MIS 985:

Practical Business Analytics

Course Overview & Introduction

Yihuang K. Kang

Instructor

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  - Phone: +886 7-5252000 ext. 4737

- **Shot me an email with "MIS 985 - "**
  - e.g. "MIS 985 - A quick question about Homework #1"
  - Please organize your email before you hit "Send"!
- **Talk is cheap, show me the data**
- **Contact me before "it's too late"**

Prerequisite

- Basic understanding of relational databases, SQL, data structures, and probability & statistics.

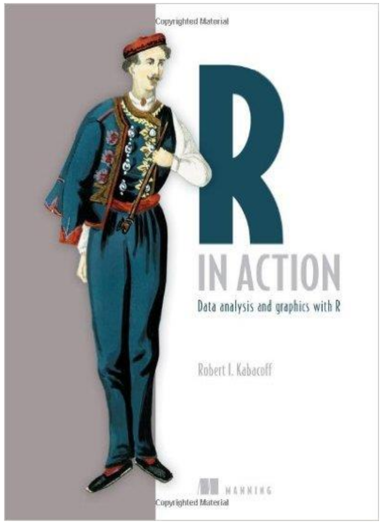
- College-level calculus and matrix operations (Linear Algebra) are required.

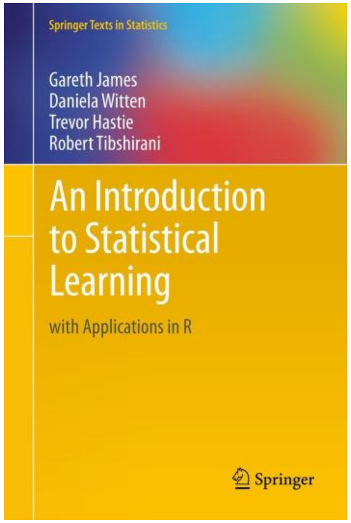
- Familiar with at least one high-level programming language. Scientific programming language, such as R, MATLAB, Python, SAS, Julia are preferred.

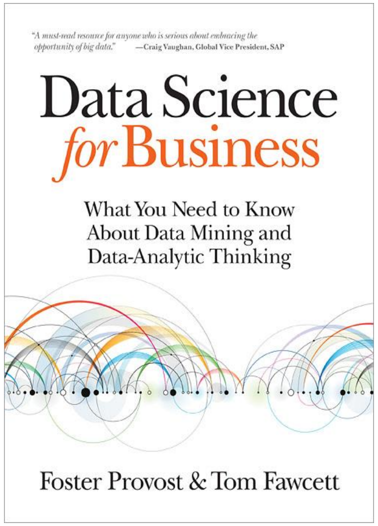
Syllabus

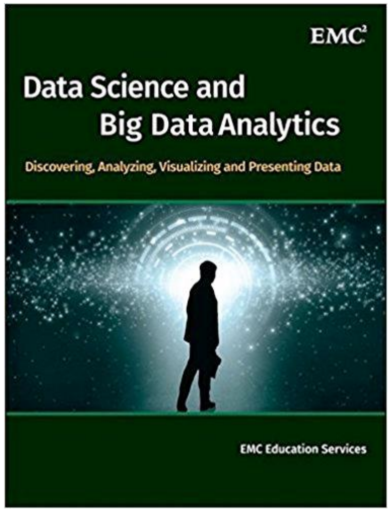
- **You will…**
  - exercise logical and computational thinking
  - sharpen your data analytics skills
  - learn how to use R to deal with "big data"
- **Time & Location**
  - Wed 7:10-9pm (online), Sat 1-4pm (monthly on-site, CM 3051),
- **Teaching Assistant:**
  - 毛文瑞(rex850327@gmail.com)
  - 黃升泰(rex850327@gmail.com)
  - 周詠捷(johnny83051202@gmail.com)
  - 楊宛蓁(w126251@gmail.com)
  - 郭博文(willy821002@gmail.com)

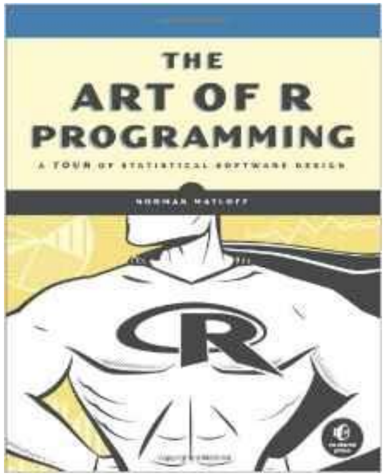
Syllabus (cont.)

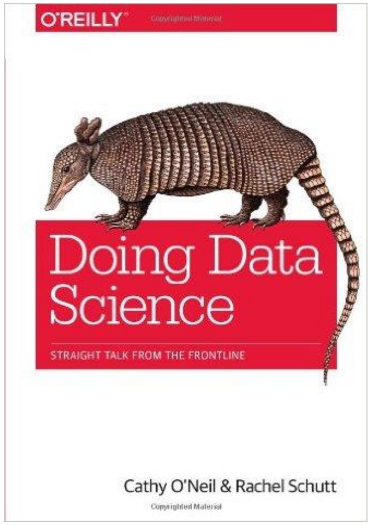




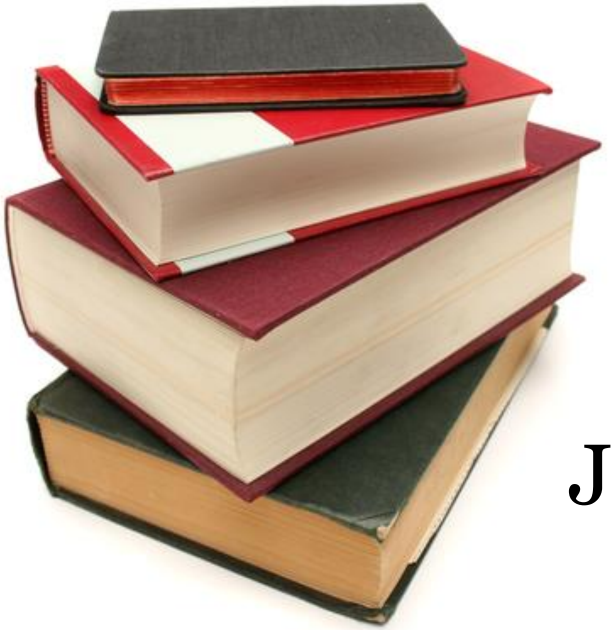

"A must-read resource for anyone who is serious about embracing the opportunity of big data." —Craig Vaughan, Global Vice President, SAP
Data Science for Business
What You Need to Know About Data Mining and Data-Analytic Thinking
Foster Provost & Tom Fawcett


EMC²
Data Science and Big Data Analytics
Discovering, Analyzing, Visualizing and Presenting Data
EMC Education Services





Syllabus (cont.)



As for the reading list…

Just read as many as you can!

Syllabus (cont.)

