Introduction to Data Science Module 3

Data Types and Storage

FIT1043 2017 Lecture 4

Monash University

Reminder: Assessment

- all the Python you need to know is covered in tutorials

- Assignment 1: motion chart using Python code
  - Also: expect a question in exam like:
  - "compare Python as a data science tool with X" or
  - "interpret a given line of Python code"…

- the exam is based on the lectures
  - use Alexandria as readings to support understanding

Discussion: Python Language

- easy to learn
- flexible and multi-purpose
- great libraries
- good visualization for basic analysis

Unit Schedule: Modules

Module	Week	Content
1.	1	Overview and look at projects
	2	(Job) roles, and the impact
2.	3	Data business models / application areas
3.	4	**Characterising data and "big" data**
	5	**Data sources and case studies**
4.	6	Resources and standards
	7	Resources case studies
5.	8	Data analysis theory
	9	Regression and decision trees
	10	Data analysis process
6.	11	Issues in data management
	12	GUEST SPEAKER & EXAM INFO

Characterising Data (ePub section 3.1)

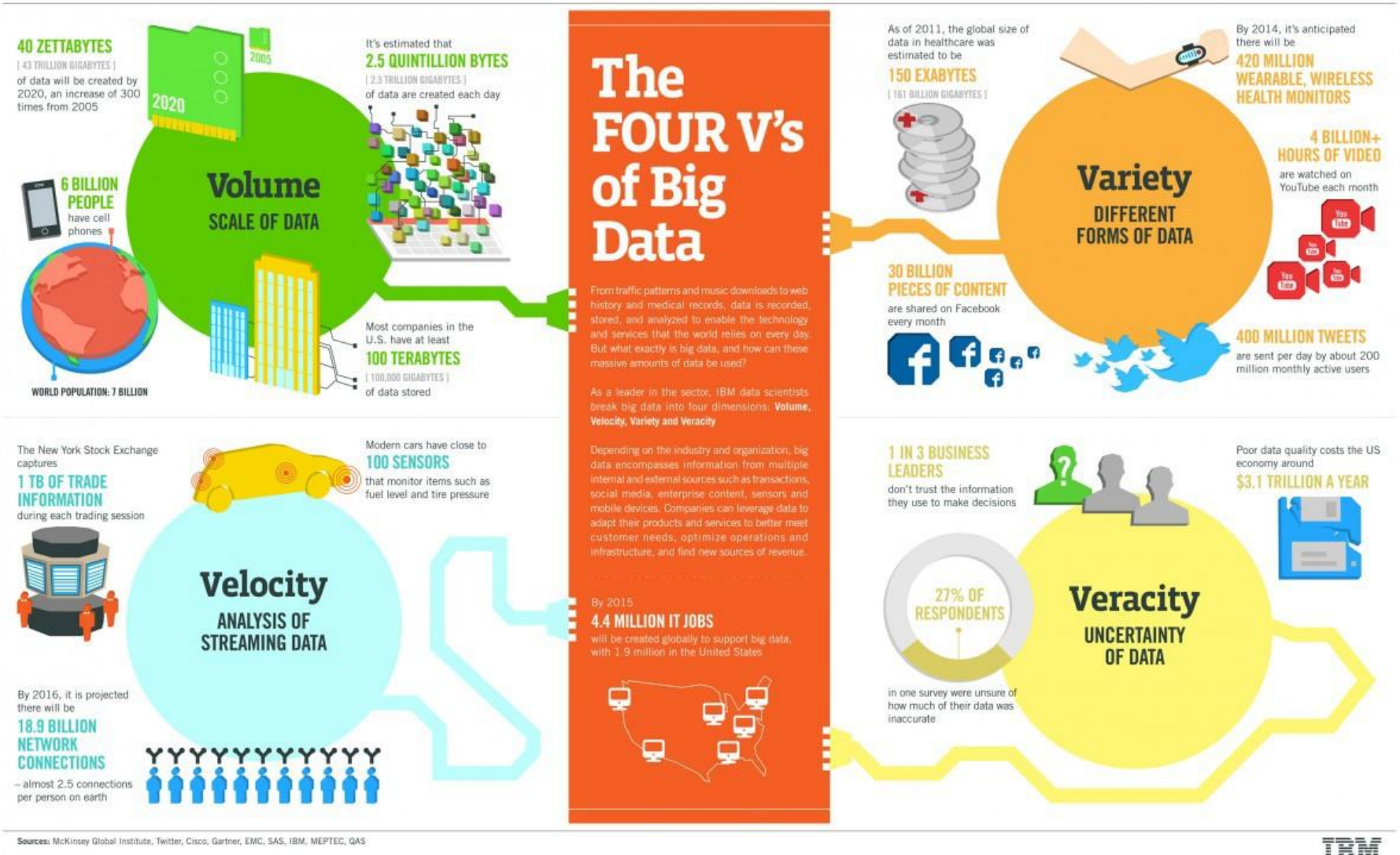
some general characteristics of data sets used to assess a data science project

- the Four V's of big data
- metadata
  - data about data is critical to understanding
- growth laws
  - understanding the exponential growth

Characterising Data
The V's

The Four V's of Big Data

"The Four V's of Big Data," by IBM (infographic)



Big Data

From *Big data* on Wikipedia:

> *Big data usually includes data sets with* **sizes beyond the ability of commonly used software tools** *to capture, curate, manage, and process data within a tolerable elapsed time. Big data "size" is a constantly moving target, ...*

Big Data and “V”s

- 2001 Doug Laney produced report describing 3 V’s:

  “3-D Data Management: Controlling Data Volume, Velocity and Variety”

- these characterise bigness, adequately
- other V’s characterise problems with analysis and understanding

  Veracity: correctness, truth, *i.e.*. lack of ...
  Variability: change in meaning over time, *e.g.*, natural language

- think of any more? write a blog!

MARS Question

The 3Vs of big data are important because:

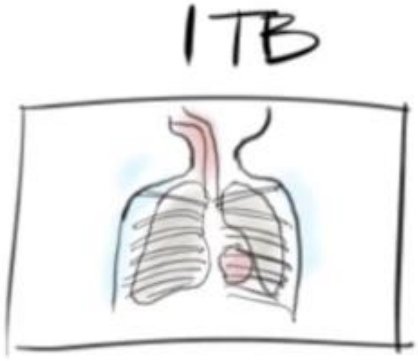
A. they are an industry standard.
B. they are the basis for the development of more Vs (e.g. Value).
C. they are used to describe in what way a dataset may be too big to handle.
D. they are from the influential Gartner Inc.

MARS Question

video "*Big Ideas: How Big is Big Data?*" by Patricia Florissa

Which of the following is considered as big data?

A. power point presentation



B. Healthcare image

C. Movie

Summary

BIG DATA is ANY attribute that challenges CONSTRAINTS of a system CAPABILITY or BUSSINESS NEED

Characterising Data
Metadata

data about data is critical to understanding

MetaData

metadata ::= structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use or manage an information resource.

metadata is:

- **data about data**
- **structured** so that a computer can process & interpret it

Why Use Metadata

- facilitate data discovery
- help users determine the applicability of the data
- enable interpretation and reuse
- clarify ownership and restrictions on reuse

MetaData (cont.)

