Big Data

Introduction

Rachana B S, Usha Devi B G, Resma K S, Prafullata K A, Subramaniam K V

Department of Computer Science and Engineering

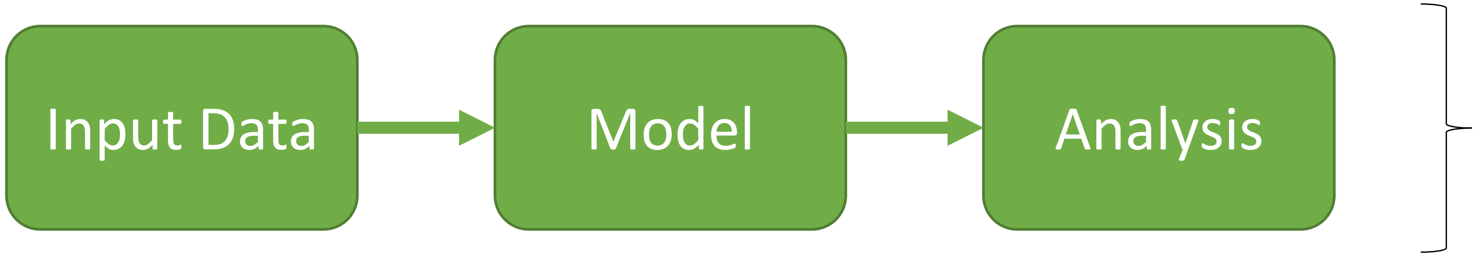
{rachanabs,ushadevibg, resma, prafullatak, subramaniamkv}@pes.edu

+91 80 6666 3333 Extn 877

What is Big Data?

There is no one standard single definition.

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…



Modelling pipeline

<u>Model</u> –is a human construct that better helps us understand real-world systems/phenomena.

With Big Data, this means….

Big Data themes

How to manage very large amounts of data (*data management)*

Google: store index to WWW and search

and extract value and knowledge from them (*analytics)*

Amazon: store user purchases and make recommendations

Large-Scale Data Management

Big Data Analytics

Data Science and Analytics

Big Data: Motivating Example

Big Data themes

How to manage very large amounts of data (*data management)*

and extract value and knowledge from them (*analytics)*

Google: store index to WWW and search

Amazon: store user purchases and make recommendations

Large-Scale Data Management

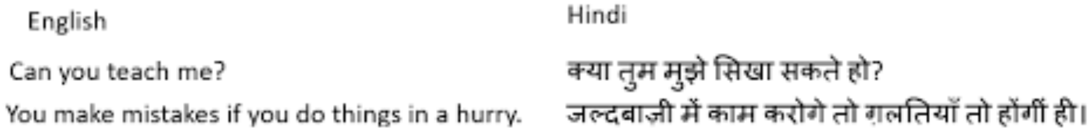
Big Data Analytics

Data Science and Analytics

High level approach: motivating example

Machine Translation

Translating a sentence from English → Hindi



English	Hindi
Can you teach me?	क्या तुम मुझे सिखा सकते हो?
You make mistakes if you do things in a hurry.	जल्दबाज़ी में काम करोगे तो ग़लतियाँ तो होंगीं ही।

https://towardsdatascience.com/intuitive-explanation-of-neural-machine-translation-129789e3c59f

What would be the traditional approach?

How will it differ from the Big Data approach?

