

Natural Language Quantification

ds4all.io

1/ Find: patterns, topics, concepts

2/ Quantify: money

3/ Create: high-impact documents

Case study: Topic modeling of NSF grants

The screenshot shows the official website of the National Science Foundation (NSF). At the top left is the NSF logo with the tagline "WHERE DISCOVERIES BEGIN". A navigation bar at the top includes links for FUNDING, AWARDS, DISCOVERIES, NEWS, PUBLICATIONS, STATISTICS, ABOUT NSF, and FASTLANE. Below the navigation bar is a search bar with a magnifying glass icon. An orange "QUICK LINKS" button is positioned above the search bar. The main content area is titled "Advanced Search Results". On the left, there is a sidebar with search filters: "You Searched For:", "Active Awards true", "Expired Awards true", "Amount More than \$1,000,000", "Original Date On or After From 01/01/2015", "Refined by Refine Search", and "State Alaska(3), Arkansas(2), Arizona(17), California(52), Colorado(21), Connecticut(1), Florida(1), Georgia(1), Illinois(1), Indiana(1), Massachusetts(1), Michigan(1), Minnesota(1), Missouri(1), New Jersey(1), New Mexico(1), New York(1), North Carolina(1), Ohio(1), Oregon(1), Pennsylvania(1), Rhode Island(1), Texas(1), Washington(1), Wisconsin(1), Wyoming(1)". The main results section displays three grant entries with their titles, award numbers, principal investigators, co-principal investigators, organizations, start dates, award amounts, and relevance scores.

Advanced Search Results

You Searched For:		Export up to 3,000 Awards:	CSV XML Excel Text	Email this Link Export All Results
Active Awards	true	Sort By:	Relevance	Displaying 1 - 90 of 482
Expired Awards	true	Results size:	90 per page	Page 1 of 6
Amount	More than \$1,000,000	Table	List	
Original Date	On or After			
From	01/01/2015			
Refined by				
Refine Search				
State				
Alaska(3)				
Arkansas(2)				
Arizona(17)				
California(52)				
Colorado(21)				
Connecticut(1)				
Florida(1)				
Georgia(1)				
Illinois(1)				
Indiana(1)				
Massachusetts(1)				
Michigan(1)				
Minnesota(1)				
Missouri(1)				
New Jersey(1)				
New Mexico(1)				
New York(1)				
North Carolina(1)				
Ohio(1)				
Oregon(1)				
Pennsylvania(1)				
Rhode Island(1)				
Texas(1)				
Washington(1)				
Wisconsin(1)				
Wyoming(1)				
MRI: Acquisition of an Analytical Transmission Electron Microscope for High-resolution, Rapid Nanoscale Compositional Mapping of Earth, Planetary, and Advanced Materials				
Award Number:1531243; Principal Investigator:Thomas Zega; Co-Principal Investigator:Neal Armstrong, Thomas Sharp, Erica Corral, Weigang Wang; Organization:University of Arizona;NSF Organization:DMR Start Date:09/01/2015; Award Amount:\$1,500,000.00; Relevance:96.0;				
Developing Indicators for Undergraduate STEM Education				
Award Number:1533989; Principal Investigator:Heidi Schweingruber; Co-Principal Investigator:; Organization:National Academy of Sciences;NSF Organization:DUE Start Date:06/15/2015; Award Amount:\$1,407,585.00; Relevance:96.0;				
CC*DNI DIBBs: Give Your Data the Edge: A Scalable Data Delivery Platform				
Award Number:1541318; Principal Investigator:Larry Peterson; Co-Principal Investigator:Nirav Merchant, Hao Xu, Andrew Bavier, Scott Baker; Organization:University of Arizona;NSF Organization:ACI Start Date:09/01/2015; Award Amount:\$3,804,911.00; Relevance:96.0;				
Single Molecule Studies of Protein Folding				
Award Number:1122225; Principal Investigator:Susan Marqusee; Co-Principal Investigator:; Organization:University of California-Berkeley;NSF Organization:MCB Start Date:08/01/2011; Award Amount:\$1,188,118.00; Relevance:80.32;				
STEM in the PlayScape: Building Knowledge for Educational Practice				
Award Number:1516191; Principal Investigator:Victoria Carr; Co-Principal Investigator:Rhonda Brown, Heidi Kloos; Organization:University of Cincinnati Main Campus;NSF				

Data



Award Abstract #1122225

Single Molecule Studies of Protein Folding

NSF Org: [MCB](#)
[Div Of Molecular and Cellular Bioscience](#)

Initial Amendment Date: June 20, 2011

Latest Amendment Date: July 1, 2015

Award Number: 1122225

Start Date: August 1, 2011

Awarded Amount to Date: \$1,188,118.00

Number
M = 1.2 M\$

Investigator(s): Susan Marqusee marqusee@berkeley.edu (Principal Investigator)

Sponsor: University of California-Berkeley
Sponsored Projects Office
BERKELEY, CA 94704-5940 (510)642-8109

