Hadoop and data integration with System z

Dr. Cameron Seay, Ph.D — North Carolina Agricultural and Technical State University

Mike Combs — Veristorm

August 10, 2015, Session 17487

The Big Picture for Big Data

The Big Picture for Big Data

"The Lack of Information" Problem

1 in 3 — Business leaders frequently make decisions based on information they don't trust, or don't have

1 in 2 — Business leaders say they don't have access to the information they require to do their jobs

83% — Of CIOs cited "Business Intelligence and Analytics" as part of their visionary plans to enhance competitiveness

60% — Of CIOs need to do a better job capturing and understanding information rapidly in order to make swift business decisions

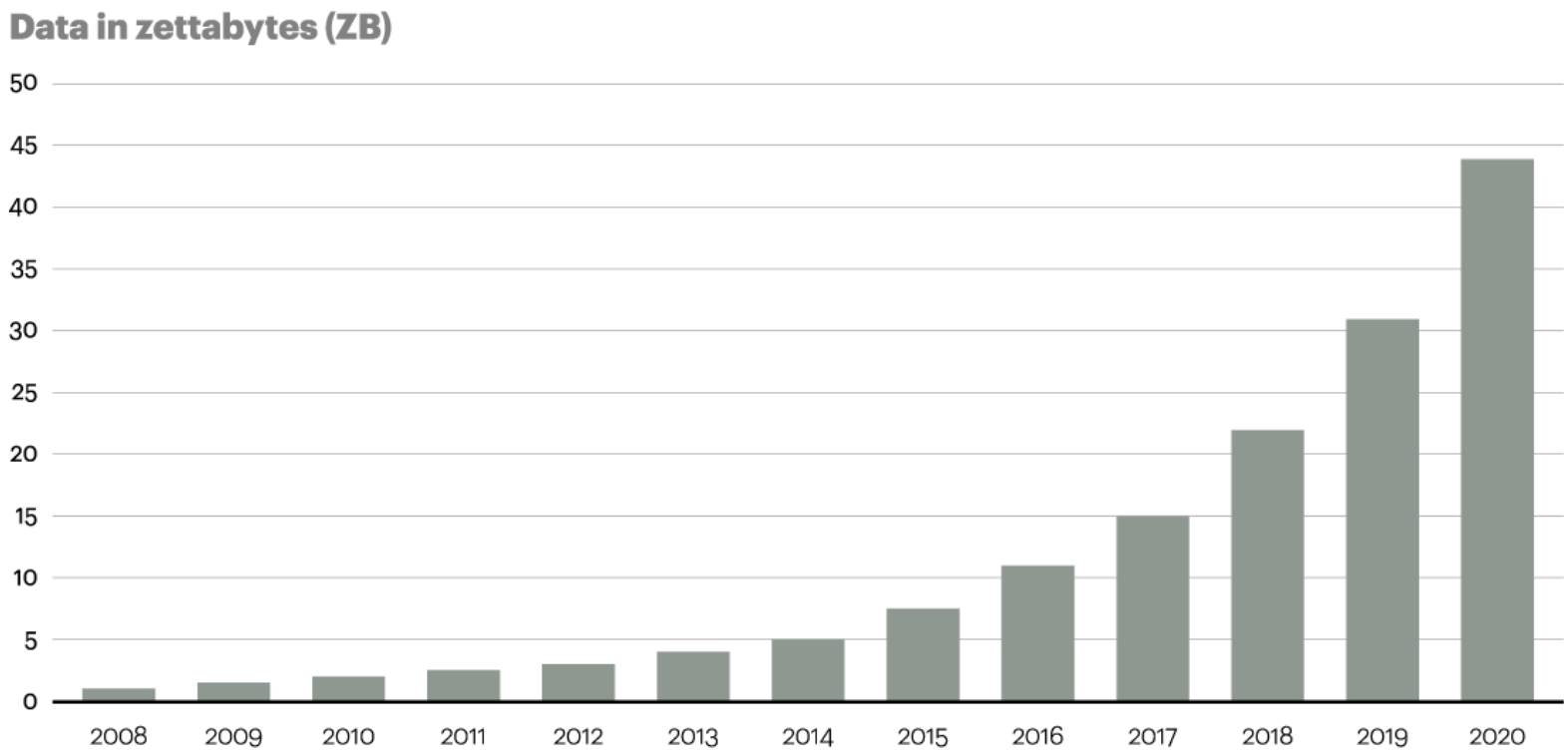
"The Surplus of Data" Problem

- "The 3 V's" of Big Data
  - Volume: More devices, higher resolution, more frequent collection, store everything.
  - Variety: Incompatible data formats
  - Velocity: Analytics fast Enough to be Interactive and Useful. Fast enough for mobile.

(Doug Laney, Gartner Research)

Big Data: Volume

Data is growing at a 40 percent compound annual rate, reaching nearly 45 ZB by 2020



Source: Oracle, 2012

Big Data: Variety

20% is "Structured"

- Tabular Databases like credit card transactions and Excel spreadsheets
- Web forms

80% is "Unstructured"

- Pictures: Photos, X-rays, ultrasound scans, Instagram
- Sound: Music (genre, BPM, etc.), speech
- Videos: computer vision, cell growing cultures, storm movement
- Text: Emails, doctor's notes, tweets, Facebook posts
- Microsoft Office: Word, PowerPoint, PDF

Big Data: Velocity

- To be relevant, data analytics must timely
- Results can lead to new questions; solutions should be interactive
- Information should be searchable

- Marketing
  - Targeted marketing, online advertising, cross-selling
- CRM
  - Reduce churn, maximize customer value
- Finance
  - Credit scoring, trading
- Operations
  - Fraud detection, workforce management, supply chain management

IT leads Big Data usage.. but departments are catching up...

"What groups or departments are currently using Big Data/planning to use Big Data?"

Operations **54%** (e.g. supply-demand)	Marketing **47%** (e.g. campaigns)	IT Analytics **47%** (e.g. network secure)	Product Dev. **22%** (e.g. social feedback)
Finance **46%** (e.g. risk exposure)	Sales **37%** (e.g. cross/upsell)	Research **30%** (e.g. simulation)	Logistic & Distr. **18%** (e.g. route opt.)
Customer Service **26%** (e.g. segmentation)	Manufacturing **18%** (e.g. process opt)	GRC **15%** (e.g. auditing)	Human Resources **11%** (e.g. head hunting)
Procurement **15%** (e.g. best buy)	Supply Chain **15%** (e.g. sourcing)	Other **7%**	Don't know **3%**

Source: Forrsights BI/Big Data Survey

Base: 176 big data users and planners

Big Data Industry Value

US health care
- $300 billion value per year
- ~0.7 percent annual productivity growth

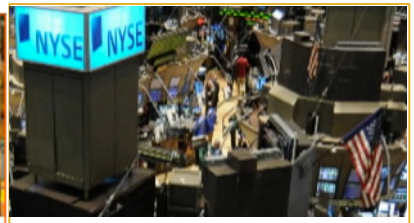
Europe public sector administration
- €250 billion value per year
- ~0.5 percent annual productivity growth

Global personal location data
- $100 billion+ revenue for service providers
- Up to $700 billion value to end users

One standard deviation higher utilization of big data technologies is associated with 1–3% higher productivity.

