Data Analytics (CS61061)

Lecture #1

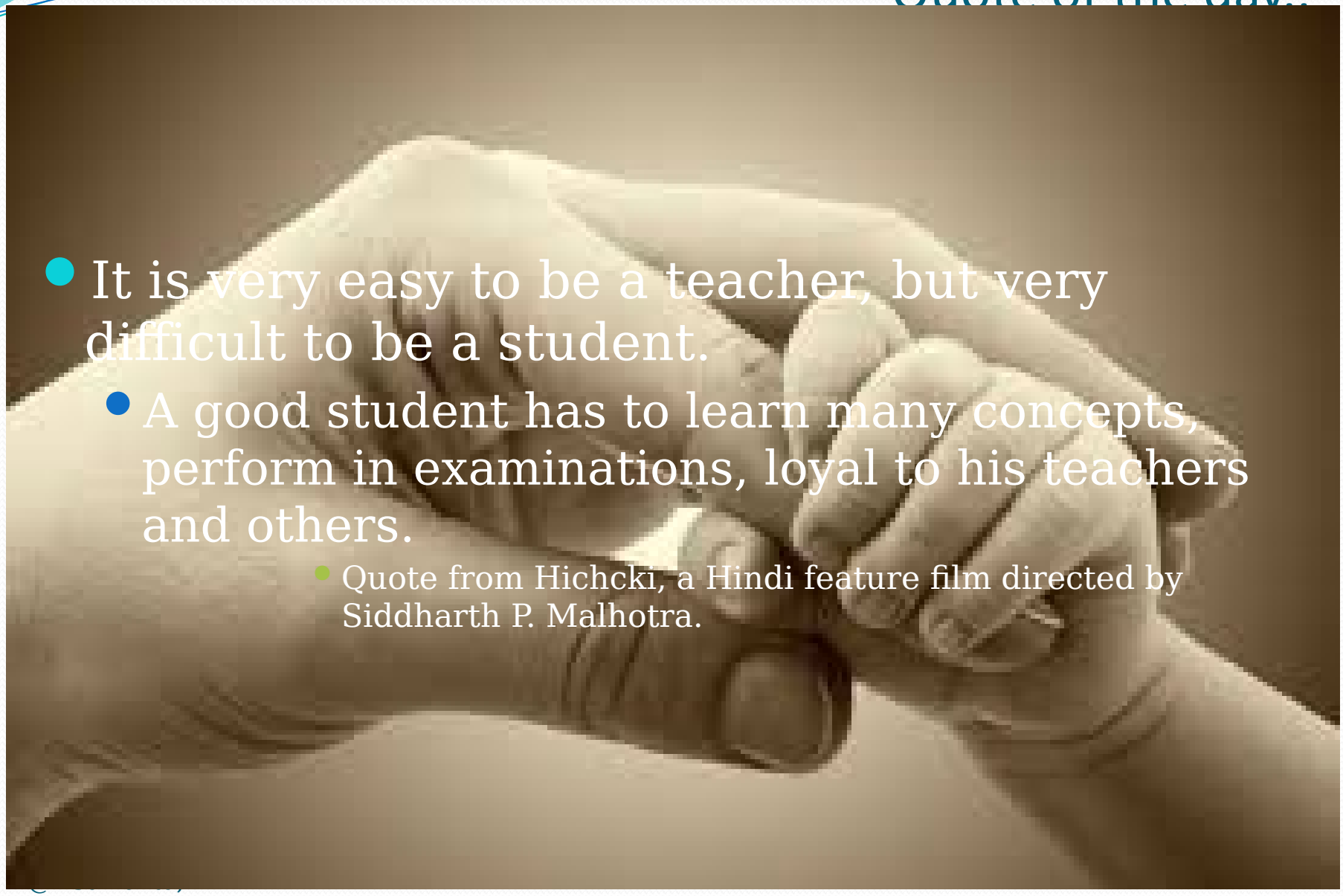
Introduction to Data

Dr. Debasis Samanta

Professor

Department of Computer Science & Engineering

Quote of the day..



- It is very easy to be a teacher, but very difficult to be a student.
  - A good student has to learn many concepts, perform in examinations, loyal to his teachers and others.
    - Quote from Hichcki, a Hindi feature film directed by Siddharth P. Malhotra.

