RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

ARTIFICIAL INTELIGENCE AND TECHNOLOGY IN ACCOUTING AND AUDITING

Applying to Government Issues

5 SBCASP - April 26, 2018 - Brasilia

Miklos A. Vasarhelyi

KPMG Distinguished Professor of AIS

Rutgers Business School

Outline

- The CarLab
- RADAR
- Big Data
- Exogenous Data
- Disruption
  - Artificial Intelligence and cognitive computing
  - Blockchain
  - Intelligent Process automation
  - Apps and Ubiquitous data
  - Human Behavior Change

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The CarLab

Continuous Audit and Reporting Laboratory

–**Graduate School of Management**

–Rutgers University


Rutgers
Business
School
Thought Leadership
Rutgers
Business
School

BRIGHAM YOUNG UNIVERSITY			
The Ranking of Rutgers in the Accounting Areas			
Areas	Ranking 2008-2013	Ranking 2002-2013	Ranking 1990-2013
AIS	#1 out of 179	#1 out of 207	#1 out of 241
Audit	#6 out of 320	#7 out of 370	#11 out of 438
Financial	#70 out of 356	#89 out of 406	#83 out of 470
Managerial	#120 out of 286	#80 out of 346	#66 out of 413
Tax	#53 out of 129	#76 out of 178	#79 out of 246
Other	#35 out of 171	#18 out of 248	#25 out of 341

Usage

http://raw.rutgers.edu/RADL.html

Content

- **Undergraduate, Graduate, PhD, & Audit Analytics Content**

Undergraduate	Graduate	PhD	Audit Analytics Certificate
• Introduction to Financial Accounting • Introduction to Managerial Accounting • Intermediate Accounting I • Intermediate Accounting II • Advanced Accounting • Auditing Principles • Management and Cost Accounting • Accounting Information Systems • Business Law I • Business Law II • Federal Taxation I • Accounting in the Digital Era • Computer Augmented Accounting • Decoding of Corporate Financial Communications	• Accounting Principles and Practices • Information Technology • Government and Not-for-Profit Accounting • Advanced Auditing and Information Systems • Advanced Accounting • Corporate Taxation • Income Taxation	• Special Topics in Accounting • Survey of Accounting Information Systems • Current Topics in Auditing • Machine Learning	• Introduction to Audit Analytics • Special Topics in Audit Analytics • Information Risk Management • Tutorials for Risk Management

Our Government Accounting Efforts

- Leading Master's Program in Government Accounting (online)
- Linking with our technological leadership
- Working with Exchange Regulatory Commissions
  - CVM, Indonesia, Korea
- Proposing several approaches for government reporting at federal, state, and municipality
- Working with the Volcker alliance
- Armchair audit work

Introduction to Audit Analytics:

https://www.youtube.com/playlist?list=PLauepKFT6DK8nsUG3EXi6lYVX0CPHUngj

Special Topics in Audit Analytics:

https://www.youtube.com/playlist?list=PLauepKFT6DK-PpuseJtSMlIy-YBhaV4TH

Information Risk Management:

https://www.youtube.com/playlist?list=PLauepKFT6DK8uxePhPCoHjDf8DlhRtGS

Special Topics in Audit Analytics

by Rutgers Web • 26 videos • 145 views • Last updated on Jun 5, 2015

Play all | Share | Save

1	WATCHED	Special Topics in Audit Analytics: Week 1- (Lecture 2: Analytics Big Data Audit Automation) by Rutgers Web	32:52
2		Special Topics in Audit Analytics: Week 1-(Lecture 3: The Audit Ecosystem) by Rutgers Web	17:41
3		Special Topics in Audit Analytics: Week 1-(Lecture 4: Audit Data Standard) by Rutgers Web	35:45
4		Special Topics in Audit Analytics: Week 2-(Lecture 2) by Rutgers Web	37:05
5		Special Topics in Audit Analytics: Week 3-(Lecture 1- Hypothesis Testing) by Rutgers Web	17:40
6		Special Topics in Audit Analytics: Week 3-(Lecture 2- Hypothesis testing 2) by Rutgers Web	12:20
7		Special Topics in Audit Analytics: Week 3-(Lecture 3 : Confidence interval) by Rutgers Web	8:49
8		Special Topics in Audit Analytics: Week 3-(Lecture 4 -Two sample test) by Rutgers Web	24:39
9	WATCHED	Special Topics in Audit Analytics: Week 3-(Lecture 5: two dependent sample test) by Rutgers Web	13:34
10		Special Topics in Audit Analytics: Week 3-(Lecture 6: Introduce R) by Rutgers Web	7:24
11		Special Topics in Audit Analytics: Week 3-(Lecture 7: Demonstration with R) by Rutgers Web	30:19
		Special Topics in Audit Analytics: Week 4-(Lecture 1)	

Rutgers AICPA Data Analytics Research Initiative

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Rutgers Business School
Newark and New Brunswick

AICPA

The mission of RADAR is to facilitate the further integration of data analytics into the audit process, and to demonstrate through research how this can effectively lead to advancements in the public accounting profession.

Additional information can be found at: http://raw.rutgers.edu/radar

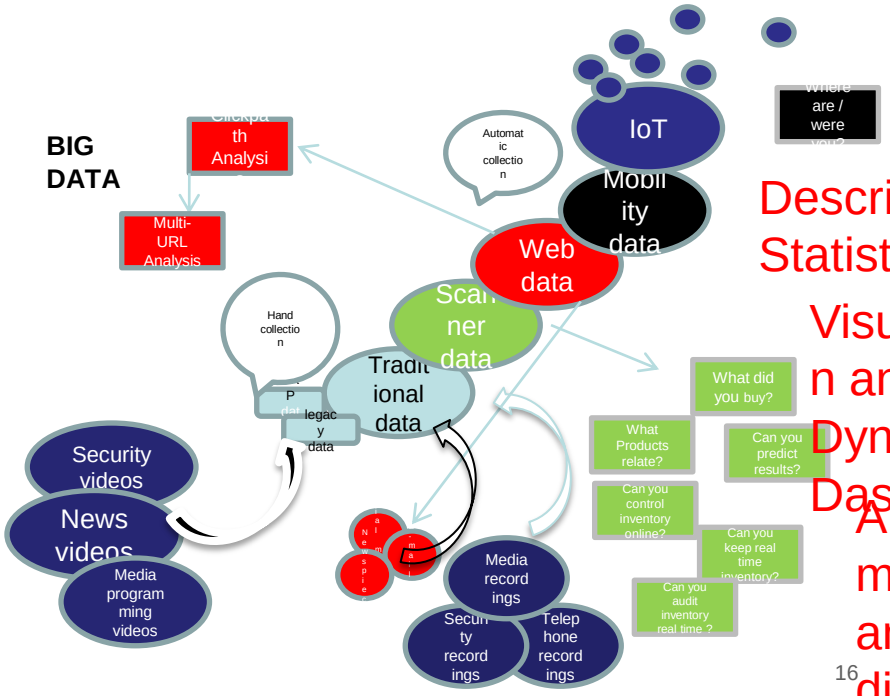
Rutgers AICPA Data Analytics Research Initiative

- Scope and Objectives:
  - The scope of the Initiative encompasses the testing of theory and methodology
  - Theory and methodology tested under RADAR helped to inform the development of the AICPA Guide to Audit Data Analytics and Analytical Procedures
  - The research findings will also serve as the basis for a dialog with the Auditing Standards Board (ASB), the International Audit and Assurance Standards Board (IAASB) and the Public Company Audit Oversight Board (PCAOB)

Rutgers AICPA Data Analytics Research Initiative

- **Research Projects**
  - *Multidimensional Audit Data Selection*
  - *Process Mining*
  - *Visualization*

BIG DATA



Descriptive Statistics

Visualization and Dynamics Dashboards

Analytic modeling and discovery tools

Traditional IT

Unstructured data

Text mining

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Exogenous data analytics for Auditing

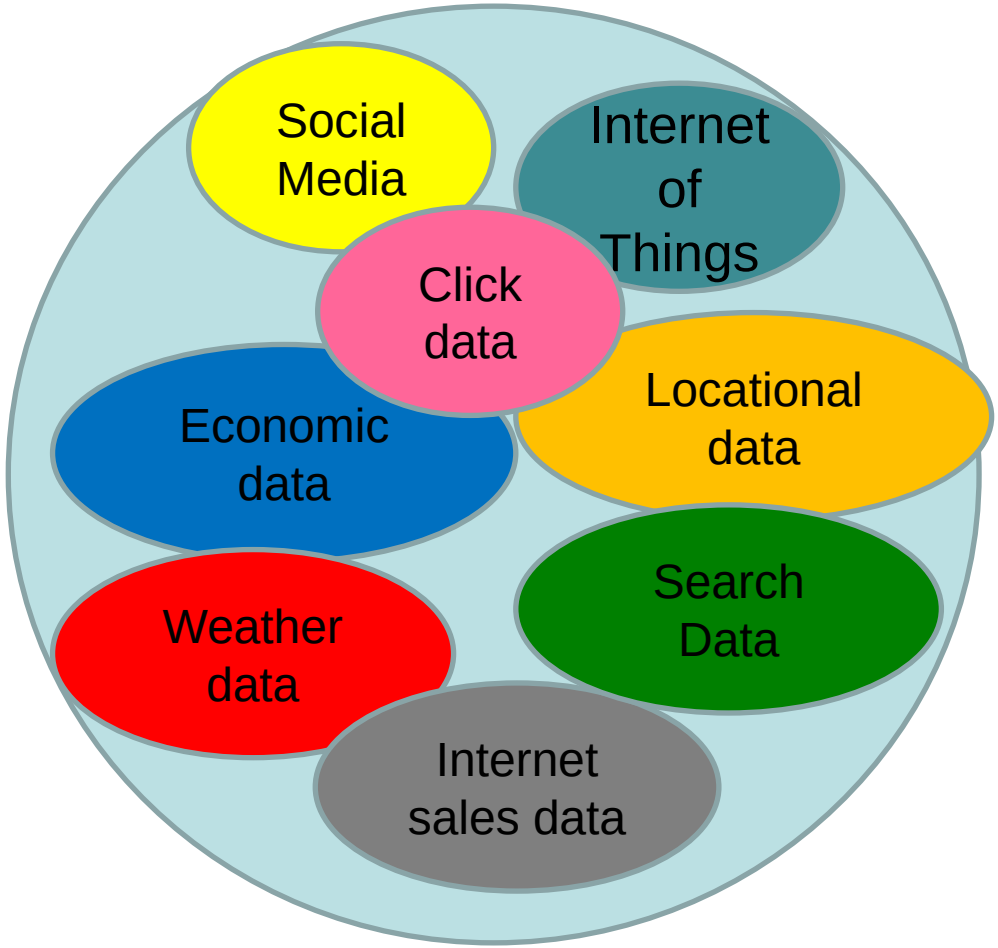
Miklos A. Vasarhelyi
Helen Brown Liburd

Rutgers Business School

Some sources

- Amazon sales
- Google searches
- Apps used
- Calls made
- GPS or JEEP location
- Sites accessed
- Car license plates photographed
- Pictures of parking lots
- Face recognition pictures
- Site clickpaths

Exogenous Data



ED may be of easier access

ED is likely less tamperable

ED relationships will be stochastic

ED is a form of confirmation

ED may complement many current procedures

ED may create many new procedures

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Facilitating Citizens' Voice and Process Reengineering Using a Cloud-based Mobile App