US retail
- 60+% increase in net margin possible
- 0.5–1.0 percent annual productivity growth

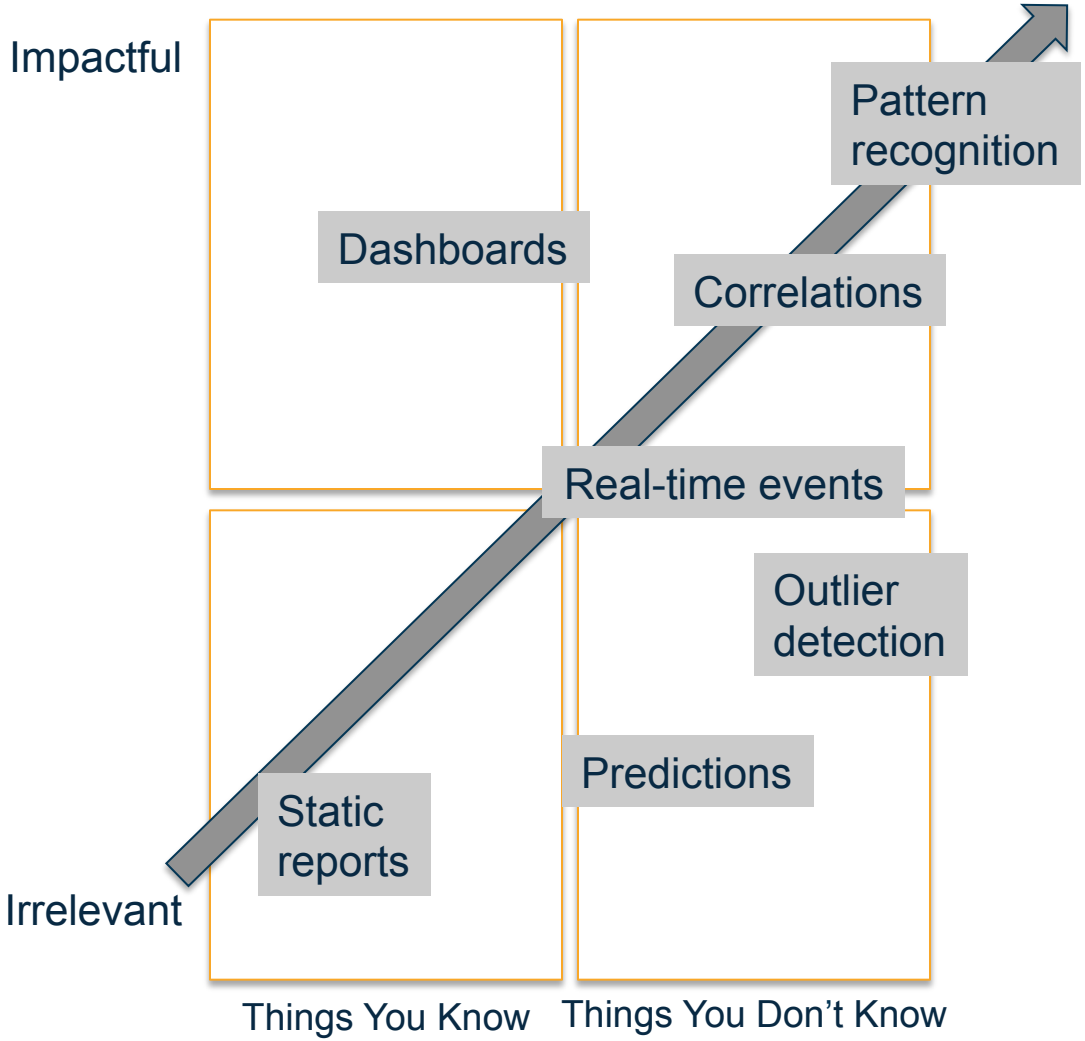
Manufacturing
- Up to 50 percent decrease in product development, assembly costs
- Up to 7 percent reduction in working capital



Finance and Insurance
- ~1.5 to 2.5 percent annual productivity growth
- $828 billion industry

SOURCE: McKinsey Global Institute analysis

Data IQ



Where is your organization?
What is your plan?
What's your next milestone?

Nine Data Mining Tasks

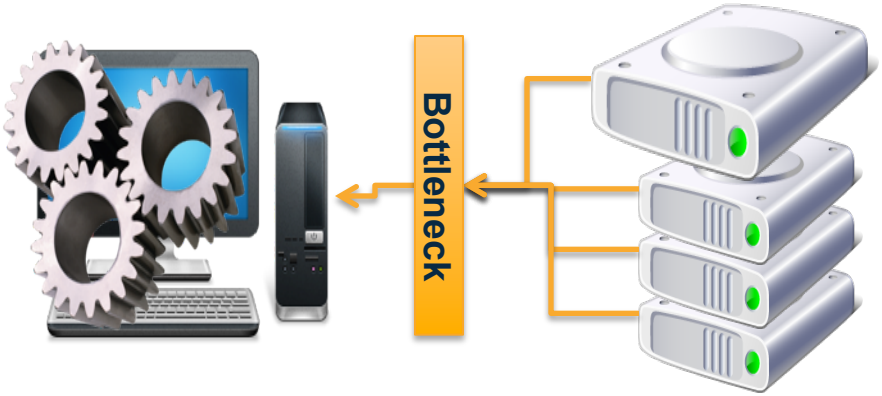
- Classification & Scoring
  - Who will respond to this ad?
  - How likely are they to repay their loan?
- Regression
  - How many videos will they stream on a weekday?
- Similarity matching
  - People like you...
- Clustering
  - Do our customers form natural groups?
- Market-basket analysis
  - What items are commonly purchased together?
- Profiling
  - What is the typical mobile data usage of this segment?
- Link prediction
  - You and Karen have 10 friends in common, would you like to friend Karen?
- Data reduction
  - Trades data detail for better insight; movie list → favorite genres
- Causal modeling
  - Understand influences. A/B tests.

Data Science for Business, Tom Fawcett, Foster Provost

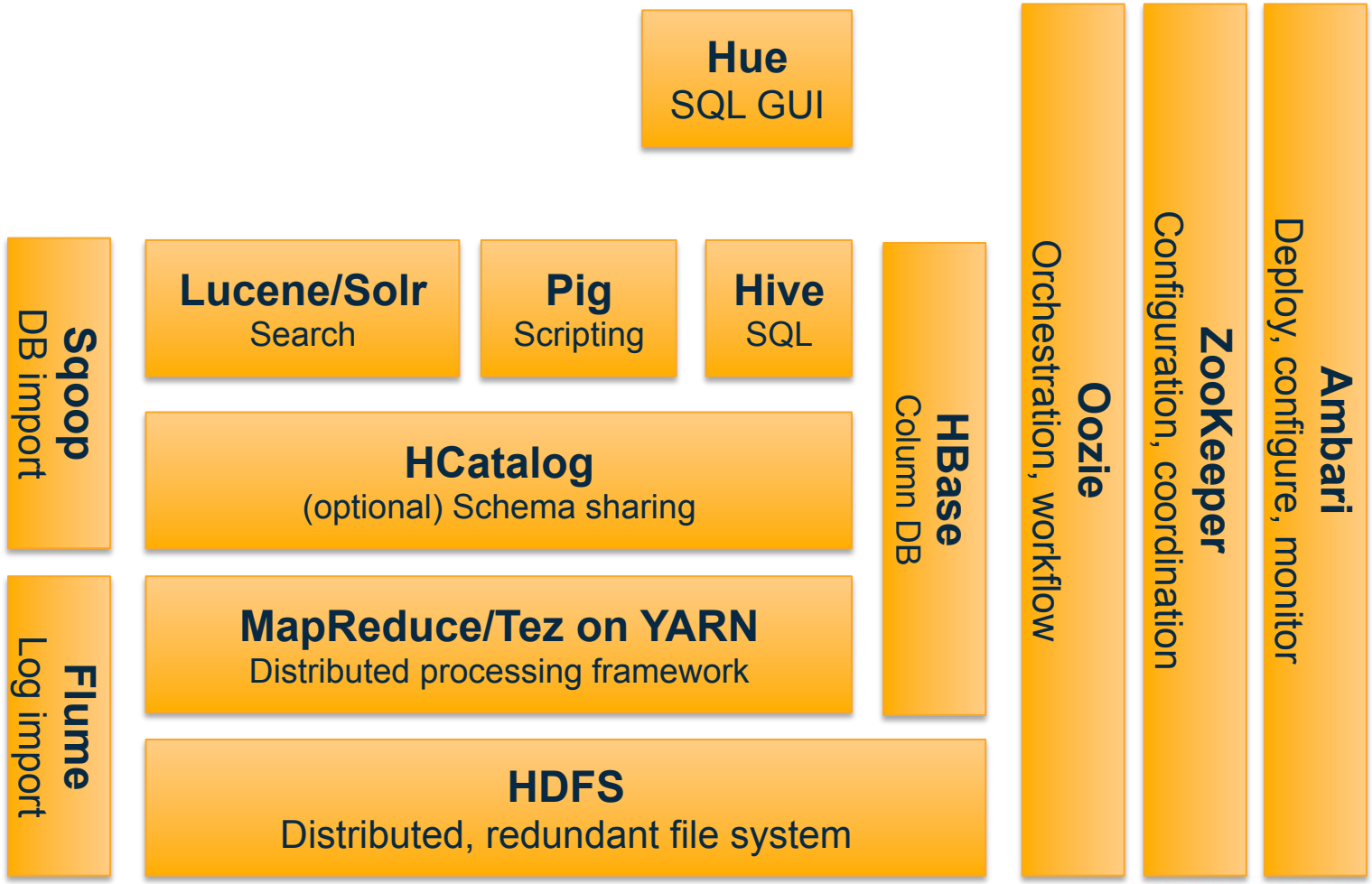
What is Hadoop and Why is it a Game Changer?