MetaData can be:

Descriptive: describes content for identification and retrieval
e.g. title, author of a book

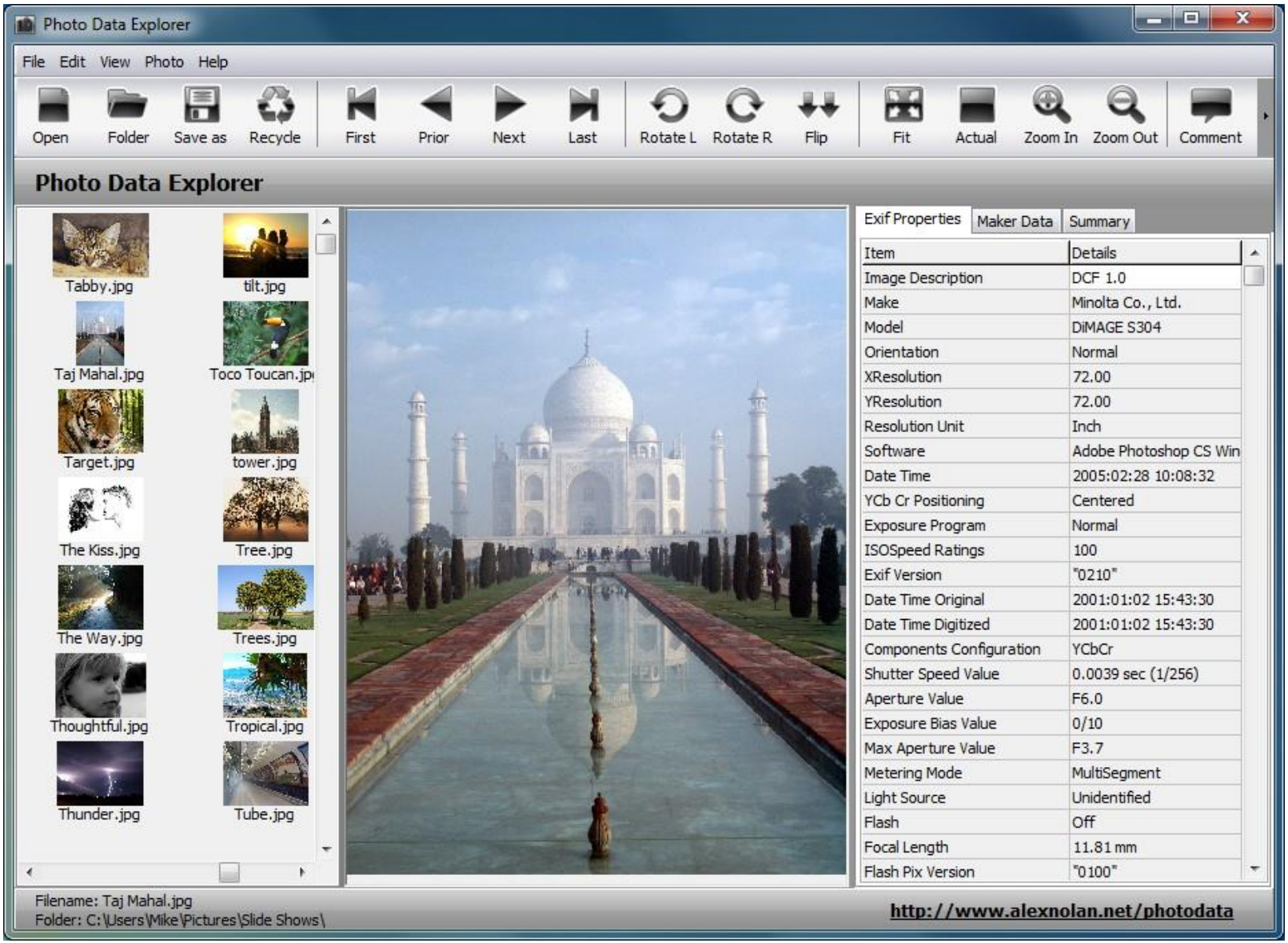
Structural: documents relationships and links
e.g. chapters in a book, elements in XML, containers in MPEG

Administrative: helps to manage information
e.g. version number, archiving date, Digital Rights Management (DRM)

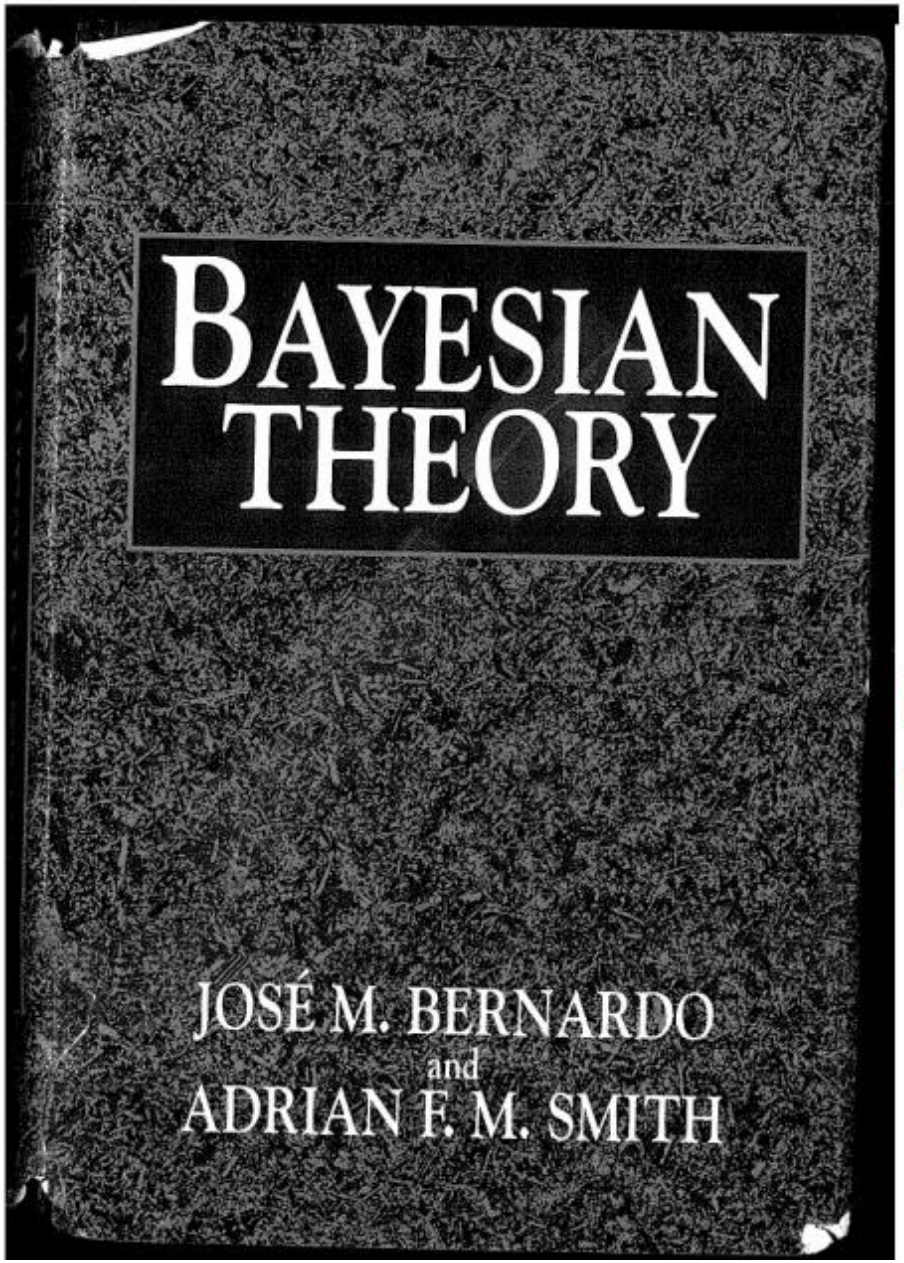
MARS Question

Name a type of metadata might be associated with an image.