In this discussion…

- Introduction to data
- Current trend
- Data and Big Data
- Big Data vs. small data
- Tools and techniques

Introduction to Data

Introduction to data

- Example:

  10, 25, …, Kharagpur, 10CS3002, namo@gov.in

  … Anything else?

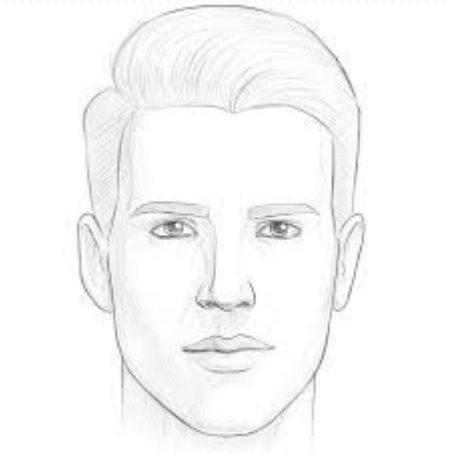
- Data versus Information

  100.0, 0.0, 250.0, 150.0, 220.0, 300.0, 110.0

  Is there any information?

Introduction to data

- Is there any data you can find in the following of them?



Current Trend

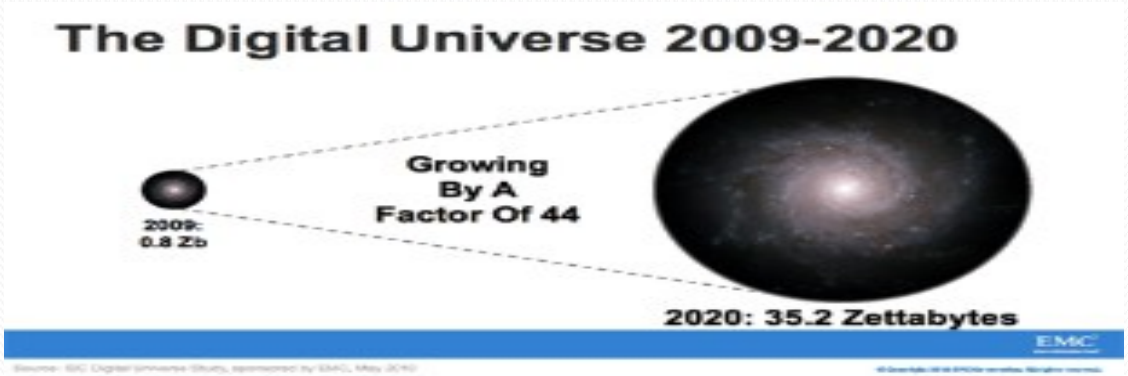
How large your data is?

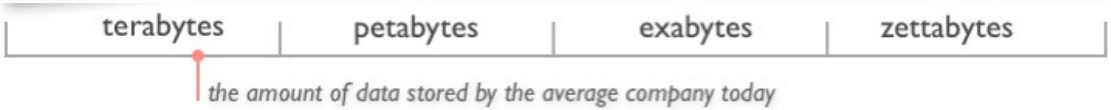
- What is the maximum file size you have dealt so far?
  - Movies/files/streaming video that you have used?
- What is the maximum download speed you get?
  - To retrieve data stored in distant locations?
- How fast your computation is?
  - How much time to just transfer from you, process and get result?

Memory unit	Size	Binary size
kilobyte (kB/KB)	10^3	2^{10}
megabyte (MB)	10^6	2^{20}
gigabyte (GB)	10^9	2^{30}
terabyte (TB)	10^{12}	2^{40}
petabyte (PB)	10^{15}	2^{50}
exabyte (EB)	10^{18}	2^{60}
zettabyte (ZB)	10^{21}	2^{70}
yottabyte (YB)	10^{24}	2^{80}

1024 Yottabytes = 1 Brontobyte
1024 Brontobytes = 1 Geopbyte

Growth of data





Sources of data

- "Every day, we create 2.5 quintillion bytes of data
  - So much that 90% of the data in the world today has been created in the last two years alone.
  - All these data coming from where?

Sources of data: Examples

Social media and networks
(All of us are generating data)

Scientific instruments
(Collecting all sorts of data)

Mobile devices
(Tracking all objects all the time)

Sensor technology and networks
(Measuring all kinds of data)

..... to name a few!

Big Data

Now data is Big Data!

- No single standard definition!