- Hadoop solves the problem of moving big data
  - Eliminates **interface** traffic jams
  - Eliminates **network** traffic jams
  - New way to move Data
- Hadoop automatically divides the work
  - Hadoop software divides the job across many computers, making them more productive

Without Hadoop



Hadoop Projects & Ecosystem



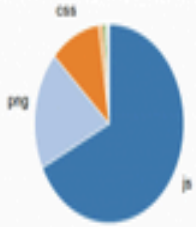
HUE

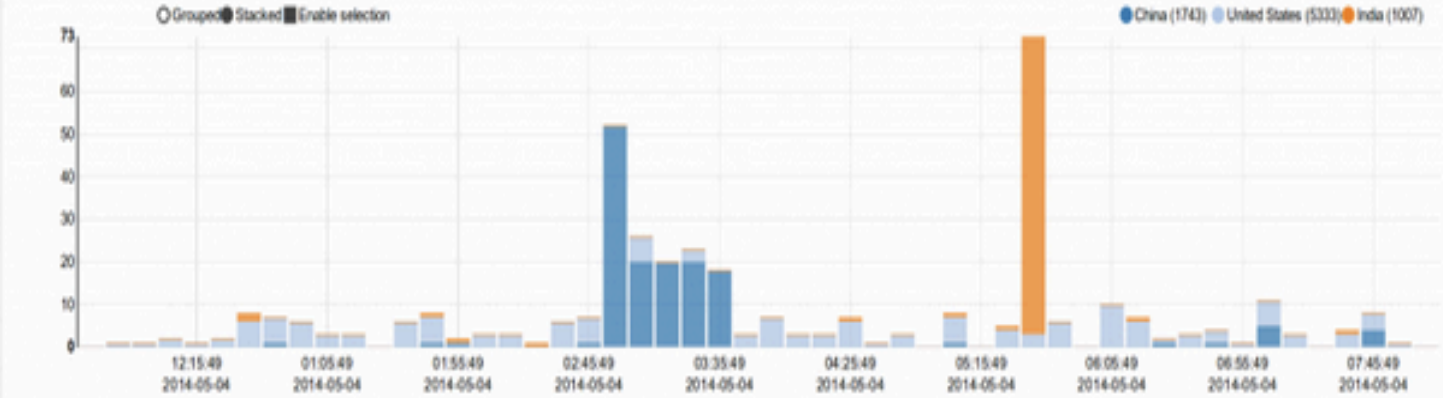
Query Editors · Data Browsers · Workflows · Search · File Browser · Job Browser · romain

Search: Apache Logs | impala | hive

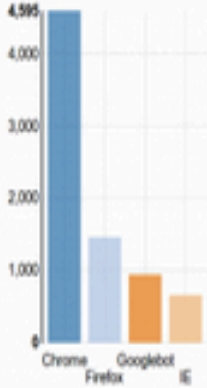
Brazil (289)
Show more...

extension





user_agent_family



country_code3 · region_code

bytes

0 - 900000 (8083)
900000 - 1800000 (0)
1800000 - 2700000 (0)
2700000 - 3600000 (0)
3600000 - 4500000 (0)
4500000 - 5400000 (0)

Grid Results

Filter fields

All (28) / Current (4)

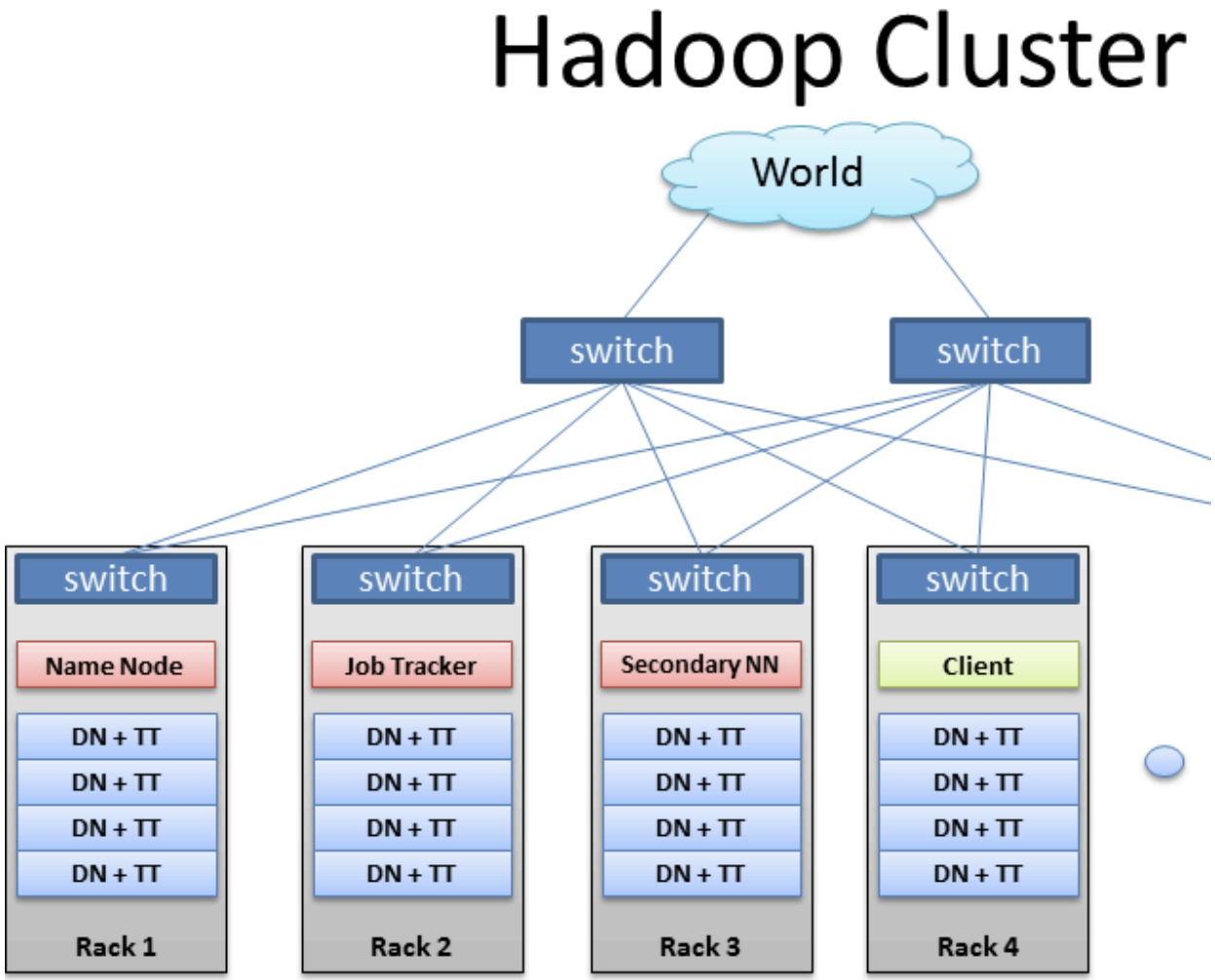
Field Name
version
app

Showing 1 to 40 of 8083 results

code	app	request	bytes
302	impala	GET /impala/list_designs?q-page=1&q-type=impala HTTP/1.0	446
200	impala	GET /impala/list_designs?q-page=1&q-type=impala HTTP/1.0	10839
302	impala	GET /impala/query_history?q-type=impala&q-user=rw1hd7z&q-auto_queryoff HTTP/1.1	549