- **Grading**

  In-class group quiz: 30%

  Homework: 30%

  Term project proposal: 20%

  Term project defense: 20%

- **Term Project**

  ✓Organize your data science team

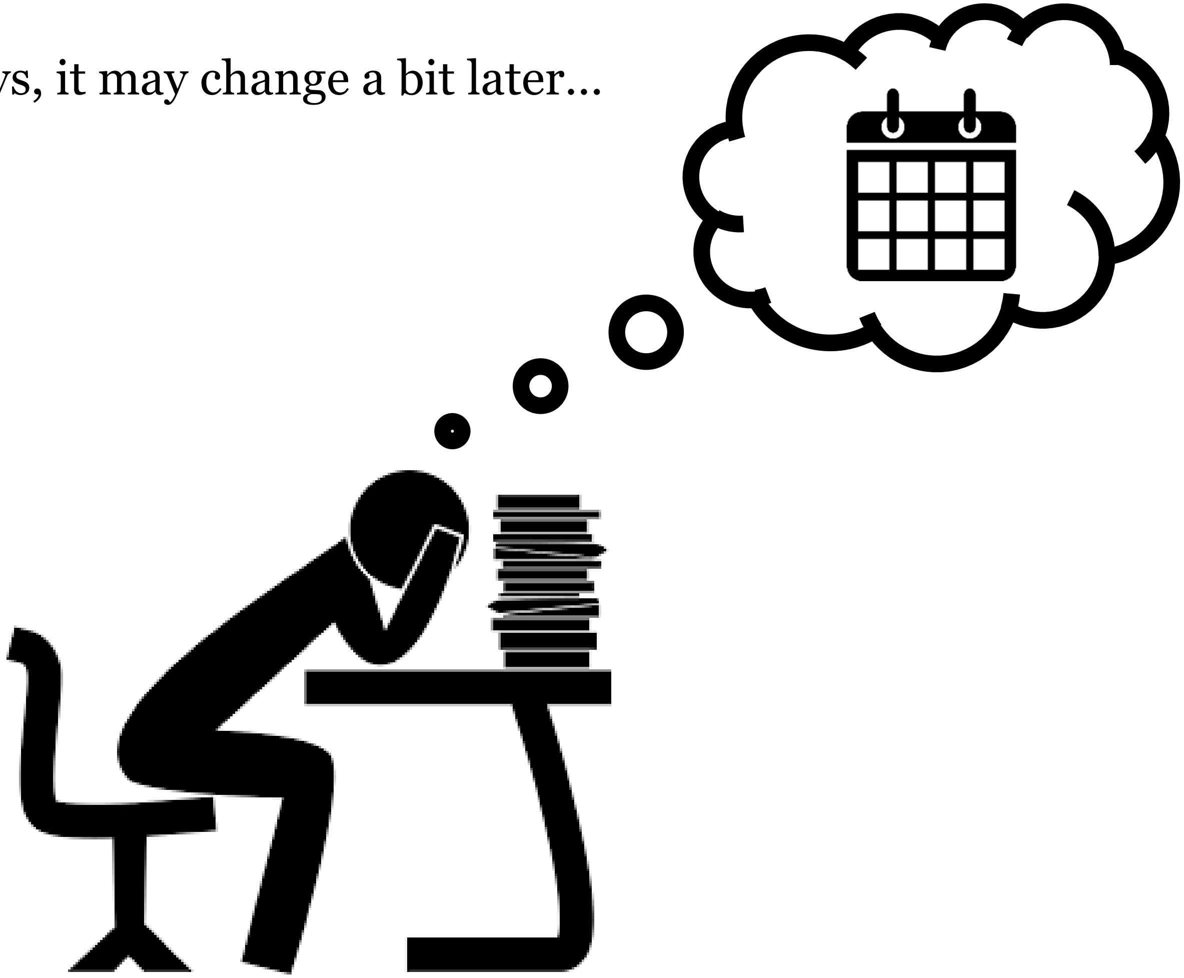
  ✓Group of **3-5** people

  ✓Get people with different backgrounds

Syllabus (cont.)

