Introduction to Big Data Technologies

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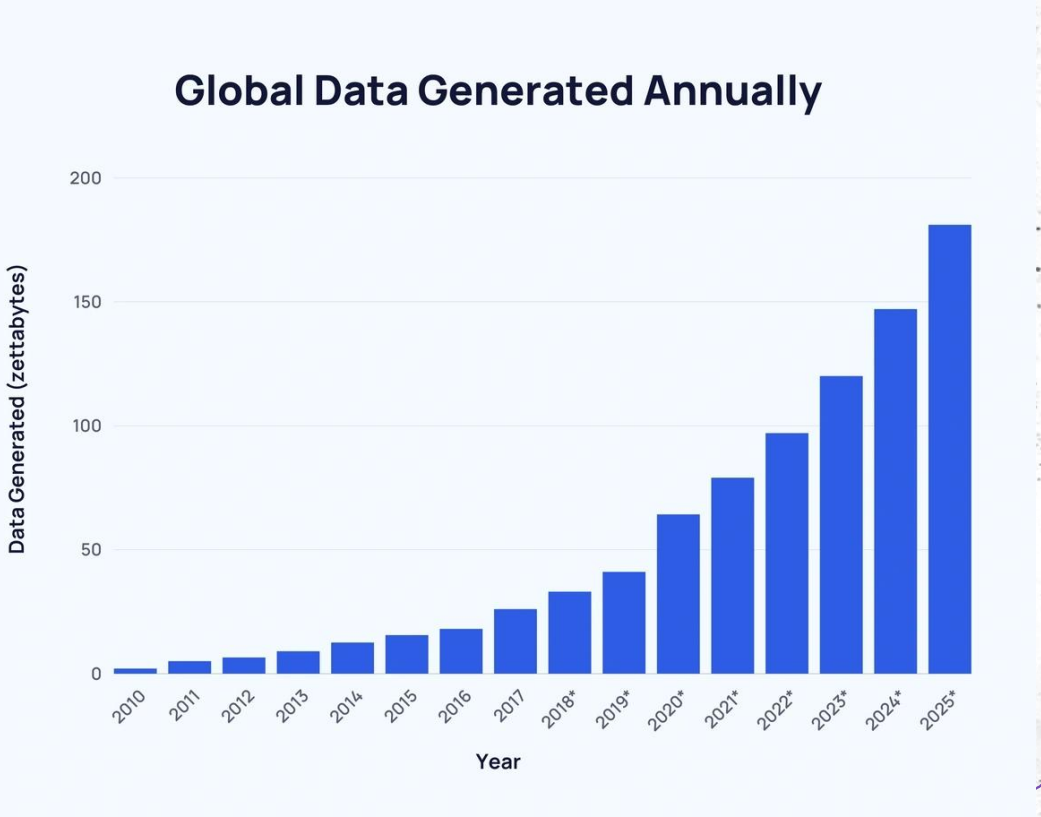
What is Big Data

Big Data

- Data is all around you.

- In recent years there has been a shift in the type of data:
  - Structured -> Unstructured
  - Fixed, pre-determined units -> Variable units
  - Smaller size -> Very large sizes
  - Lot of time for analysis -> Instant analysis

How Big is Big Data?