EXIF Metadata



Book Metadata



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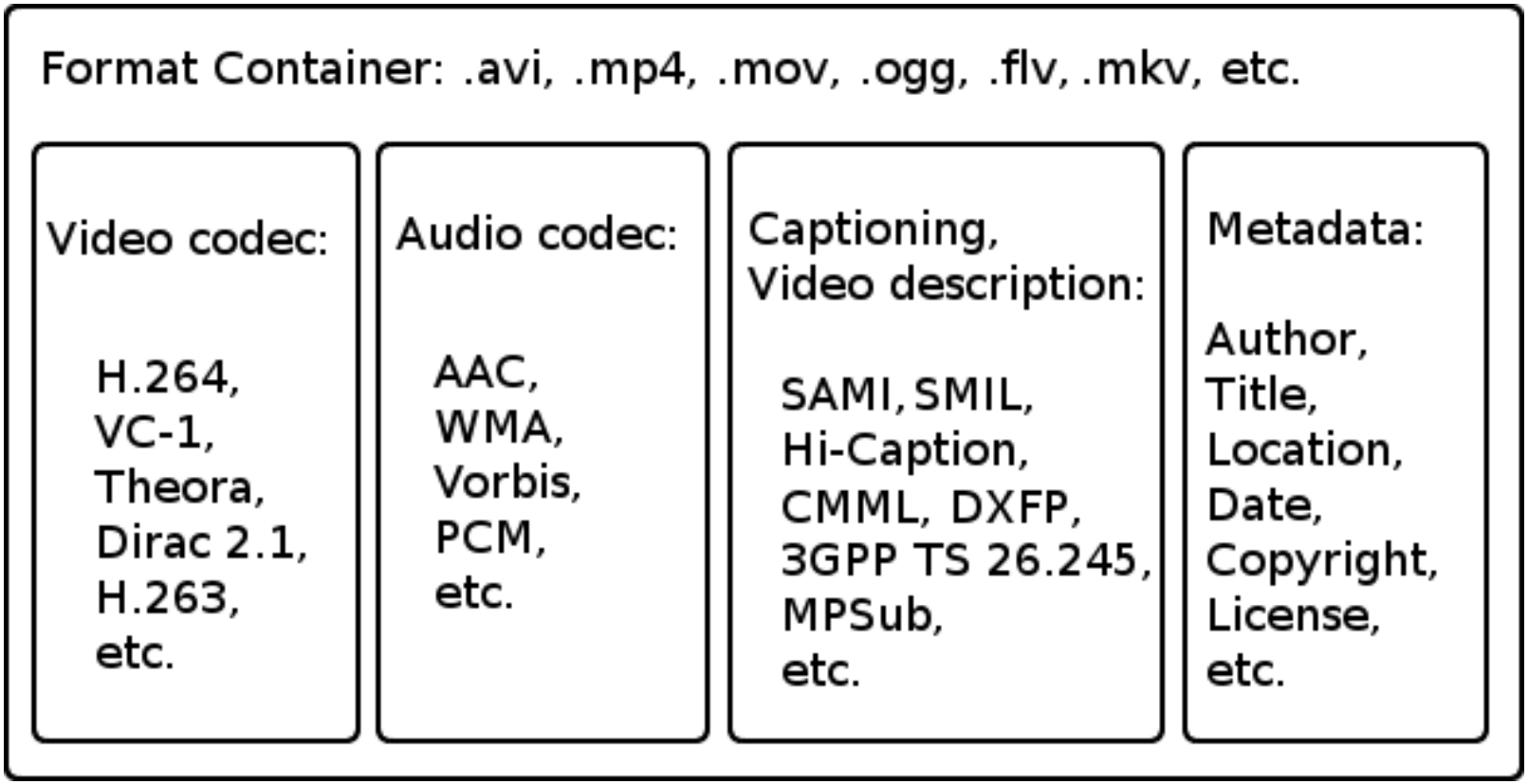
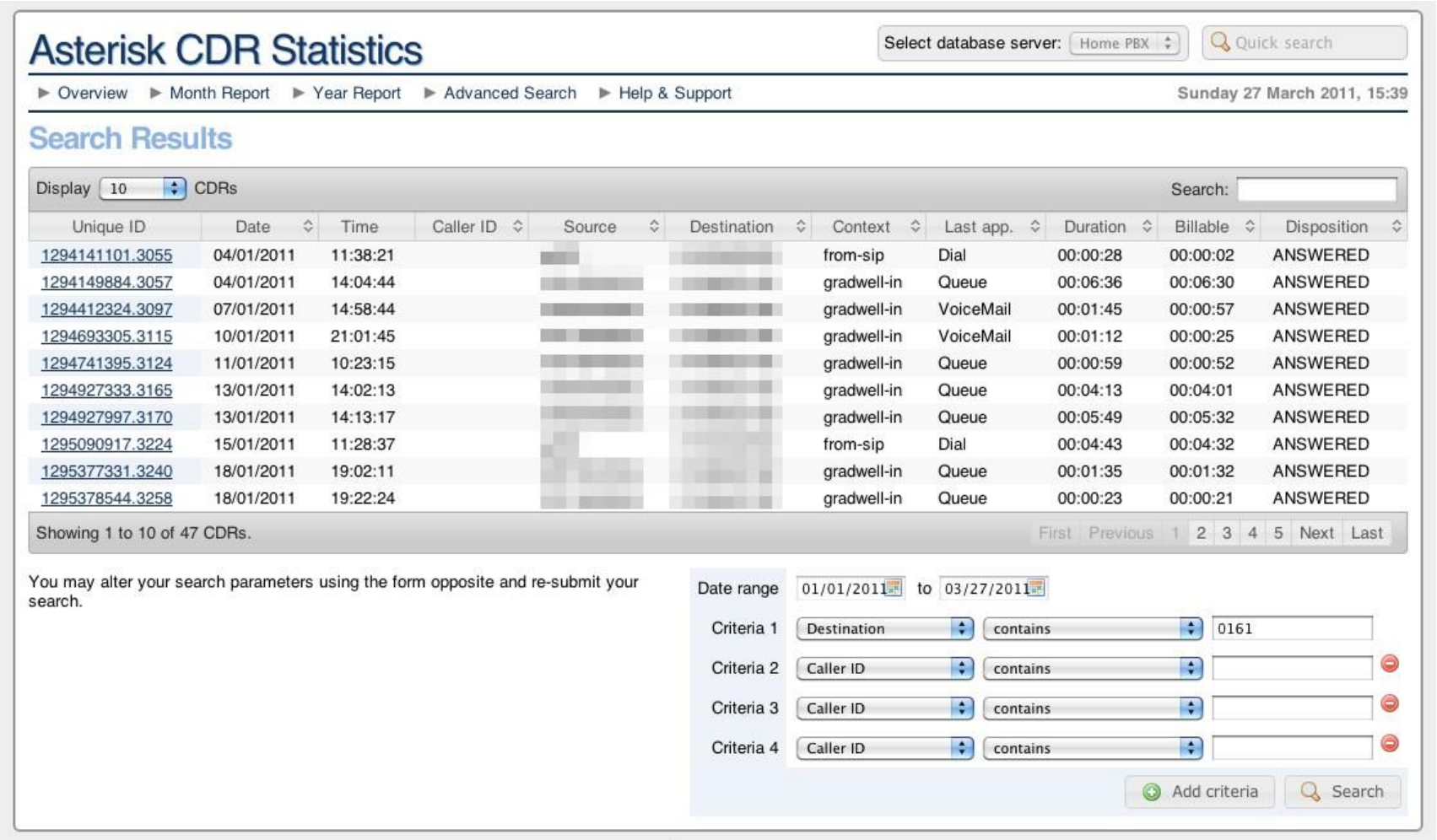