NSF Program(s): Molecular Biophysics

ABSTRACT

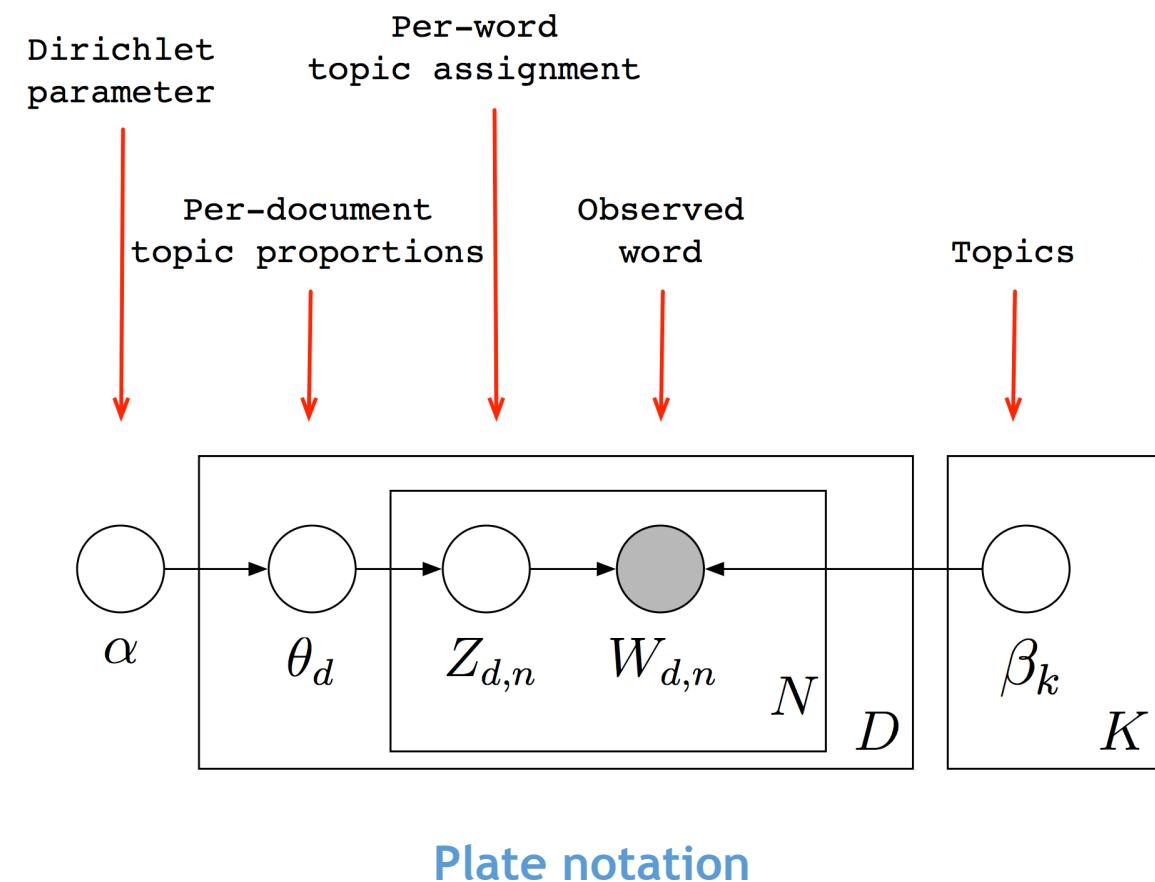
The objective of this project is to investigate the molecule studies. Protein folding, the mechanism the energy landscape of a protein (the structures all of the accessible conformations), remains a r biology. Without a better understanding of how t sequence, the expanding sequence databases co important questions. The project aims to develop a single protein molecule using tools such as an monitoring the conformation of the protein by fol in the protein. The results will yield observables t studies of protein folding and the design of the experiments will be carried out in an iterative collaboration with theoreticians in the field. Mechanical stress plays a ubiquitous role in protein function and biology, and therefore, in addition to providing needed insight into the protein-folding problem this work will also provide much needed information about the mechanical stability of proteins.



In addition to its impact in protein folding and macromolecular biophysics, the research in this project requires training at the intersection of physics and biology: the work is a collaborative effort between a physics and a biochemistry lab. The work is not just interdisciplinary; it is actually interdependent, requiring state-of-the-art experiments in both physics and molecular biology. The work requires a combination of students and postdoctoral trainees with diverse backgrounds to work closely together. The project also involves the help of undergraduates, particularly those with a background in engineering and physics, giving them direct exposure to the biological sciences. In sum, this work offers a unique educational experience for the students and post-doctoral fellows involved in the project, and will help to train a new generation of scientists fluent in both the biological and quantitative sciences.

Finding topics

Blei, Ng & Jordan: Latent Dirichlet Allocation, *JMLR* 3 (2003) 993-1022



ABSTRACT

The objective of this project is to investigate the molecule studies. Protein folding, the mechanism the energy landscape of a protein (the structures all of the accessible conformations), remains a n biology. Without a better understanding of how t sequence, the expanding sequence databases co important questions. The project aims to develop a single protein molecule using tools such as an monitoring the conformation of the protein by fol in the protein. The results will yield observables t studies of protein folding and the design of the experiments will be carried out in an iterative collaboration with theoreticians in the field. Mechanical stress plays a ubiquitous role in protein function and biology, and therefore, in addition to providing needed insight into the protein-folding problem this work will also provide much needed information about the mechanical stability of proteins.



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Topic composition

Number of awards > 5k
Number of words > 1M

Biological Science
Received after 2015

Topic 1: behavior social female male animal species individuals

Topic 2: cell membrane protein transport molecular cellular biology

Topic 3: fellowship biology animal training plan fellow include

Topic 4: bacteria metabolism microbes production energy pathways cell

Topic 5: cell development signaling protein gene molecular mechanisms

Topic 6: data develop model methods tools computational biology

Topic 7: researchers science network biology community scientific

Topic 8: fungi soil plant microbes carbon ecosystem decomposition

Topic 9: gene evolution species population variation different change

Topic 10: pollen habitat bees plant pollination change sperm

Topic 11: forest climate change ecosystem model tree data

Topic 12: students program reu biology edu training pi

Topic 13: gene dna chromatin epigene expression methylation

Topic 14: biology model systems network develop program division

Topic 15: species population plant diversity ecological effects

Topic 16: enzyme protein iron amino acid reaction function

Topic 17: university state students researchers system center

Topic 18: marine ecosystem ocean sea fish animal algae

Topic 19: gene rna protein expression transcription regulatory

Topic 20: cell imaging biology high resolution instrument develop

Topic 21: protein structure molecular interactions binding function folding

Topic 22: students undergraduate science school high graduate biology

Topic 23: dna gene chromosome repair cell protein bacteria

Topic 24: host disease pathogen pathogens immune bacteria plant

Topic 25: species diversity evolution data life tree phylogene

Topic 26: change environmental stress conditions climate responses

Topic 27: plant gene crop arabidopsis growth development production

Topic 28: brain neurons behavior neural animal system sensory

Topic 29: collection data specimens change resource biology available

Topic 30: nitrogen carbon stream nutrient water dioxide fixation

Topic proportion for one doc:



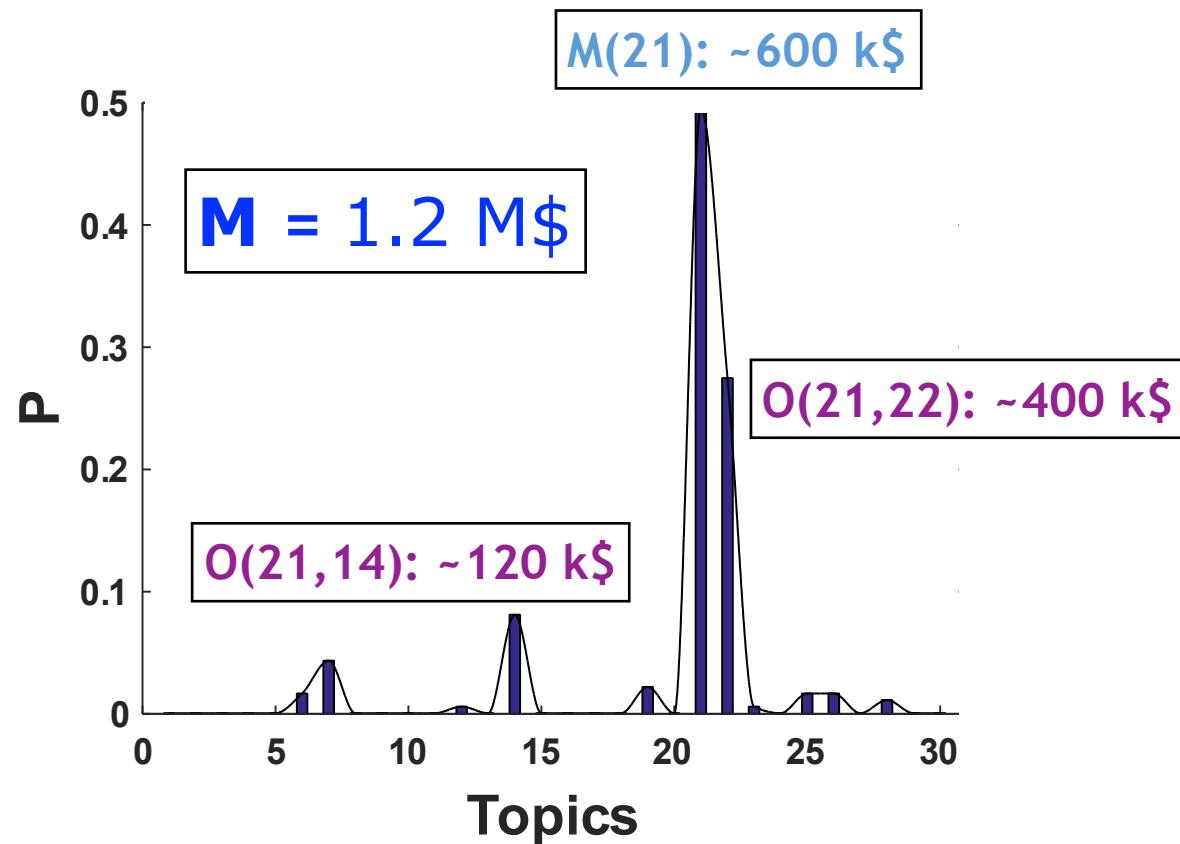
Award Abstract #1122225

Single Molecule Studies of Protein Folding

Topic 21: protein structure molecular interactions binding function folding

Topic 22: students undergraduate science school high graduate biology

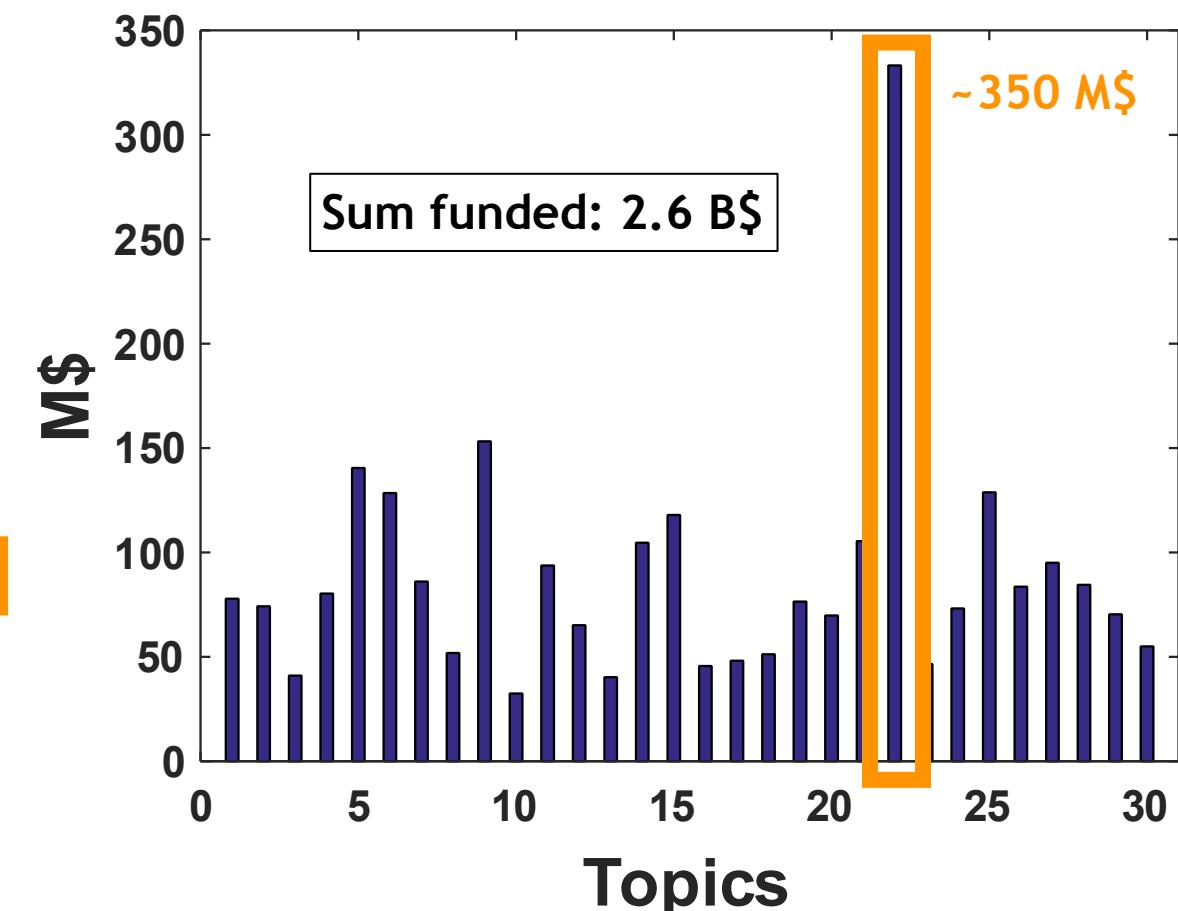
Topic 14: biology model systems network develop program division