- **Schedule**

  Well, as always, it may change a bit later…



How to Survive

✓Practice makes perfect

✓Participate in class discussions

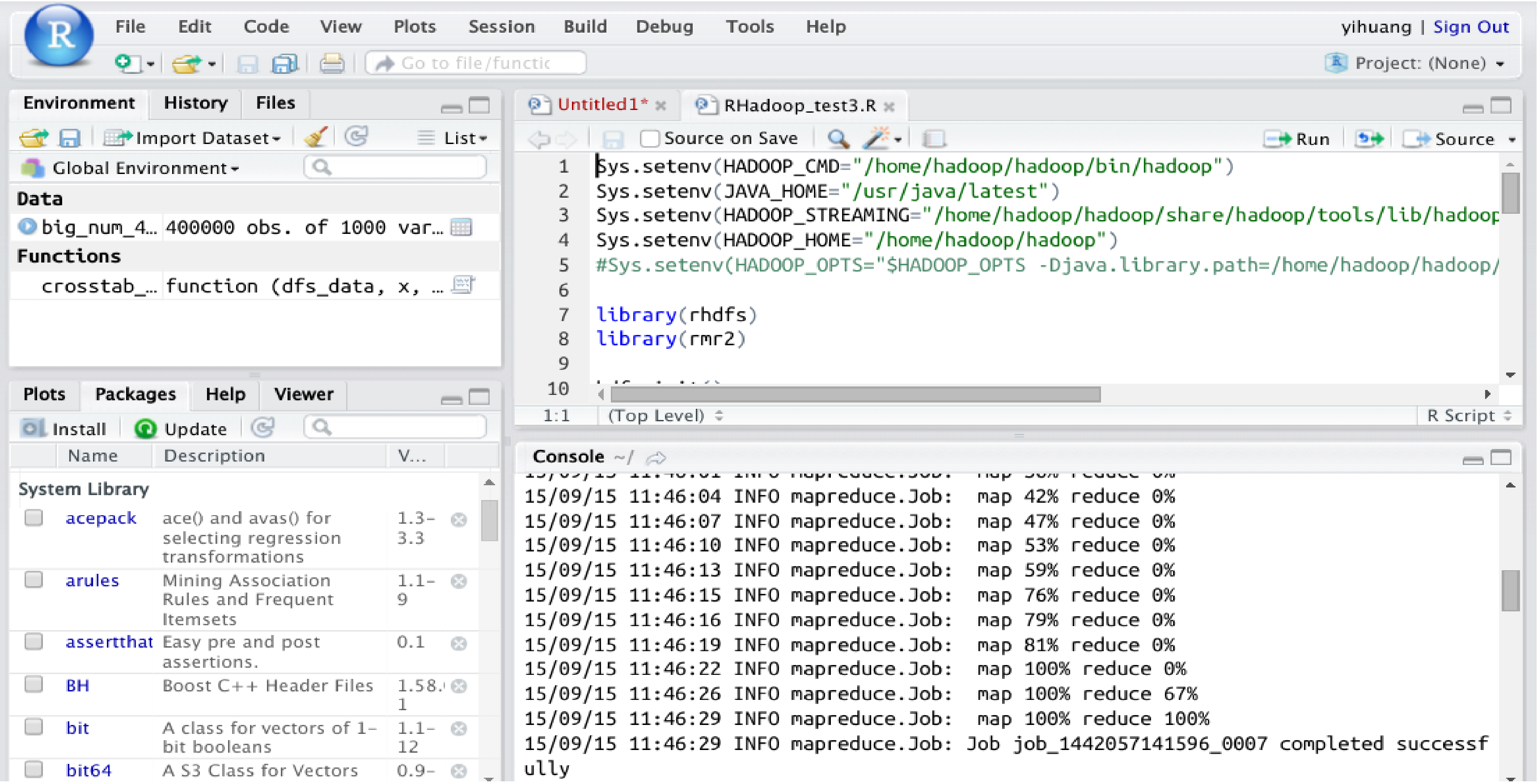
✓Love your data

✓Work ~~hard~~ ***smart!***

✓Ask geeks around you

CM Unified Analytics Platform

- RStudio Server: http://hdp.cm.nsysu.edu.tw:8787/



Data

big_num_4…	400000 obs. of 1000 var…	

Functions

crosstab_…	function (dfs_data, x, …	

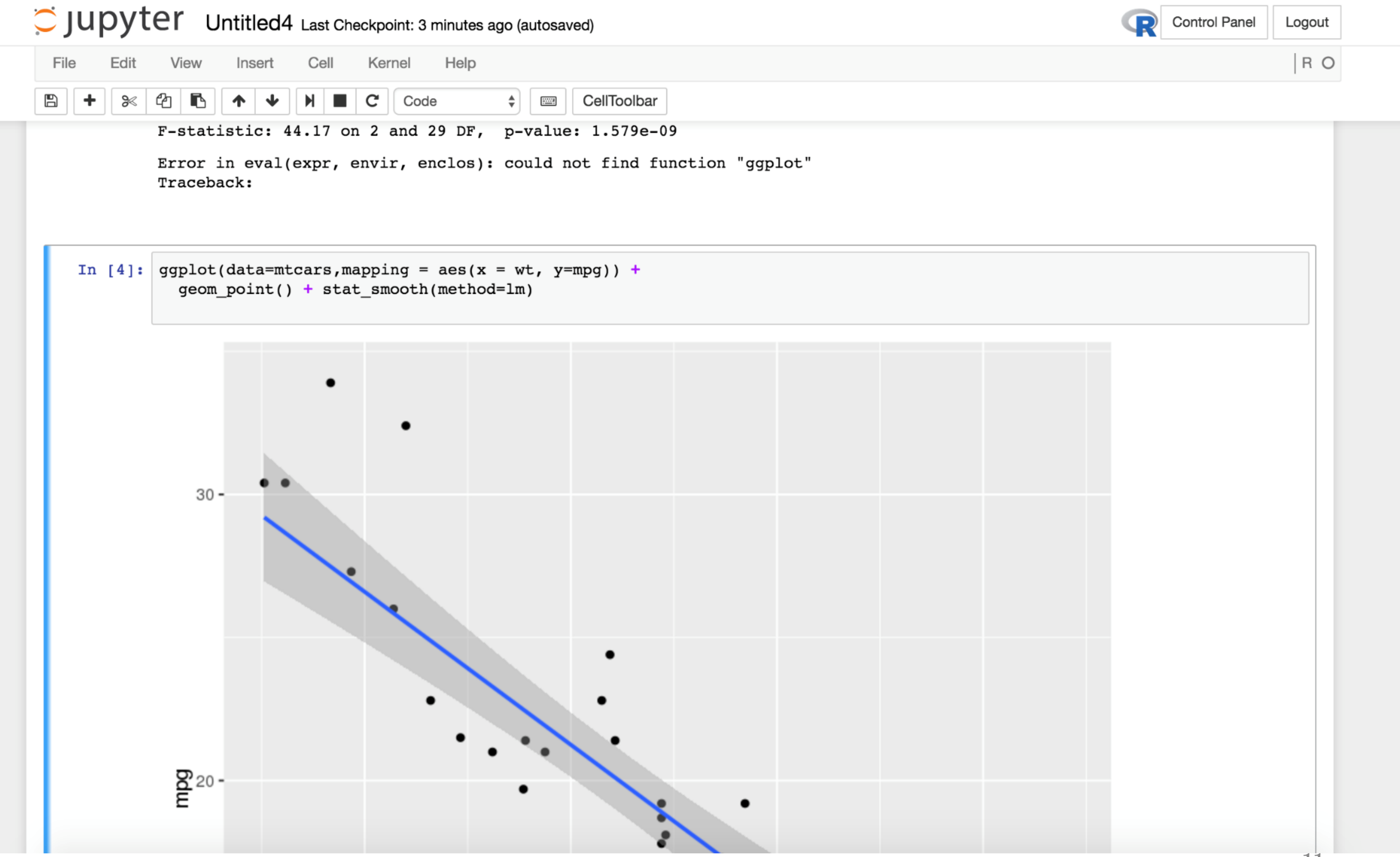
```
Sys.setenv(HADOOP_CMD="/home/hadoop/hadoop/bin/hadoop")
Sys.setenv(JAVA_HOME="/usr/java/latest")
Sys.setenv(HADOOP_STREAMING="/home/hadoop/hadoop/share/hadoop/tools/lib/hadoop
Sys.setenv(HADOOP_HOME="/home/hadoop/hadoop")
#Sys.setenv(HADOOP_OPTS="$HADOOP_OPTS -Djava.library.path=/home/hadoop/hadoop/

library(rhdfs)
library(rmr2)
```

	Name	Description	V...
	System Library		
□	acepack	ace() and avas() for selecting regression transformations	1.3-3.3
□	arules	Mining Association Rules and Frequent Itemsets	1.1-9
□	assertthat	Easy pre and post assertions.	0.1
□	BH	Boost C++ Header Files	1.58.0-1
□	bit	A class for vectors of 1-bit booleans	1.1-12
□	bit64	A S3 Class for Vectors	0.9-

```
15/09/15 11:46:04 INFO mapreduce.Job:  map 42% reduce 0%
15/09/15 11:46:07 INFO mapreduce.Job:  map 47% reduce 0%
15/09/15 11:46:10 INFO mapreduce.Job:  map 53% reduce 0%
15/09/15 11:46:13 INFO mapreduce.Job:  map 59% reduce 0%
15/09/15 11:46:15 INFO mapreduce.Job:  map 76% reduce 0%
15/09/15 11:46:16 INFO mapreduce.Job:  map 79% reduce 0%
15/09/15 11:46:19 INFO mapreduce.Job:  map 81% reduce 0%
15/09/15 11:46:22 INFO mapreduce.Job:  map 100% reduce 0%
15/09/15 11:46:26 INFO mapreduce.Job:  map 100% reduce 67%
15/09/15 11:46:29 INFO mapreduce.Job:  map 100% reduce 100%
15/09/15 11:46:29 INFO mapreduce.Job: Job job_1442057141596_0007 completed successf
ully
```

CM Unified Analytics Platform(cont.)



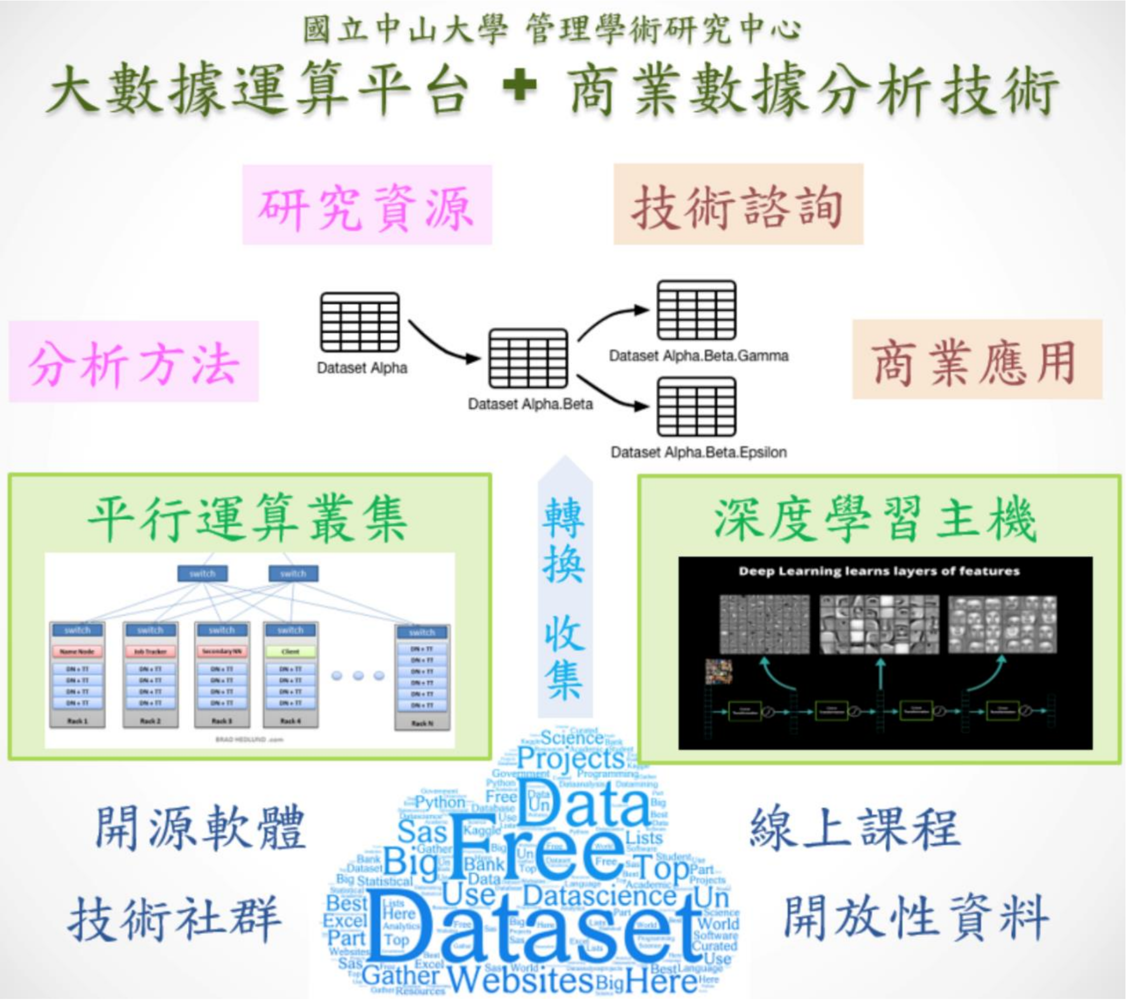
```
F-statistic: 44.17 on 2 and 29 DF,  p-value: 1.579e-09

Error in eval(expr, envir, enclos): could not find function "ggplot"
Traceback:
```

```
In [4]: ggplot(data=mtcars,mapping = aes(x = wt, y=mpg)) +
          geom_point() + stat_smooth(method=lm)
```

CM Unified Analytics Platform(cont.)