Typical Hadoop Cluster

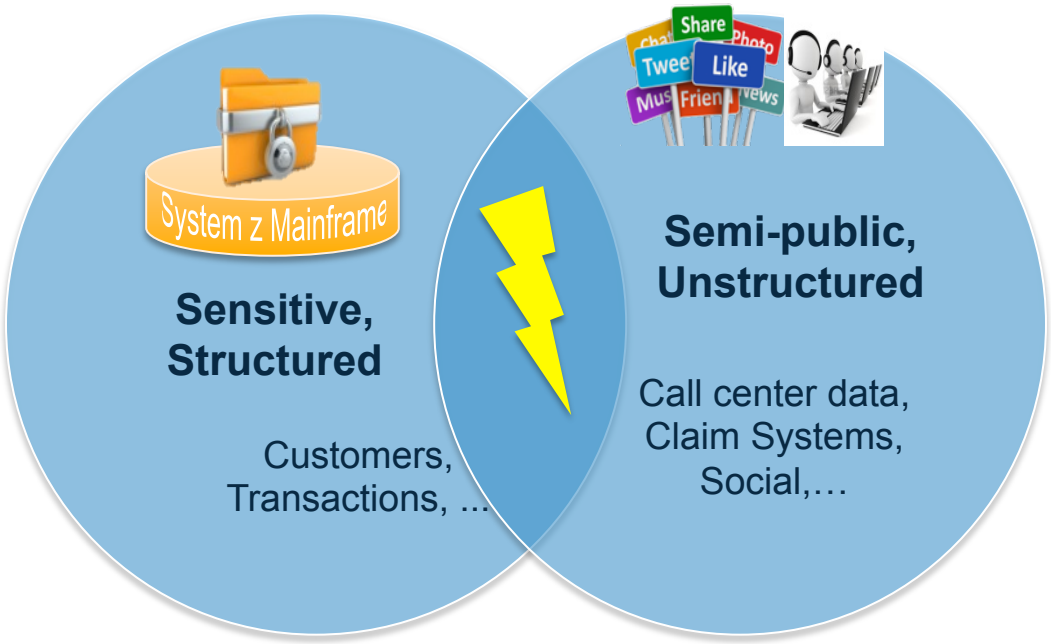
- NameNode
  - Files, metadata in RAM, logs changes
- Secondary NameNode
  - Merges changes. Not a backup!
- JobTracker
  - Assigns nodes to jobs, handles failures
- Per DataNode
  - DataNode— Files and backup; slave to NameNode
  - TaskTracker— Manages tasks on slave; slave to JobTracker



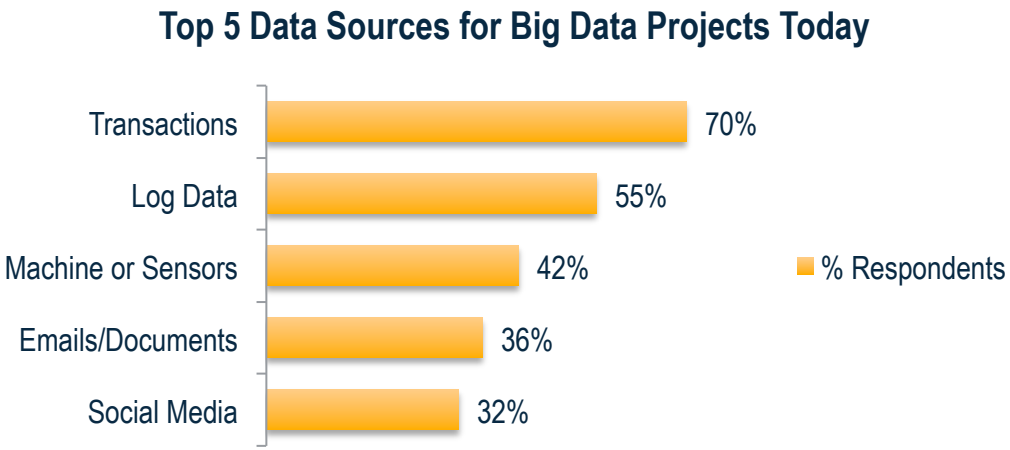
BRAD HEDLUND .com

The ROI Behind the Hype

The most relevant insights come from enriching **your** primary enterprise data.



Integration Problem For Data Scientists



"Survey Analysis - Big Data Adoption in 2013 Shows Substance Behind the Hype", Gartner, 2013, Link

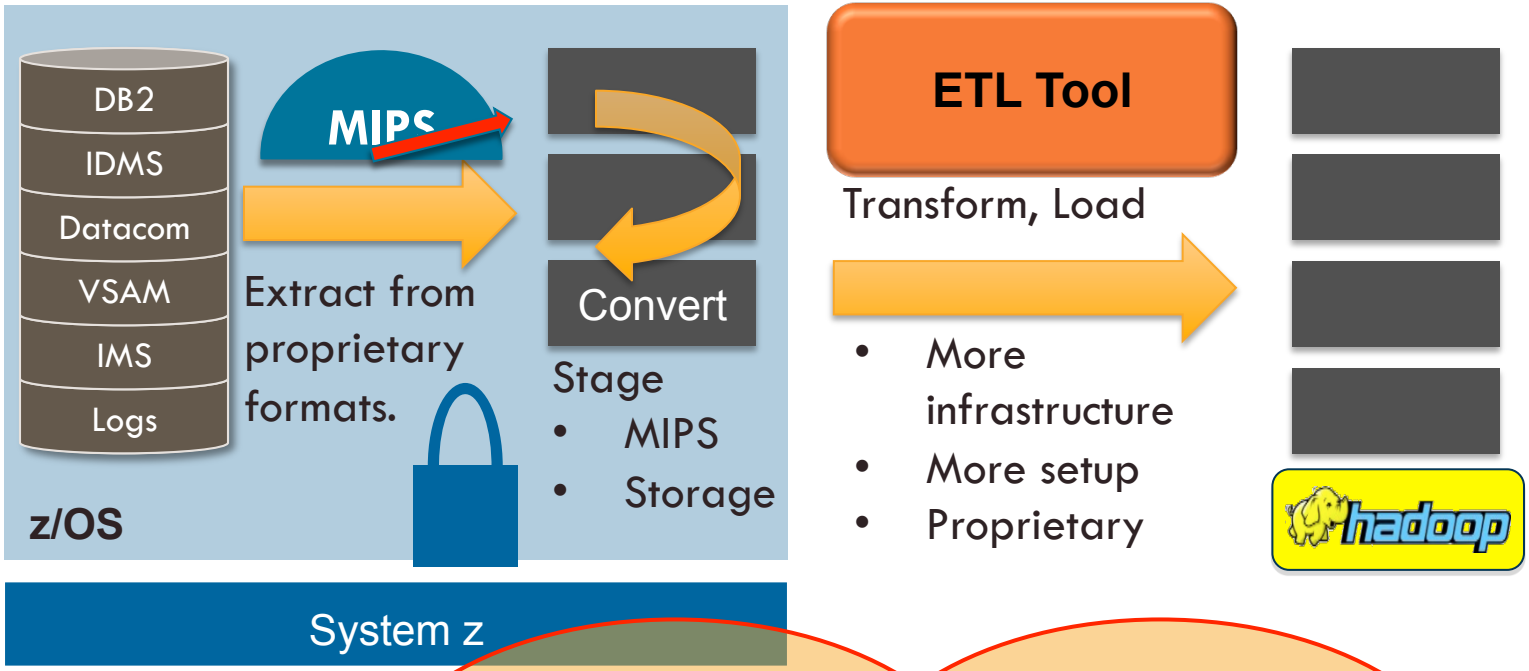
"By most accounts **80%** *of the dev effort in a big data project goes into data integration*