- 'Big-data' is similar to 'Small-data', but bigger

  …but having data bigger consequently requires different approaches

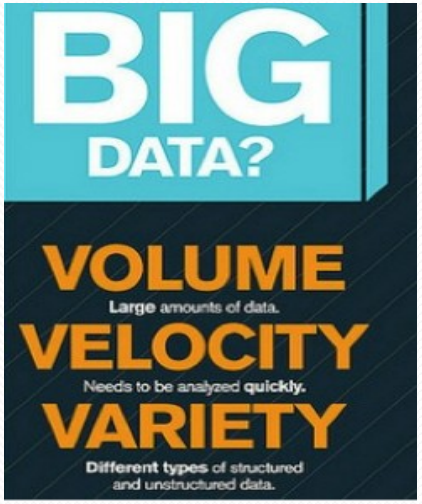
  - techniques, tools and architectures

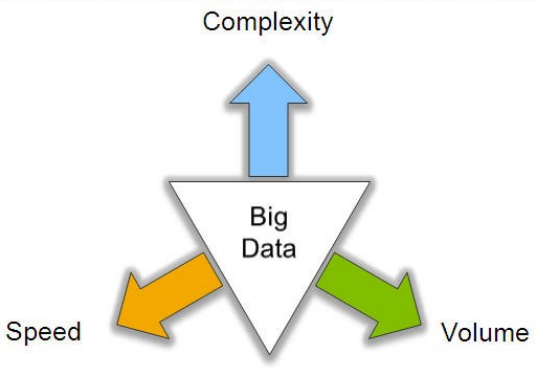
  …to solve: new problems

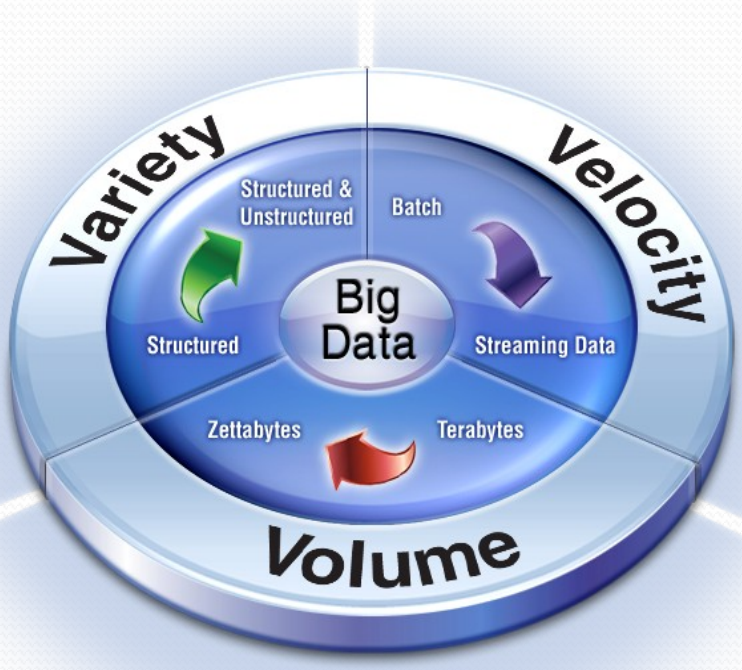
  …and, of course, in a better way

Big data is data whose scale, diversity, and complexity require new architecture, techniques, algorithms, and **analytics** to manage it and extract value and hidden knowledge from it…