Examples: Call Data Record



Asterix Call Detail Record for an IP phone system

Examples: Javadoc

Self documenting code

```
/**
 * <h1>Function Description</h1> using <b>HTML Tags</b> and {@literal <b> JavaDoc </b> }
 * <ul><li>HTML list element 1</li><li>HTML list element 2</li></ul>
 * For more details: {@link http://www.dvteclipse.com/documentation/sv/Export_HTML_Documentation.html DVT Documentation}
 *
 * @param slave_name - first param
 * @param min_addr - second param
 * @param max_addr - third param
 * @return min_addr
 *
 * @see get_type
 * @see build_phase
 *
 * @author Author's name
 * @version 1.0
 */
function void set_slave_address_map(string slave_name,
  int min_addr, int max_addr);
  ubus_slave_monitor tmp_slave_monitor;
  if( bus_monitor != null ) begin
    // Set slave address map for bus monitor
    bus_monitor.set_slave_configs(slave_name, min_addr, max_addr);
  end
  // Set slave address map for slave monitor
  $cast(tmp_slave_monitor, lookup({slave_name, ".monitor"}));
  tmp_slave_monitor.set_addr_range(min_addr, max_addr);
  return min_addr;
endfunction : set_slave_address_map
```

public void **set_slave_address_map**(string slave_name, int min_addr, int max_addr)

Function Description

using **HTML Tags** and JavaDoc

- HTML list element 1
- HTML list element 2

For more details: DVT Documentation

Returns:
min_addr

Arguments:
slave_name - first param
min_addr - second param
max_addr - third param

See Also:
get_type
build_phase

Version:
1.0.

MetaData: Key Concepts

Machine-readable data: data (or metadata) which is in a format that can be understood by a computer
e.g., XML, JSON

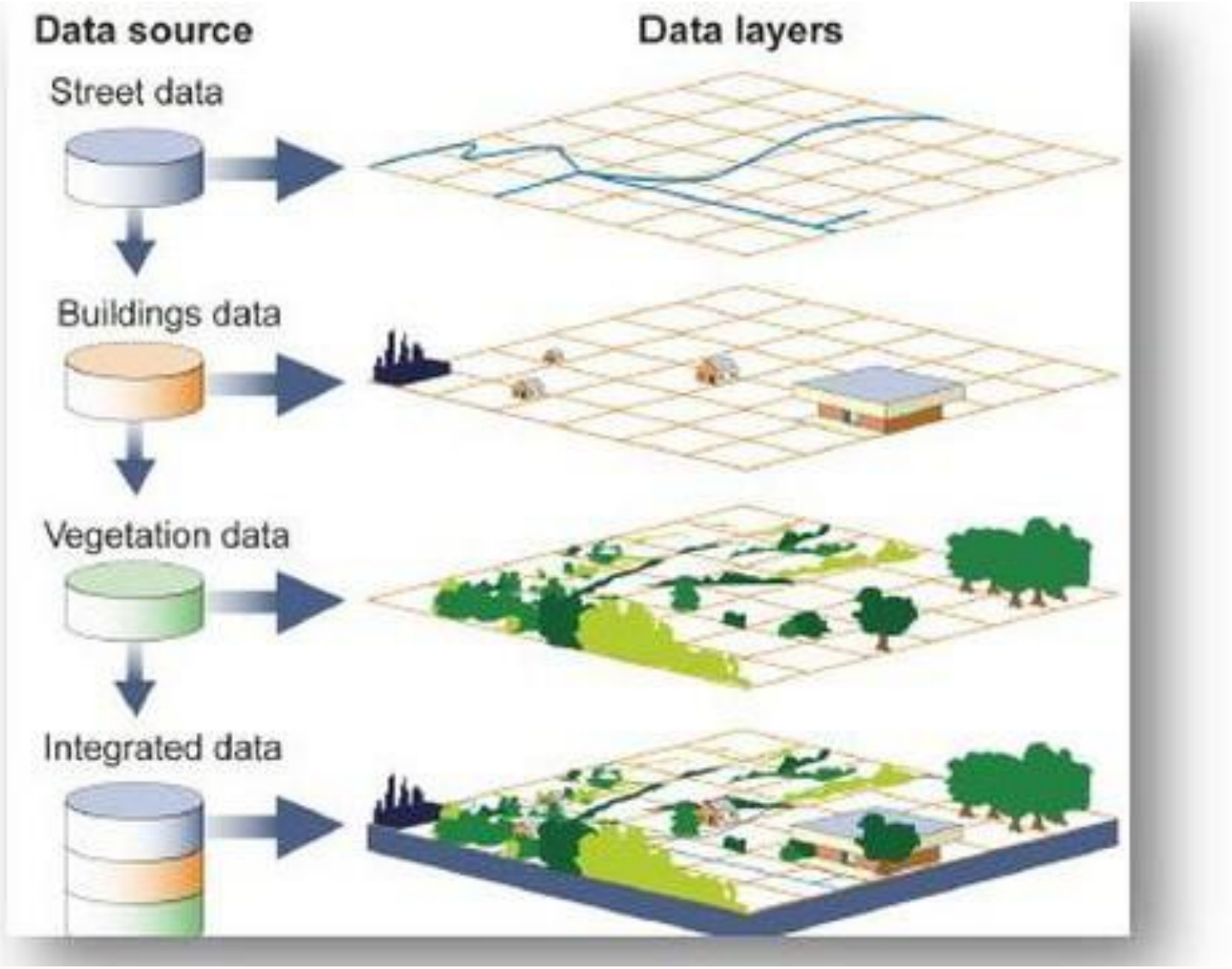
Markup language: system for annotating a document in a way that is syntactically distinguishable from the text
e.g., Markdown, Javadoc

Digital container: file format whose specification describes how different elements of data and metadata coexist in a computer file
e.g., MPEG