…and only **20%** *goes towards data analysis."*

"Extract, Transform, and Load Big Data With Apache Hadoop", Intel, 2013, Link

- Enterprise data analysts require near-realtime mainframe data
- Mainframe users wish to off-load batch processes to Hadoop for cost savings

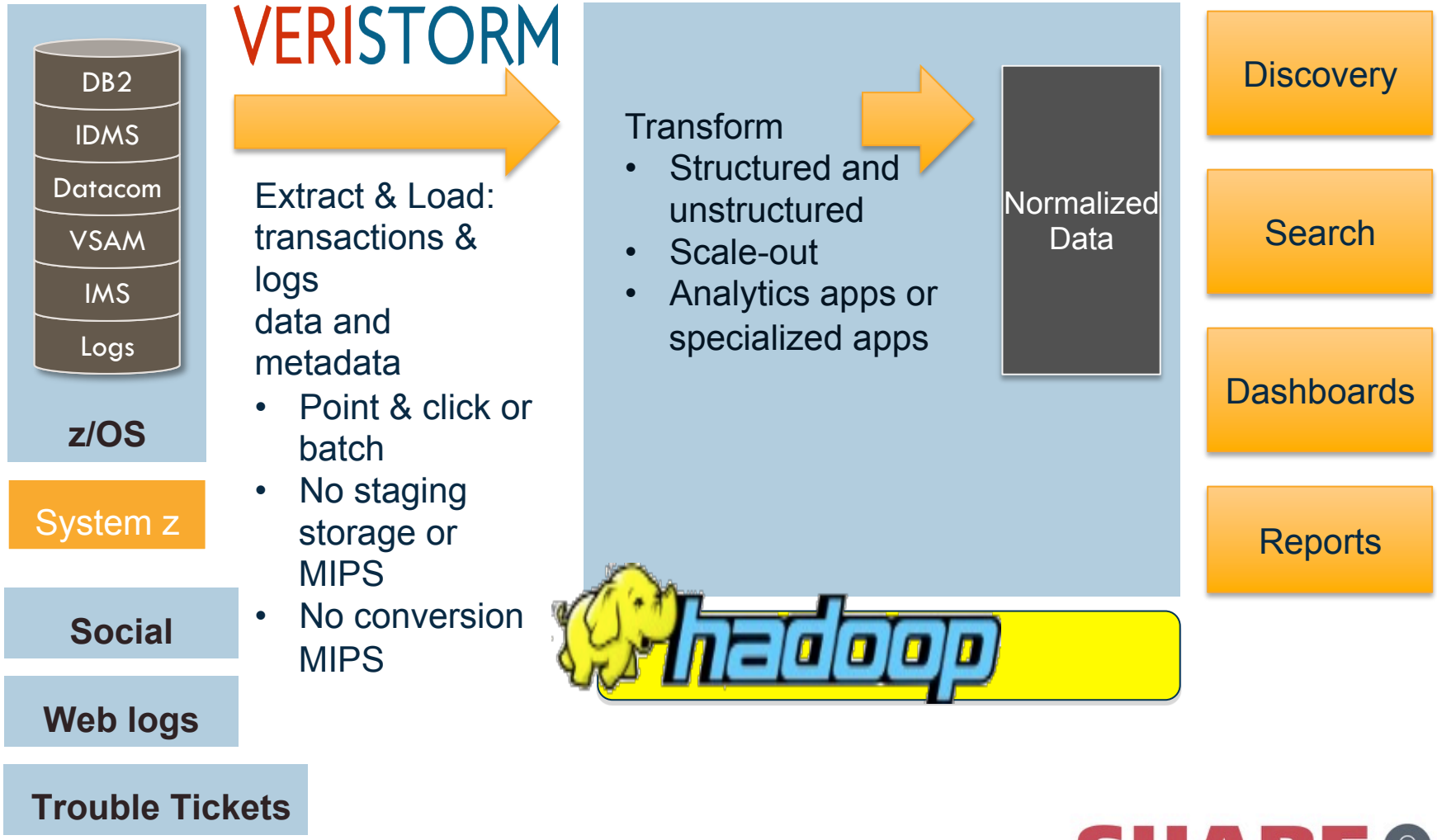
Data Ingestion Challenges



Mainframe Skills
JCL, HFS, OMVS, COBOL Copybooks, EBCDIC, Packed Decimal, Byte ordering, IPCS, z/VM

Distributed Skills
Hadoop, MongoDB, Cassandra, Cloud, Big Data Ecosystem, Java, Python, C++

With Veristorm: EL-T, not ETL



User-friendly Web UI for managing Mainframe extraction

vStorm Enterprise Manag
192.168.55.15:8080/zdoop/
vEMC | Hadoop-NN18 | Hadoop-TT18 | Hadoop-MR18 | Flume Master

VERISTORM

vStorm (admin) | View | Help

Source Browser
- Connections
  - Social Media
  - JDBC
  - 192.168.55.13 - (zOS Platform)
    - DASD - ('VSTORM1')
    - USS - (/u/VSTORM1)
    - Database Server - (DB2 Z)
      - Schemas
        - DSN8910
        - DSNRGCOL
        - SYSIBM
        - SYSIBMTS
        - VSTORM1
          - Tables
            - NYSE_2000_DB10
  - System Logs

Target Browser
- Connections
  - 192.168.55.15
    - HDFS - (/)
    - Local File System - (/
    - HIVE
    - Network Streaming -