Daniel E. O'Leary
University of Southern California

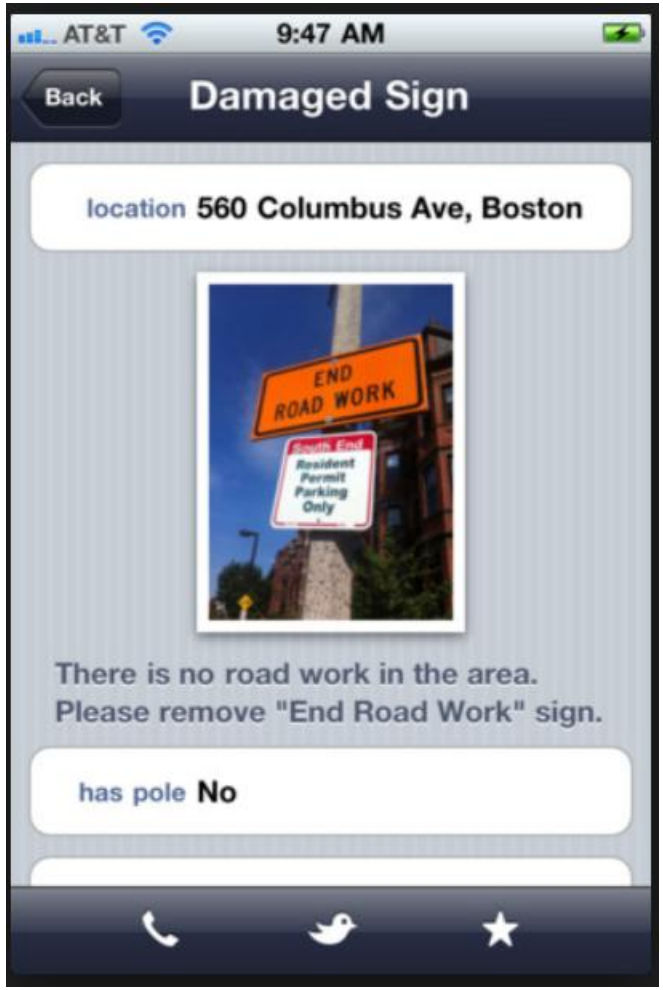
How do Boston and other cities Monitor Infrastructure?

- City generated information
  - Employee generated (Historical Process)
  - City Worker App
  - (Maximo Integration (IBM Asset Management))
- Data gathered from citizens
  - Call Center (Started with the telephone)
  - Web Page (Started with the Internet/Web)
  - Citizens Connect App (*focus of this paper*)
  - Twitter
- It is possible to see “layering of technologies”

Click to edit Master title style

Citizens Connect AKA Boston 311

Cloud-based app allows you to report infrastructure issues



At this point, a number of cities around the US use this app.

Pictures and GPS

Developed in ~ 2009

DIGITAL LIFE

Potholes And Repairs? Boston Has An App For That

December 3, 2009 · 12:01 AM ET
Heard on Morning Edition

TOVIA SMITH

How (why) does it work?

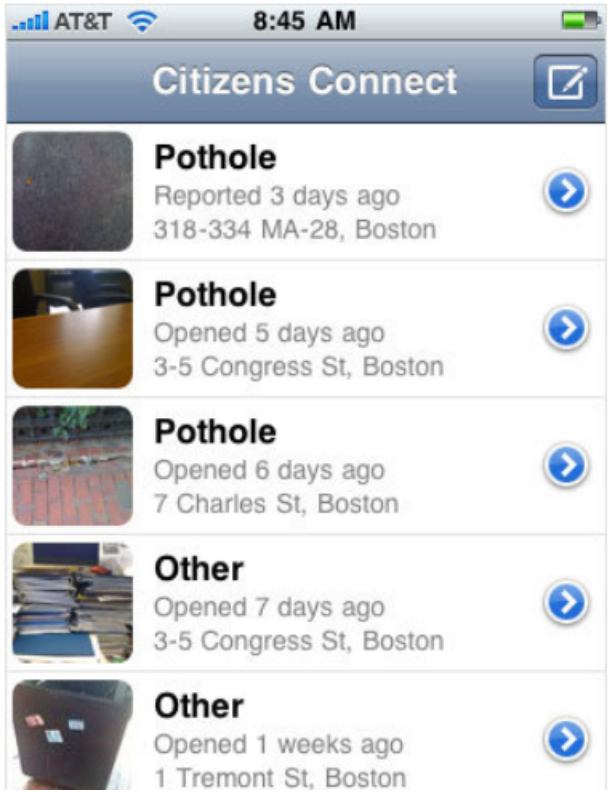
A few weeks ago, 41-year-old Bostonian Heather Sears thought the coolest app on her iPhone was SitOrSquat — a listing of the city's cleanest, closest restrooms. But today, she's even more excited about Boston's Citizens Connect — a new way to use an iPhone to fight city hall.

"Voice"

The new app allows anyone to make a one-touch kvetch about anything from potholes to broken streetlights in Boston.

"I was thrilled to be able to walk down the alley to where I park my car and say, 'All right, there's more graffiti. I want it off now!' " Sears says. "I was like armed and dangerous."

"Power to People!" "Voice"



Hirschman's Exit, Voice, Loyalty

- (Provides a theory with which to "think" ab… anticipate what is going on in the dat…
- Cloud-based app provides anot…
- With the app, the voice b… and actualized in rea…
  - Phone pictur… …better
  - *Would … …app use*
- *Wou… …ow over time, as … …opportunities.*
- H… …ve, Vote against Party, Vote against ex… …g legislation, Make social media remarks aga…
  - H… …an suggests more voice if exit is difficult

Many forms of "exit"

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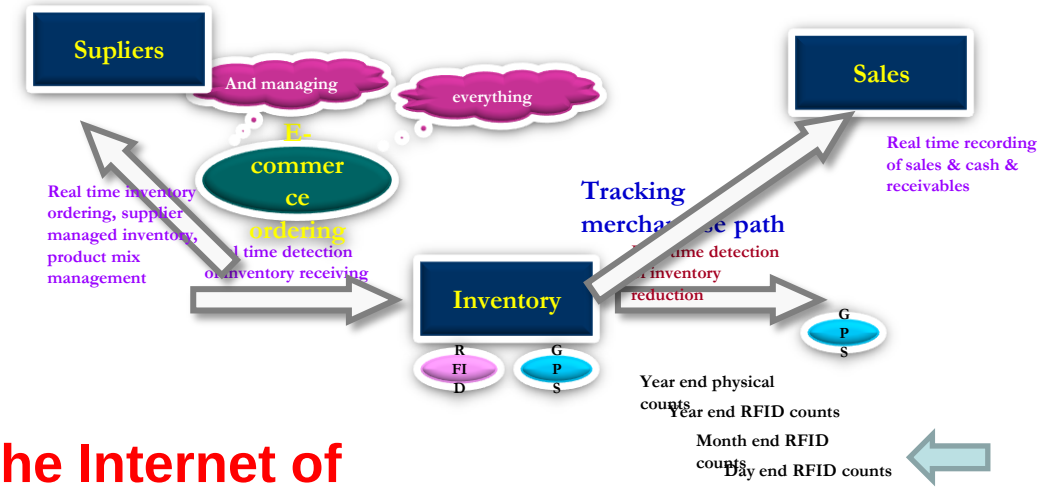
Imagineering Audit

Jun Dai and Miklos A Vasarhelyi

ASSURING INVENTORY and other things



The Internet of Things

Every second RFID and GPS and e-commerce records

- Forget about privacy…. Its gone….
- Fortunately you are not very interesting

- Technology giveth ….
- Technology taketh

Disruption

- Apps
- Blockchain and Smart Contracts
- Deep Learning / AI
- Cognitive computing – Siri/ Alexa-like specialized tools
- Intelligent Process Automation
- Drones and Robots

1766-2016
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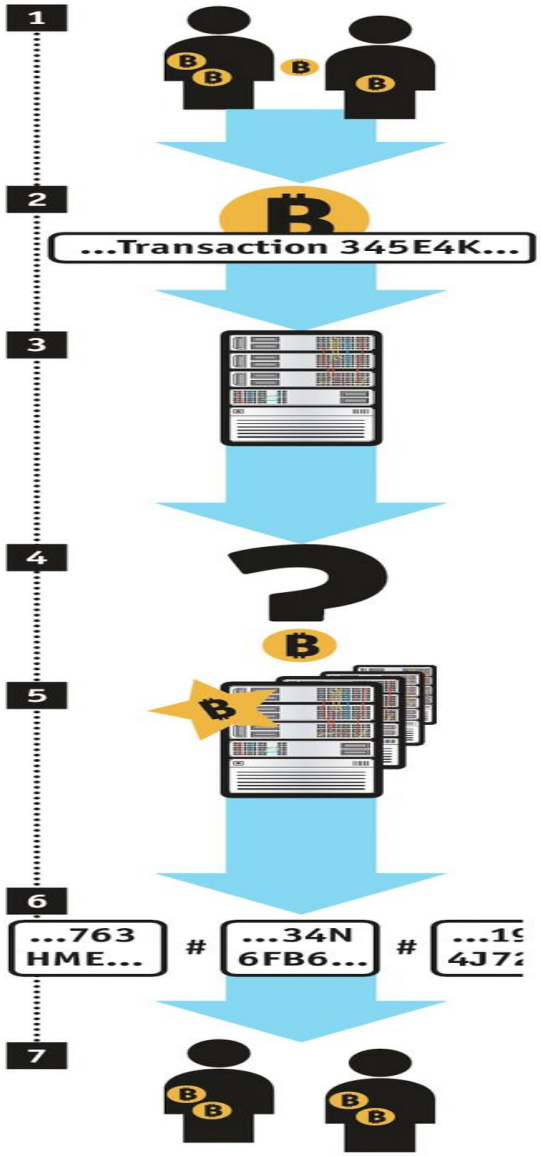
Blockchain for Accounting and Assurance

By Andrea Rozario & Miklos A. Vasarhelyi
Of Rutgers, the State University of New Jersey

How Blockchain works – Bitcoin Example



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Auditing with Smart Contracts in a Blockchain

April 16, 2018

Introduction

- The advent of new technologies has forced businesses to adapt to an electronic world and modify their business practices

- Blockchain demonstrates great potential as a tamper-proof audit trail, fused with smart contracts, blockchain can improve business processes
  - Bills of lading and debt covenants

- How will blockchain and smart contracts disrupt the audit profession?
  - Audit blockchain and smart contracts
  - Audit with blockchain and smart contracts