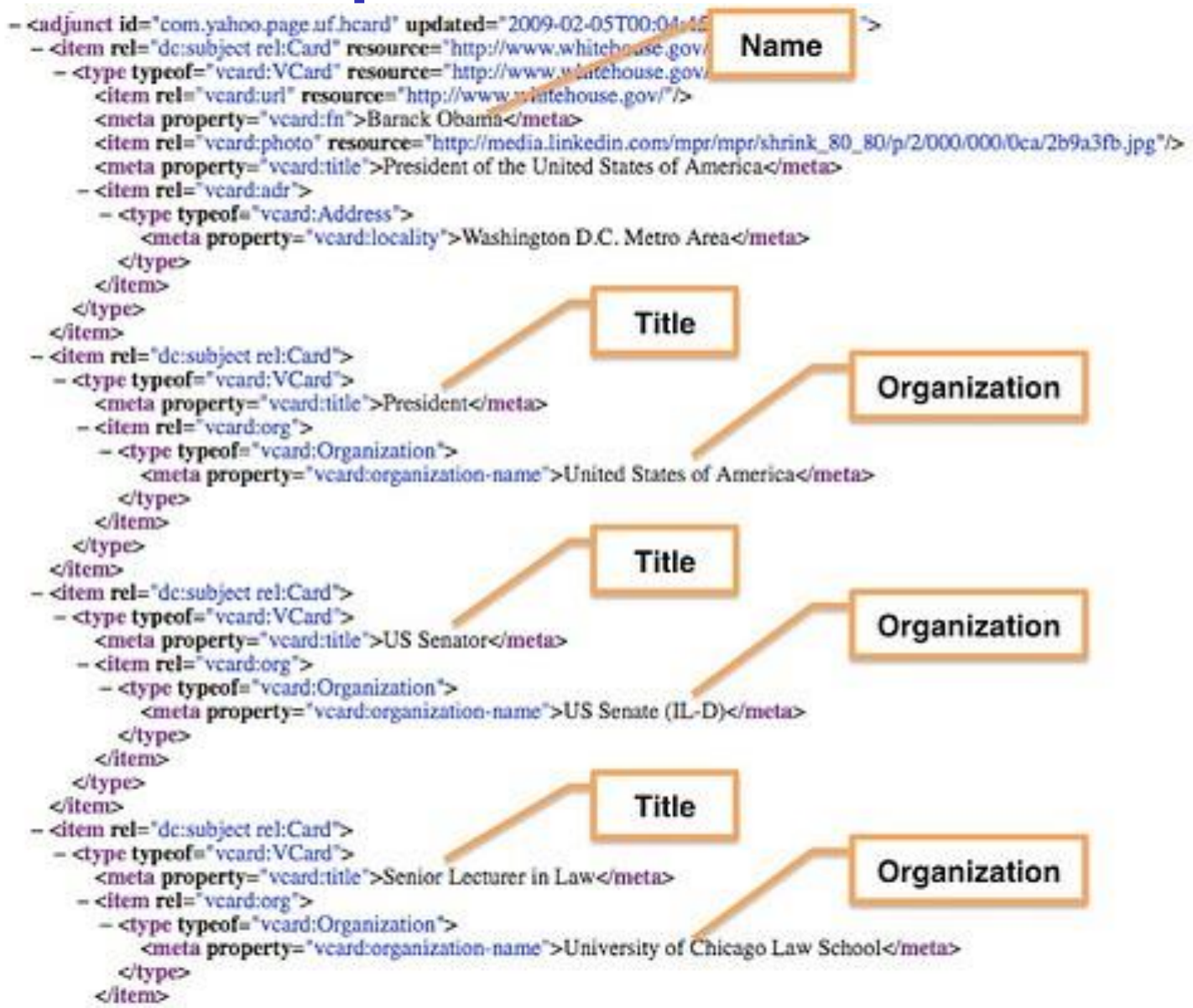
Characterising Data
Kinds of data

a quick walkthrough of different data types

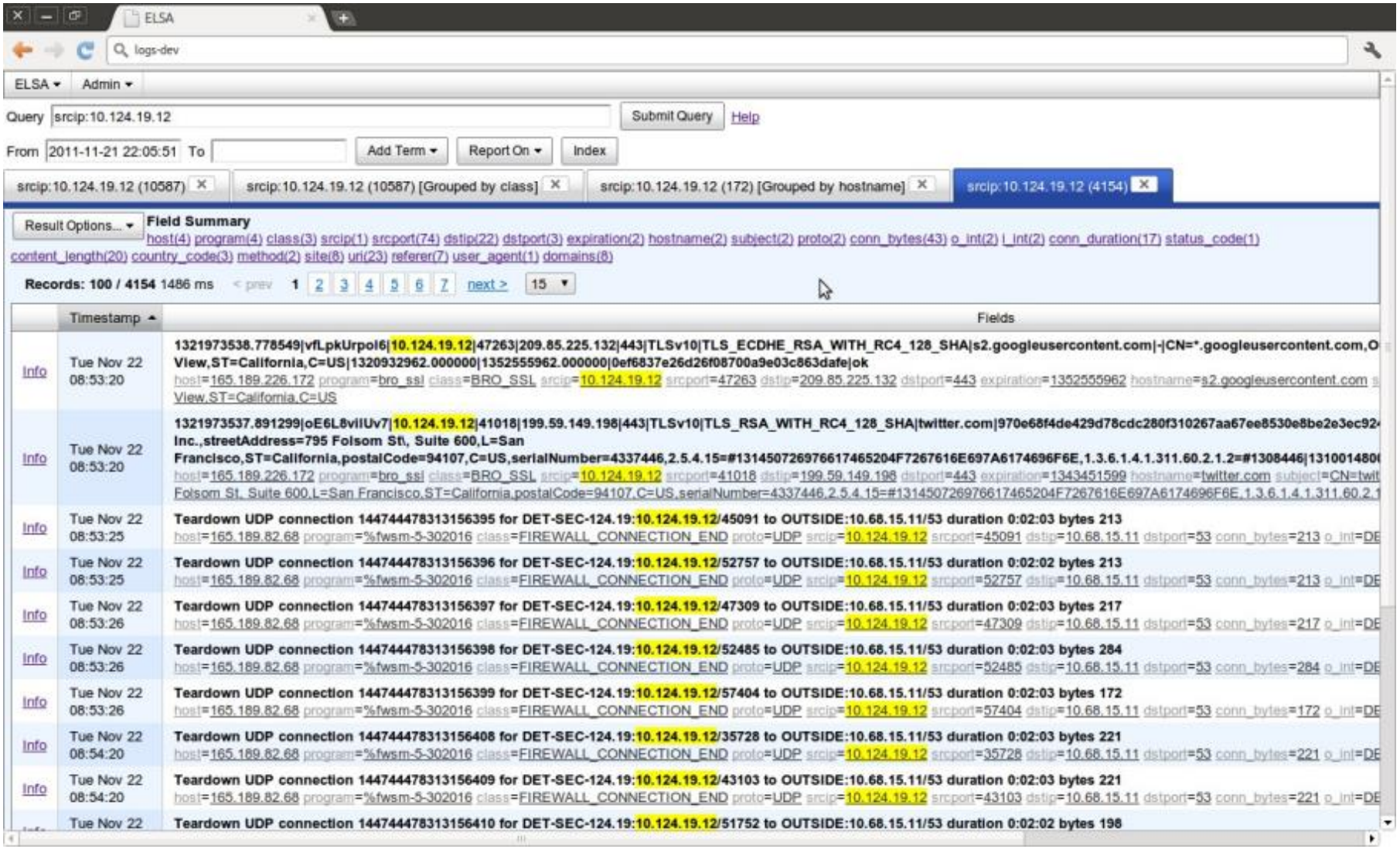
Geospatial Data



Linked Open Data: XML



IP Connection Data



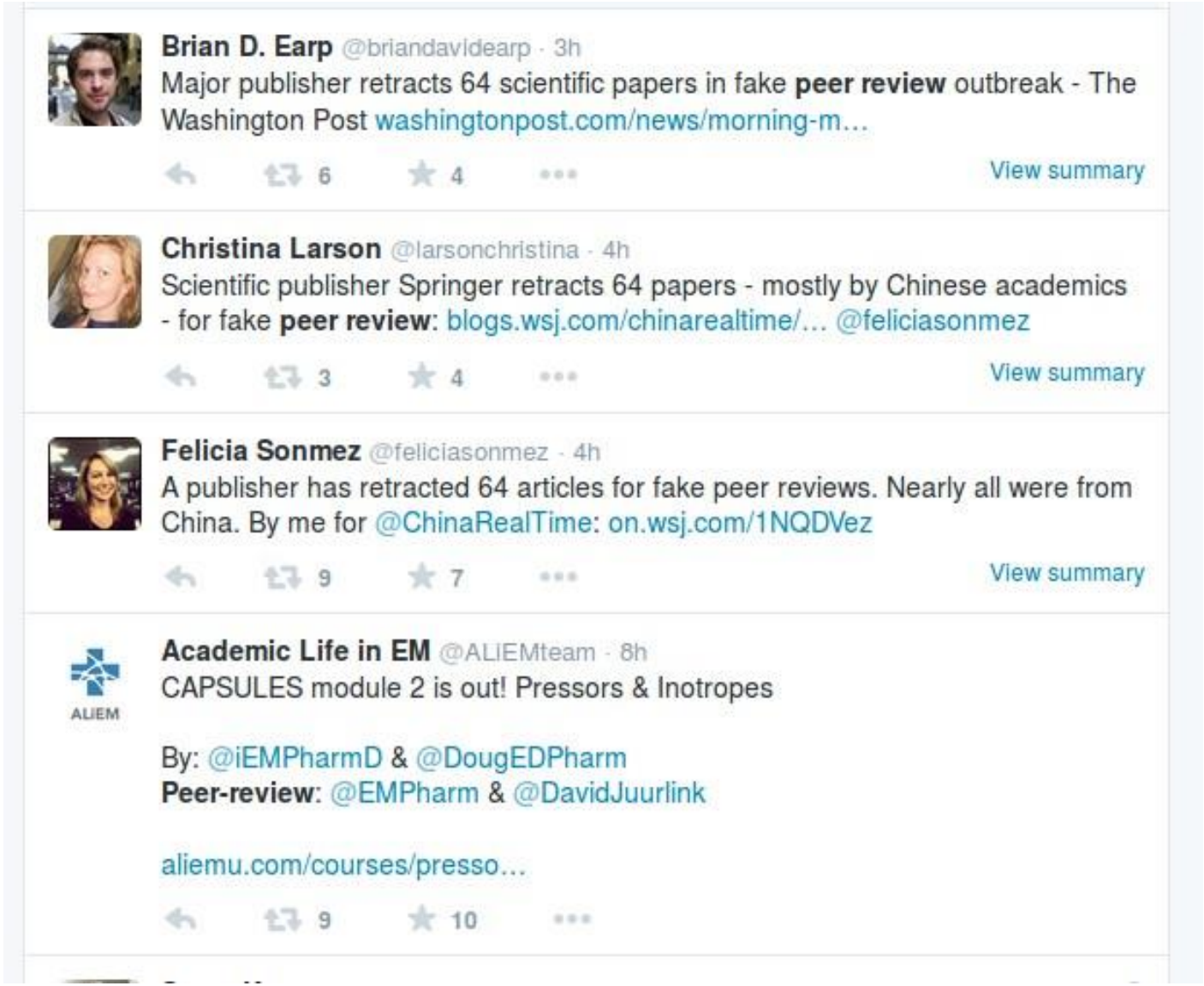
Transactional Data

Trans

Entity: All Entity | Time: Default member: All Time Calendar | Account: All Account

	Credit	Debit	Account	Entity	Transaction	Txn Date
All Transactions	$2,441,364.68	$1,402,410.62				
# 501, BillPaymentCheck	$0.00	$625.00	Checking	Wheeler's Tile Etc.	BillPaymentCheck # 501	12/15/2012
# none, Transfer	$0.00	$500.00	Savings	None	Transfer # none	12/15/2012
# none, ReceivePayment	$440.00	$0.00	Undeposited Funds	Roche, Diarmuid:Garage repairs	ReceivePayment # none	12/15/2012
# none, Bill	$0.00	$670.00	Accounts Payable	Keswick Insulation	Bill # none	12/15/2012
# 6236, PurchaseOrder	$0.00	$65.00	Purchase Orders	Daigle Lighting	PurchaseOrder # 6236	12/15/2012
# 502, BillPaymentCheck	$0.00	$640.92	Checking	Daigle Lighting	BillPaymentCheck # 502	12/15/2012
# 503, BillPaymentCheck	$0.00	$754.50	Checking	Patton Hardware Supplies	BillPaymentCheck # 503	12/15/2012
# 1097, Invoice	$12,420.98	$0.00	Accounts