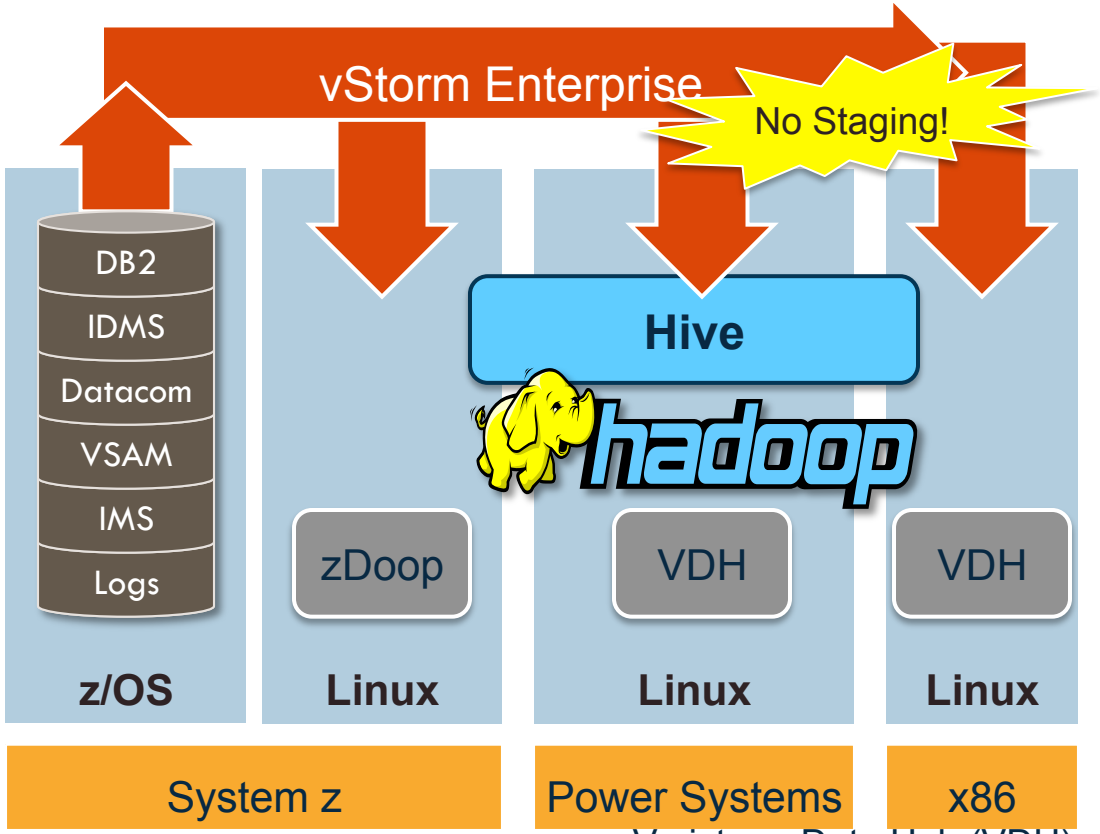
Select source content on z/OS

Select copy target: HDFS, Hive, Linux

#	EXCHANGE	STOCK_SYM	TRANDATE	STOCK_PRICE_O	STOCK_PRICE_H	STOCK
1	NYSE	ASP	2001-12-31	12.55	12.80	12.42
2	NYSE	ASP	2001-12-28	12.50	12.55	12.42
3	NYSE	ASP	2001-12-27	12.59	12.59	12.50
4	NYSE	ASP	2001-12-26	12.45	12.60	12.45

Browse or graph content!

vStorm Enterprise – Mainframe data to Mainstream



Veristorm Data Hub (VDH)

- IBM BigInsights
- Cloudera
- Hortonworks
- MapR

Financial Services Use Case

Problem	Solution	Benefits

• High cost of searchable archive on mainframe
  • $350K+ storage costs (for 40TB)
  • MIPS charges for operation
• $1.6M+ development costs due to many file types, including VSAM
• 2000+ man-days effort and project delay
	• Move data to Hadoop for analytics and archive
	• Shift from z/OS to IBM Linux (processors) on z to reduce MIPS
	• Use IBM SSD storage
	• Use IBM private cloud softlayer
	• Tap talent pool of Hadoop ecosystem
		• Reduction in storage costs
		• Dev costs almost eliminated
		• Quick benefits and ROI
		• New analytics options for unstructured data
		• Retains data on System z for security and reliability

Health Care Use Case

Problem	Solution	Benefits
• Relapses in cardiac patients • "One size fits all" treatment • $1M+ Medicare re-admission penalties • Sensitive patient data on Mainframe • No efficient way to offload and integrate	• Identify risk factors by analyzing patient data* • Create algorithms to predict outcomes	• 31% reduction in re-admissions • $1.2M savings in penalties • No manual intervention • No increase in staffing • 1100% ROI on $100K

* Mainframe database requires special skills to access without Veristorm

Retail Use Case

Problem	Solution	Benefits
• Streams of user data not correlated • e.g. store purchases, website usage patterns, credit card usage, historical customer data • Historical customer data Mainframe based – no efficient, secure integration	• Secure integration of historical customer data, card usage, store purchases, website logs • Customer scores based on the various data streams • High scoring customers offered coupons, special deals on website	• 19% increase in online sales during slowdown • Over 50% conversion rate of website browsing customers • Elimination of data silos – analytics cover all data with no reliance on multiple reports / formats

Big Data at NCAT

North Carolina Agricultural and Technical State University

- NC A&T State University
- Located in Greensboro, NC, enrollment approx. 10,500.
- One of the 100+ Historically Black Colleges and Universities
- Established in 1891 as a Land Grant College
- Still produces more African American engineers than any school in the world
- I am in the Computer Systems Technology Dept. in the School of Technology

Enterprise Systems Program, School of Technology at NC A&T:

- Mission: To support education, research, and business development in the System z space
- NCAT System z Environment:
  - Since 2010
  - Z9, 18 GPs, no IFLs, 128GB storage, 4 TB DASD (online)
  - 44 TB DS8300 (offline)
  - 2 LPARs (using 1)
  - z/VM is the base OS, all other OSes are guests of z/VM
  - Plan in the works with our business partners to acquire a BC12
  - Using GPs as IFLs (special no-MIPS deal with IBM)
  - Allocate GPs to the LPAR
  - VM 5.4
  - SUSE 11, Debian, RHEL
  - DB2, LAMP, SPSS for System z, Cognos, zDoop and more

System z as a Private Cloud

- Students & faculty need to rapidly deploy, clone, and turn down servers
  - Helps manage the student (user) learning process
- First university to adopt CSL Wave
- Adding rapid deployment of Hadoop clusters
- Early adopter of vStorm Enterprise
- On-demand scaling by simply adding IFLs
- No additional power or space
- Use existing skills, processes, security (RACF/LDAP), management tools

Research Support

- Several researchers at A&T have a focus on analytics
- Areas of Focus
  - Sentiment Analysis (opinion analysis)
  - Health Informatics (fraud detection, Medicare/Medicaid)
  - Predictive Analytics (student outcomes, product viability, etc.)
- Faculty have expressed interest in Hadoop
  - Need to manage larger data sets
  - Collecting unstructured/non-relational data
  - Want to pool data without pre-determined query in mind
  - Interactive/discovery and query

Education

- 4 undergraduate courses: intro, intermediate, advanced mainframe operations and z/VM
- 2 graduate courses (mainframe operations, z/VM)
- Proposed graduate certificate of enterprise systems (under review)
- High school outreach programs in enterprise systems
- 1 semester zVM class (CPCMS, Install Linux as a guest, getting Linux running, using VM as a deployment tool for Linux)
- VM will be increasingly important; key to preparing students for careers in Big Data

Student Example

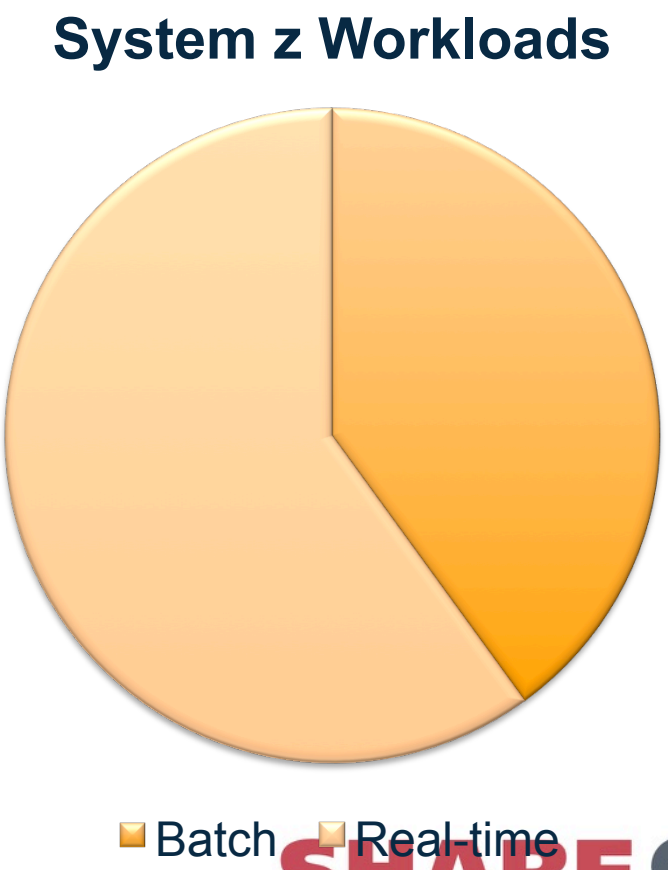
- Over 70 students placed in enterprise systems positions
- Heavy focus on IBM's *Master the Mainframe* contest
- Two students participants in IBM's 50th Anniversary of the Mainframe
  - Dontrell Harris, a keynote speaker, capacity planning specialist at Met Life
  - Jenna Shae Banks, a judge for the first *Master the Mainframe* world championship
  - Placements at IBM, Met Life, USAA, BB&T, Fidelity, Wells Fargo, Bank of America, First Citizen's Bank, John Deere, State Farm and others

