

Applied Text Mining in Python

Topic modeling

Documents Exhibit Multiple Topics

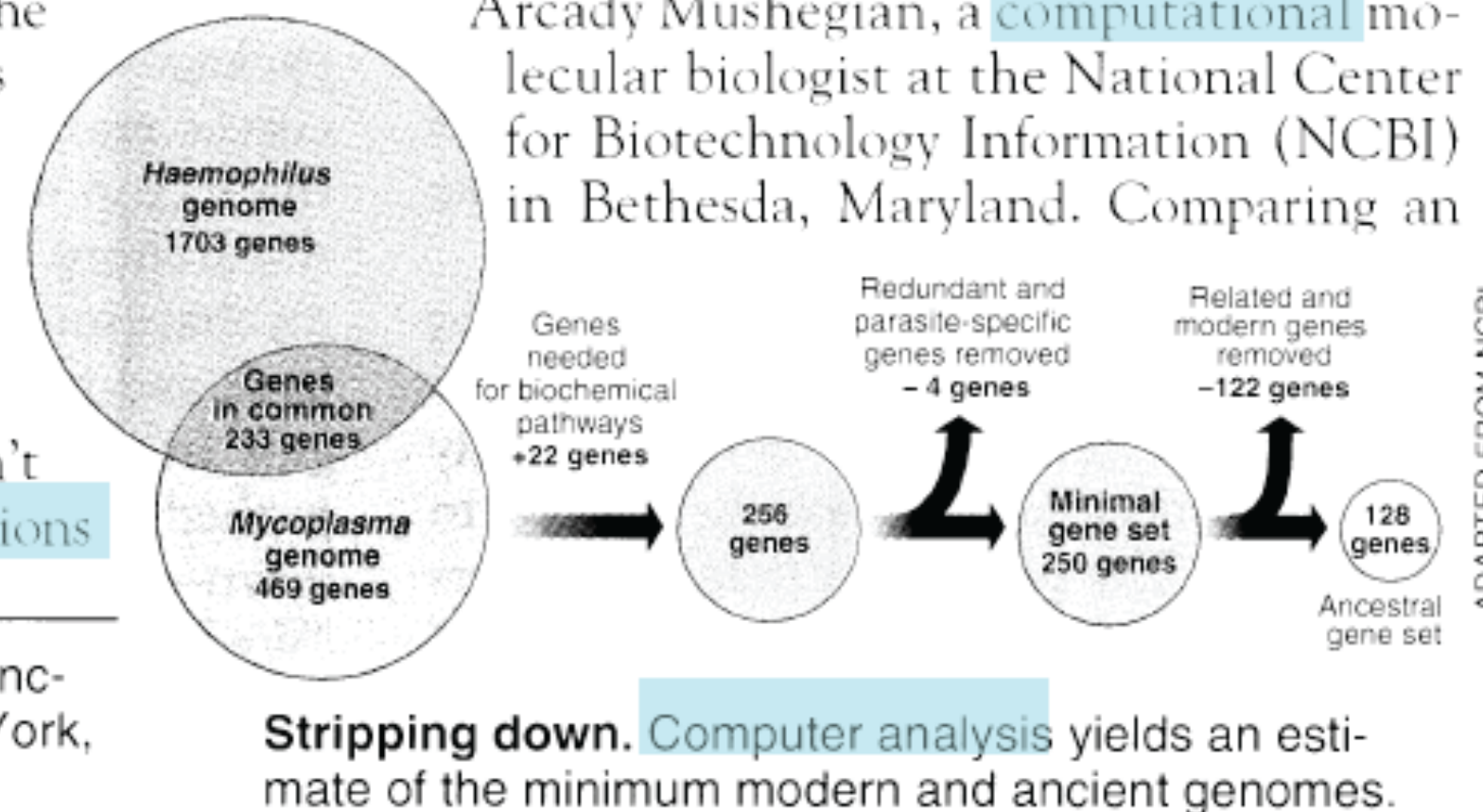
Seeking Life's Bare (Genetic) Necessities