Evolving Auditing with Blockchain and Smart Contracts

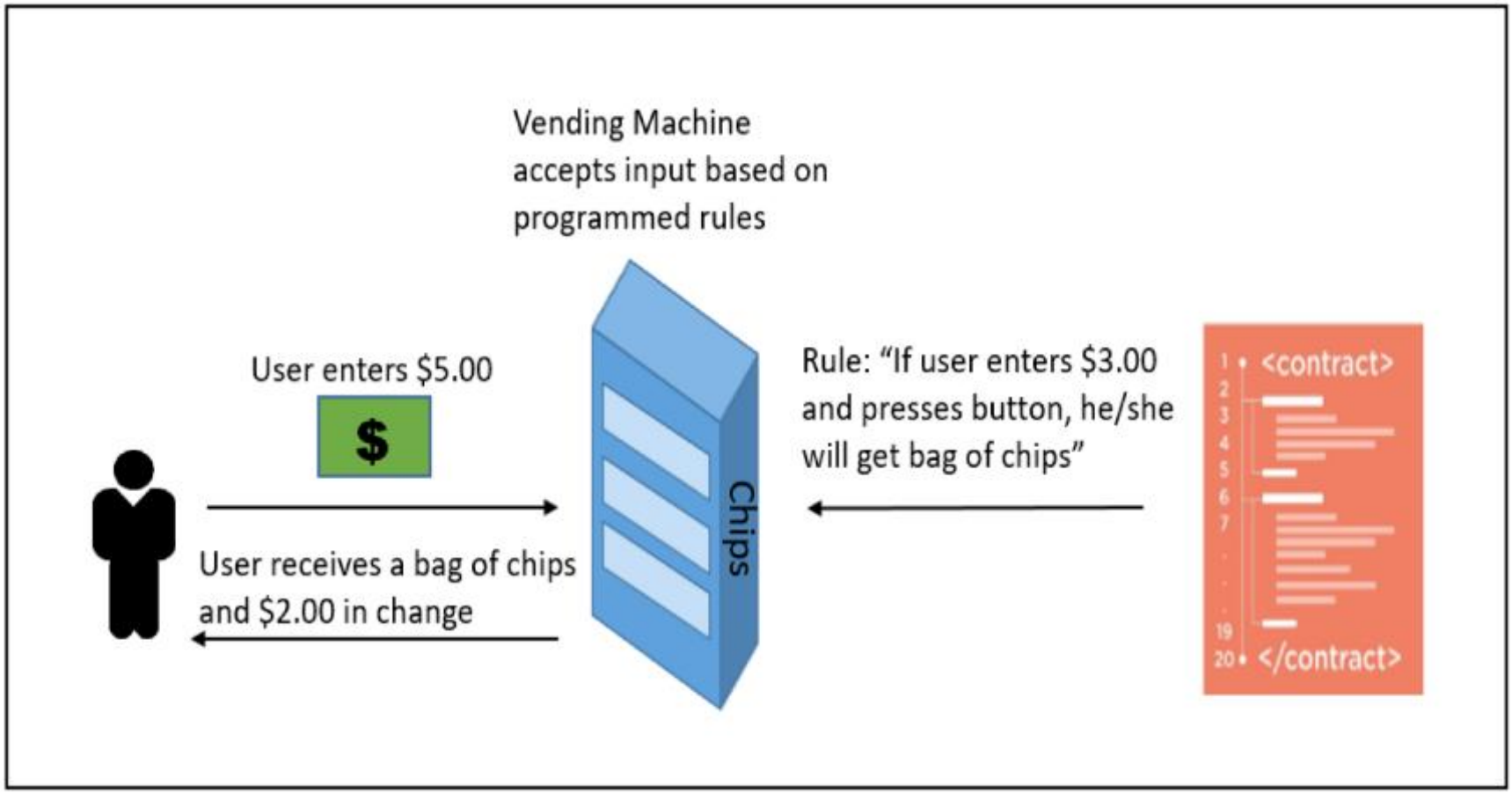
- The traditional audit model was not designed for a digital business environment

- Auditors should rethink the audit process in light of emerging technologies
  - Blockchain and smart contracts improve process quality and thus have the potential to improve audit quality
  - Blockchain provides a unified platform for reliable digital audit evidence and (smart) audit analytics

- Smart contracts deployed on a blockchain can facilitate the execution of audit procedures, provide close to real-time audit reporting and more transparency to stakeholders

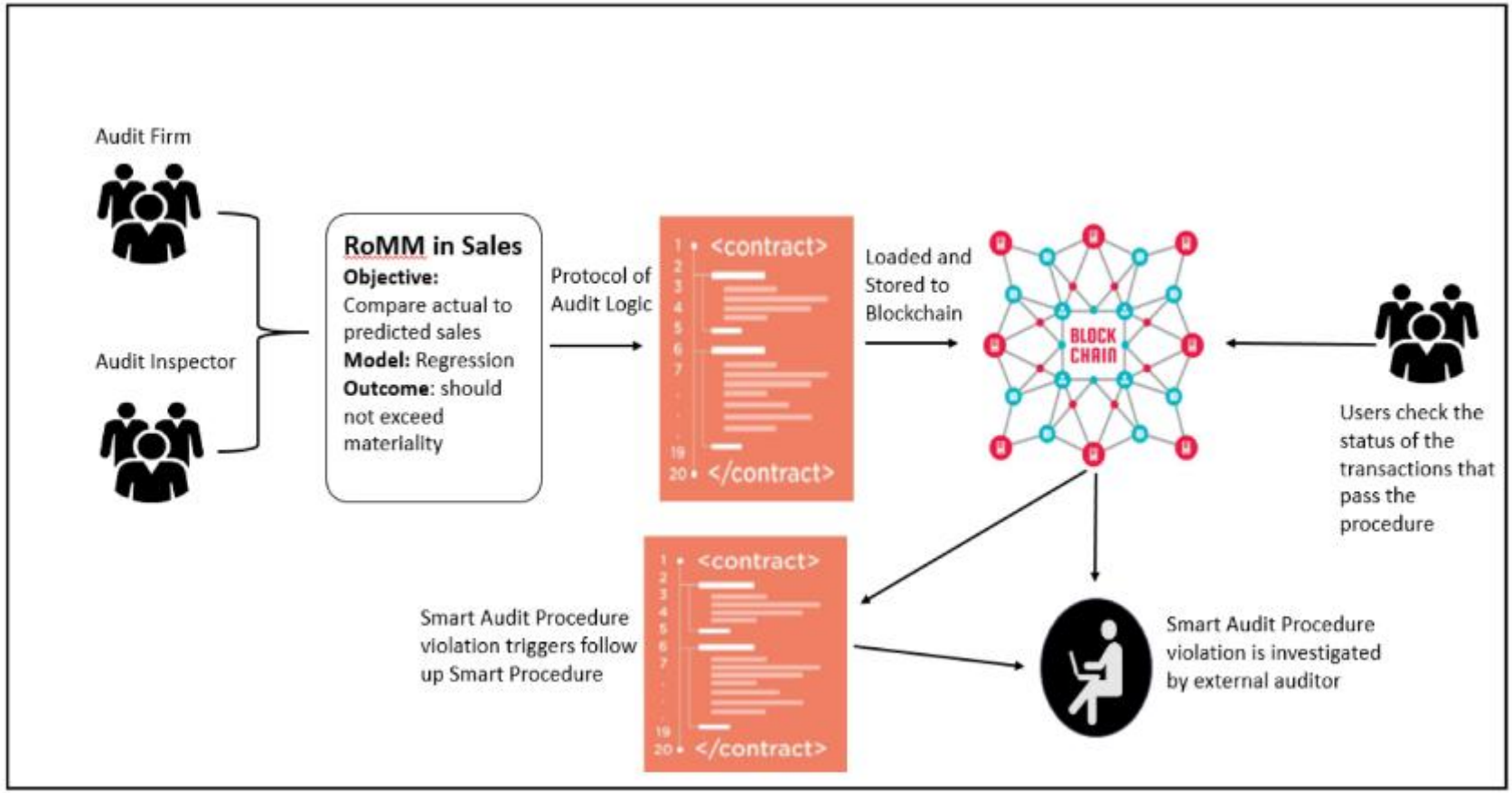
Smart Contracts Background and Relevance to Auditing

- Smart contracts are “computerized transaction protocol that executes the terms of a contract” (Szabo 1994)

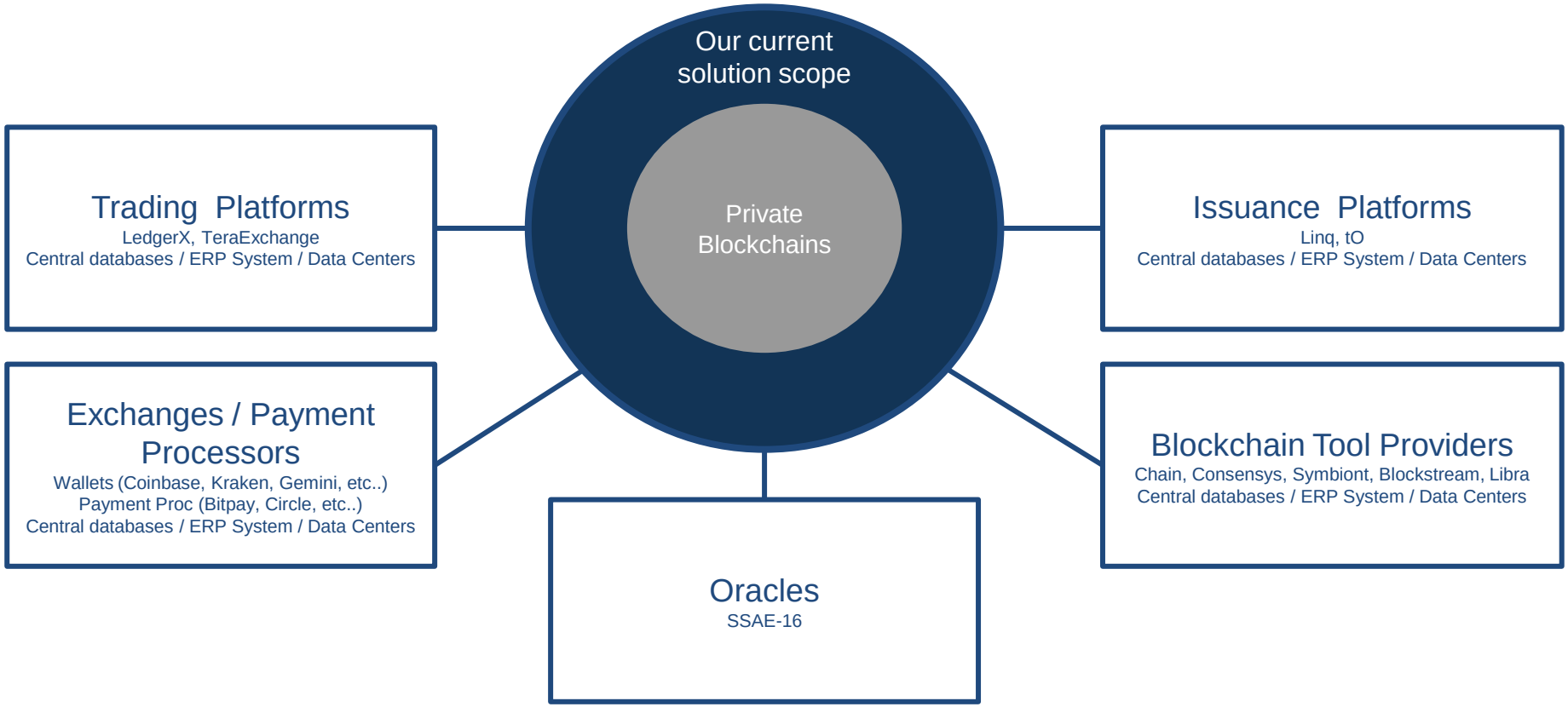


Smart Contracts Background and Relevance to Auditing (cont'd)

- Smart audit procedures can help reduce the expectation gap between the procedures auditors perform versus those procedures audit inspectors, and investors, expect them to perform



Initial Scope - Libra Blockchain Audit Tools



Conclusion

- Blockchain and smart contracts have the potential to disrupt business ecosystems and consequently, the audit ecosystem

- Smart audit procedures as a emerging audit analytic tools can change the way audits are performed