CM Unified Analytics Platform (cont.)


國立中山大學 管理學術研究中心
大數據運算平台 + 商業數據分析技術
研究資源
技術諮詢
分析方法
商業應用
Dataset Alpha
Dataset Alpha.Beta
Dataset Alpha.Beta.Gamma
Dataset Alpha.Beta.Epsilon
平行運算叢集
轉換收集
深度學習主機
Deep Learning learns layers of features
開源軟體
技術社群
線上課程
開放性資料
Free Data Dataset Projects Science Big Use Datascience Websites Here Gather

Please check out http://cm.nsysu.edu.tw/~msrc/wp/ for more information.

II. 系統技術規格：

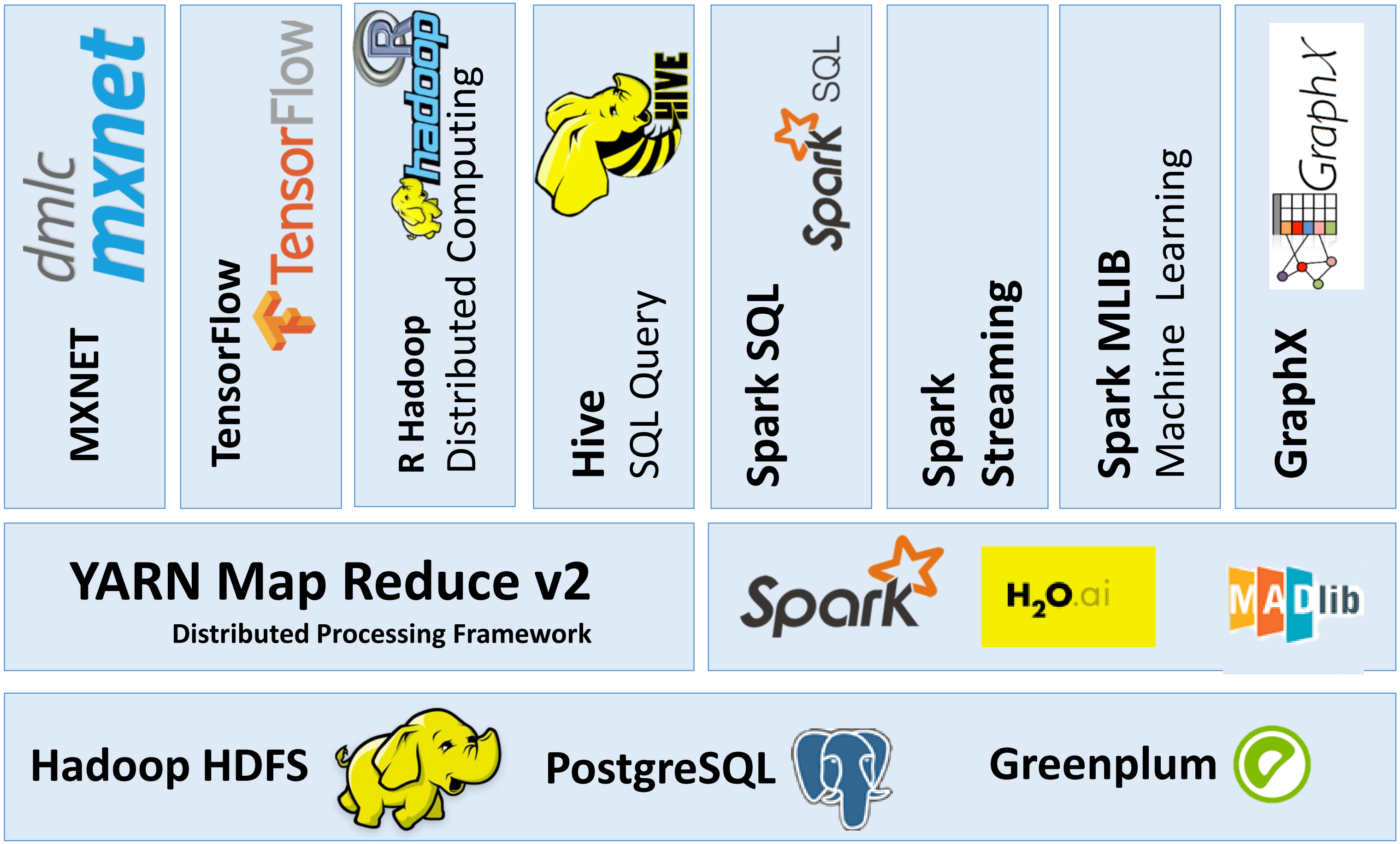
A. CPU 平行運算叢集：

- 1 x Master Node: 32 cores, 100G
- 17 x Worker Nodes: 8 cores, 61G
- R 3.4.1, RStudio 1.0.153
- Apache HADOOP 2.7
- Apache Spark 2.1.0
- Apache Zeppelin 0.7.2
    - R 3.4.1
    - Python 2.7.5
    - scala 2.11.8

B. GPU 深度學習主機：

- 1 x Server: 48 cores, 280G
- 1 x GPU Card: Tesla P100-PCIE-16GB
- R 3.4.1, RStudio 1.0.153
- Python 2.7.5
- MxNet 0.11.0
- Tensorflow-GPU 1.3.0
- Keras 1.2.2 + MxNet 0.11.0
- Keras 2.0.8 + Tensorflow 1.3.0

CM Big Data Analytics Software Stack



MXNET

TensorFlow

R Hadoop
Distributed Computing

Hive
SQL Query

Spark SQL

Spark
Streaming

Spark MLIB
Machine Learning

GraphX

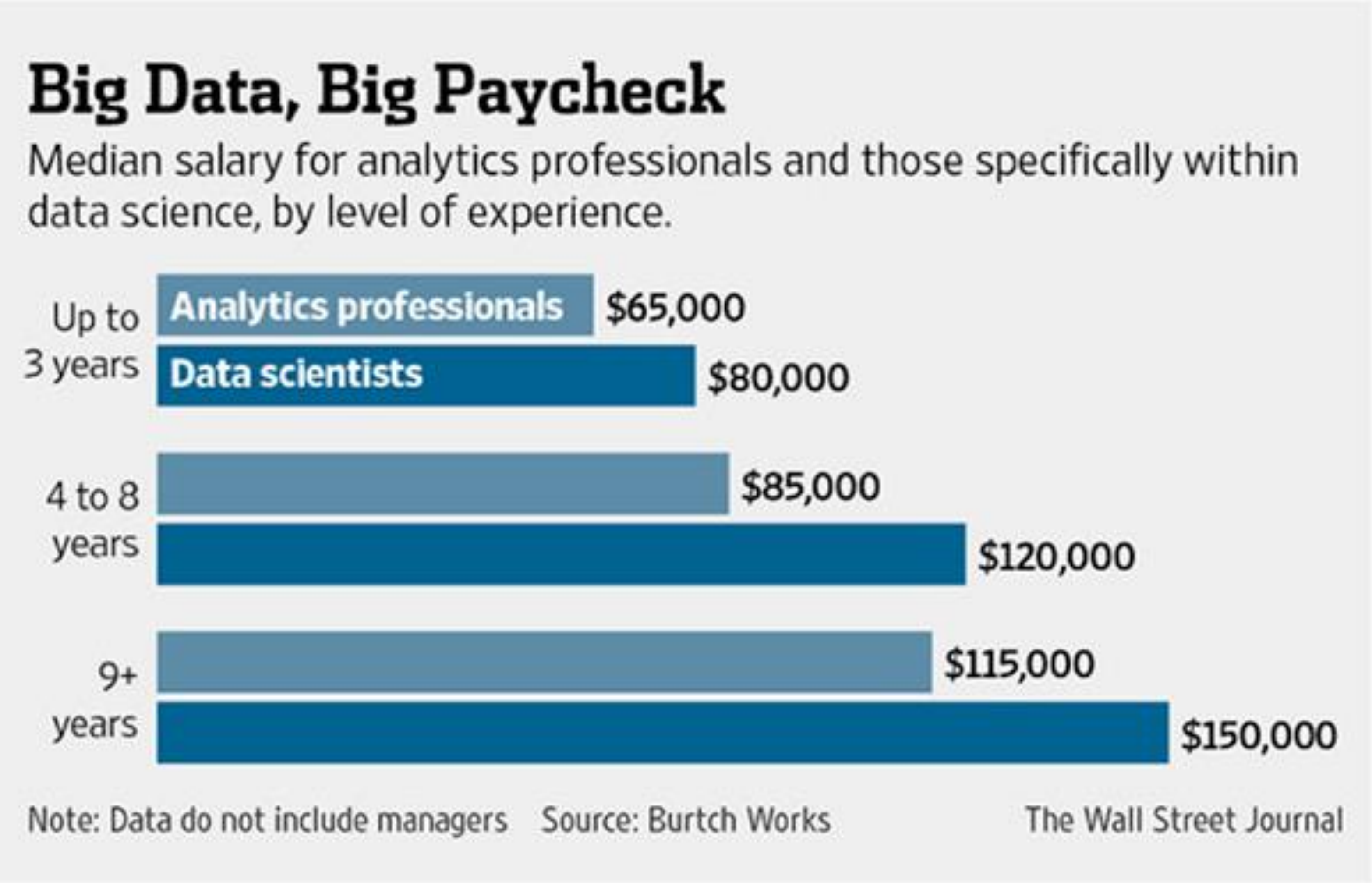
YARN Map Reduce v2
Distributed Processing Framework

