Text Analysis in R

Introduction

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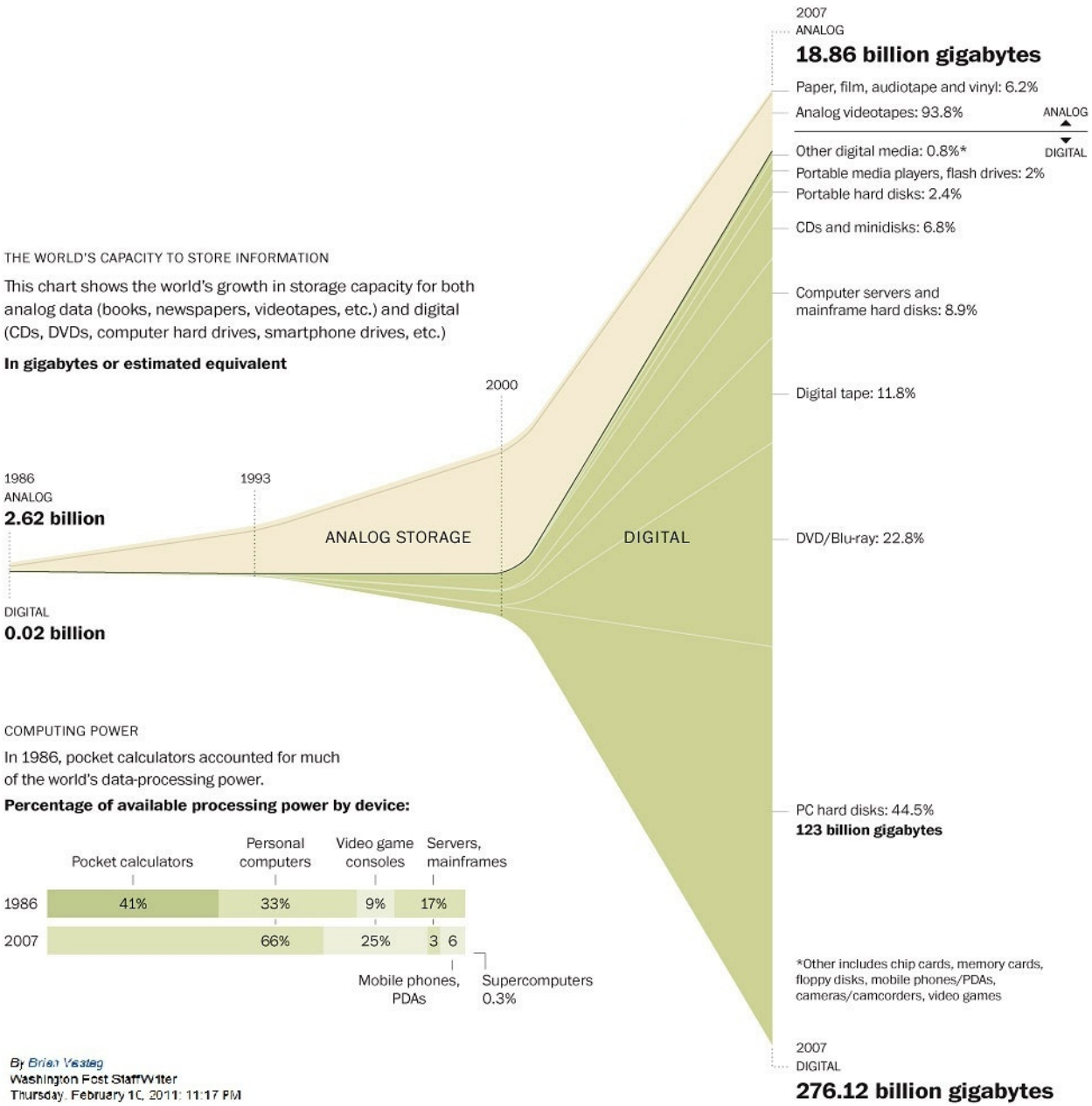