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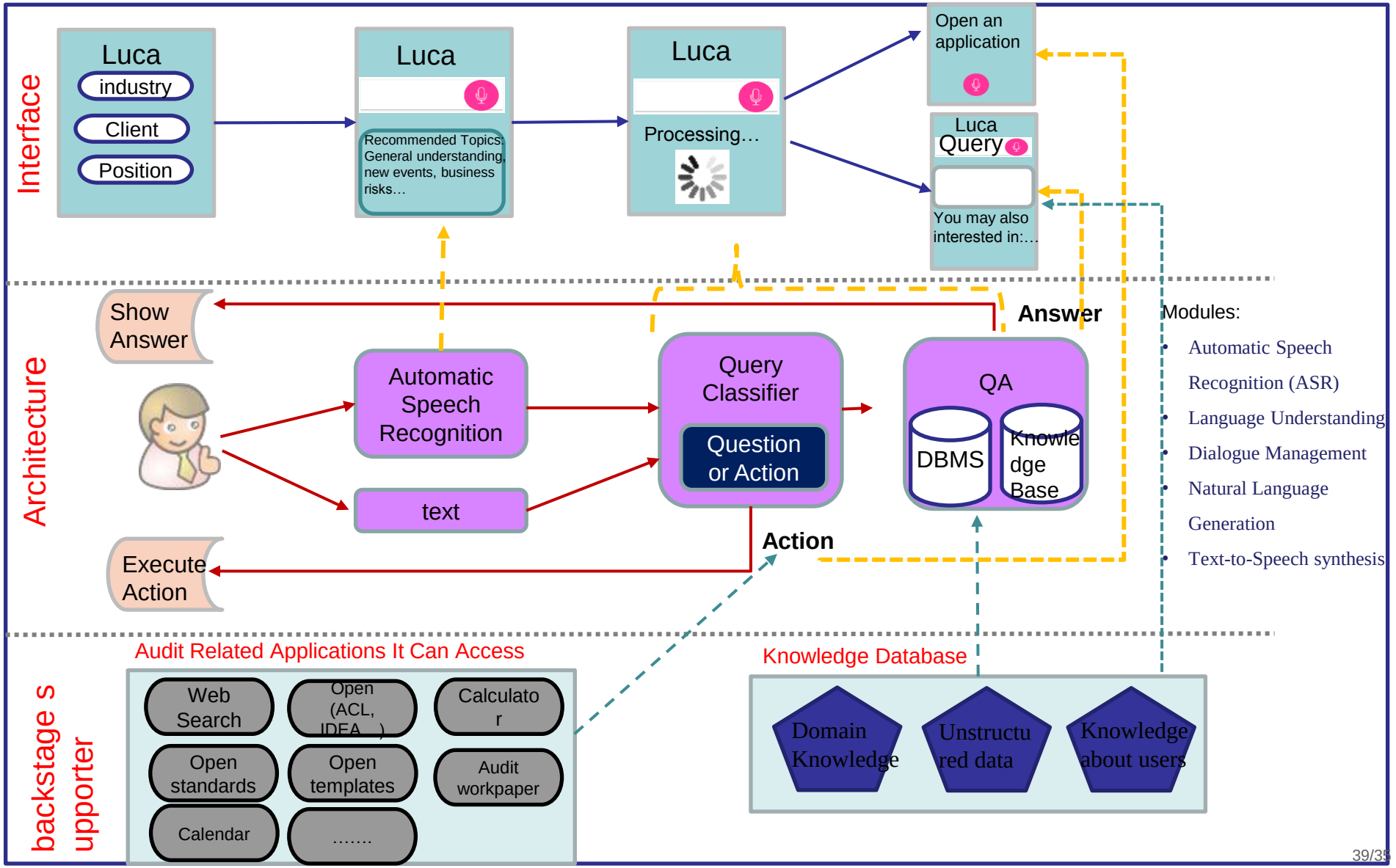
Developing A Cognitive Assistant For Audit Plan Brainstorming Sessions

Qiao Li

Rutgers Business School

Architecture of the Proposed Audit Cognitive Assistant



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APPLICATIONS OF DATA ANALYTICS: VISUALIZATION AND CLUSTER ANALYSIS OF GOVERNMENTAL DATA

Prof. Miklos Vasarhelyi
Zamil S. Alzamil

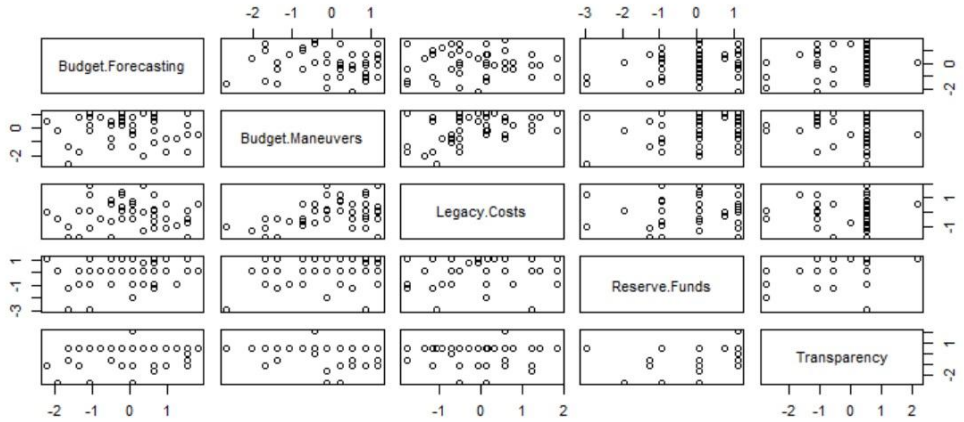
- **Data:** Volcker's Survey Results Data (Average Grades, 2015 - 2017).
  - How the U.S. states score on an annual basis on budgeting.
  - "Truth and Integrity in State Budgeting: What is the Reality?.", November 2, 2017.
- **Using five-variables:**
  1. Budget Forecasting.
  2. Budget Maneuvers.
  3. Legacy Costs.
  4. Reserve Funds.
  5. Transparency.
- **Methodology:**
  a. Data Visualization.
  b. Data Analytics: *k*-means & hierarchical cluster analysis.

DATA VISUALIZATION

Variables Correlation Coefficient

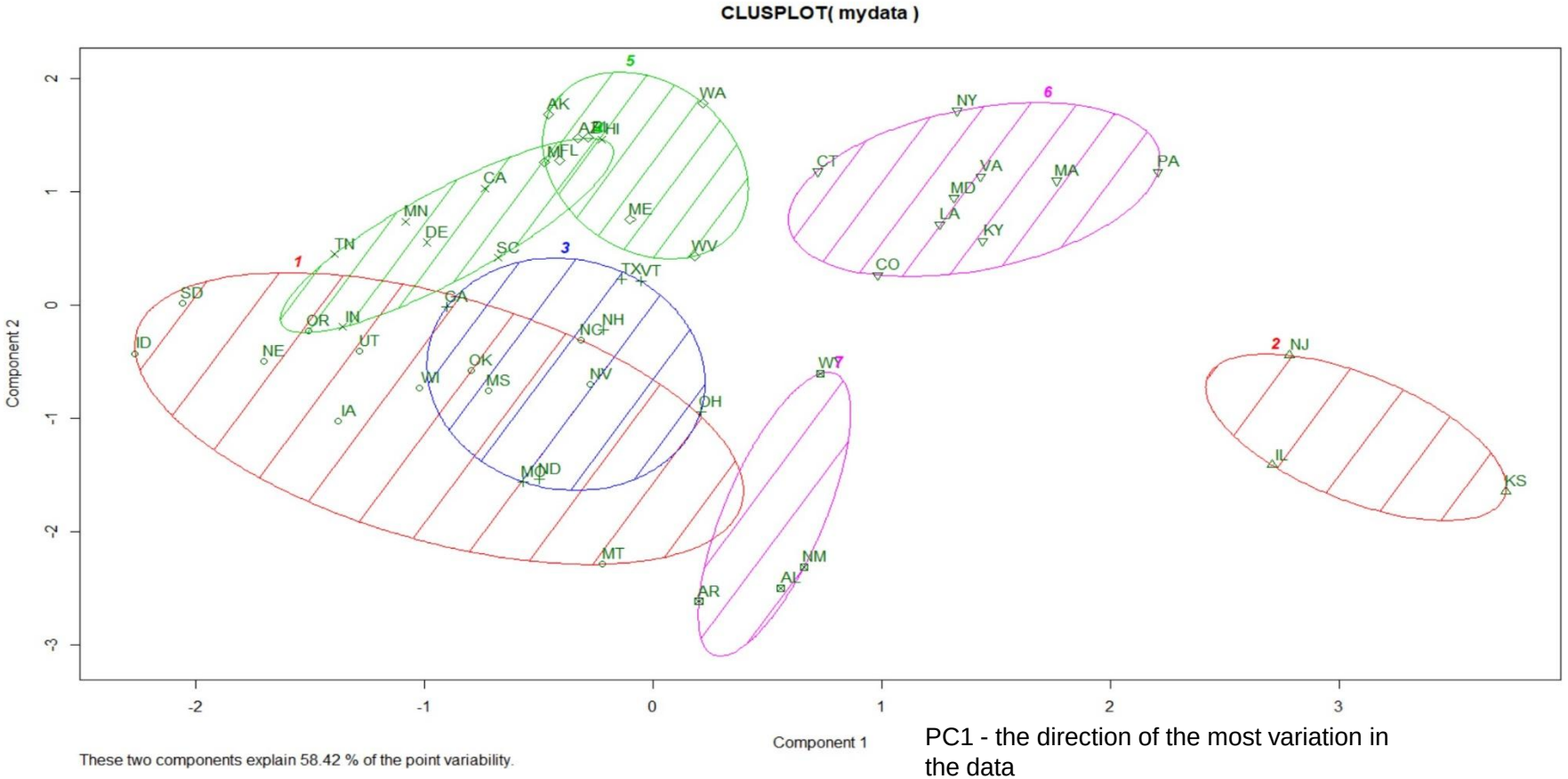
First we establish that there is a moderate correlation (relationship) between the variables of legacy costs and budget maneuvers (~0.512)

	Budget.Forecasting	Budget.Maneuvers	Legacy.Costs	Reserve.Funds	Transparency
Budget.Forecasting	1.000000000	-0.007919089	-0.03613848	0.25110021	0.18377649
Budget.Maneuvers	-0.007919089	1.000000000	0.51272449	0.22466741	-0.11578494
Legacy.Costs	-0.036138475	0.512724489	1.00000000	0.02784838	0.04485754
Reserve.Funds	0.251100213	0.224667415	0.02784838	1.00000000	0.09371242
Transparency	0.183776490	-0.115784941	0.04485754	0.09371242	1.00000000



- This analysis could assist in:
  - More insights into the survey results data.
  - Assist in selecting appropriate variables to build models.

