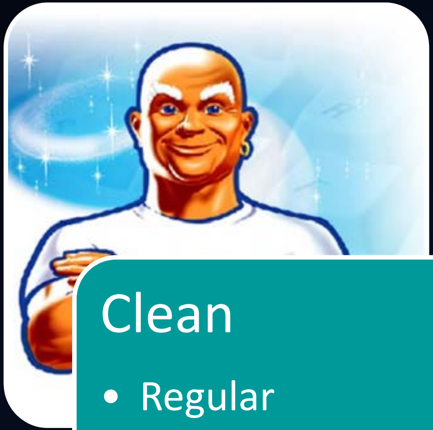
Total days = 717!

(717 > 120)!

Help! Automate / Scale Processes

Harvest (dirty) files

- Web Crawler using Stata



Clean

- Regular expressions in Stata
- four stage parsing strategy

Analyze

- Vikram (Michael helping): Run on AWS cloud

Why AWS (EC2- Elastic Compute)?

- No local UKY resources to run Coh-Metrix (Windows) at scale
- AWS - platform for software testing using “clean” installs (no software conflicts & correct available tools)
- Prototype: create working machines
- Post-prototyping, create new “virtual machines” for rapid scalability and load sharing
- Cost savings - Spot Market ($) vs On Demand pricing ($$$) vs buying hardware ($$$)
- AWS $100 credit for prototyping

Analyzing files on AWS

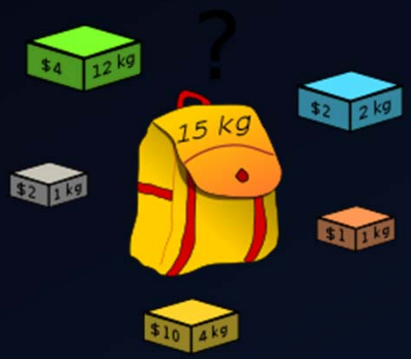
Problem :

- Coh-Metrix software does not run in parallel
- Each file separately loaded and processed
- Processing time varies (file size + Cohmetrix analysis (metadata))

Solution :

- Knapsack problem: use one-Dimensional Bin Packing Algorithm
- Minimize number of bins (machines), process all files, equalize processing time, minimize cost

The Knapsack problem (Wikipedia)

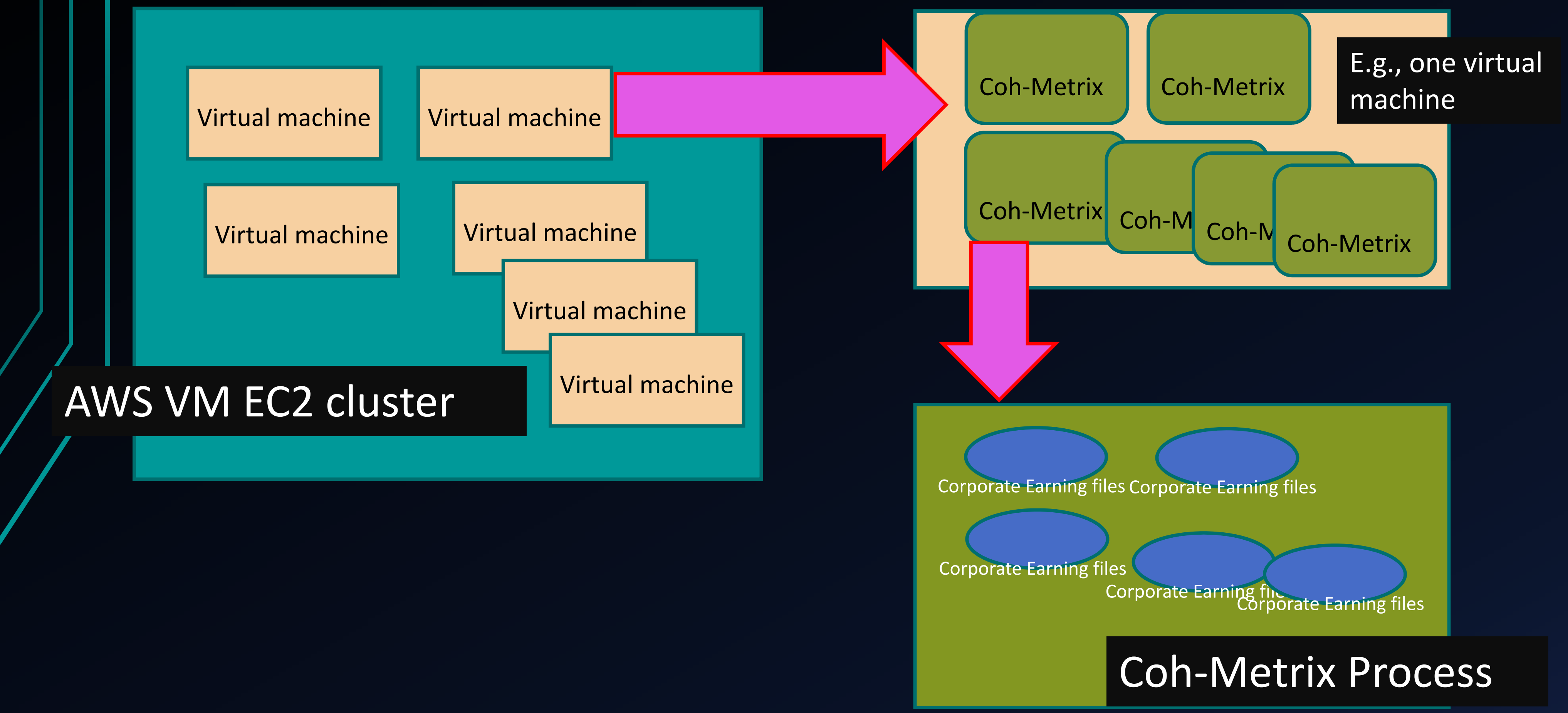


- Given n items to put in a sack, each with a unique weight, determine the number of items to include in m sacks so that the total weight is equalized
- Here: Given 200,000 files, each with a unique processing time, determine the needed virtual machines, so that total processing time is equalized (and therefore total cost is minimized)

How to load balance 200K files across virtual machines

- Bin Packing Solution:
  - Input: – 200K+ files with varying sizes (few KB to several MB)
  - Analyze the distribution of file sizes across multiple VM’s with minimal wastage of CPU time (and money!) across virtual machines
  - Task: – Find a packing of files in equal-sized bins that minimizes the number of bins (Virtual Machines) used

Load Balancing and Bin Packing



Running Coh-Metrix on AWS Spot Market

- Task demands: 200,000 files can take 5 to 30 minutes to process
- Processing: running many copies of software on each machine (~ 25)
  - Specify: hardware - 32 core virtual machines
- Identify AWS zones (physical locations) to run software (minimize cost)
- Spread (binpack): Match files to virtual machines (how many machines?)
- The process:
  - Step 1: Create Virtual machines (based on prototype)
  - Step 2: Deploy machines (Map to AWS zones and binpack)
  - Step 3: Monitor Processing (Spot Market).
    - If outbid or prices changes, then bid higher and / or return to Step 2
    - Over time, learned to do this more efficiently

Results

- It worked!
- Complete results in ~ 90 days
- Cost ~ $1,000

What’s next? Additional “holistic” analyses of market information

- SEC data?
- Social media data?
- Audit