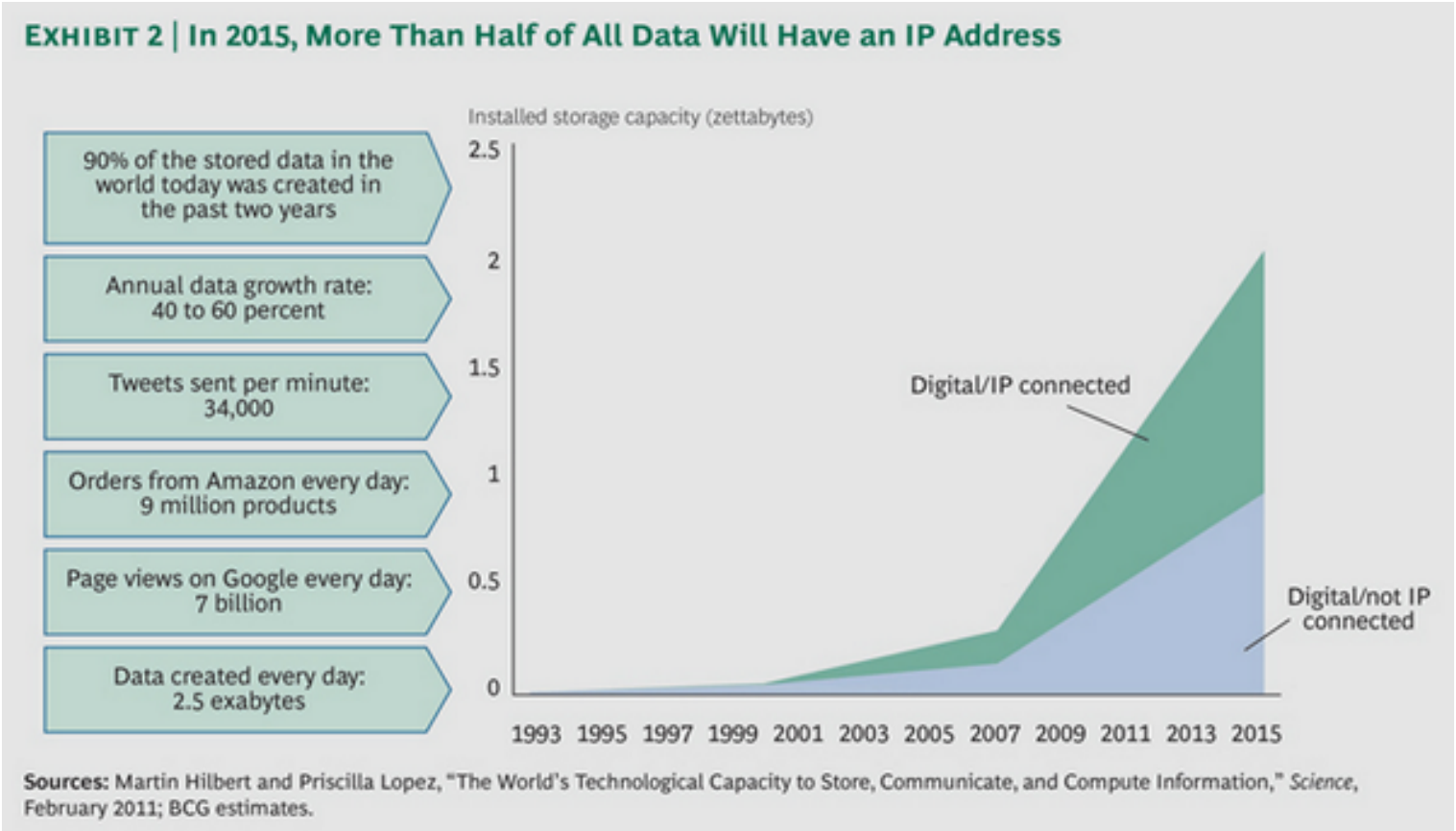
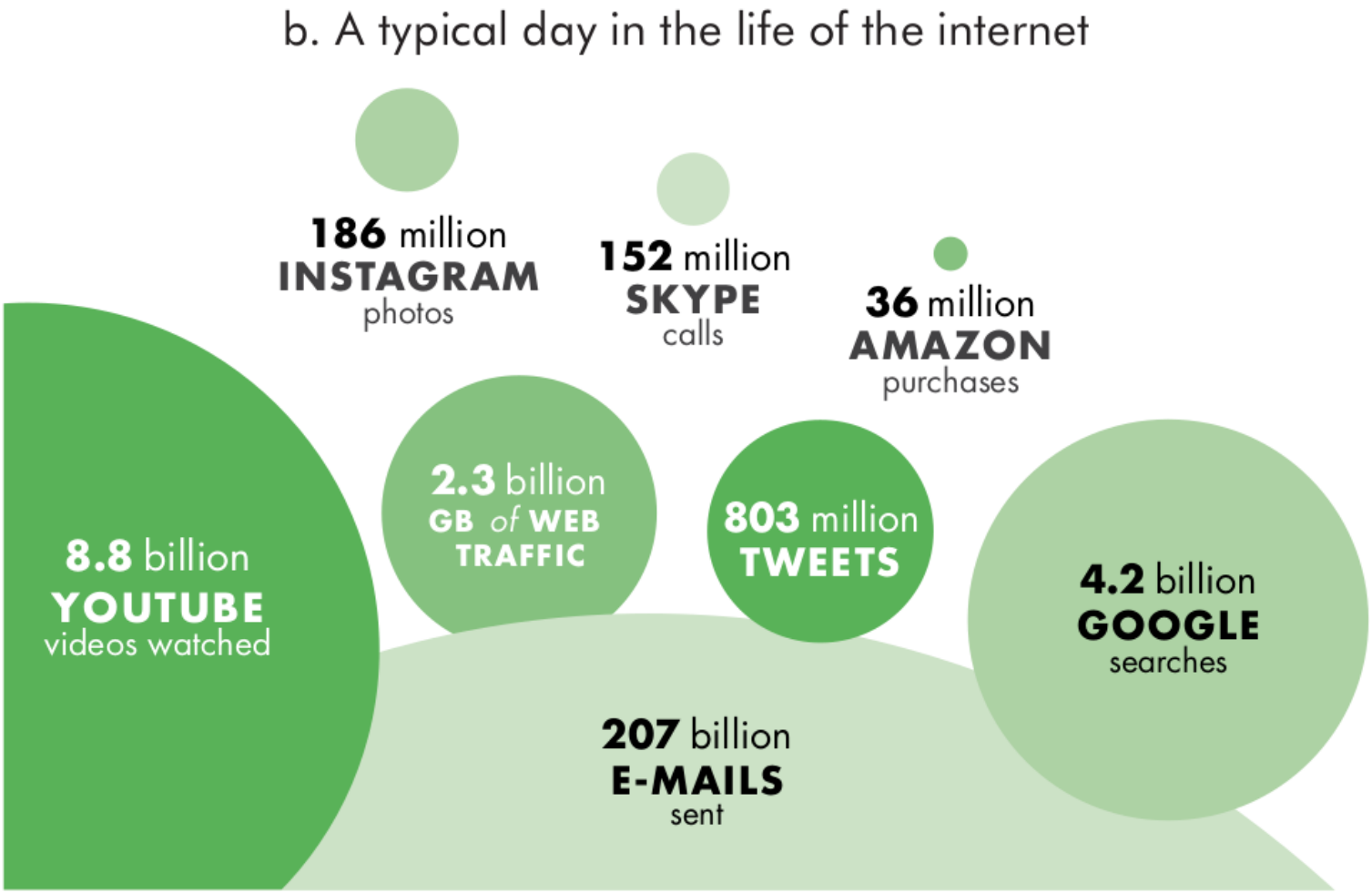
Worldwide data storage capacity