Hadoop HDFS

PostgreSQL

Greenplum

> *"By 2018, the United States will experience a shortage of 190,000 skilled data scientists, and 1.5 million managers and analysts capable of reaping actionable insights from the big data deluge."*
>
> – *McKinsey Report, 2013*

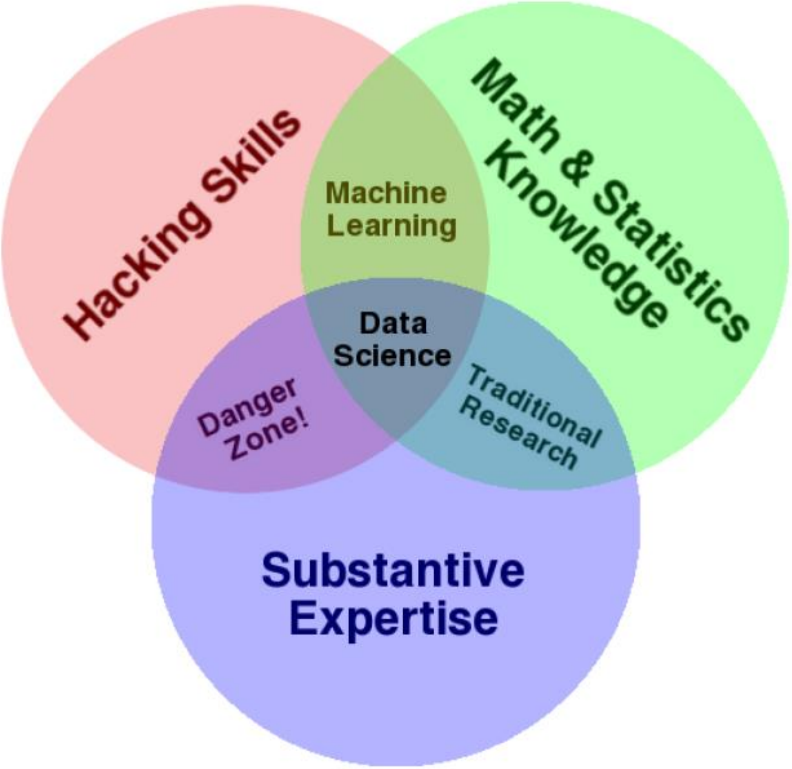


Big Data, Big Paycheck

Median salary for analytics professionals and those specifically within data science, by level of experience.

Note: Data do not include managers Source: Burtch Works The Wall Street Journal

What is "Data Science"

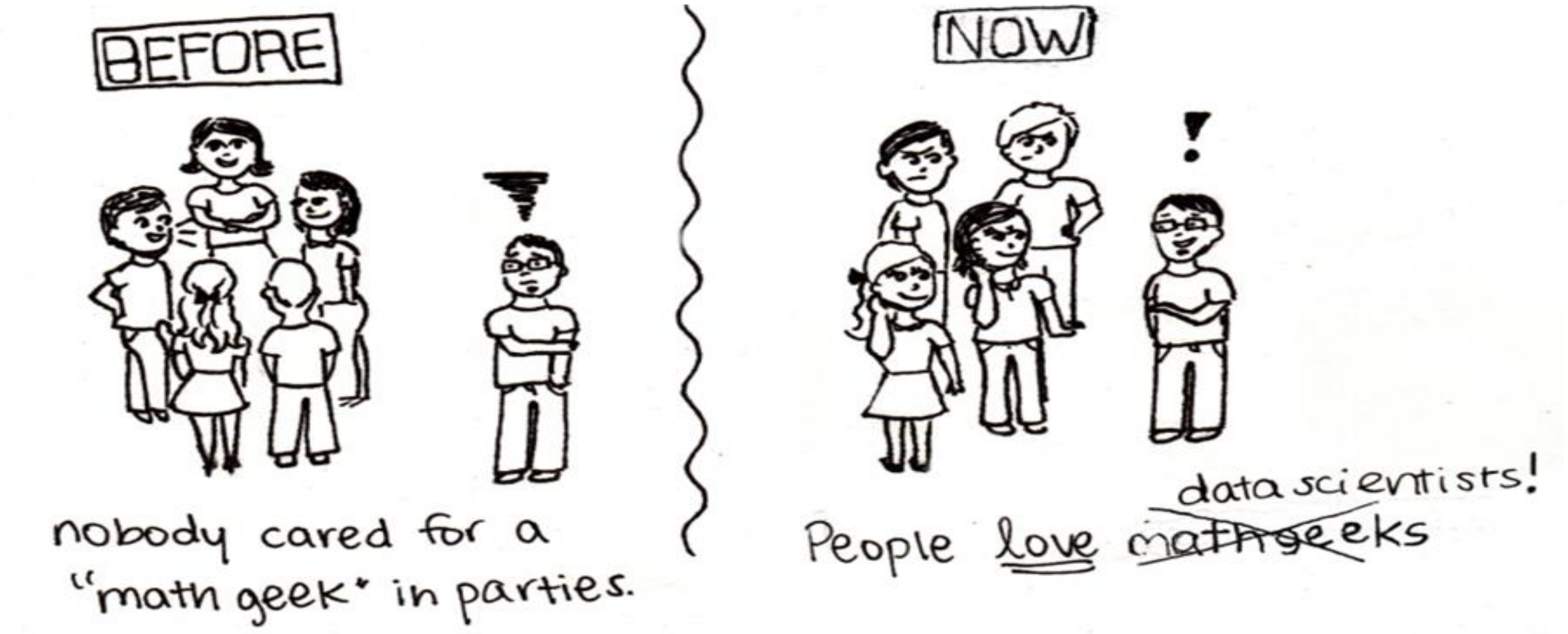


Drew Conway's Venn diagram of data science

The rise of "Data Scientists"