K-MEANS CLUSTERING: Representation of Clusters Solution



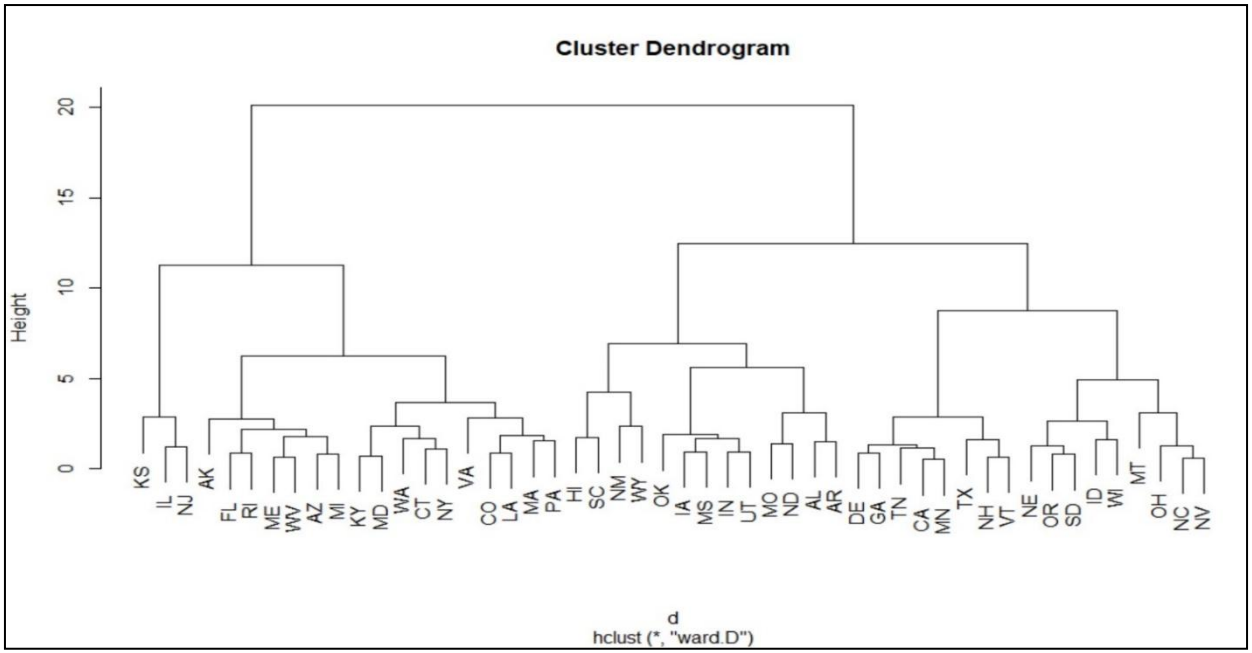
PC1 - the direction of the most variation in the data

CONT'D

- As shown from the previous figure, the states are clustered as follow (based on their scores of these five variables):
  1. Budget Forecasting.
  2. Budget Maneuvers.
  3. Legacy Costs.
  4. Reserve Funds.
  5. Transparency.

Cluster	Members
#1	ID, SD, NE, IA, UT, OR, WI, OK, MS, NV, NC, MT
#2	NJ, IL, KS
#3	TX, VT, GA, MO, ND, OH, NH
#4	TN, MN, DE, CA, HI, SC, IN
#5	AK, WA, AZ, FL, ME, WV, MI, RI
#6	CT, NY, PA, MA, VA, MD, LA, KY, CO
#7	NM, AL, AR, WY

Hierarchical Clustering: A dendrogram Representation of Clusters Solution



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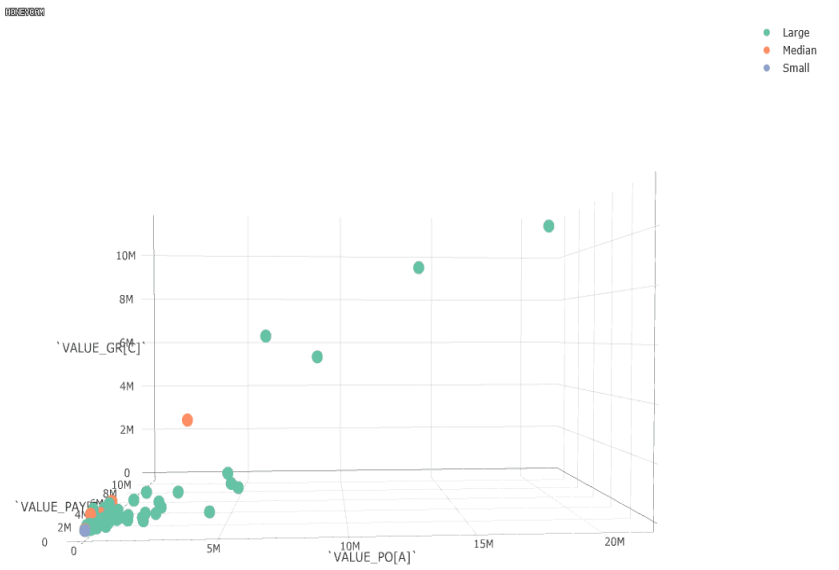
Dynamic Visualization as Audit Evidence

–Graduate School of Management
–Rutgers University

Dynamic Visualization as Audit Evidence

3D scatter Interactive Visualization

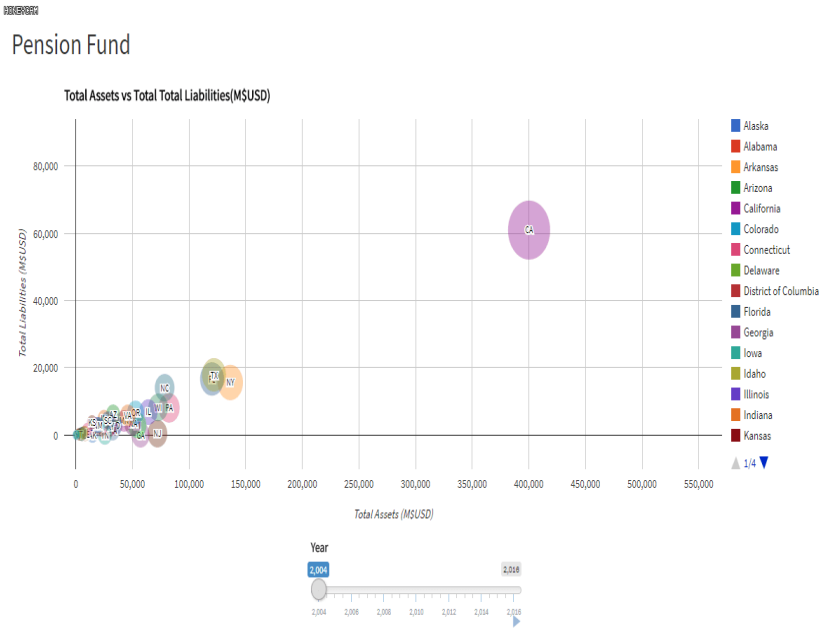


Interaticve+Analisys_R.html

- Use 3D scatter plot to investigate relationship between more than three values and identify potential risks
- Provides more information than using 2D plot
- Process Mining Data Log
  - Value of Purchase Order
  - Value of Payment
  - Value of Goods Received

Dynamic Visualization as Audit Evidence (cont'd)

Time Series Interactive Visualization



- Investigate the time change of more than 2 values
- Select only cases you want to examine with Interactive Visualization Technique
- See how the target changes compared with other cases
- 50 States Comprehensive Annual Financial Report(CAFR) Pension Fund Balance Sheet (2004 – 2016)
  - Total Liabilities
  - Total Assets

The DATA Act

Timeline of the Grantee Pilot Program:

Date	DATA ACT/PILOT PROGRAM EVENT
5/09/2014	DATA ACT passed into law
5/09/2015	Pilot Program begins with selected grant recipients
5/09/2017	Pilot program finishes
5/09/2018	OMB reports results to Congress
8/09/2018	OMB decides to require (or not) grant recipients to report in the format required by the DATA ACT

The DATA Act

Pilot Program:

- Affects state and local governments, transportation authorities, hospitals, universities, charities and not-for-profits
- Little standardization in accounting practices across jurisdictions and recipients (Bloch et al 2015)
- Standardization of data terms/definitions
- Reports must be published in machine readable transparent format

Federal Level:

- Separated reports and agencies will now be standardized
- Newly formed central reporting website www.usaspending.gov where all will file statements and reports will be published
- Currently all financial statements are in PDF: DATA Act requires that reports be in machine-readable and open data format, such as that of XBRL

US Open Data Initiatives

- http://www.data.gov
- http://www.ohiocheckbook.com
- https://data.austintexas.gov/
- http://www.transparency.utah.gov
- http://www.data.cityofchicago.gov
- http://www.checkbooknyc.com/
- https://data.cityofnewyork.us/
- http://www.data.detroitmi.gov
- https://www.usaspending.gov/Pages/Default.aspx

In Brasil, ahead of the US

- Data Portal
- SPED
- SICONFI
- etc

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Deep Learning

Ting Sun and Miklos Vasarhelyi
Rutgers Business School
July 24, 2016

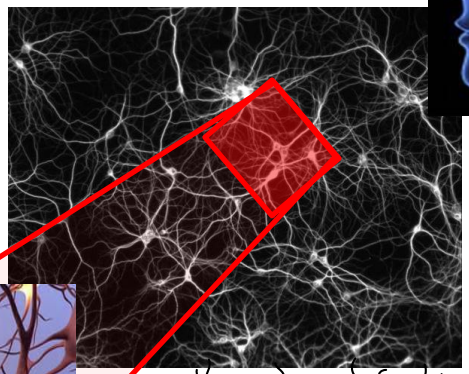
What is deep learning?

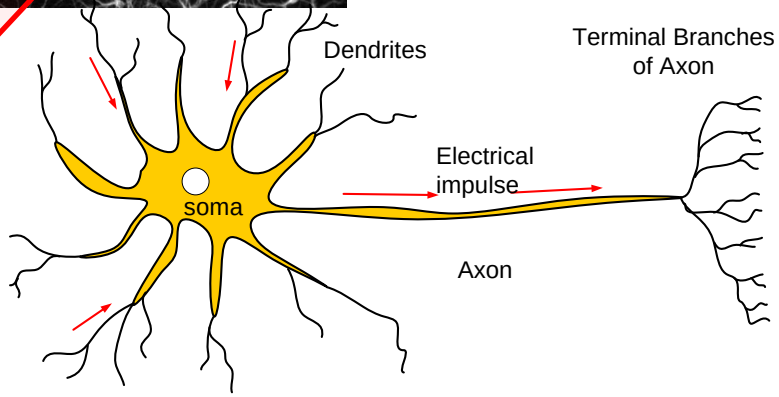
Deep learning mimics how a human brain thinks. It makes a machine think like human.

“The general idea of deep learning is to use neural networks to build multiple layers of abstraction to solve a complex semantic problem.”

-- Aaron Chavez, formerly chief scientist at Alchemy API

Biological Neurons

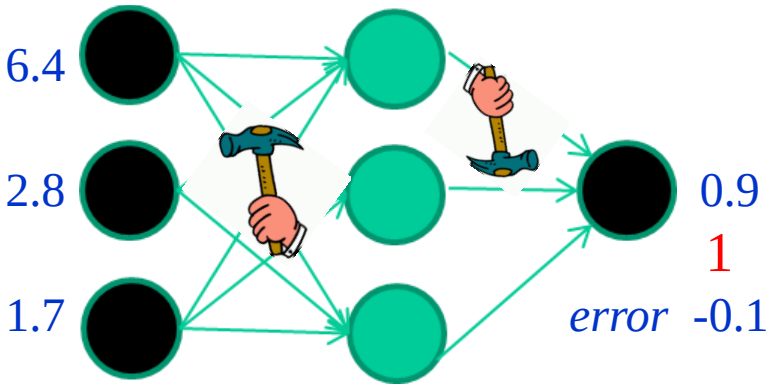




Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

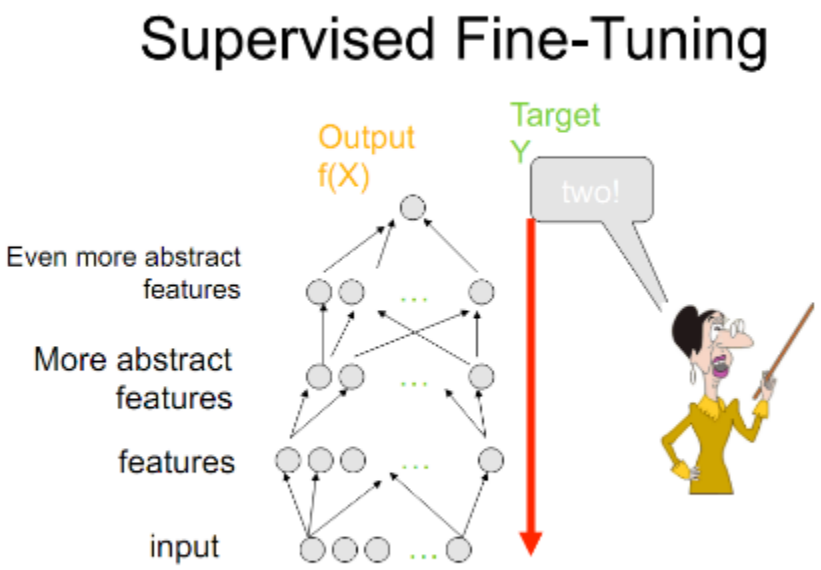
And so on ….