Receivable	Robson, Darci:Robson Clinic	Invoice # 1097	12/15/2012
# 504, BillPaymentCheck	$0.00	$6,935.75	Checking	Perry Windows & Doors	BillPaymentCheck # 504	12/15/2012
# 505, BillPaymentCheck	$0.00	$45.00	Checking	Lew Plumbing	BillPaymentCheck # 505	12/15/2012
# 12/03, Bill	$0.00	$122.68	Accounts Payable	Cal Gas & Electric	Bill # 12/03	12/15/2012
# 506, BillPaymentCheck	$0.00	$1,631.52	Checking	East Bayshore Tool & Supply	BillPaymentCheck # 506	12/15/2012
# 507, BillPaymentCheck	$0.00	$1,358.00	Checking	Timberloft Lumber	BillPaymentCheck # 507	12/15/2012
# 508, BillPaymentCheck	$0.00	$1,476.23	Checking	East Bayshore Tool & Supply	BillPaymentCheck # 508	12/15/2012
# 509, BillPaymentCheck	$0.00	$450.00	Checking	Hopkins Construction Rentals	BillPaymentCheck # 509	12/15/2012
# 510, BillPaymentCheck	$0.00	$896.00	Checking	Timberloft Lumber	BillPaymentCheck # 510	12/15/2012
# 511, BillPaymentCheck	$0.00	$696.52	Checking	East Bayshore Tool & Supply	BillPaymentCheck # 511	12/15/2012
# 512, BillPaymentCheck	$0.00	$400.00	Checking	Patton Hardware Supplies	BillPaymentCheck # 512	12/15/2012
# 513, BillPaymentCheck	$0.00	$1,610.00	Checking	Timberloft Lumber	BillPaymentCheck # 513	12/15/2012