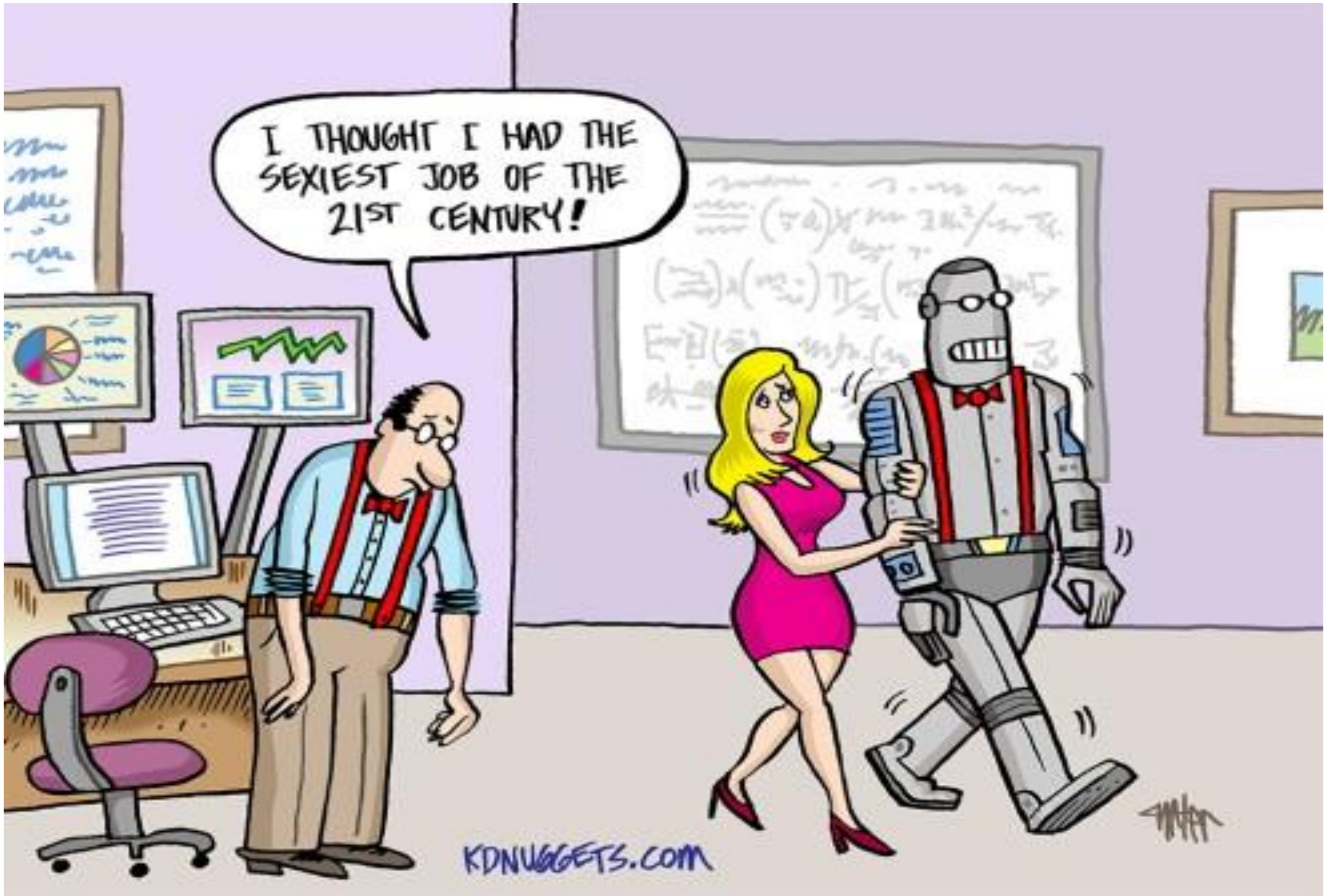
"Data Scientist is The Sexiest Job of the 21st Century"

—T. Davenport & D.J. Patil, Harvard Business Review



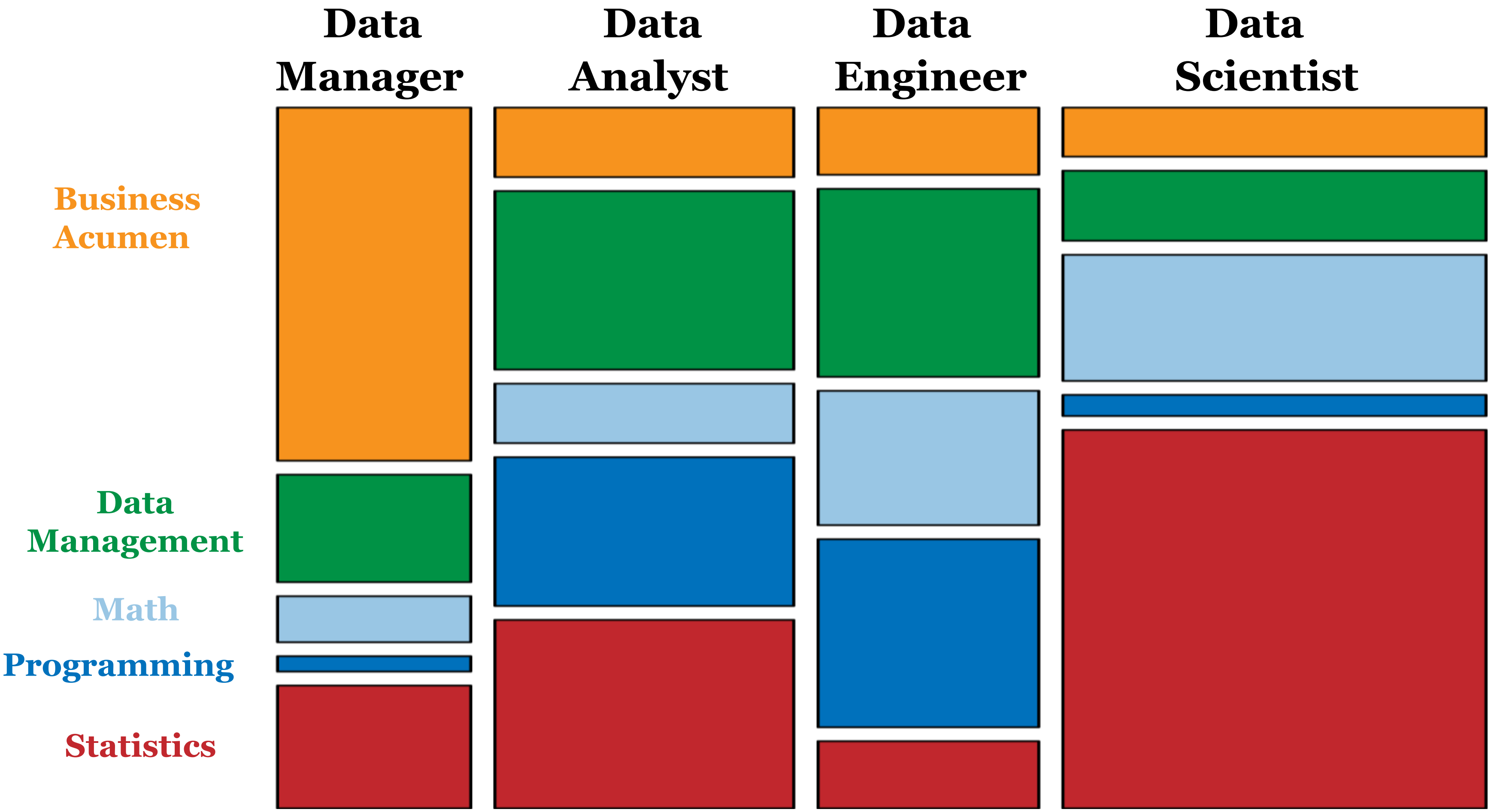
Source: http://www.techjuice.pk/how-to-become-a-data-scientist-for-free/

The "Dilemma" of the Data Scientists



Source: *http://www.kdnuggets.com/2016/08/cartoon-data-scientist-sexiest-job-21st-century.html*

Your data careers



What is "Big Data"

- Many people have defined "Big Data" with 3Vs, 4Vs, 5Vs..., many more Vs!

?
&
!
+
Volume
Velocity
Variety

- My definition is: "*Too much and complicated data to be processed by a single machine with reasonable time or resources*".

Where does the big data come from?

- **Traditional Data**
  - Any digitized contents and/or archives acquired by traditional ways, e.g. survey data, interview records, and documents.
- **Machine Data**
  - Sensor data, web logs, any log data from monitoring information systems.
- **Network Data**
  - The network of computers (The Internet)
  - The network of people (Social Networks)
  - The network of things (Internet of Things)