Repeat this thousands, maybe millions of times – each time taking a random training instance, and making slight weight adjustments

Algorithms for weight adjustment are designed to make changes that will reduce the error

Deep neural network



ANN vs. DNN: The depth of the hidden layers

Extract features from unstructured data like image, audio, video and text

As layers go further, it recognizes more advanced and more abstract features of data

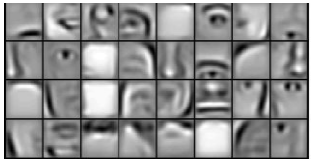
Each successive layer uses features in the previous layer to learn more complex features

Each hidden layer going further into the network is a weighted non-linear combinations of the lower level layers

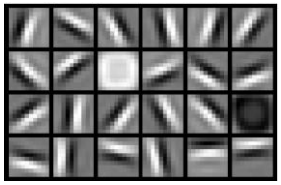
The entire deep learning process is about refining the weights

object models

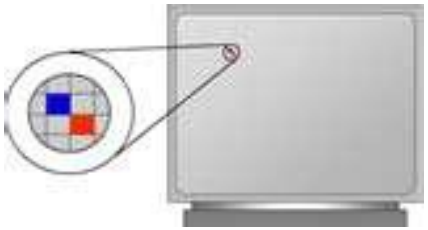
object parts (combination of edges)



edges



pixels



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DEEP LEARNING APPLICATIONS IN AUDIT DECISION MAKING

Dissertation Defense

Ting Sun

Dissertation Committee
Chair: Dr. Miklos A. Vasarhelyi
Dr. Alexander Kogan
Dr. Helen Brown-Liburd
Dr. Rajendra P. Srivastava

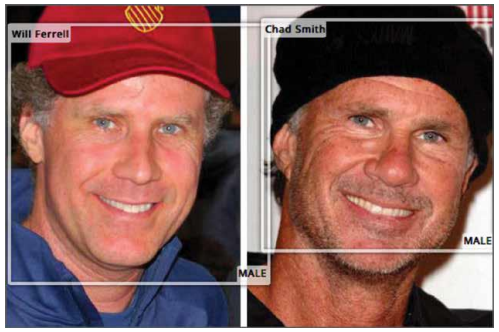
April 16, 2018

Outline

- **Introduction**
- ***Essay One*:** The Incremental Informativeness of Management Sentiment in Conference Calls for the Prediction of Internal Control Material Weaknesses
- ***Essay Two*:** The Performance of Sentiment Features of MD&As for Financial Misstatements Prediction: A Comparison of Deep Learning and Bag of Words Approaches
- ***Essay Three*:** Predicting Audit Fees with Twitter: Do the 140 Characters reveal a company's audit risk?
- **Conclusion, Limitation, and Future Research**

Examples of applications

- Voice search/voice-activated assistants: NL
- Recommendation engines: scan, keywords
- Image recognition
- Image tagging/image search: google+
- Textual analysis



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Design of Apps for Armchair Auditors to Analyze Government Procurement Contract

Jun Dai
Rutgers University

Qiao Li
Rutgers University

Miklos A. Vasarhelyi
Rutgers University

Introduction

Government procurement:

- 10%-15% of GDP; 7 trillion dollars annually in U.S.
- Not always Open and Transparent
- Fraud schemes:

bid rigging, bribery, kickbacks, cost mischarging, defective pricing, product substitution …

Introduction

What data to use?

Who has interest?

How to detect anomalies?

Background

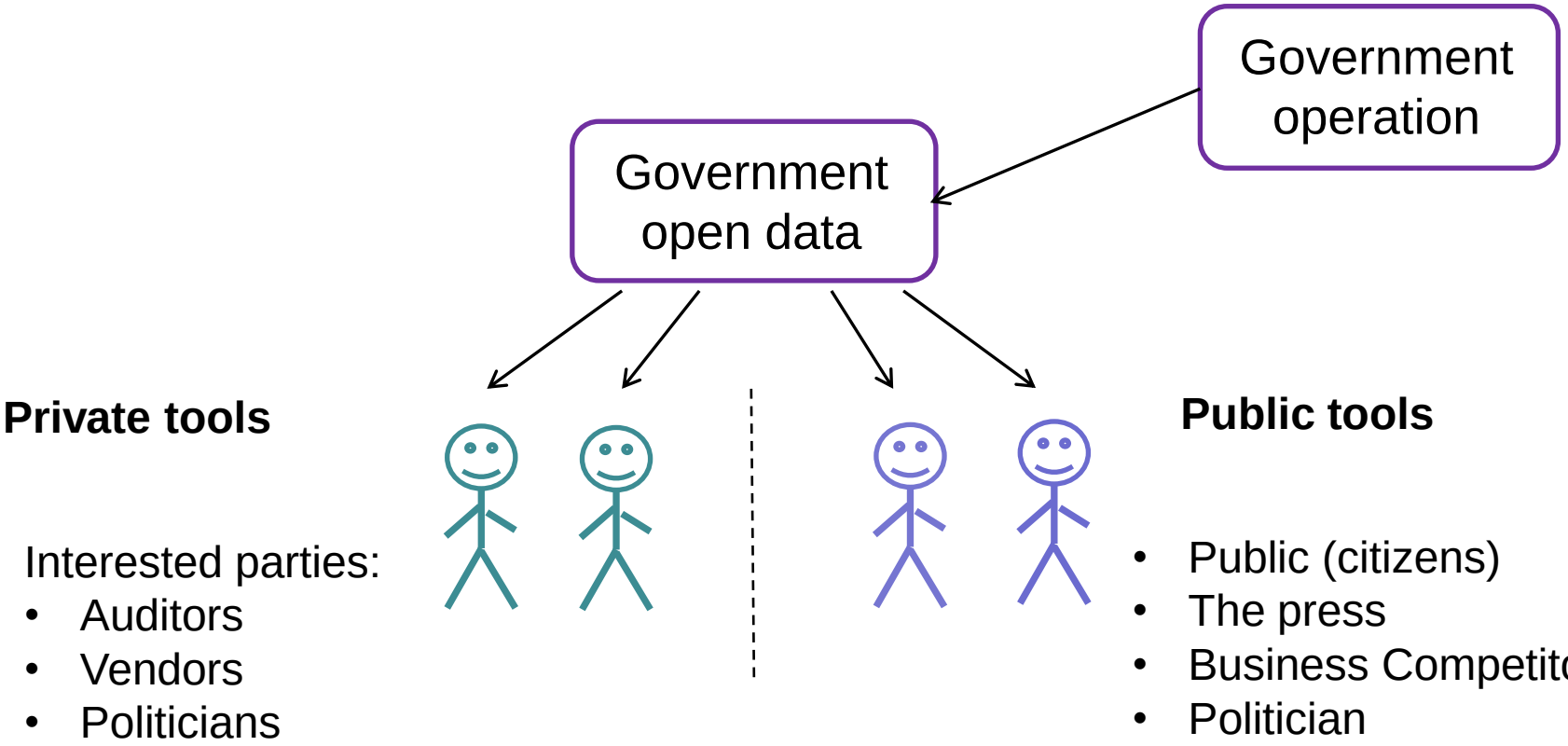
Open Data Initiatives

- Make info available and transparent
- 45 countries and 163 international regions
- U.S.
  - Data.gov
  - 39 states and 46 cities and counties
  - formats: Excel, CSV, XML, API, HTML, open XML, text, pdf
- Government procurement data:
  - China: ccgp.gov.cn
  - Australian: tenders.gov.au
  - Canada: buyandsell.gc.ca
  - Brazil : dados.gov.br
  - UK: gov.uk

Background

"Armchair Auditor"

-- Crowdsourcing analysis of government data (DE O'Leary, 2015)
-- Informal, voluntary and no requirements



Background

"Armchair Auditor"

- Pilot projects:
  - 2 English councils: Isle of Wight council and Hull City council
  - calculated government payments information

- Achievements
- in 2011, a group of activists uncovered a £1.3m audit scandal at their local council (Patrick, 2011; Patrick, 2011)

- Barrier:
- Quality and comparability of information
- Tools and knowledge
- Rules and community

Objective

Although we have open government data,
few studies discuss:

- how to use
- what tools

This paper :

Propose a list of audit apps that help armchair auditors to

- analyze open government procurement data
- Spot anomalies and identify potential issues
- find out suspicions contracts which have higher probability of fraud

Why Audit Apps

What is it

- Formalized audit procedures that are performed through computer scripts (Dai et al. 2014)

Example

- Caseware and ACL: test journal entries, account payable, assets, etc

Advantages

- simplify data analytics procedures, require few user interactions, improve audit quality

No apps for open government data analysis or for non-professional auditors such as “armchair auditors”

Proposed Apps for Government Expenditure Audit

Anomaly Type:

1. Data incompleteness and unreliability

No.	Purpose of the app	Data needed	Anomaly Indicator
1	Contract values check (unusual “0” and tiny)	initial values of contracts	Unusual number in the values, such as 0, 0.01,0.05
2	Data Completeness and Integrity Check (Missing suppliers / biding mode/ dates)	contracts data	Missing values

2. Unqualified suppliers

No.	Purpose of App	Data needed	Anomaly Indicator	Potential Fraud
1	Relationship check (gov. personnel VS contractor)	Background information of both parties	employment of contractor or sub-, or their family member in government personnel	Bribery, Kickback
2	Contractor qualification check (“blacklist” companies)	Contractor information, “blacklist”	Contractor once occurred in the “blacklist”	
3	“Waived bidding” contracts check	Bidding type information	firm has very high percentage of “waived bidding” contracts in all contracts with gov	
4	Bids wining history check	Statistic contract data	a certain contractor always or never wins a bid, or all contractors win an equal volume of contracts over time	bid rigging

3. Unnormal prices

No.	Purpose of App	Data needed	Anomaly Indicator	Potential Fraud
1	Contract prices comparison (gov. VS other clients)	Prices to different clients	Contractor submit higher price bids to government for exactly same product /service	bid rigging
2	Split purchases detection	Contract	Contracts with same suppliers, same dates and same goods	
3	Winning price prediction (Regression)	Bidding process	Abnormal winning price	bid rigging