Big Data Initiative

- Challenge & opportunity
  - Saw the potential for zVM application for Hadoop; most people focused on x86
  - Hot topic for research; important to students
  - Provide easy & controlled access to mainframe data
  - Enable the developer community to take advantage of the enterprise primary data in a model they understand
  - Familiar environment: Linux, Java, SQL & the hot technology: Hadoop
- Getting buy-in for z
  - Most don't know z at all
  - Dean, Chair, Chancellor, Provost: Needed to be sold; not IT people
  - Simplify!

Unlock New Insight and Reduce Cost

- Do More
  - Analyze large amount of information in minutes
  - Offload batch processes to IFLs to meet batch window requirement
- Reduce Cost
  - Take advantage of IFLs price point to derive more insight
- Application extensibility achieved through newly available skillset

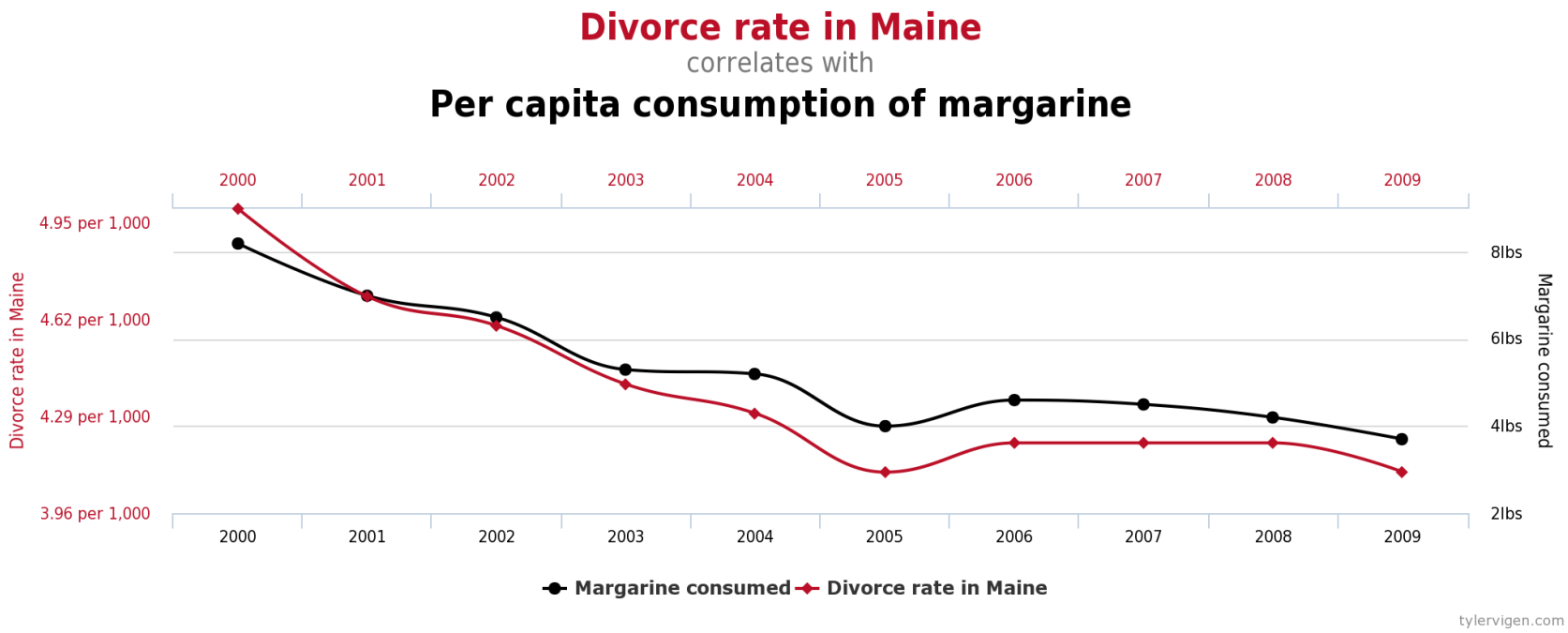


Any Questions?

- Mike Combs
  mcombs@veristorm.com
- Cameron Seay, Ph.D.
  cwseay@ncat.edu

- https://share.confex.com/share/125/webprogrameval/Session17487.html

For Fun



- Spurious Correlations
  - http://www.tylervigen.com/spurious-correlations
- New Live Poll Lets Pundits Pander To Viewers In Real Time
  - https://youtu.be/uFpK_r-jEXg
  - The Onion (satire)
- Hitler Loses His Namenode Metadata
  - https://youtu.be/DQEcxjSwh3o

Mapper.py

mapper.py

```python
#!/usr/bin/env python

import sys

# input comes from STDIN (standard input)
for line in sys.stdin:
    # remove leading and trailing whitespace
    line = line.strip()
    # split the line into words
    words = line.split()
    # increase counters
    for word in words:
        # write the results to STDOUT (standard output);
        # what we output here will be the input for the
        # Reduce step, i.e. the input for reducer.py
        #
        # tab-delimited; the trivial word count is 1
        print '%s\t%s' % (word, 1)
```

Line 19, Column 1 Spaces: 4 Python

Reducer.py

reducer.py

```python
#!/usr/bin/env python

from operator import itemgetter
import sys

current_word = None
current_count = 0
word = None

# input comes from STDIN
for line in sys.stdin:
    line = line.strip()                 # remove leading and trailing whitespace
    word, count = line.split('\t', 1)   # parse the input we got from mapper.py

    # convert count (currently a string) to int
    try:
        count = int(count)
    except ValueError:
        # count was not a number, so silently ignore/discard this line
        continue

    # this IF-switch only works because Hadoop sorts map output
    # by key (here: word) before it is passed to the reducer
    if current_word == word:
        current_count += count
    else:
        if current_word:
            # write result to STDOUT
            print '%s\t%s' % (current_word, current_count)
        current_count = count
        current_word = word

# do not forget to output the last word if needed!
if current_word == word:
    print '%s\t%s' % (current_word, current_count)
```