Topic 1: behavior social female male animal species individuals
Topic 2: cell membrane protein transport molecular cellular biology
Topic 3: fellowship biology animal training plan fellow include
Topic 4: bacteria metabolism microbes production energy pathways cell
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Topic 30: nitrogen carbon stream nutrient water dioxide fixation

Money generated by each topic over all the grants

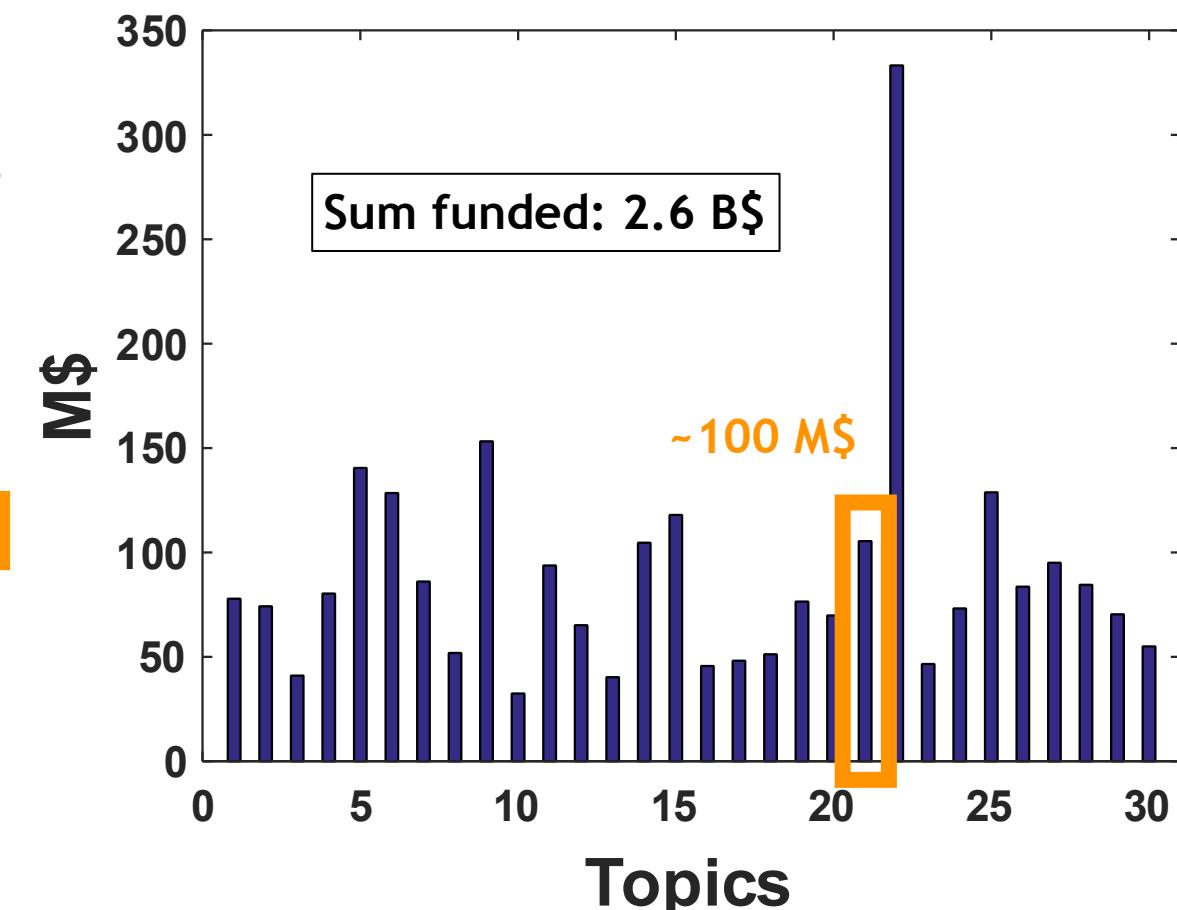
Biological Science (BIO) after 2015, above 100 k\$



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Money generated by each topic over all the grants

Biological Science (BIO) after 2015, above 100 k\$



Top 10 topics generating money

Topic 22: “**Education**” 333 M\$: students undergraduate science school high graduate biology

Topic 9: “**Genetics**” 153 M\$: gene evolution species population variation different change

Topic 5: “**Cell**” 140 M\$: cell development signaling protein gene molecular mechanisms

Topic 25: “**Evolution**” 129 M\$: species diversity evolution data life tree phylogene

Topic 6: “**Modelisation**” 128 M\$: data develop model methods tools computational biology

Topic 15: “**Ecology**” 118 M\$: species population plant diversity ecological effects communities

Topic 21: “**Protein**” 105 M\$: protein structure molecular interactions binding function folding

Topic 14: “**General**” 105 M\$: biology model systems network develop program division

Topic 27: “**Plants**” 95 M\$: plant gene crop arabidopsis growth development production

Topic 11: “**Climate**” 94 M\$: forest climate change ecosystem model tree data

Circular plot to represent topics interaction

Each unit represents 100 M\$

Only major flux are plotted.

“Protein” has generated 105 M\$
and overlapped with:

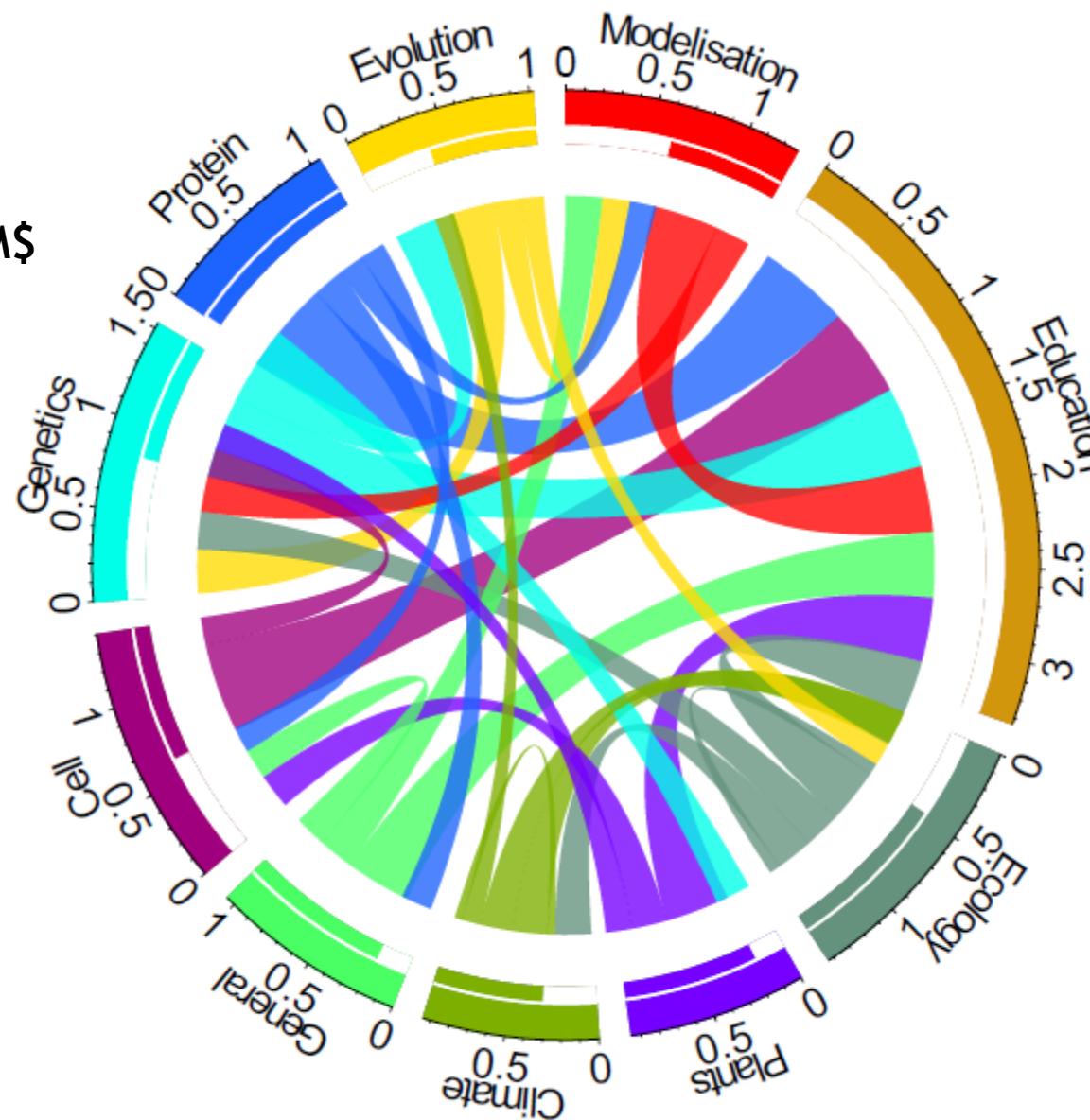
“Education” for 50 M\$

“Modelisation” for 10 M\$

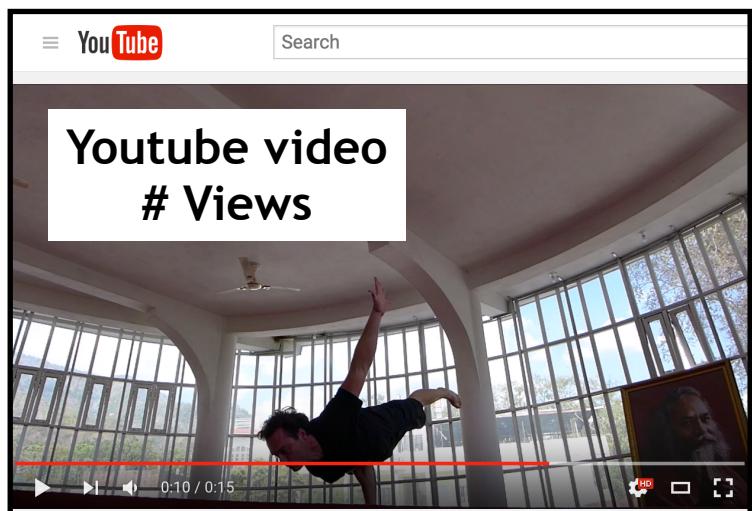
“General” for 10 M\$

“Cell” for 10M\$

- 1/ Find topics
- 2/ Quantify money
- 3/ High impact



“Data are everywhere and they are for everyone”



A screenshot of a blog post by Julie Zhuo. The post title is "Building Products". Below the title, there is a summary: "I recently gave a talk at TNW Europe about a framework we use at Facebook to help us focus our product development process. Working on that talk got me thinking about the...". On the right side of the post, there are engagement metrics: 1K likes and 20 comments. The text "Blog & article # Likes" is overlaid on the bottom right of the image.

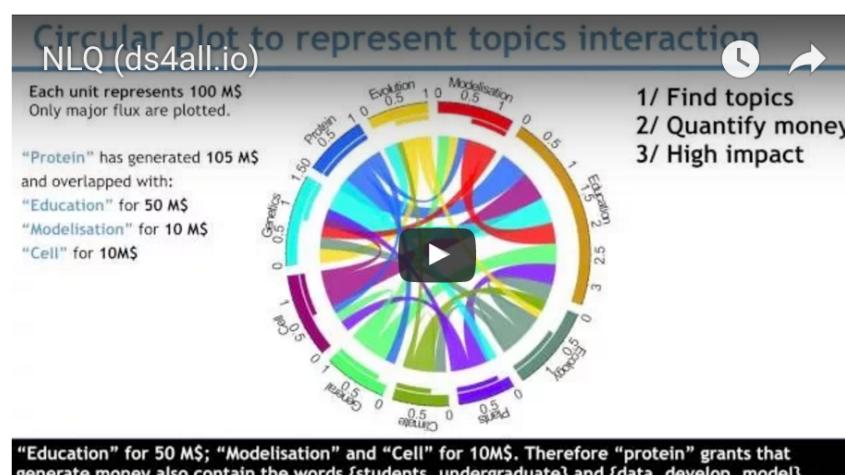
Any activity described by words and quantified by numbers.



Welcome to 'Data Science for all' ! Our mission is to empower people by providing a simple and free access to data science. Natural Language Quantification (NLQ) is the first product of ds4all.io, it can find patterns (or topics) describing an activity and quantify how much is being created by the pattern (for instance in the National Science Fundation grants, the topic "Protein" has generated 100 M\$...). You can also check a different product: a full end to end data science pipeline (click on the ds4all dropdown menu on the upper left, or [here](#)).