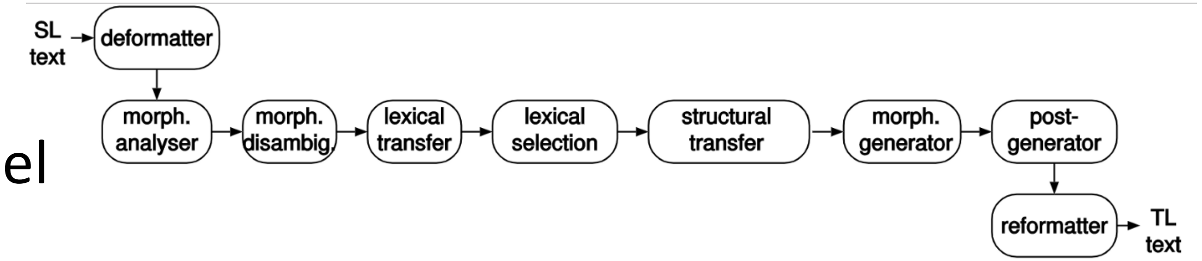
Traditional Approach

Understand the system –linguistic approach –rule based

Requires a linguistic expert to build a model

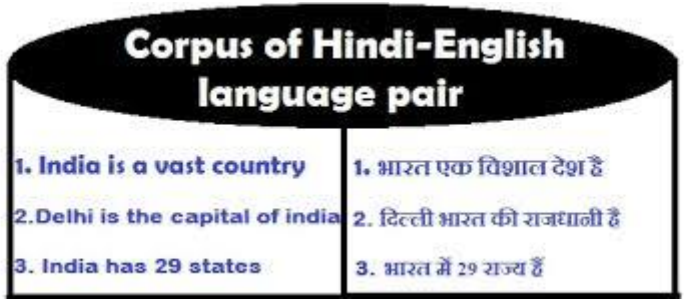
Model should include

- Language structure → morphology, grammar
- Meaning of the words
- Mapping words from one language to another



https://towardsdatascience.com/machine-translation-a-short-overview-91343ff39c9f

Big Data Approach

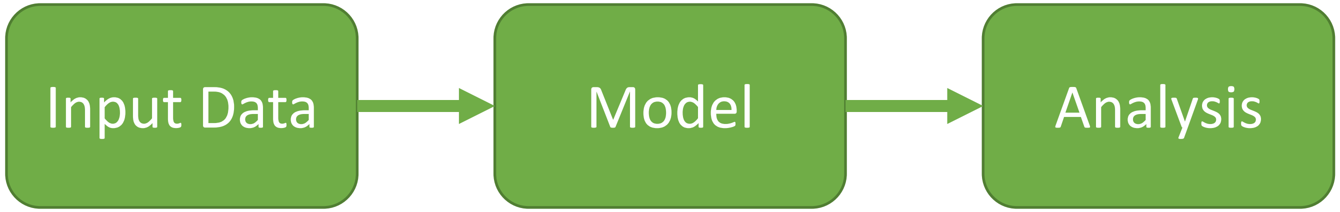


Corpus of Hindi-English language pair	
1. India is a vast country	1. भारत एक विशाल देश है
2.Delhi is the capital of india	2. दिल्ली भारत की राजधानी है
3. India has 29 states	3. भारत में 29 राज्य हैं

https://techmediahub.com/machine-translation-complete-useful-guide/

- No attempt to understand language
- Gather data about different sentences and translations
  - Requires a parallel corpus
  - Millions of sentences and their translations
- Build a statistical model
- For example:
  - Every time the word cat appears in the English sentence
  - The hindi equivalent has *billi*
  - So infer that cat can be translated as *billi*

Big Data and Analytics



Traditional Approach

The model is human generated

Big Data Approach

The model is machine generated

What about domain knowledge?

Correlation is enough?

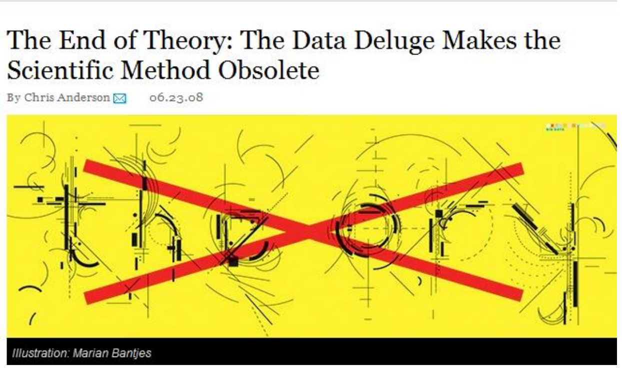
Gene sequencing of DNA fragments found in ocean by J. Craig Venter