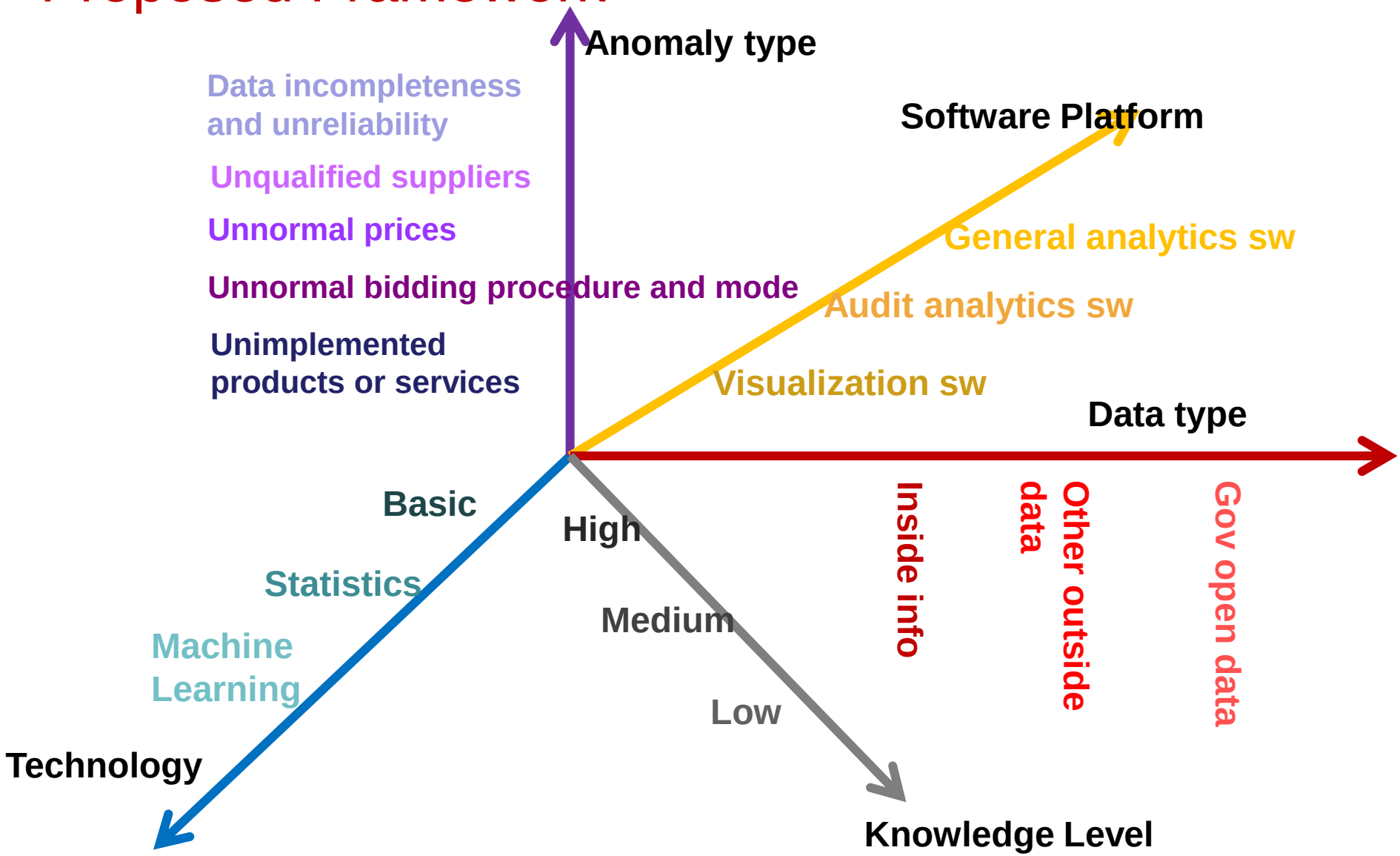
4. Unnormal bidding procedure and mode

No.	Purpose of App	Data Needed	Anomaly Indicator	Potential Fraud
1	Monopoly check	Market data	only very fewer suppliers	bid rigging, Collusion
2	Bidders withdraw detection (in a short time period)	Bidding process information	Qualified bidders inexplicably withdraw valid bids	bid rigging
4	Law check	Procurement law; bidding mode	The bidding process doesn't comply with the law (such as waive of bidding)	Bribery, Kickback

5. Unnormal products or services implementation

No.	Purpose of the app	Data needed	Anomaly indicator	Potential Fraud
1	Address check (company's & delivery)	addresses	Delivery location is not the office, plant, or job site	Charging for products not used or services not rendered
2	Weird working hours check	invoices	Employees bill for more hours than typically worked in a day	See above

Proposed Framework



Proposed Audit apps	Anomaly type	Data	Techniques	Software Platform	Knowledge Level
Descriptive dashboard	Data incompleteness and unreliability	Contract	Descriptive Analysis	Qilk sense	Medium and above
Missing values	Data incompleteness and unreliability	Contract	Query	IDEA	Low and above
Split purchases	Contracts with same suppliers, dates and goods	Contract	Matching	SAS	Medium and above
Winning price prediction	Abnormal winning price	Bidding process; Goods and service	Regression	R	Medium to high and above
Suppliers cluster	Unqualified suppliers	Contract; Supplier; Bidding process	Clustering	R	Medium to high and above
Abnormal actions in a bidding	Unfair bidding process	Biding process	Classification	R	Medium to high and above

Illustrations

Data:
Contracts of Brazil federal government from 1989 to 2014 from SIASG (Brazilian public federal procurement information system)

1. Descriptive dashboard

Software : Qlik Sense Enterprise

-- dashboard for visualization

Descriptive Analysis App

Modalidade da Licita...

- 01: CONVITE
- 02: TOMADA DE PREÇOS
- 03: CONCORRÊNCIA
- 04: CONCORRÊNCIA INTER...
- 05: PREGÃO
- 06: DISPENSA DE LICITAÇÃO
- 07: INEXIGIBILIDADE DE LI...
- 20: CONCURSO

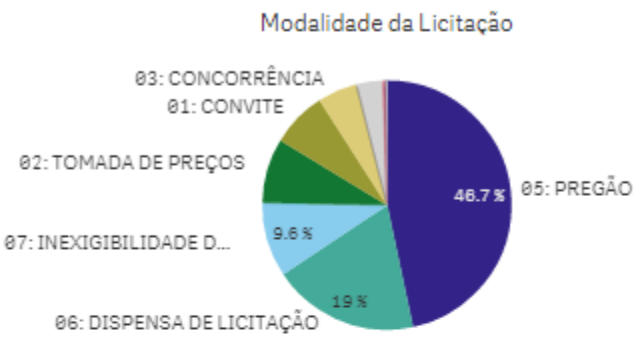
Contratada

- Fornecedor 00.000.000/00...
- Fornecedor 00.000.000/00...
- Fornecedor 00.000.000/00...

UASG

- 020001: SENADO FEDERAL
- 060001: STM _ SUPERIOR T...
- 060020: STM-3A.AUDITORI...

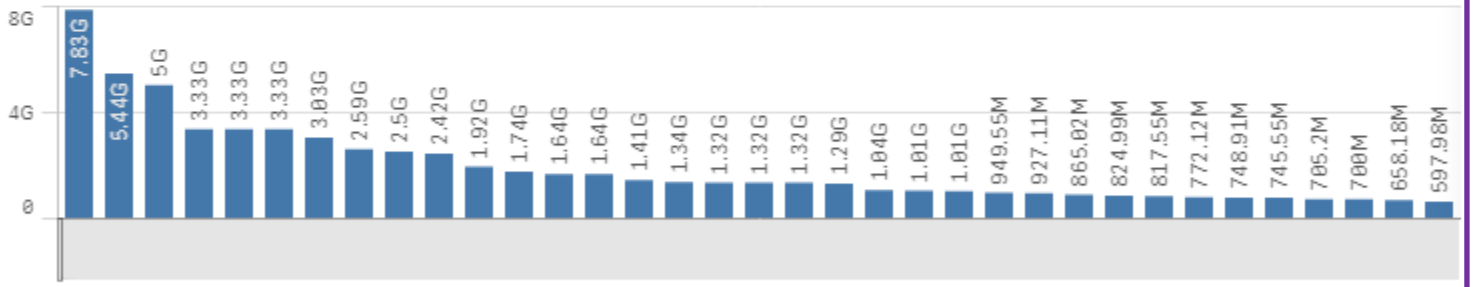
Analyze by Bidding Mode



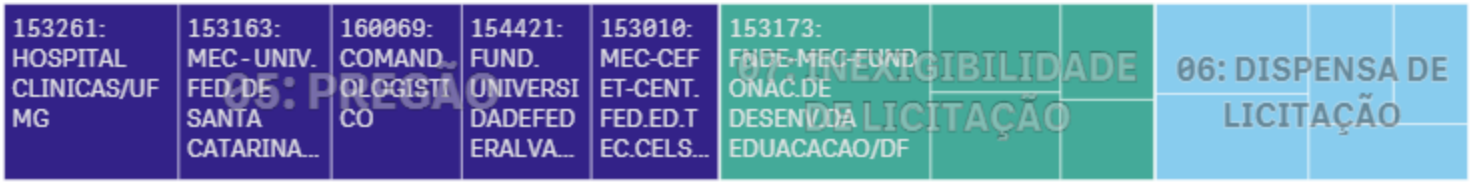
Contract Value by bidding Mode

Modalidade da Li...	avg([Valor inicial])
-	3496645
99: null	67013472
44: CONCORRÊNCIA INTERNACIONAL POR TÉCNICA E PREÇO	5866328.8
04: CONCORRÊNCIA INTERNACIONAL	5737919.4

Top contract value



Analysis by UASG



Data incompleteness and unreliability Check

Software : Caseware IDEA

-- Integrity Check for Missing Contractors

App script

```
Sub Main
	Call ExcelImport()		'C:\Users\Administrator\Downloads\integrity check.xlsx
	Call DirectExtraction()	'integrity check3-Sheet2.IMD
End Sub


' File - Import Assistant: Excel
Function ExcelImport
	Set task = Client.GetImportTask("ImportExcel")
	dbName = "C:\Users\Administrator\Downloads\integrity check.xlsx"
	task.FileToImport = dbName
	task.SheetToImport = "Sheet2"
	task.OutputFilePrefix = "integrity check3"
	task.FirstRowIsFieldName = "TRUE"
	task.EmptyNumericFieldAsZero = "FALSE"
	task.PerformTask
	dbName = task.OutputFilePath("Sheet2")
	Set task = Nothing
	Client.OpenDatabase(dbName)
End Function

' Data: Direct Extraction
Function DirectExtraction
	Set db = Client.OpenDatabase("integrity check3-Sheet2.IMD")
	Set task = db.Extraction
	task.IncludeAllFields
	dbName = "Integrity check - Contractors.IMD"
	task.AddExtraction dbName, "", "@IsBlank( CONTRATADA )"
	task.CreateVirtualDatabase = False
	task.PerformTask 1, db.Count
	Set task = Nothing
	Set db = Nothing
	Client.OpenDatabase (dbName)
End Function
```

Sample results

	IDENTIFICADOR_DO_CONTRATO
1	11460650000011984
2	15404753000011984
3	15404753000011986
4	17011650000011988
5	51208450000011992
6	51211150000011992
7	17011950000011990

Integrated results:

For contracts that lost contractor records, 90% belong to waived bidding

In 470,683 contracts,

- 35,516 contracts lose contractor information
- 6,167 contracts lose bidding mode
- 1,000 contracts lost valid dates