Natural Language Quantification

You can simply upload your data, run the algorithm and get your report. Check the '[Tutorial](#)' if you would like more information about how to perform this process. Inspiration and examples of databases (use them and get your first results in seconds) can be found in the '[Projects](#)'. Click on '[Education](#)' to learn more about data science & get guidance to build your own algorithm from scratch. This short (3 min) video summarizes everything:



ds4all.io



NLQ Report: NSF - Politics

Topic 1: benefit cost individual group provide good effect incentive

Topic 2: analysi maker actor condition action result processe outcome

Topic 3: citie acros area researcher resident investigator force consequence

Topic 4: state leader investigator researcher factor crisi les scholar

Topic 5: interest state rule congres legislator group legislature member

Topic 6: attitude citizen individual value survey difference question experiment

Topic 7: religiou group interview politic analysi way identitie processe

Topic 8: analysi effect acros measure policie change program variou

Topic 9: women policie right movement state statu succes politic

Topic 10: preference policie government decision agencie countrie firm analysi

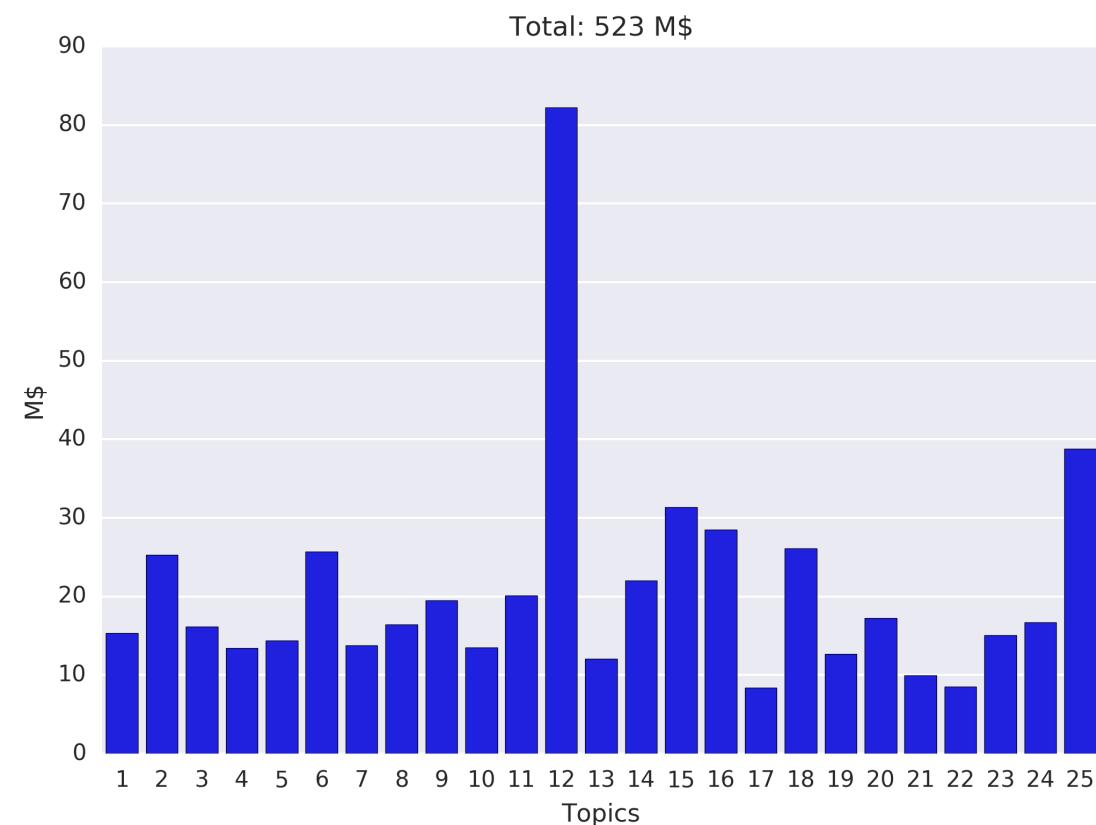
Topic 11: scientist system proces problem method politic u way

Topic 12: student scholar scientist participant issue activitie method provide

Topic 13: election voter candidate partie campaign citizen effect position

Topic 14: practice processe analysi interview studie organization technologie activitie

⋮



clement.riedel@gmail.com



in clement.riedel

‘Data Science for all’

ds4all.io

Natural Language Quantification

Thank you

Clement Riedel

Nod to the canon

NSF promotes the progress of science; advances the national health, prosperity, and welfare; secures the national defense; provides open access to data.

Blei, Ng & Jordan: Latent Dirichlet Allocation, *Journal of Machine Learning Research* 3 (2003) 993-1022

Python is powerful... and fast; plays well with others; runs everywhere; is friendly & easy to learn; is Open.

Numpy the multi-dimensional container of generic data.

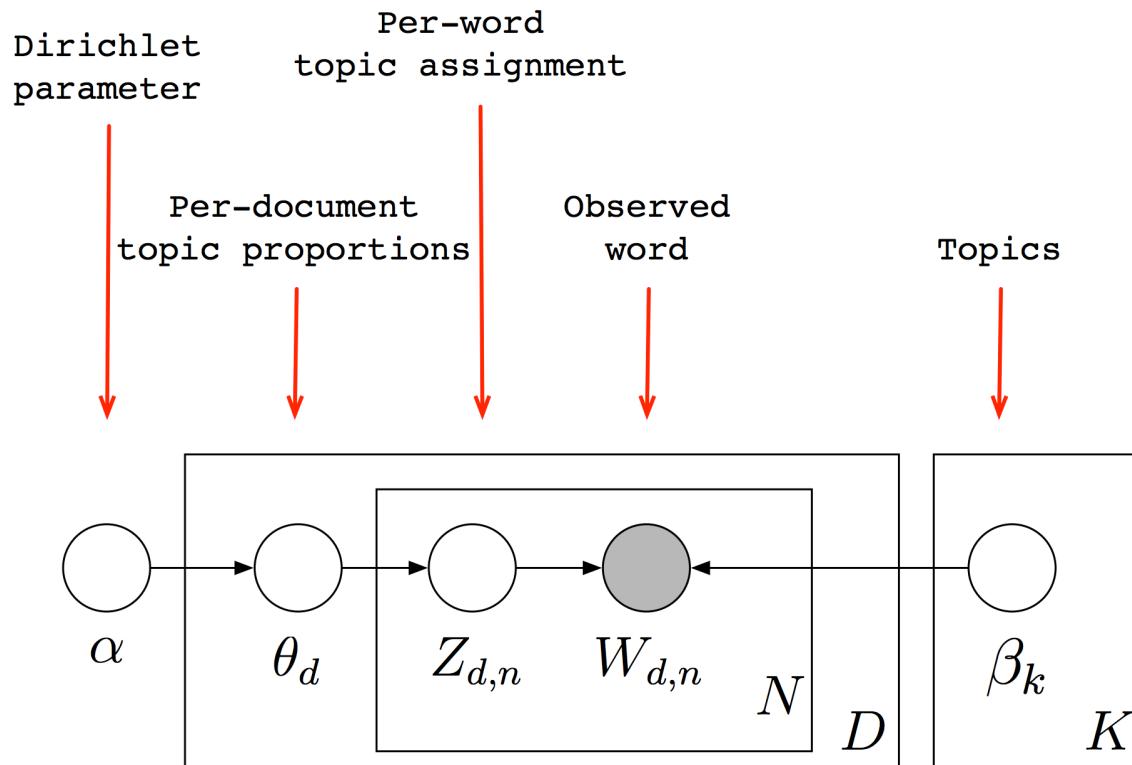
Allen B. Riddell “Topic modeling with latent Dirichlet allocation in Python”