Data, then and now



Data, then and now



Sources: World Development Indicators (World Bank, various years); WDR 2016 team; http://www.internetlivestats.com/one-second/ (as compiled on April 4, 2015). Data at http://bit.do/WDR2016-FigO_4.

Note: In panel a, for some years data for electricity are interpolated from available data. GB = gigabytes.

Introduction

- 90% of data today has been created in the last two years.
- 235 million emails sent per day.
- 3.3 million Facebook posts created every minute.
- 3.8 million Google searches performed each minute.
- 1.7 megabytes of new information created every second, per person.

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➥ An immense amount of data, new and old, is recorded as text.

➥ More generally, much of this data is unstructured.

Structured vs. unstructured

Structured data

- Adheres to a defined data model.
- Examples: Tables, spreadsheets, relational databases, ...

Unstructured data

- Does *not* adhere to a defined data model.
- Typically text-heavy.
- Examples: Text feeds, speech transcripts, audio, images ...

Structured vs. unstructured

Structured data

- Adheres to a defined data model.
- Examples: Tables, spreadsheets, relational databases, ...

Semi-structured data

- Does *not* adhere to a formal data model,
- ... *but* contains tags or semantic mark-up.
- Examples: JSON, XML, emails, tagged text, ...

Unstructured data

- Does *not* adhere to a defined data model.
- Typically text-heavy.
- Examples: Text feeds, speech transcripts, audio, images ...

Text as data

- Text differs from other, traditional forms of data.
- Text is inherently *unstructured* and *high-dimensional*.
- One of the major fields of application of machine learning methods.
- Fast-growing field. Many new techniques developed in industry.
- Recent applications in economics and other social sciences.