Characteristics of Big Data: **V3**

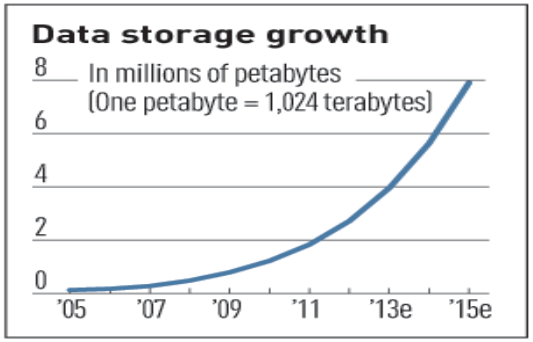


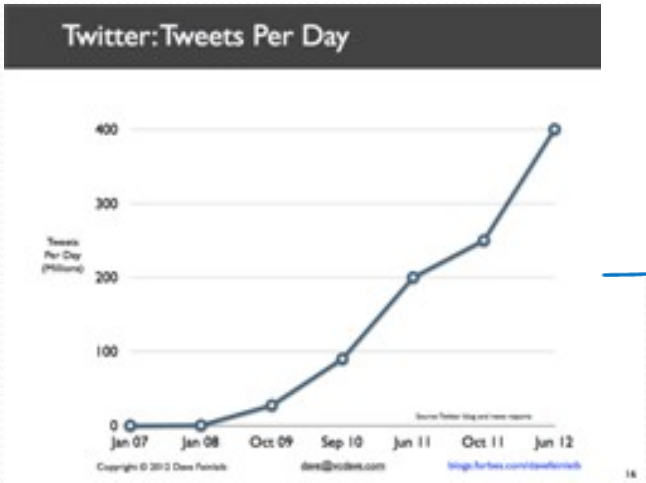




V3 : V for Volume

- Volume of data, which needs to be processed is increasing rapidly
  - More storage capacity
  - More computation
  - More tools and techniques



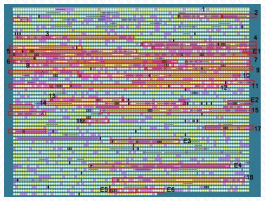


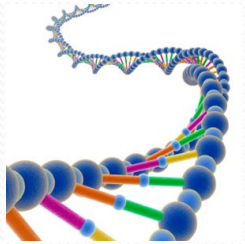
Exponential increase in collected/generated data

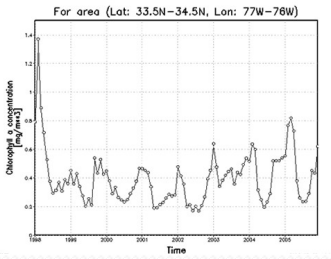
V3: V for Variety

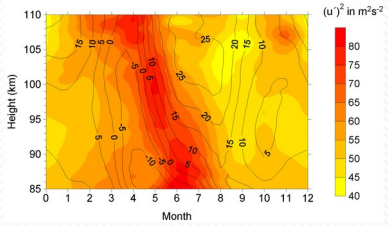
- Various formats, types, and structures
  - Text, numerical, images, audio, video, sequences, time series, social media data, multi-dimensional arrays, etc…
- Static data vs. streaming data
- A single application can be generating/collecting many types of data