Octave is a high-level interpreted language, primarily intended for numerical computations. It's free.

R is a language and environment for statistical computing and graphics. It is open. Zuguang Gu (Circlize package). GJ Abel, N Sander “Quantifying global international migration flows”. - *Science* (2014), 343, 6178, p. 1520. for the polar plots.

Galvanize DSI. Everyone I saw since I started April 2016.

Dav and Susan for their support.

**ABSTRACT**

The objective of this project is to investigate protein folding, the energy landscape of a protein (the all of the accessible conformations), and biology. Without a better understanding sequence, the expanding sequence data important questions. The project aims a single protein molecule using tools monitoring the conformation of the protein in the protein. The results will yield studies of protein folding and the design iterative collaboration with theoretician role in protein function and biology, and into the protein-folding problem this work will also provide much needed information about the mechanical stability of proteins.



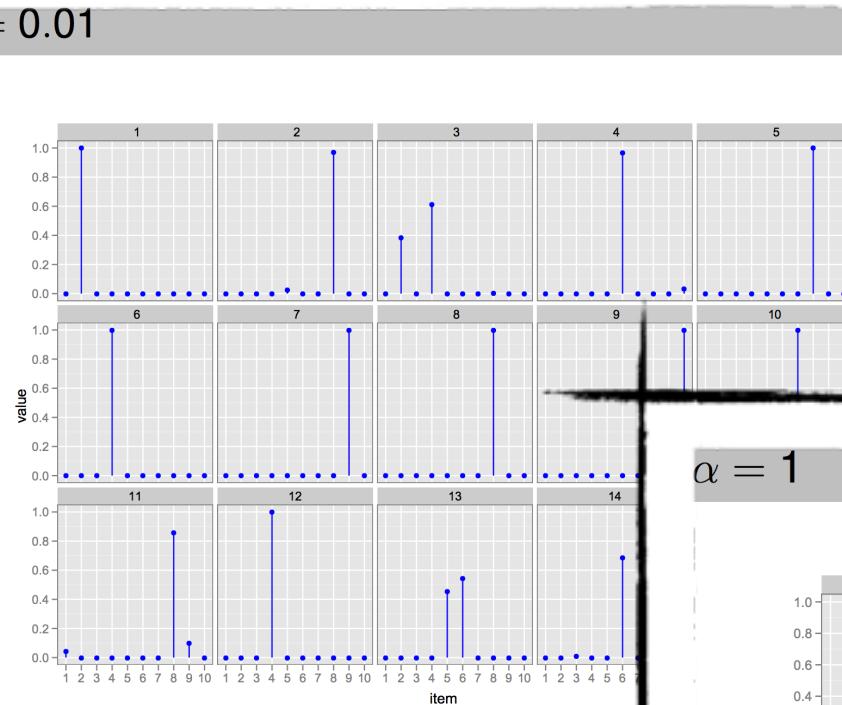
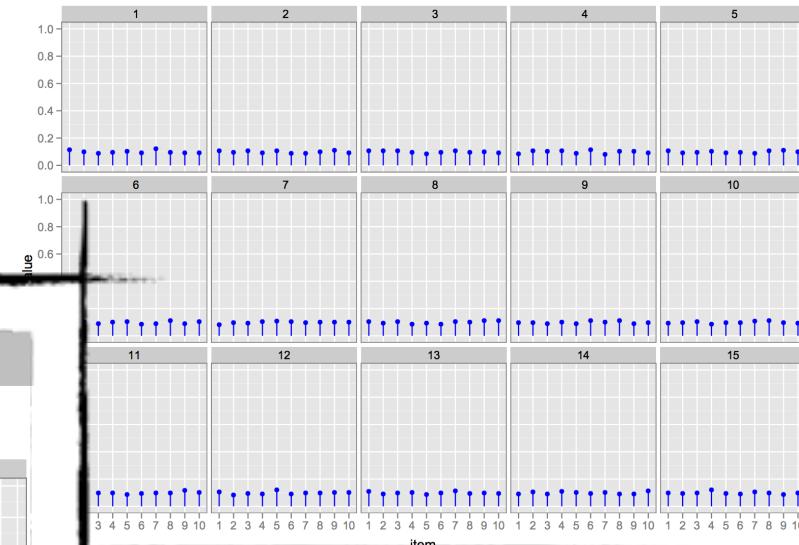
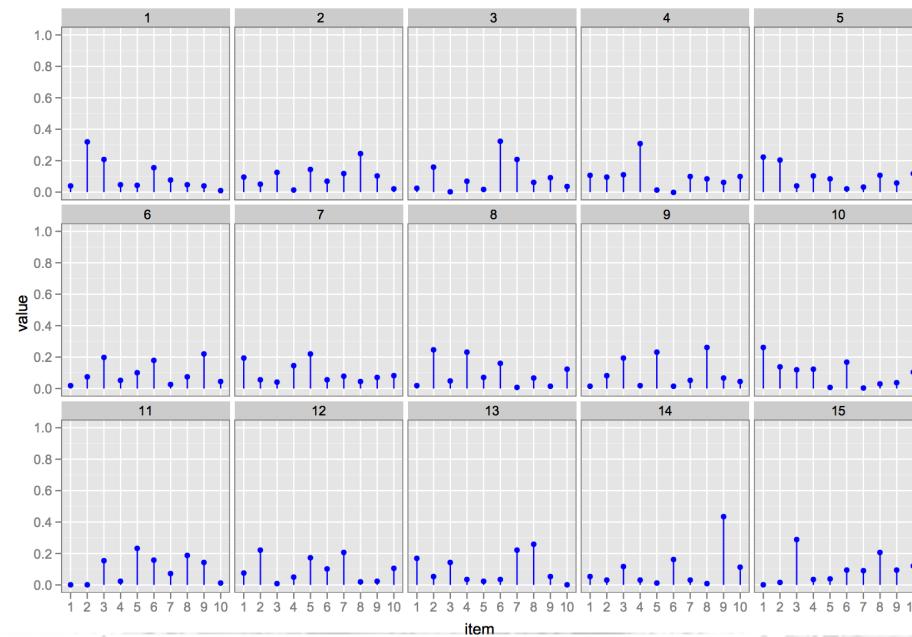
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$$\frac{p(\theta | \alpha) \prod_{n=1}^N p(z_n | \theta) p(w_n | z_n, \beta_{1:K})}{\int_{\theta} p(\theta | \alpha) \prod_{n=1}^N \sum_{z=1}^K p(z_n | \theta) p(w_n | z_n, \beta_{1:K})}$$