This lecture

This lecture covers techniques for unstructured data.

- Methods for wrangling data.

↪ When unstructured $\approx$ dirty (or differently structured).

This lecture

This lecture covers techniques for unstructured data.

- Methods for wrangling data.

➥ When unstructured $\approx$ dirty (or differently structured).

- Methods for analyzing data which are naturally unstructured.

➥ No rectangular (or graph) structure, no well-defined relations between data elements.

Focus points

Focus on three main points.

1. Processing and transforming un-/semi-structured data.
2. Representing inherently unstructured text data.
3. Analyzing text data and using models to discover structure. (Supervised and unsupervised learning.)

Outline

1. Introduction

Representation

2. Regular expressions and pattern matching
3. Representing text as data

Classical n-gram modeling approaches

4. Supervised models for text data
5. Unsupervised models for text data

Information retrieval and distributional language models

6. Distributional models of meaning
7. Vector space representations

Assignment

Dates

Monday	15.02.2021	08.30-16.30	MS Teams
Tuesday	16.02.2021	08.30-16.30	MS Teams
Wednesday	17.02.2021	08.30-16.30	MS Teams

Schedule

08.30-10.00	Lecture
10.00-10.30	Break
10.30-12.00	Lecture
12.00-13.30	Lunch
13.30-15.00	Lecture
15.00-15.30	Break
15.30-16.30	Lecture

Technical requirements

- All class material is available online:
  https://github.com/hliebert/course-text-analysis-in-r.
- The lab materials can be accessed online:
  Jupyter notebooks
  Rstudio server
- Feel free to run the lab material locally on your own computer. Clone or download the course repository to get started.
- It will run on Windows, Mac or Linux (if the dependencies are satisfied).

Programs

Minimal

- A browser.

Local

- R
- Editor or GUI (RStudio, VScode with R plugin, Jupyter, Emacs+ESS, ...).
- Run the R install script provided with the class material to install the R package dependencies and the R Kernel for Jupyter notebooks.

Optional

- Jupyter notebooks or Python. Install Anaconda (or its smaller miniconda version). On Linux, you can also use pip and virtualenv.
- A shell (bash or zsh pre-installed on Linux or MacOS, WSL or Git Bash on Windows).
- Git

Assignment

1. Independent project (100%)

- Deadline: 15.03.2021.
- More details during the course of the lecture.

Primary references

- The course covers relatively broad and diverse topics, no single reference. Seminal references in the slides.
- Primary and secondary references below.
- Hastie et al. and Jurafsky & Martin books are available online (use newest 3rd edition draft of J & M).


Gentzkow, M., B. Kelly, and M. Taddy (2019). Text as Data. *Journal of Economic Literature* 57(3), 535–574. DOI: 10/gf7rd5.


Hastie, T., R. Tibshirani, and J. Friedman (2001). *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Ed. by R. Tibshirani and J. H. (H. Friedman. New York.


Jurafsky, D. and J. H. Martin (2009). *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*. 2nd ed. Prentice Hall Series in Artificial Intelligence. Upper Saddle River, N.J: Pearson Prentice Hall.

Secondary references

- Reference material, further reading, applied or introductory text books.


Baumer, B., D. Kaplan, and N. Horton (2017). *Modern Data Science with R*. CRC.


Casella, G. and R. L. Berger (2001). *Statistical Inference*. Second. Duxbury Press.


Chacon, S. and B. Straub (2014). *Pro Git*. Apress.


Goldberg, Y. (2017). *Neural Network Methods for Natural Language Processing*. Synthesis Lectures on Human Language Technologies 37. San Rafael: Morgan & Claypool Publishers.


James, G., D. Witten, T. Hastie, and R. Tibshirani (2015). *An Introduction to Statistical Learning with Applications in R*. Springer.


Matloff, N. (2011). *The Art of R Programming: A Tour of Statistical Software Design*. No Starch Press.


Shotts, W. E. (2019). *The Linux Command Line: A Complete Introduction*. Second edition. San Francisco: No Starch Press.

Secondary references


Silge, J. and D. Robinson (2017). *Text Mining with R: A Tidy Approach*. First edition. Boston: O'Reilly.


Wasserman, L. (2006). *All of Nonparametric Statistics*. Springer.


Wasserman, L. (2010). *All of Statistics: A Concise Course in Statistical Inference*. Springer Texts in Statistics. New York, NY: Springer.