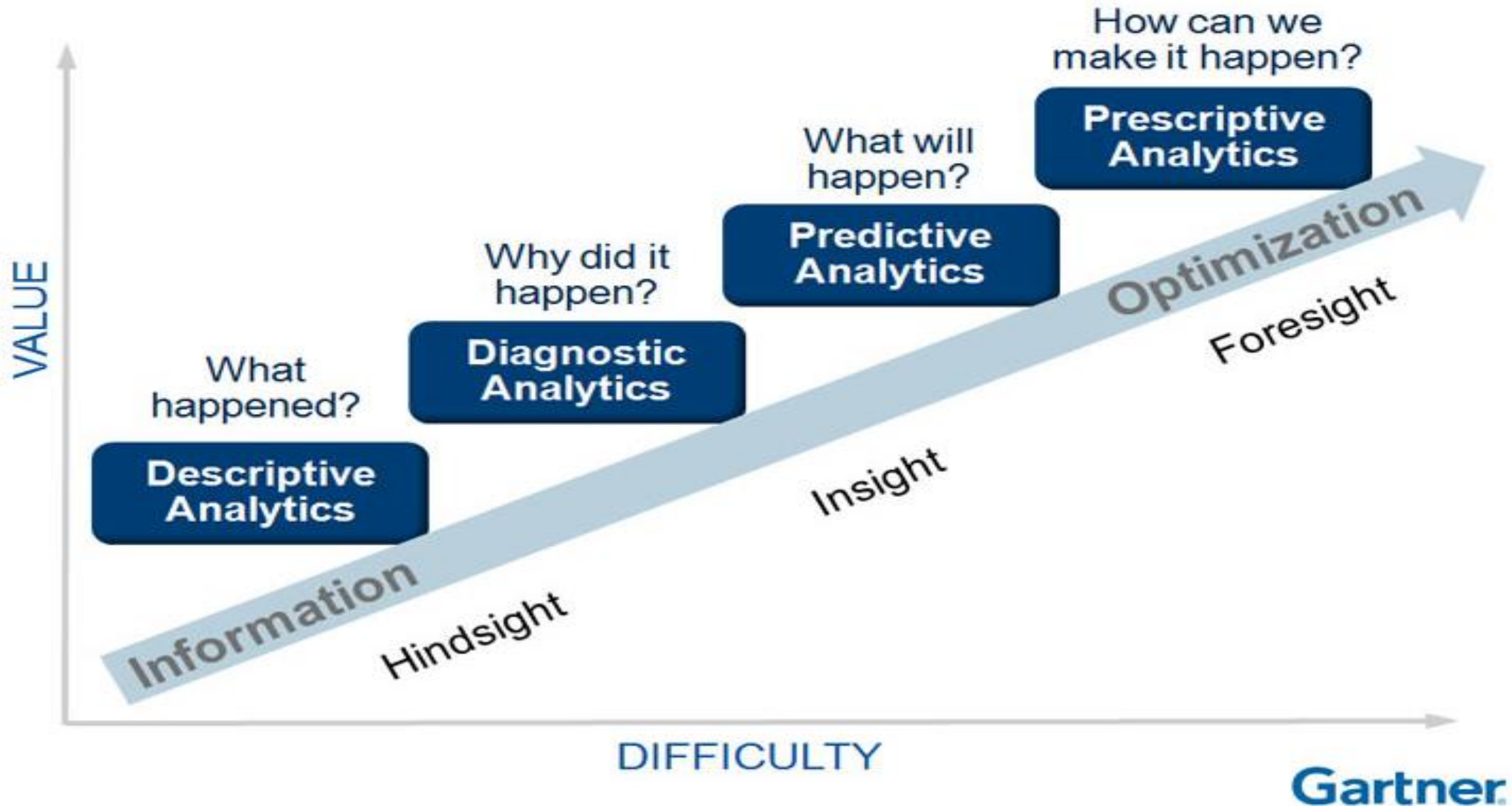
Types of Big Data

- **Structured data**
  - Data with clear schema/metadata/data model that describes & defines how the data elements relate to one another. E.g. relational databases, data cubes/warehouses.

- **Semi-Structured data**
  - Data with only tag/field definitions but without formal structures of data models to define relations. E.g. data used in information exchanges, such as XML & JSON. Emails/pictures/other files with tags/field definitions.

- **Unstructured data**
  - Unorganized data without any pre-defined schema. E.g. body of an e-mail message, pictures, audio, and video.

Wait.. we're talking about "Big Data Analytics"?

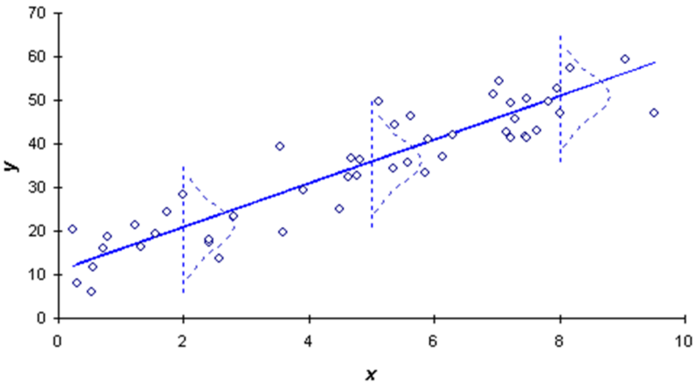


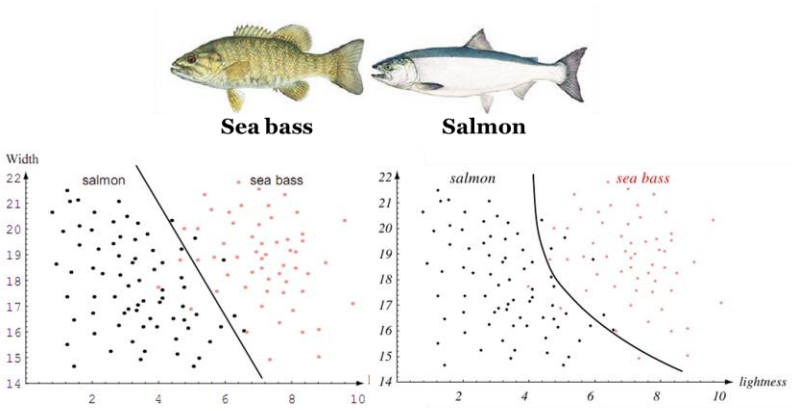
Data is NOT always the cure!

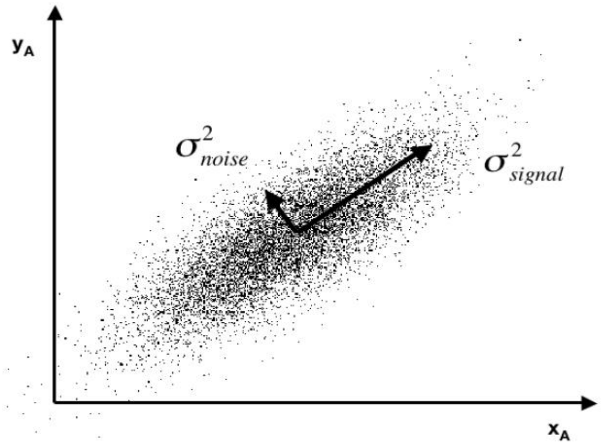
- The "Big Data" does eliminate intuition. However, our interpretations of it have great impact on the results. Let's check out this article in New York Time . It says "*Let's put everything in and let the data speak for itself.*" This is a bit horrible quote and don't let it mislead you.

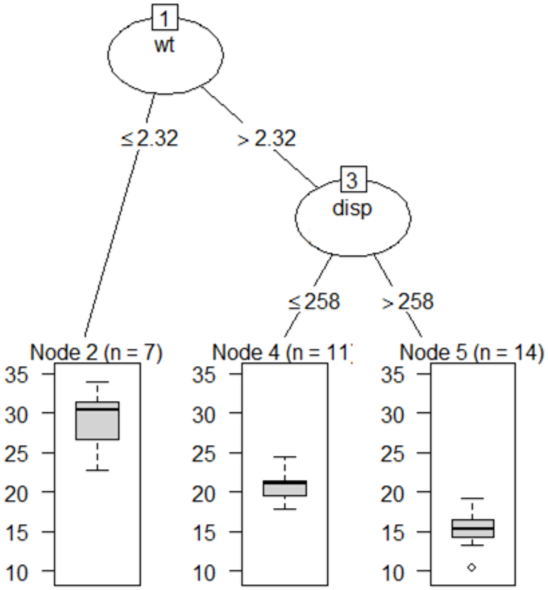
"...Data is just a quantitative,
pale echo of the events of our society...".
–O'Neil, "On Being a Data Skeptic"