- 1000s of new species
- No idea of what species looks like or any other info

All models are wrong, and increasingly you can succeed without them

Peter Norvig, Google's research director

“The unreasonable effectiveness of d



The End of Theory: The Data Deluge Makes the Scientific Method Obsolete

By Chris Anderson 06.23.08

Illustration: Marian Bantjes

http://www.wired.com/science/discoveries/magazine/16-07/pb_theory

Conclusions from Peter Norvig's talk

Algorithms are not important, data is

- Domain knowledge (e.g., physics/grammar) is not important

Demonstrates how images can be merged together using just data

And translation of text giving examples of issues in segmentation

EXPERT OPINION

Contact Editor: **Brian Brannon**, bbrannon@computer.org

The Unreasonable Effectiveness of Data

Alon Halevy, Peter Norvig, and Fernando Pereira, *Google*

Peter Norvig, Head Google Research, *The Unreasonable Effectiveness of Data*
https://www.youtube.com/watch?v=yvDCzhbjYWs

What about domain knowledge?

Can we rely only on data alone?

Does this mean that domain knowledge is obsolete?

Big Data: Pitfalls in Analysis

Issues in machine translation

What about *let the cat out of the bag*?

Naïve translation - *billi ko bag ke bahar chhod diya*

English meaning: reveal a secret

To be able to solve this, we need information about the language → domain knowledge and some experimentation

EXPERT OPINION

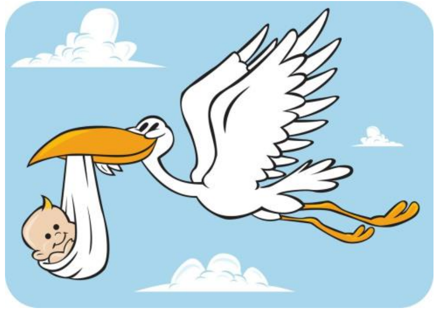
Contact Editor: **Brian Brannon**, bbrannon@computer.org

The Unreasonable Effectiveness of Data

Alon Halevy, Peter Norvig, and Fernando Pereira, *Google*

Peter Norvig, Head Google Research, *The Unreasonable Effectiveness of Data*
https://www.youtube.com/watch?v=yvDCzhbjYWs

Pitfall : Spurious correlation



C->A, C->B

Does A->B?

Example:

Do storks deliver babies?

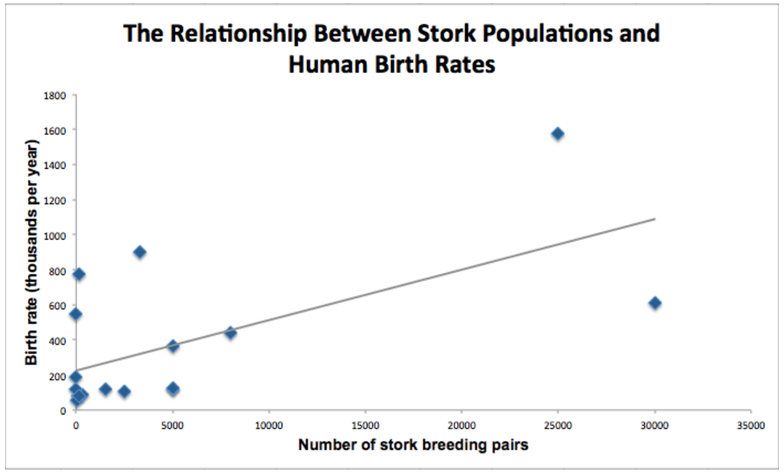


Chart shows positive correlation between

Stork population and human birth rates in European countries

What it does not show is a hidden variable

Available nesting area?

http://en.wikipedia.org/wiki/Spurious_relationship

http://www.cut-the-knot.org/do_you_know/misuse.shtml

Pitfall : Gaps in the data

Selection bias

Convenience

Example

- Rutgers University study
- Examine decision-making process in emergency
- Study tweets during Hurricane Sandy
- Most tweets from Manhattan!
- If studying impact of Sandy: ***<u>Manhattan most impacted!</u>***

UNITED STATES
MEXICO
Gulf of Mexico
Havana
CUBA
Caribbean Sea
Guatemala City
Managua
San José
Panama City
Caracas
Bridgetown
VENEZUELA

More Data, More Problems: Is Big Data Always Right? ARI ZOLDAN
http://www.wired.com/insights/2013/05/more-data-more-problems-is-big-data-always-right/

Pitfall : Gaps in the data

Another example: medicine

Missing data is always a challenge

but we also know that esu

more likely to go missing.