Twitter Data



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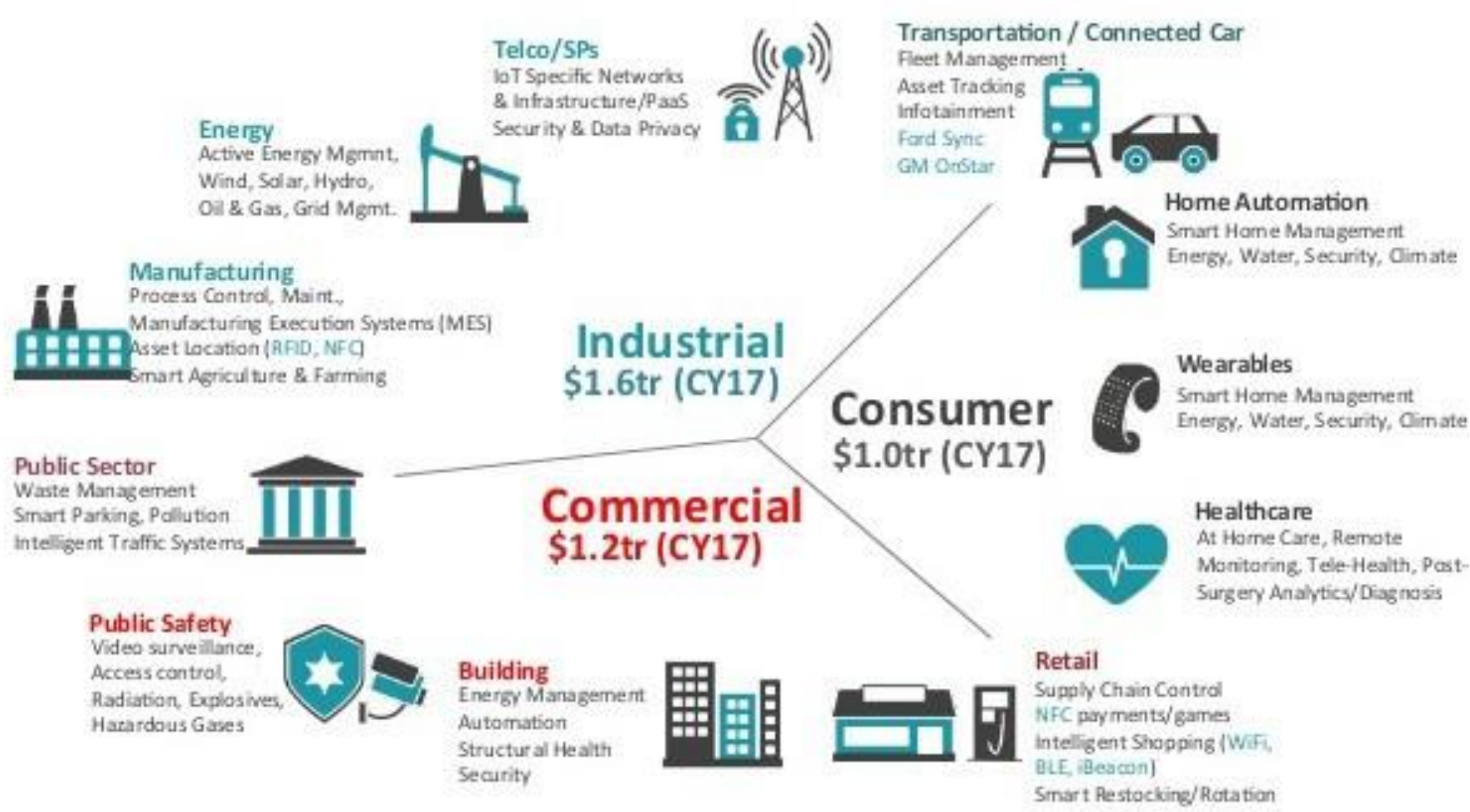
Internet of Things Data