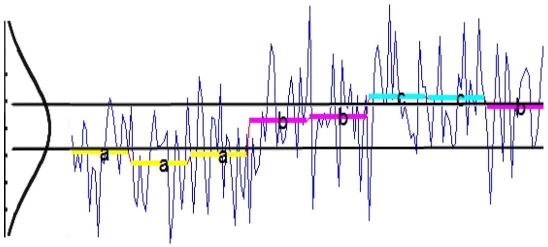
Statistical Machine Learning







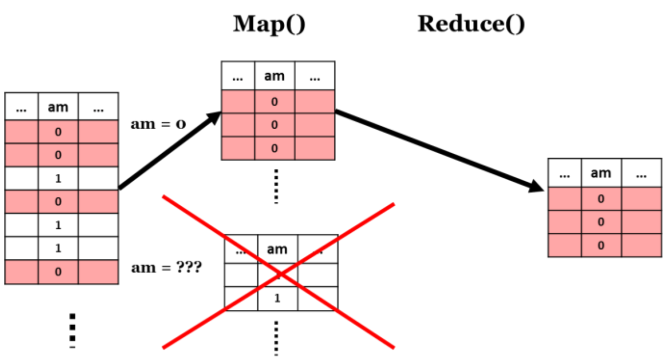




MapReduce Design Patterns

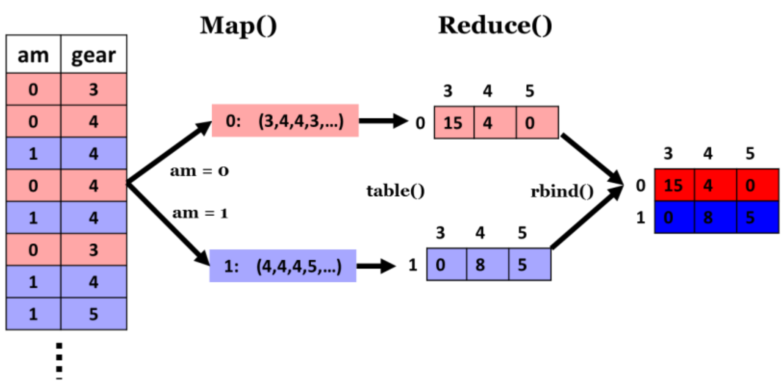
- We will surely do more than just the "word count"!

Filtering



...	am	...
	0	
	0	
	1	
	0	
	1	
	1	
	0	

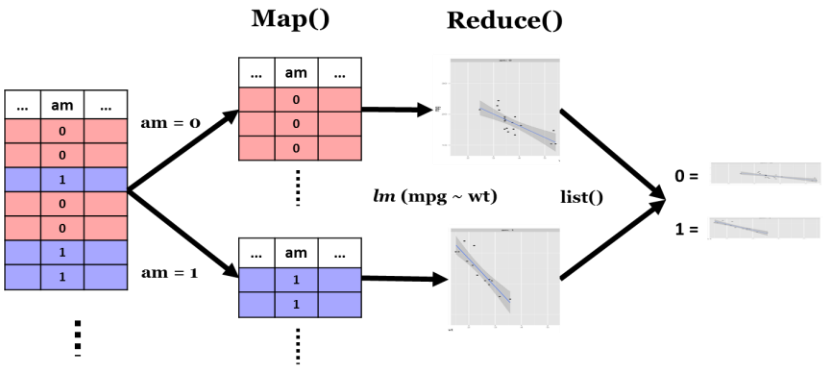
Aggregation (crosstab)



am	gear
0	3
0	4
1	4
0	4
1	4
0	3
1	4
1	5

	3	4	5
0	15	4	0
1	0	8	5

Split-Apply-Combine (e.g. model fitting)



...	am	...
	0	
	0	
	1	
	0	
	0	
	1	
	1	

Sorting patterns, Join patterns, ...

And many more!

High-performance R Programming

- We still don't know much about R's own limitations and capabilities when coping with Big Data. Why my R code is so slow? How to evaluate my R code?

- We will be discussing vectorized and functional programming, and why they matter in the age of Big Data.

- We will also be discussing how to tweak programs by writing more functional, primitive, and parallel R code, as well as how to use more CPU cores on both a single and a cluster of machines!

Two Ecosystems of Big Data Analytics

In-database Analytics

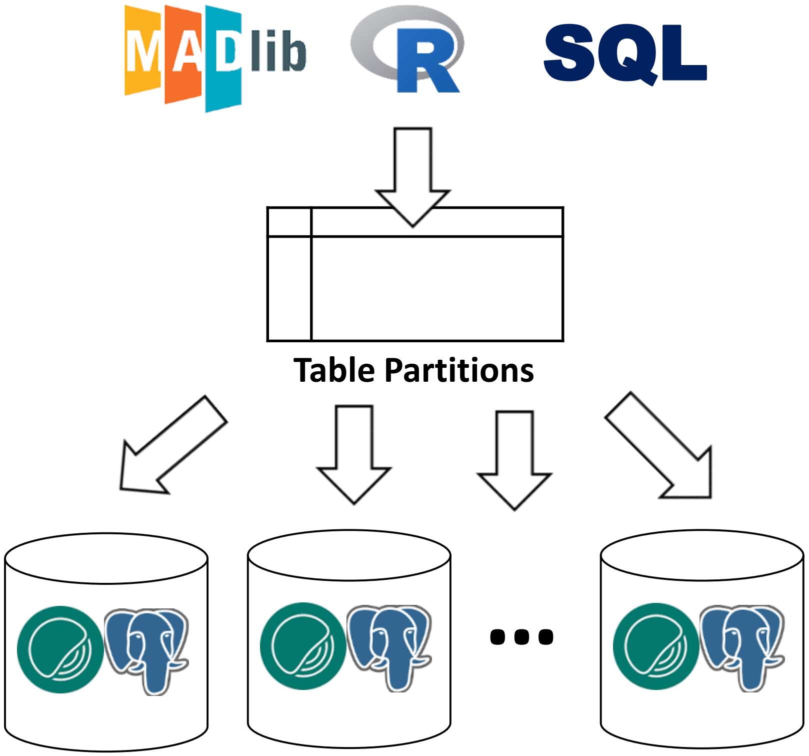
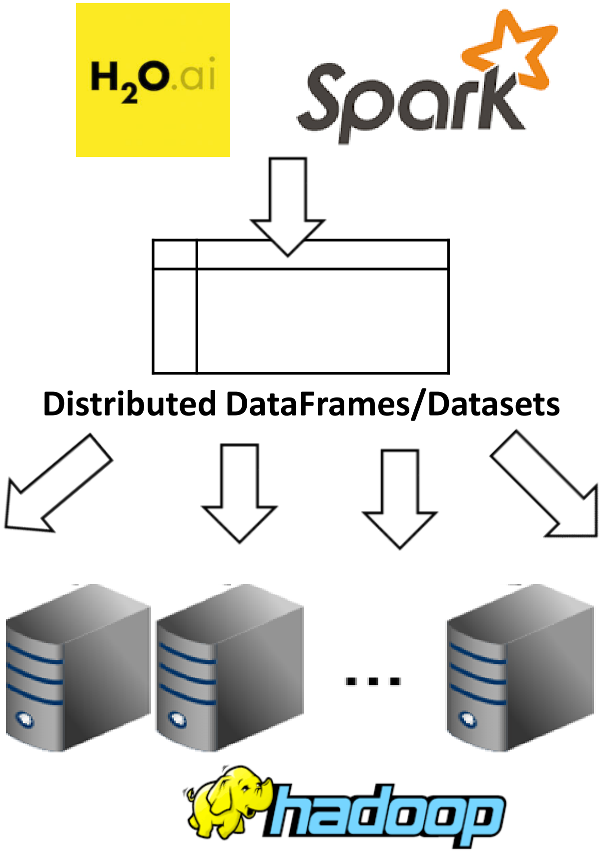


Table Partitions

Massive Parallel Processing Databases
(e.g. Teradata, PostgreSQL, Greenplum,… etc.)

vs.

In-memory Analytics



Distributed DataFrames/Datasets

"AI is the New Electricity."

— Andrew Ng (吳恩達)

What would make an AI company?

- Strategic Data Acquisition
- Centralized Data Warehouse (Unified Data Analytics Platform)
- Pervasive Automation

Trends in Big Data Analytics

- ✓ The flood of "data lake"
- ✓ The rise of out-of-memory analytics/algorithms
- ✓ The dawn of *fast scalable data applications*
- ✓ The use of *in-memory* & *in-database* computations
- ✓ The pursuit of accountable and transparent AI
- ✓The fall of business without AI strategies

Your homework this week

❑ Make a choice. Quit or stay. We will be getting an account for the access to CM Big Data Analytics Platform next week.

❑ Review R programming. Especially those of you who are not familiar with any scientific computing languages.

❑ Get the textbooks & papers and start reading!

See you next week!