Source: Statista

Who Produces Big Data

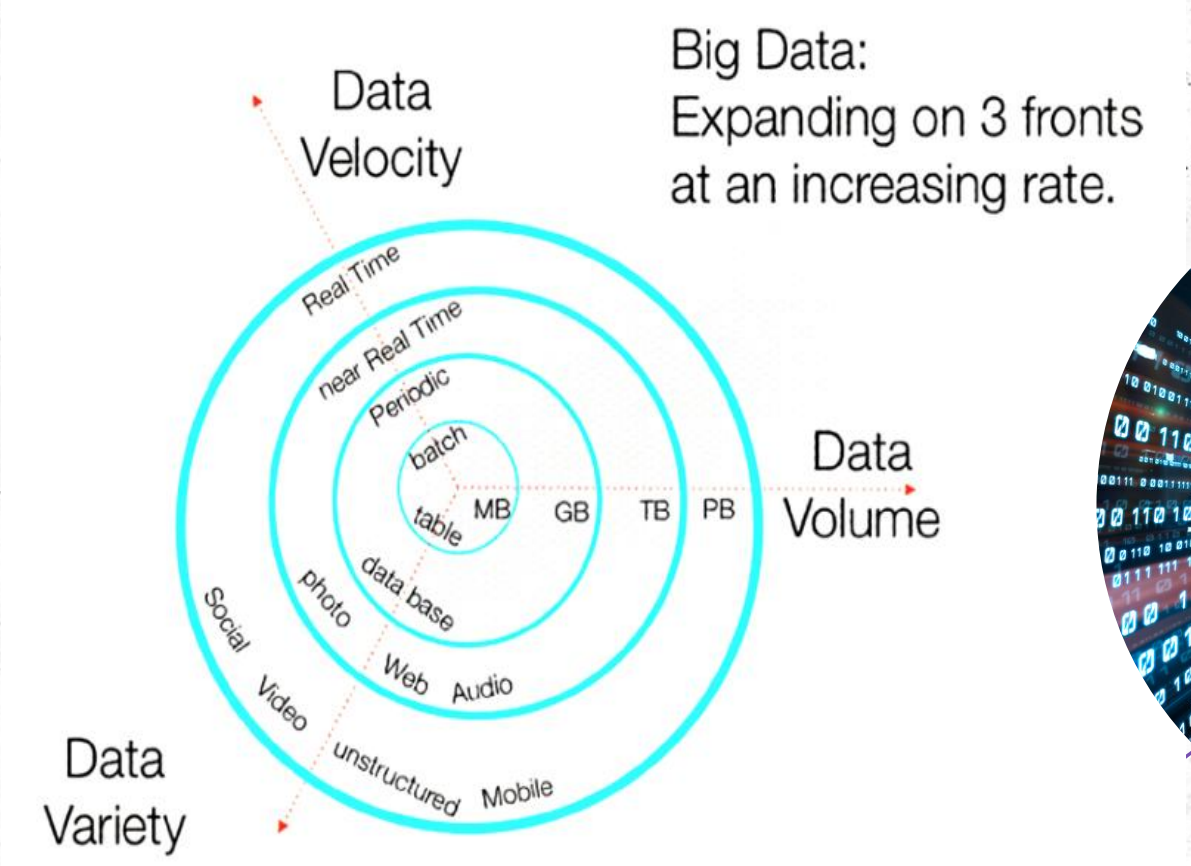
- Social Networks
- Media
- Telecom Companies
- Healthcare and Medicine
- Large science projects
- Each one of us!

Defining Big Data

Data growth challenges and opportunities are three-dimensional, i.e. increasing volume (amount of data), velocity (speed of data in and out), and variety (range of data types and sources).

- Doug Laney of Gartner group

Defining Big Data



V's of Big Data

Characteristics of Big Data.

- Volume
- Velocity
- Variety
- Veracity
- Variability
- Value

More details at:
https://cloud.google.com/learn/what-is-big-data

Big Data

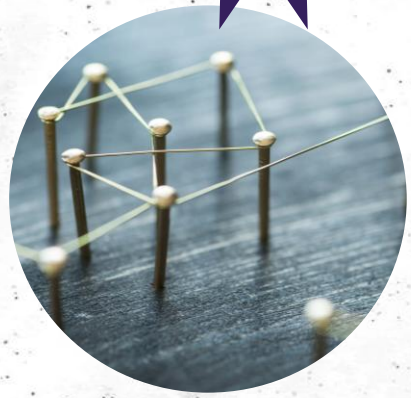
- Big Data produced by major entities is in raw form.
- Need to extract value from this raw data.
- This is where the field of analytics, and data mining come into play.
- Need a way to store and process this data inexpensively.
- Cluster computing solves this issue

02

Cluster Computing

Cluster Computing

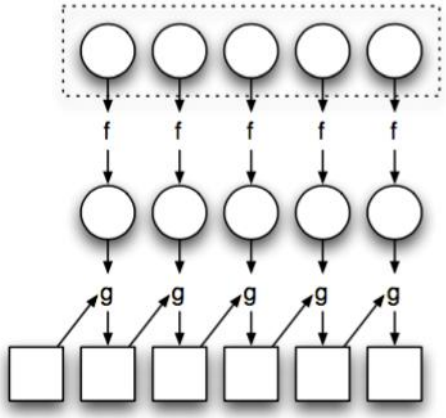
- Set of computers (nodes) connected together and working in sync.
- Distributed Computing
- Different than multi-core computing
- Higher availability
- Higher processing power
- Cheaper as compared to multi-core computing
- The newest manifestation of cluster computing is cloud computing.