To extract knowledge all these types of data need to be linked together





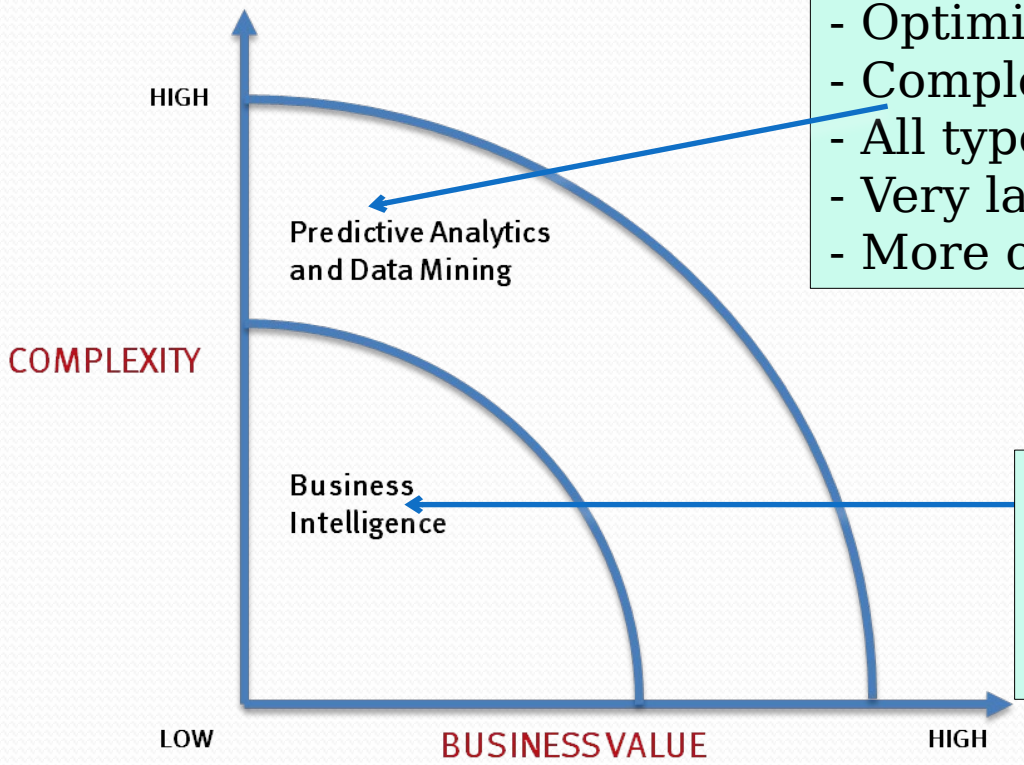




V3: V for Velocity

- Data is being generated fast and need to be processed fast
  - For time-sensitive processes such as catching fraud, big data must be used as it streams into your enterprise in order to maximize its value
  - Scrutinize 5 million trade events created each day to identify potential fraud
  - Analyze 500 million daily call detail records in real-time to predict customer churn faster
- Sometimes, 2 minutes is too late!
  - The latest we have heard is 10 ns (nano seconds) delay is too much

Big Data vs. small data



- Optimizations and predictive analytics
- Complex statistical analysis
- All types of data, and many sources
- Very large datasets
- More of a real-time

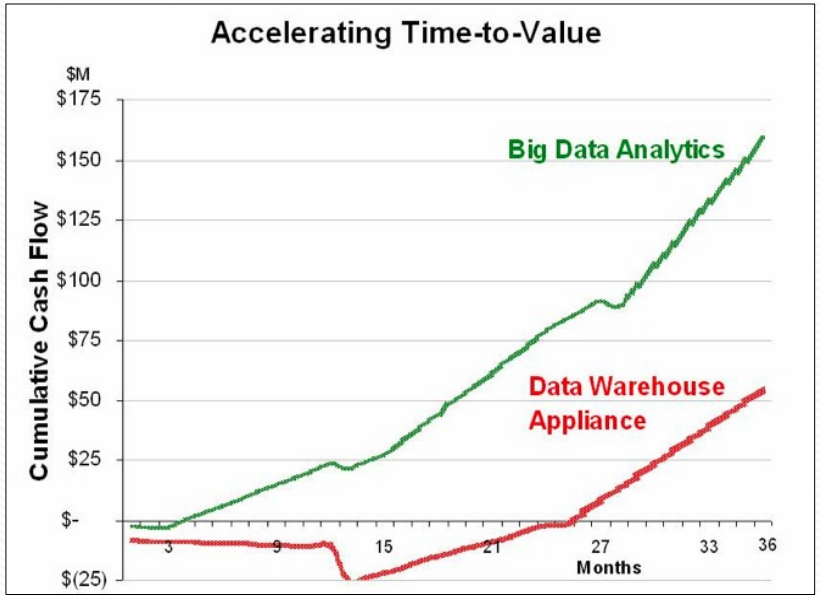
- Ad-hoc querying and reporting
- Data mining techniques
- Structured data, typical sources
- Small to mid-size datasets

Big Data vs. small data

- Big Data is more real-time in nature than traditional applications

- Big Data architecture
  - Traditional architectures are not well-suited for big data applications (e.g. Exa-data, Tera-data)

  - Massively parallel processing, scale out architectures are well-suited for big data applications