COLD SPRING HARBOR, NEW YORK—How many **genes** does an **organism** need to **survive**? Last week at the genome meeting here,* two genome researchers with radically different approaches presented complementary views of the basic genes needed for **life**. One research team, using **computer** analyses to compare known **genomes**, concluded that today's **organisms** can be sustained with just 250 genes, and that the earliest life forms required a mere 128 **genes**. The other researcher mapped genes in a simple parasite and estimated that for this organism, 800 genes are plenty to do the job—but that anything short of 100 wouldn't be enough.

Although the numbers don't match precisely, those **predictions**

* Genome Mapping and Sequencing, Cold Spring Harbor, New York, May 8 to 12.

“are not all that far apart,” especially in comparison to the 75,000 **genes** in the human genome, notes Siv Andersson of Uppsala University in Sweden, who arrived at the 800 number. But coming up with a consensus answer may be more than just a **genetic numbers** game, particularly as more and more **genomes** are completely mapped and sequenced. “It may be a way of organizing any newly **sequenced genome**,” explains Arcady Mushegian, a **computational** molecular biologist at the National Center for Biotechnology Information (NCBI) in Bethesda, Maryland. Comparing an



Latent Dirichlet Allocation (Blei et al., '03)

Topic 1: Genetics

gene, sequence, genome, ...