Data incompleteness and unreliability Check

Software: Caseware IDEA

-- unusual initial values

App script

```
Sub Main
        Call ExcelImport()          'C:\Users\Administrator\Downloads\initial value.xlsx
        Call DirectExtraction()     'initial value2-Sheet1.IMD
End Sub


' File - Import Assistant: Excel
Function ExcelImport
        Set task = Client.GetImportTask("ImportExcel")
        dbName = "C:\Users\Administrator\Downloads\initial value.xlsx"
        task.FileToImport = dbName
        task.SheetToImport = "Sheet1"
        task.OutputFilePrefix = "initial value2"
        task.FirstRowIsFieldName = "TRUE"
        task.EmptyNumericFieldAsZero = "FALSE"
        task.PerformTask
        dbName = task.OutputFilePath("Sheet1")
        Set task = Nothing
        Client.OpenDatabase(dbName)
End Function

' Data: Direct Extraction
Function DirectExtraction
        Set db = Client.OpenDatabase("initial value2-Sheet1.IMD")
        Set task = db.Extraction
        task.IncludeAllFields
        dbName = "small value.IMD"
        task.AddExtraction dbName, "", " VALOR_INICIAL  < 0.1"
        task.CreateVirtualDatabase = False
        task.PerformTask 1, db.Count
        Set task = Nothing
        Set db = Nothing
        Client.OpenDatabase (dbName)
End Function
```

Sample results

IDENTIFICADOR_DO_CONTRATO	VALOR_INICIAL
17007854000011994	0.00
17005854000011996	0.00
15326654000011996	0.00
15325454000011996	0.00
15326654000011996	0.00
15325454000011996	0.00
15301752000011996	0.00
20100454000012000	0.00
15303252000011996	0.00
25502652000012000	0.00

Integrated results:

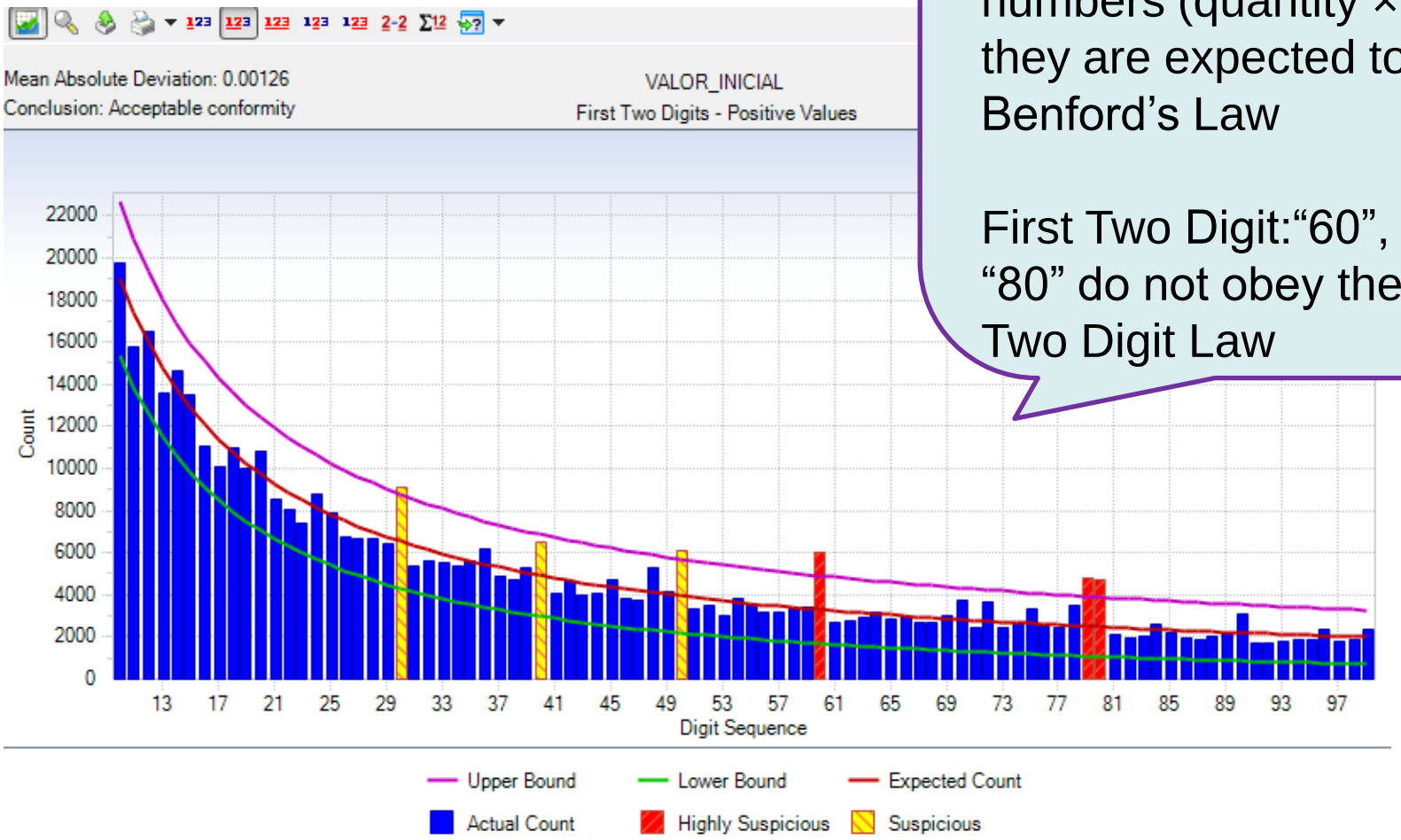
501 contracts that have “0” value after removing contracts pertaining to government departments

527 contracts have values that <1; the values are 0.01, 0.05, 0.1, and 0.53 Brazilian real

Unnormal prices

Software: Caseware IDEA

-- Benford's Law Check



Widely used for accounting fraud detection

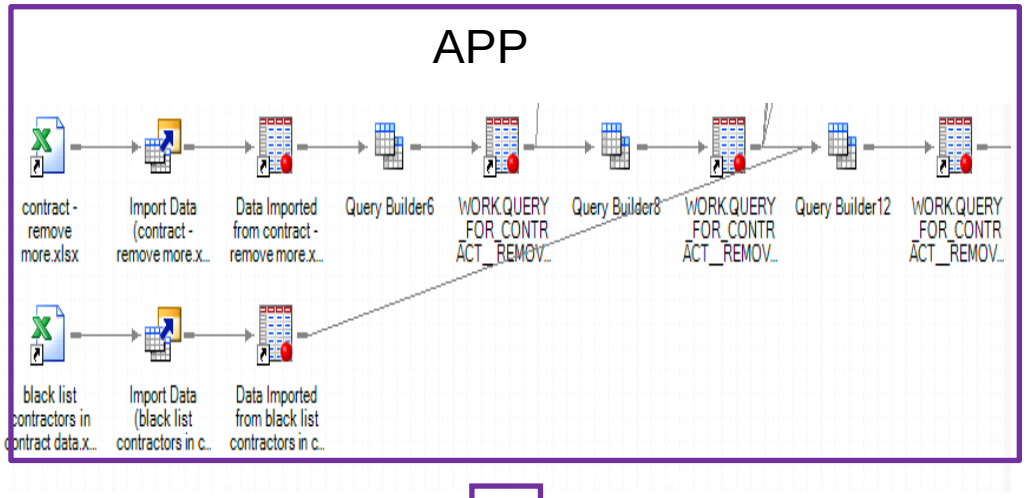
Values should come from mathematical combination of numbers (quantity × price), they are expected to obey Benford's Law

First Two Digit:"60", "79" and "80" do not obey the First Two Digit Law

Unqualified suppliers

Software: SAS

--“black list” Contractor Detection



Sample results

Contractor	Frequency
33.000.118	1717
00.212.655	405
29.739.737	404
10.788.628	375
00.329.379	345

Integrated results:

- 25,100 contracts are made with contractors listed in the blacklist
- 1,936 unique suspicious contractors (firms)

Unnormal bidding mode

Software: Excel
-- Big Data Collection

legal foundation explaining why the contract can waive bidding processes

Contract ID	Bidding Mode	Objective	Link to legislation
11460650000011984	06: DISPENSA DE LICITAÇÃO	Contratação de imóveis para instalação da Agência do IBGE nomunicípio de Conceição do Araguaia/PA.	De acordo com artigo 24, Inciso X, da Lei 8.666/93 C/CR.PR. 06/96, ARTIGO 3.
38004450000011992	06: DISPENSA DE LICITAÇÃO	Contrato de locação do imovel da Av. Dr. Vicente Machado n.º 362 - Curitiba/PR.	Art. 24, Inciso X, da lei 8666/93.
17011650000011988	07: INEXIGIBILIDADE DE LICITAÇÃO	Contrato nº 01/88 tem por objeto a locação dos imóveis nºs 26, 38 e44 da Praça Oliveira Figueiredo, Barra do Piraí, Estado do Rio de Janeiro.	Decretos-Leis nos. 2300/86 e 2348/87 e Lei 6649/79
17011950000011990	06: DISPENSA DE LICITAÇÃO	Locação dos imóveis de nos. 26, 38 e 44 da Praça Oliveira Figueire-do para abrigar a Agência da Receita Federal em Barra do Pirai	Decretos-Leis nos. 2300/86 e 2348/87 e Lei 6649/79

Limitations and Future Research

- Design, improve and test the apps
- developing rule-based algorithm for improved government procurement anomoly detection, applying the idea of exceptional exception (Issa, 2013) to rank suspicious contracts based on predefined rules

RUTGERS
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TO WRAP UP!

W

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- Accrued liabilities
- Bonds payable
- Collateralized borrowing
- Deferred loss on refunding
- Derivative instruments
- Due to Federal government
- Due within one year
- Lottery prizes payable
- Notes payable
- Obligations under lease/purchase and other financing arrangements
- Other long-term liabilities
- Other postemployment benefits
- Payable to local governments
- Pension contributions payable
- Pollution remediation
- Tax refunds payable

dern

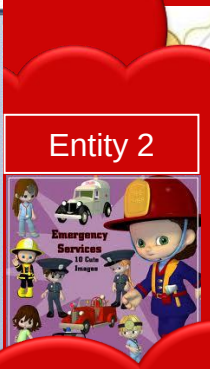
Customizable reports

GASB GOVERNMENTAL ACCOUNTING STANDARDS BOARD

- Provide customized reports
- Facilitate the diffusion of financial information

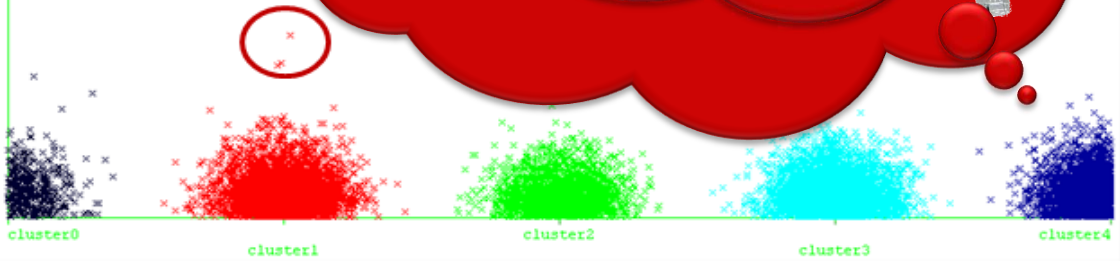
XBRL enables two foreign computers to communicate

What we expect fr



On Demand
Continuous Audit
& Monitoring
Reports

- Facilitate acces
- Eventually enab
  reports (continu



Thank you!