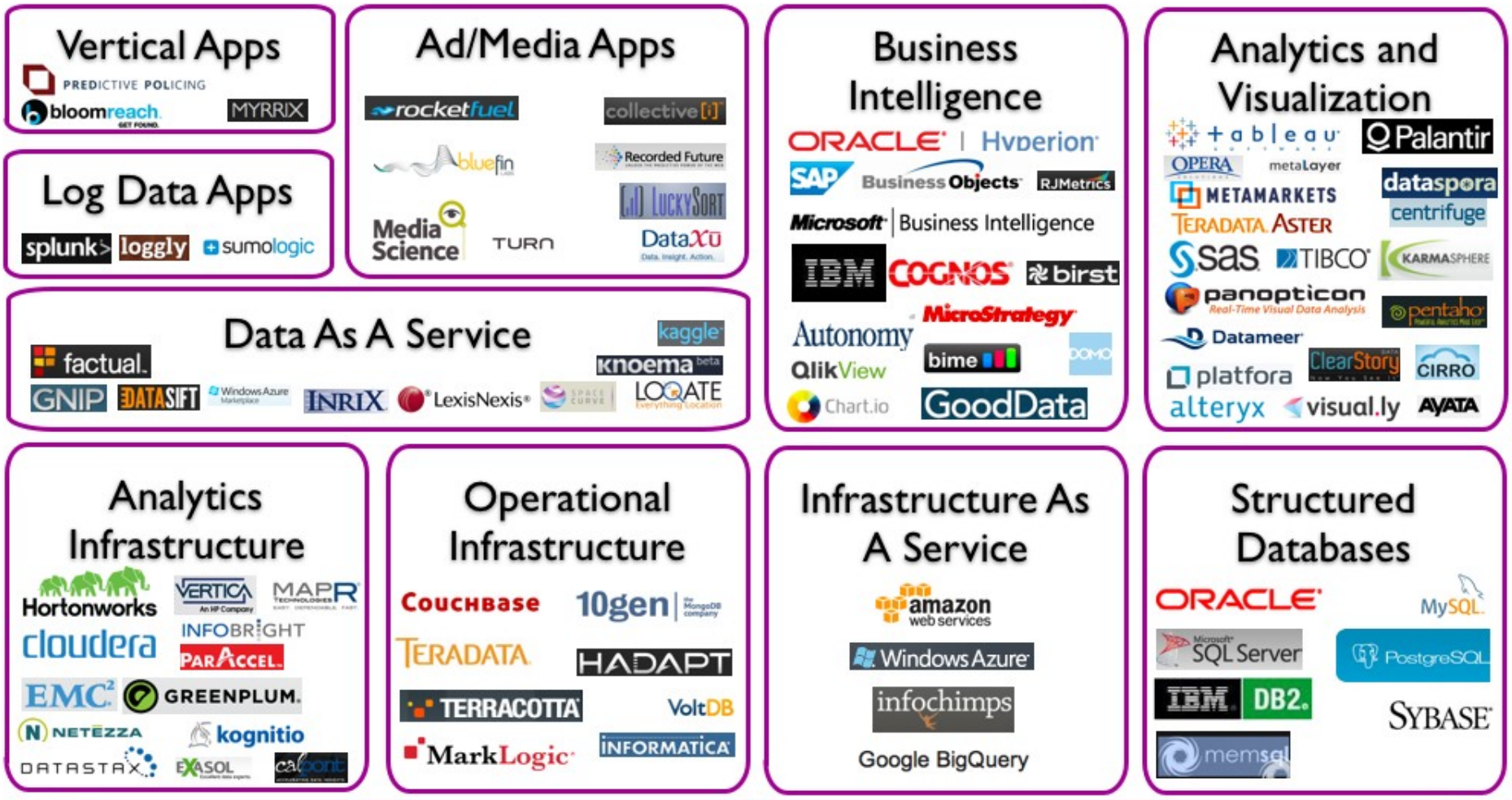
Tools and Techniques

Challenges ahead…

- **The bottleneck is in technology**
  - New architecture, algorithms, techniques are needed
- **Also in technical skills**
  - Experts in using the new technology and dealing with Big data

Who are the major players in the world of Big Data?

Big Data Landscape



dave@vcdave.com

blogs.forbes.com/davefeinleib

Major players…

- Google
- Hadoop
- MapReduce
- Mahout
- Apache Hbase
- Cassandra

Tools available

- **NoSQL**
  - DatabasesMongoDB, CouchDB, Cassandra, Redis, BigTable, Hbase, Hypertable, Voldemort, Riak, ZooKeeper
- **MapReduce**
  - Hadoop, Hive, Pig, Cascading, Cascalog, mrjob, Caffeine, S4, MapR, Acunu, Flume, Kafka, Azkaban, Oozie, Greenplum
- **Storage**
  - S3, HDFS, GDFS
- **Servers**
  - EC2, Google App Engine, Elastic, Beanstalk, Heroku
- **Processing**
  - R, Yahoo! Pipes, Mechanical Turk, Solr/Lucene, ElasticSearch, Datameer, BigSheets, Tinkerpop

Any question?

Questions of the day…

1. What is the smallest and largest units of measuring size of data?

2. How big a Quintillion measure is?

3. Give examples of the smallest and the largest entities of data.

4. Give FIVE parameters with which data can be categorized as i) simple, ii) moderately complex and iii) complex?

Questions of the day…

5. What type of data are involved in the following applications?
    1. Weather forecasting
    2. Mobile usage of all customers of a service provider
    3. Anomaly (e.g. fraud) detection in a bank organization
    4. Person categorization, that is, identifying a human
    5. Aadhar data
    6. Streaming data from all flying aircrafts of Boeing