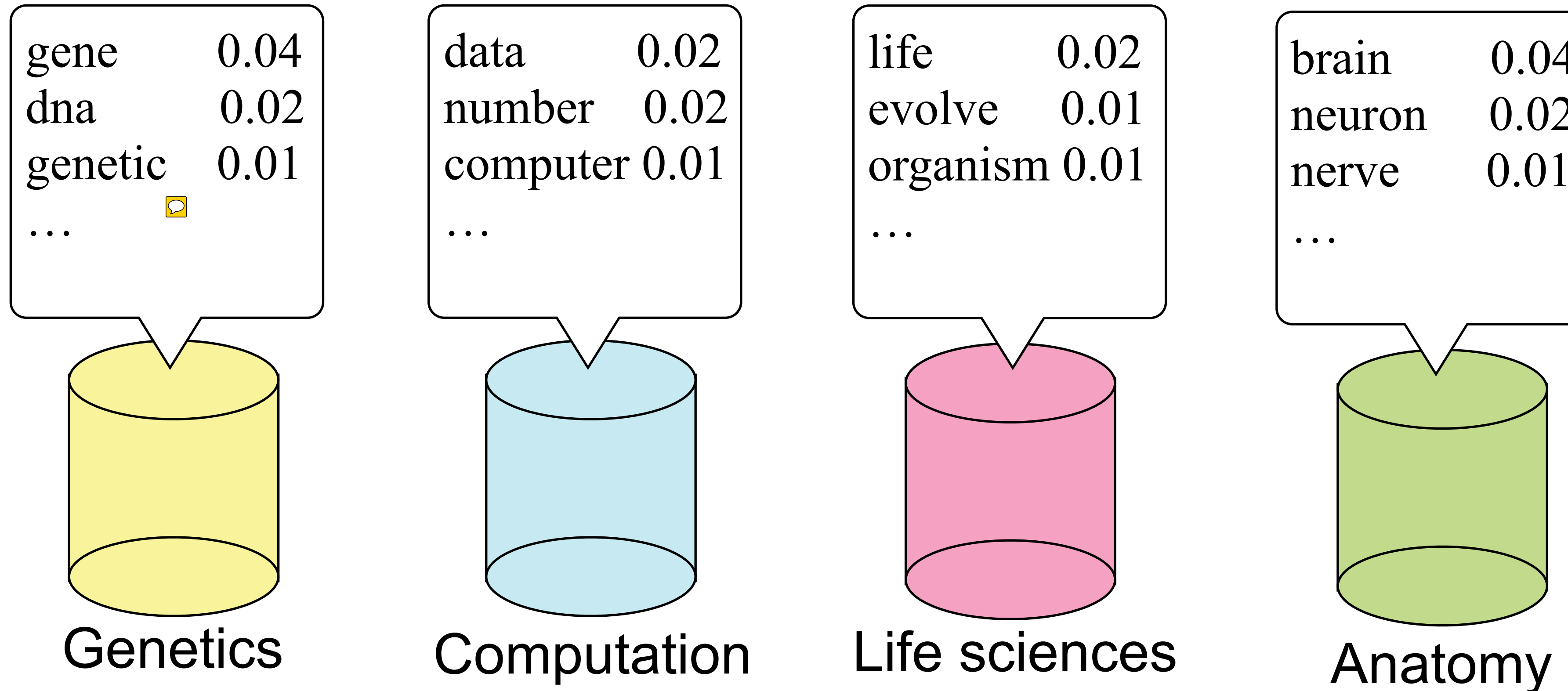
Topic 2: Computation

number, computer, analysis, ...

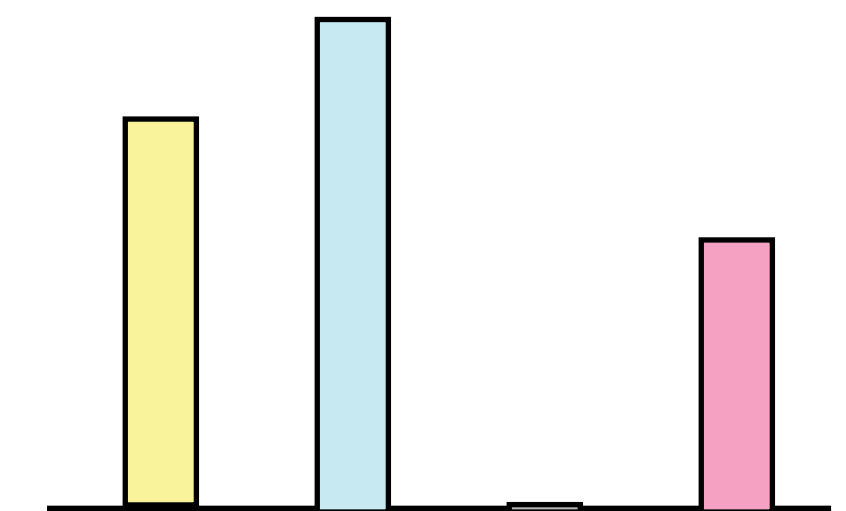
Topic 3: Life sciences

life, survive, organism, ...

Intuition: Documents as a mixture of topics



Seeking life's bare (genetic) necessities



What is **Topic Modeling**?

- A course-level analysis of what's in a text collection
- **Topic**: the **subject** (theme) of a discourse
- **Topics** are **represented** as a **word distribution**
- **A document is assumed to be a mixture of topics**

More examples of topics

human	evolution	disease	computer
genome	evolutionary	host	models
dna	species	bacteria	information
genetic	organisms	diseases	data
genes	life	resistance	computers
sequence	origin	bacterial	system
gene	biology	new	network
molecular	groups	strains	systems
sequencing	phylogenetic	control	model
map	living	infectious	parallel
information	diversity	malaria	methods
genetics	group	parasite	networks
mapping	new	parasites	software
project	two	united	new
sequences	common	tuberculosis	simulations

(Figure courtesy Prof. David Blei)

What is Topic Modeling? (2)

- What's known:
 - The text collection or corpus
 - Number of topics
- What's not known:
 - The actual topics
 - Topic distribution for each document

What is Topic Modeling? (3)

- Essentially, **text clustering** problem
 - Documents and words clustered simultaneously
- Different topic modeling approaches available
 - **Probabilistic Latent Semantic Analysis** (PLSA) [Hoffman '99]
 - **Latent Dirichlet Allocation** (LDA) [Blei, Ng, and Jordan, '03]