How to Program a Cluster

- MapReduce programming

- **Key feature: higher order functions**
  - Functions that accept other functions as arguments
  - **Map** and **Fold** **(Reduce)**



f is applied to every element and it results in a new list

g starts with an initial value and reduces every element i.e. compacts list to a scalar

Figure: Illustration of *map* and *fold*.

Map Operation

- **Define a function:**
```
square x = x * x
```
- **Apply on a list:**
```
>>> map square [1, 2, 3, 4, 5]
```
- **Get another list:** `[1, 4, 9, 16, 25]`

Reduce (Fold) Operation

- **Define an operator: +**
- **Initial value = 0**
- **Apply on a list:** `[1,2,3,4,5]`
- **Get a scalar: 15**

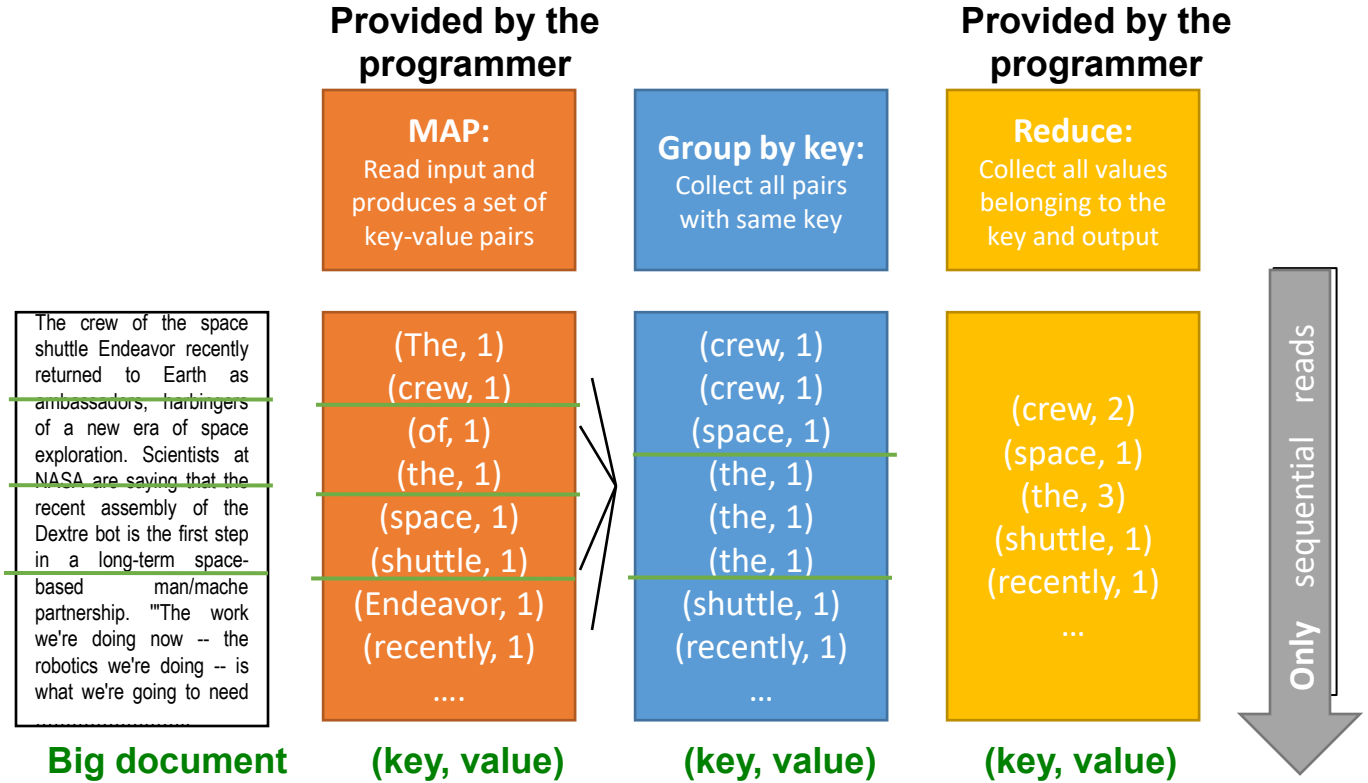
Example – Word Count

Programming Model: MapReduce

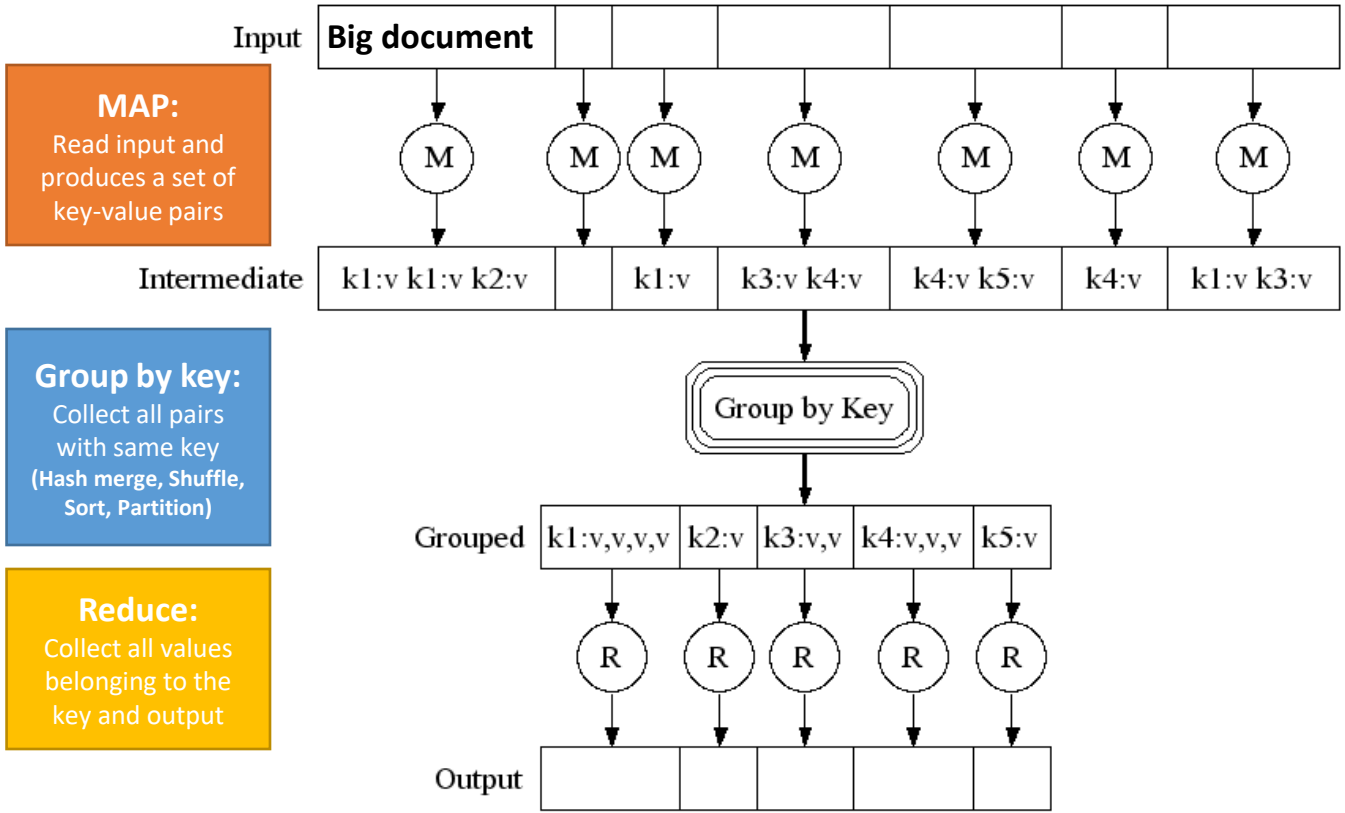
Warm-up task:

- We have a huge text document
- Count the number of times each distinct word appears in the file
- **Sample application:**
  - Analyze web server logs to find popular URLs

MapReduce: Word Counting



Map-Reduce: A diagram



Word Count Using MapReduce

```
map(key, value):
// key: document name; value: text of the document
  for each word w in value:
      emit(w, 1)

reduce(key, values):
// key: a word; value: an iterator over counts
      result = 0
      for each count v in values:
            result += v
      emit(key, result)
```

Map-Reduce: Environment

Map-Reduce environment takes care of:

- Partitioning the input data (input splits)
- Scheduling the program's execution across a set of machines
- Performing the **group by key** step
- Handling machine failures
- Managing required inter-machine communication

Spark Coding

Spark Coding

- We will use Google Colab as the coding environment.
- Steps:
  1. Go to Google Colab:
     colab.research.google.com

  2. Create a new notebook and connect to the cloud

  3. After connecting to cloud, install Spark and write code
- PySpark notebook can be downloaded from
  github.com/a-nagar/big_data

Thanks!

Do you have any questions?

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