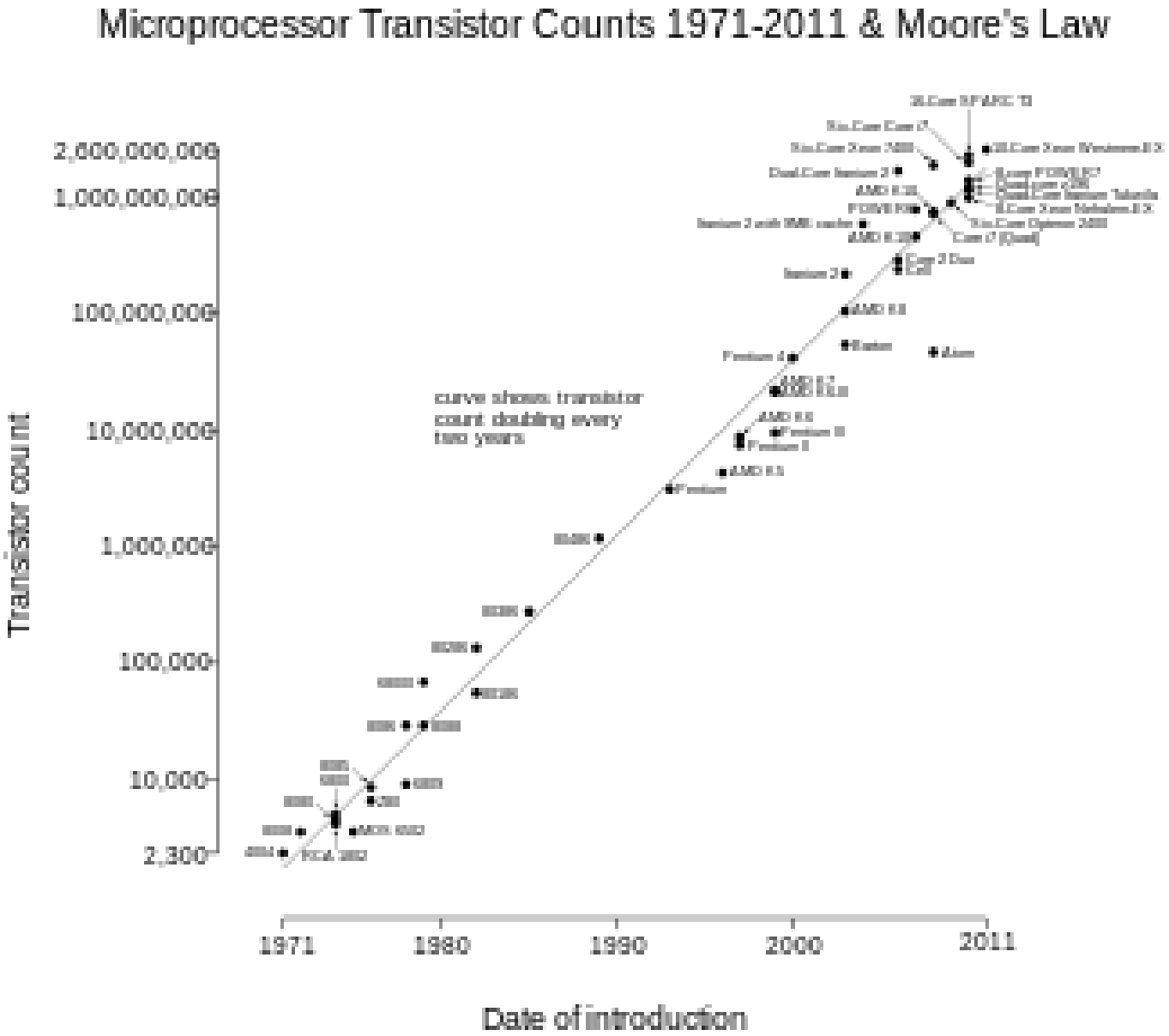


Source: IDC Internet of Things Spending Guide by Vertical Market 2014

Characterising Data
Growth laws

understanding the exponential growth

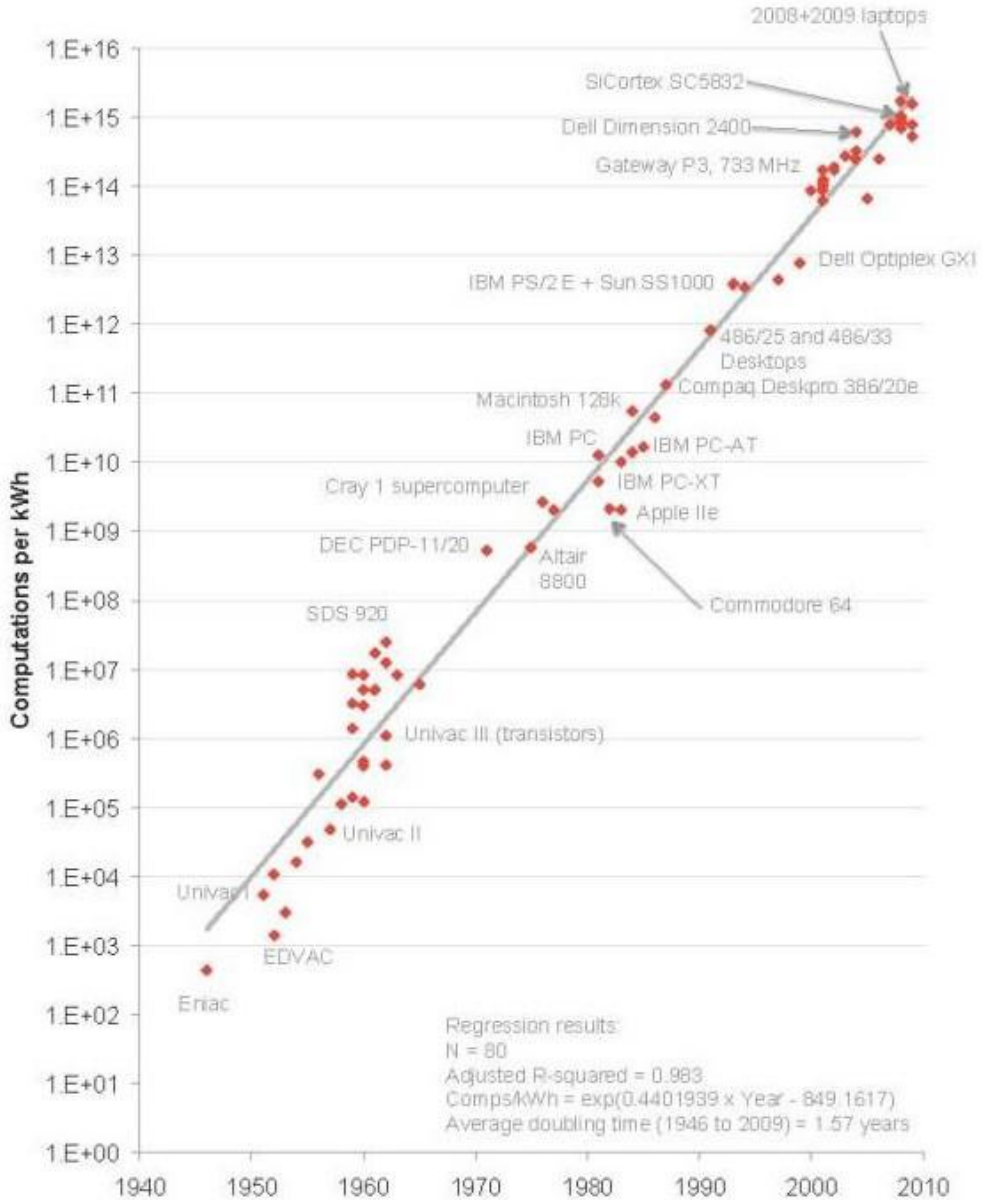
Moore's Law


Microprocessor Transistor Counts 1971-2011 & Moore's Law
2,600,000,000
1,000,000,000
100,000,000
10,000,000
1,000,000
100,000
10,000
2,300
Transistor count
curve shows transistor count doubling every two years
1971
1980
1990
2000
2011
Date of introduction

Moore's Law

- stated to double every 2 years starting 1975
- transistor count translates to:
  - more memory
  - bigger CPUs
  - faster memory, CPUs (smaller==faster)
- pace currently slowing

Koomey's Law



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Koomey's Law

- corollary of Moores Law
- amount of battery needed will fall by a factor of 100 every decade
- leads to ubiquitous computing

Bell's Law

- corollary of Moore's Law and Koomey's Law
- at a broad level, whole new computing classes will emerge every decade

Yes: PCs, mobile computing, cloud, internet-of-things

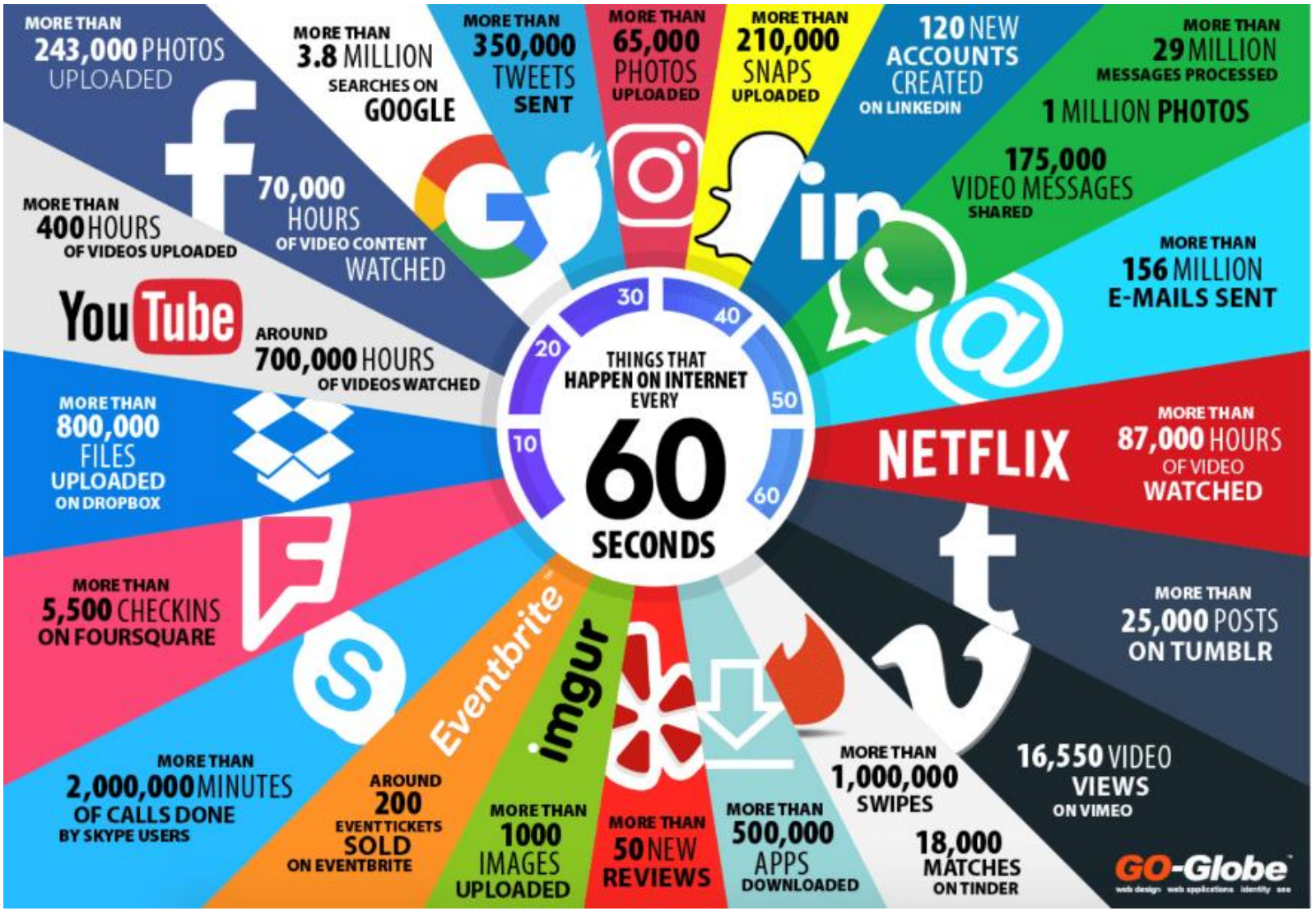
No: Java, big data, Hadoop, flash memory

Zimmerman's Law

- Zimmerman is creator of Pretty Good Privacy (PGP), an early encription system
- "surveillance is constantly increasing"
- privacy constantly decreasing

Things that happen in 60secs

from *GO-Gulf*



Introduction to R for Data Science

MARS Question

Which of the following R commands is not a summary statistics of my_table?

A. min(my_table$ages)
B. mean(my_table$height)
C. sd(my_table$height)
D. str(my_table)

Next Week: Distributed Processing and Data Case Studies (ePub sections 3.3, 3.4)

Homework:

- follow up on some of the case studies in 3.3 yourself!