Line 20, Column 1 Spaces: 4 Python

White Papers and Articles

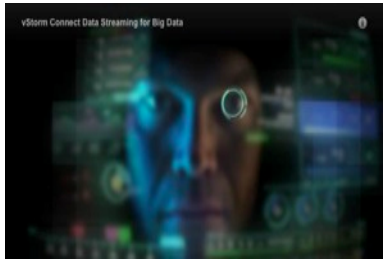
- "The Elephant on z", IBM & Veristorm, 2014
  - veristorm.com/go/elephantonz
- "Bringing Hadoop to the Mainframe", Paul Miller, Gigaom, 2014
  - veristorm.com/go/gigaom-2014
- "Inside zDoop, a New Hadoop Distro for IBM's Mainframe", Alex Woodie, Datanami, 2014
  - veristorm.com/go/datanami-2014-04
- "vStorm Enterprise Allows Unstructured Data to be Analyzed on the Mainframe", Paul DiMarzio, 2014
  - veristorm.com/go/ibmsystems-2014-06
- "Veristorm looks to bring mainframe transactional data in from the cold", Krishna Roy, 451 Research, 2014
  - veristorm.com/go/451research-2014
- "vStorm Enterprise vs. Legacy ETL Solutions for Big Data Integration", Anil Varkhedi, Veristorm, 2014
  - veristorm.com/go/vsetl
- "Is Sqoop appropriate for all mainframe data?", Anil Varkhedi, Veristorm, 2014
  - veristorm.com/go/vssqoop
- "Mainframe Makeover", Doug Henschen, InformationWeek, 2015
  - http://tinyurl.com/oxart8v
- IBM Infosphere BigInsights System z Connector for Hadoop
  - ibm.com/software/os/systemz/biginsightsz
  - (Includes data sheet, demo video, Red Guide)
- "Strategic Thinking Profile: Veristorm", Jeff Kaplan, ThinkStrategies, 2015
  - http://tinyurl.com/pwcspu9
- Solution Guide: "Simplifying Mainframe Data Access", 2015
  - redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/tips1235.html
- CA Technologies vStorm Connect Data Streaming for Big Data
  - ca.com/us/opscenter/vstorm-connect-data-streaming-for-big-data.aspx
  - (includes data sheet, FAQ, analyst paper, infographic)
- "Disrupting Data Integration", Anil Varkhedi, Veristorm, 2015
  - http://www.veristorm.com/content/disrupting-data-integration

Videos

Animated Intro

veristorm.com/go/animated

CA Streaming for Big Data



veristorm.com/go/ca-vstorm

Veristorm on POWER8

veristorm.com/go/vsonpower

11-minute Introduction

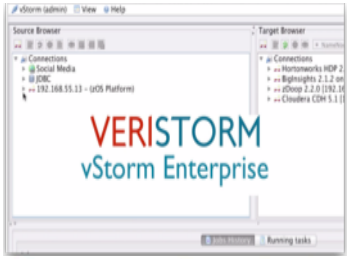
veristorm.com/go/introvid11m

VERISTORM

Big Data & Analytics

https://youtu.be/azUJIlu-zSg

2-minute Demo

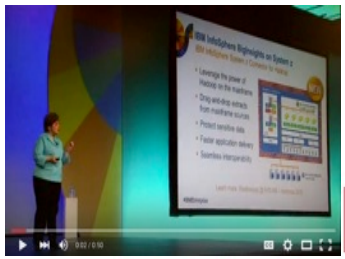


veristorm.com/go/demovid2m

Forrester Webinar

veristorm.com/go/webinar-2014q3

IBM intro z

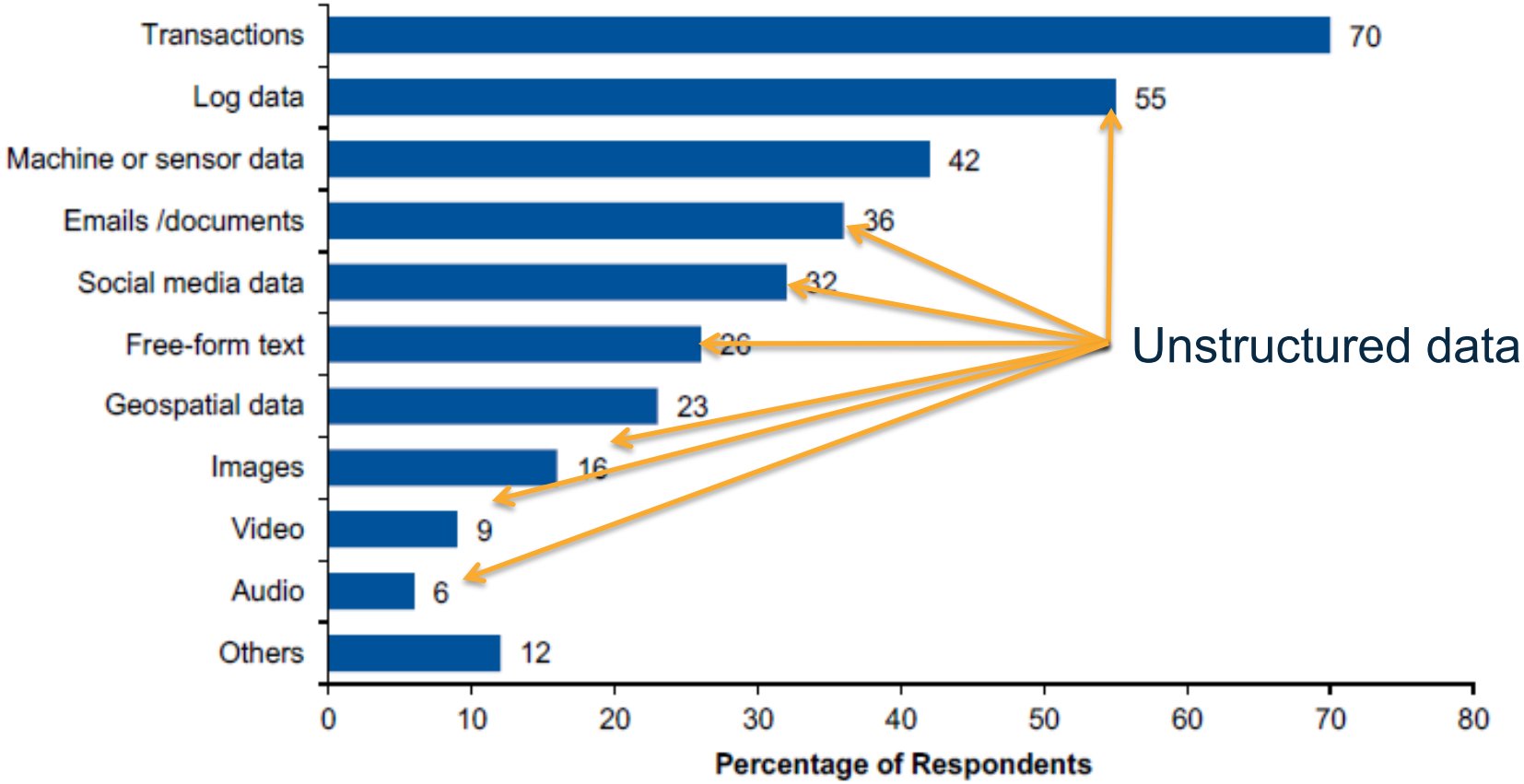


https://youtu.be/kInTa-dozD4

Abstract

- Hadoop and data integration with System z
- Big Data technologies like Hadoop are transforming analytics and processing, but what is the role of System z? We'll examine System z advantages as a platform for Hadoop and as a rich source of enterprise data for processing in Hadoop both on and off the platform. How can System z and Hadoop respond quickly to the organizational needs to make data-driven decisions in near real-time, when the questions aren't well-known in advance?
- Dr. Cameron Seay, Ph.D., Assistant Professor, Computer Systems Technology, of North Carolina Agricultural and Technical State University will **share his experience with Hadoop on z applied to analytics and research projects**.
- Mike Combs, VP of Marketing, Veristorm, will **discuss how rapid, no-transformation access to mainframe data from Hadoop can enable new solutions, including lightweight performance management and capacity planning**.

Today's Big Data Initiatives: Transactions, Logs, Machine Data



N =465 (multiple responses allowed)

Source: Gartner (September 2013)

Transaction Data = Mainframe Computers

- Mainframes run the global core operations of
  - 92 of top 100 banks
  - 21 of top 25 insurance
  - 23 of top 25 retailers
- Process 60% of **all** transactions
- Mainframe computers are the place for essential enterprise data
  - Highly reliable
  - Highly secure
- IBM's Academic Initiative
  - 1000 higher education institutions
  - In 67 nations
  - Impacting 59,000 students
- However, mainframe data uses proprietary databases which must be translated to talk to formats familiar in "Big Data"