This means we have a *biased sample*,

overestimating the benefits of treatments.

O'REILLY

Strata CONFERENCE

Making Data Work

Feb 28–Mar 1, 2012

Santa Clara, California

#strataconf

strataconf.com

Keynote by Ben Goldacre

Ben Goldacre, *Bad Science*

The Information Architecture of Medicine is Broken Ben Goldacre
http://strataconf.com/strata2012/public/schedule/detail/22941

https://www.youtube.com/watch?v=AK_EUKJyusg

Big Data: How to address the issues?

Summary of the methods

Use domain knowledge to check model for validity

Estimate errors

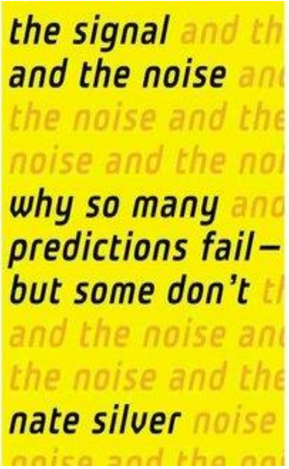
Let's look to some experts

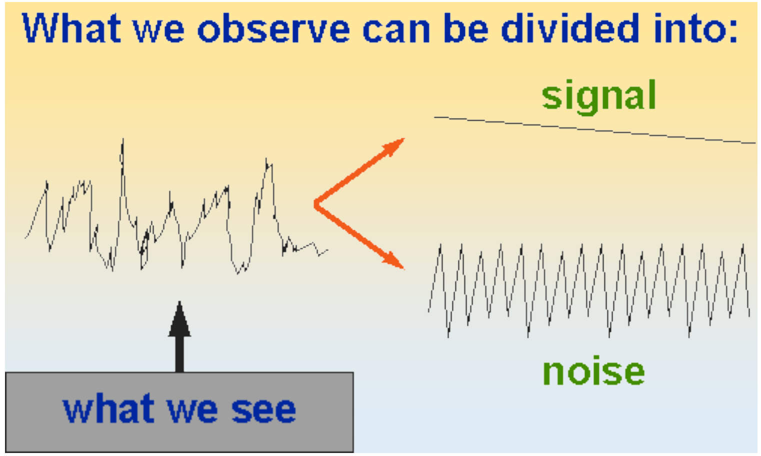
Nate Silver book

The Signal and the noise

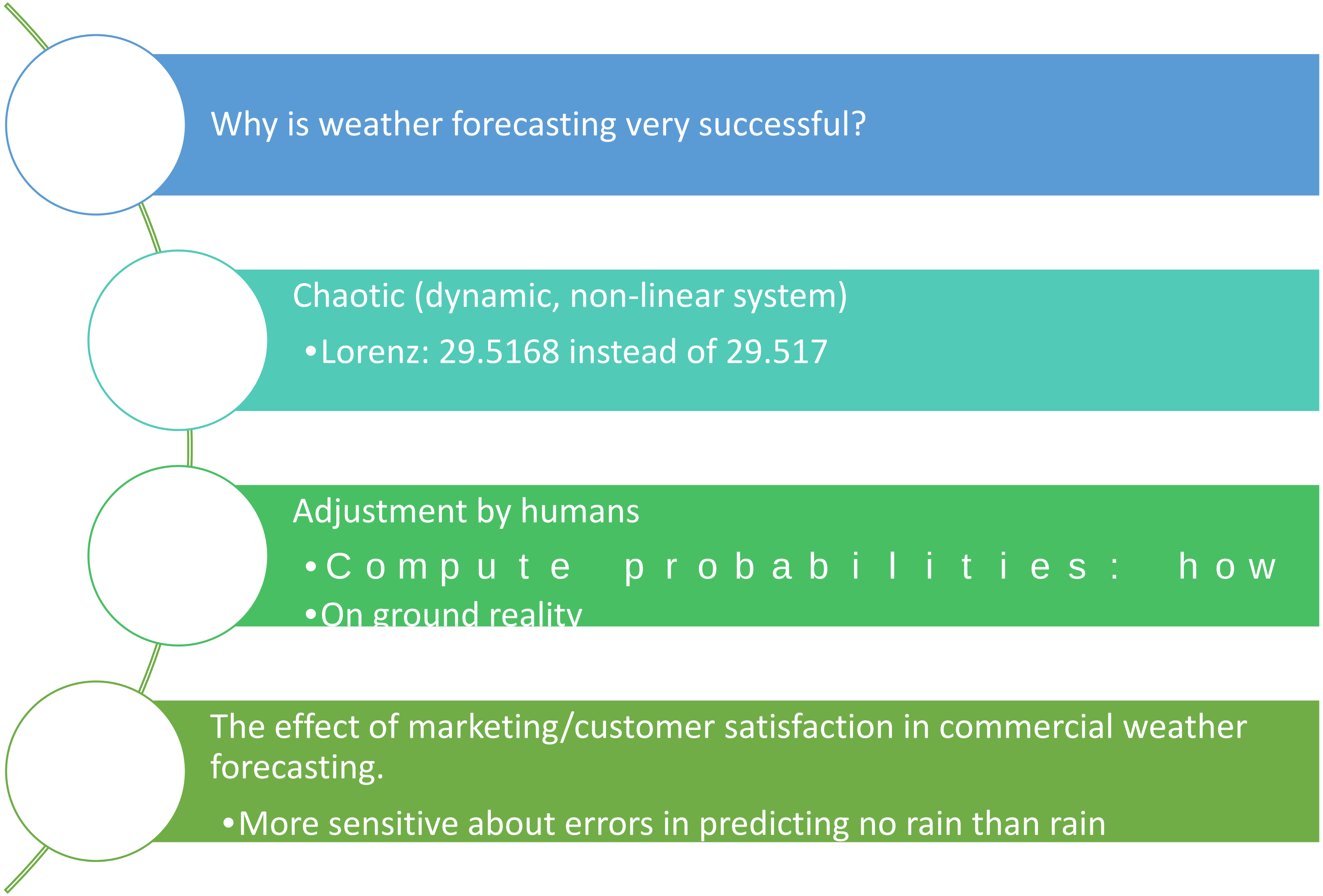
On Time Magazine 2009 –100 most influential people

Correctly predict US 2008/2012 elections


the signal
and the noise
why so many
predictions fail–
but some don't
nate silver



Example: Weather Forecasting



Why is weather forecasting very successful?

Chaotic (dynamic, non-linear system)

- Lorenz: 29.5168 instead of 29.517

Adjustment by humans

- Compute probabilities: how
- On ground reality

The effect of marketing/customer satisfaction in commercial weather forecasting.

- More sensitive about errors in predicting no rain than rain

Big Data Error Estimation

- Purely empirical: cannot be analysed by theory
- Divide data into *training set* and *testing set*
- Develop algorithm using training set; estimate error from testing set
  - Can be used to compare analytics algorithms
- Examples
  - Nate Silver: weather prediction: human adjustment
  - Amazon recommendations
    - Derive model using historical data; make recommendations
    - Get statistics on how many people look at or buy recommendations

Big Data: Summary and architecture

Big Data themes

How to manage very large amounts of data (*data management)*

↑

and extract value and knowledge from them (*analytics)*

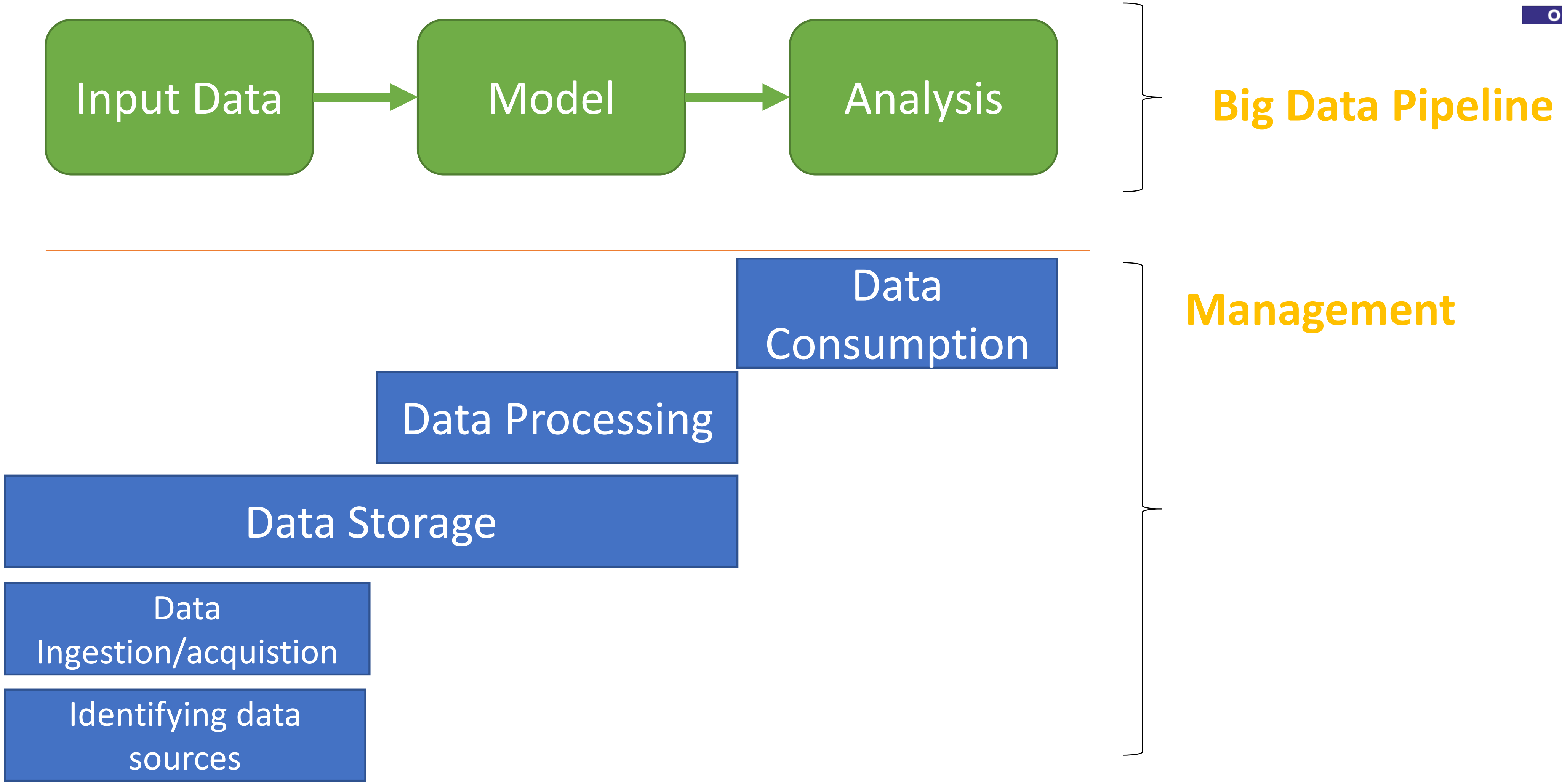
Google: store index to WWW and search

Amazon: store user purchases and make recommendations

Large-Scale Data Management

Big Data Analytics

Data Science and Analytics



Input Data → Model → Analysis

Big Data Pipeline

Data Consumption

Data Processing

Data Storage

Data Ingestion/acquistion

Identifying data sources

Management

THANK YOU

K V Subramaniam

Department of Computer Science and Engineering

subramaniamkv@pes.edu

+91 80 6666 3333 Extn 877

Content Creators

Prof Prafullata K A
Prof Usha Devi
Prof Rachana
Prof Resma