α

plots from David Blei for KDD-2011

Dirichlet parameter

 $\alpha = 0.01$  $\alpha = 100$  $\alpha = 1$ 

Input: Term document matrix

(~300 MB)

Document 1: “The objective of this project is to investigate the protein-folding problem using single molecule studies. Protein folding, the mechanism by which the amino acid sequence directs the energy landscape of a protein (the structures, energies....”

⋮

Document 5284: “Each year honey bees contribute billions of dollars of value to the United States economy by pollinating food crops. During the past decade, North American honey bee populations have declined, primarily because of the death of colonies during winter...”

- 1/ Remove stop words & stemming
- 2/ Add words to the term document matrix
- 3/ Solve posterior using collapsed Gibbs sampling
- 4/ Obtain: Topics composition
& Topics proportion per document

Number of awards	objective	project	investigate	protein	folding	bees	pollen	honey
Doc 1	1	5	1	12	5	0	0	0
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Doc 5284	1	0	0	0	0	12	1	1

Number of unique words

Output: List of topics & topic table (csv)

(~1.5 MB)

List of topics:

Topic 1: behavior social female male animal species

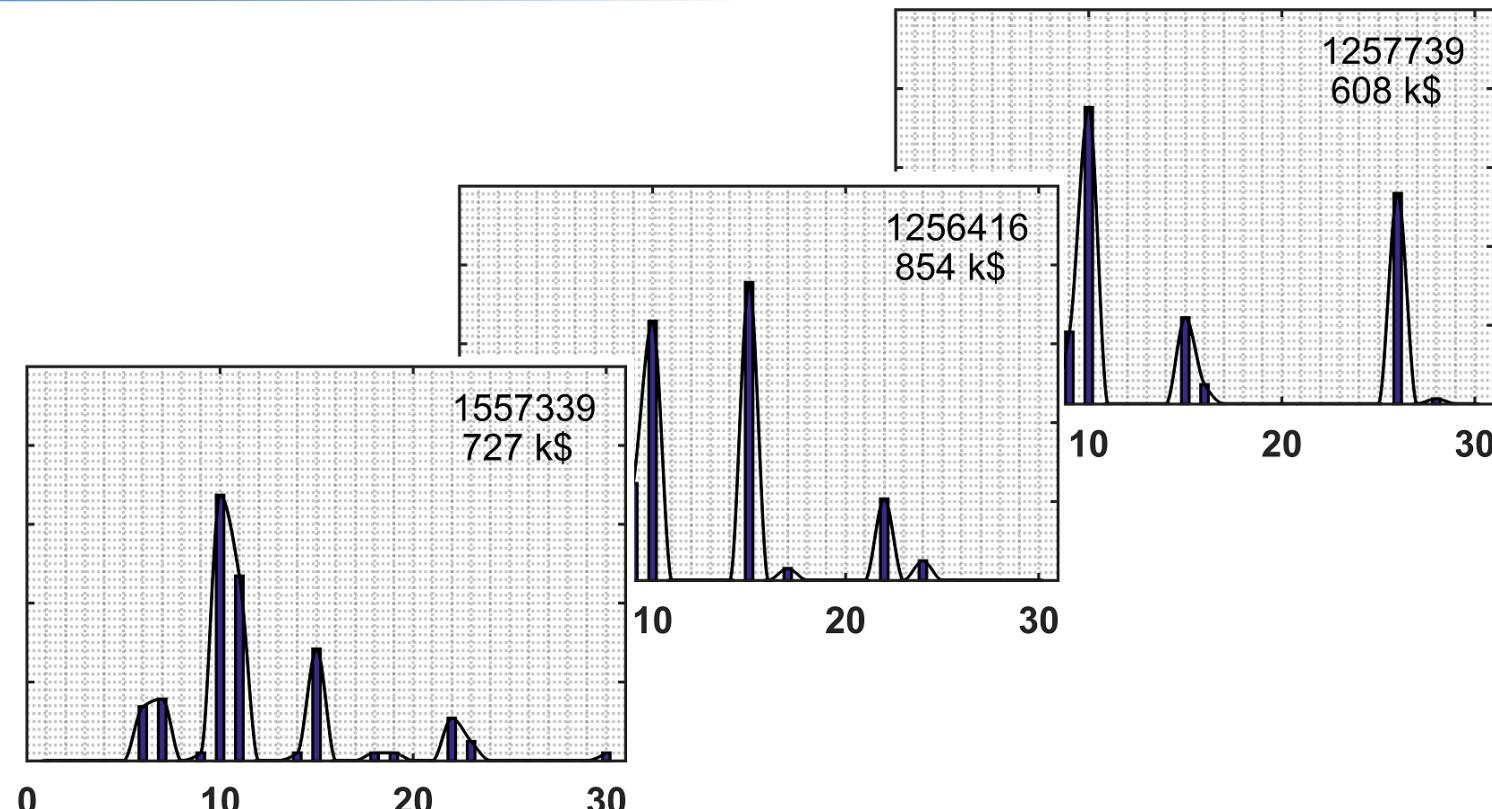
Topic 2: cell membrane protein transport molecular

Topic 3: fellowship biology animal training plan

⋮

Topic 29: collection data specimens change resource

Topic 30: nitrogen carbon stream nutrient water



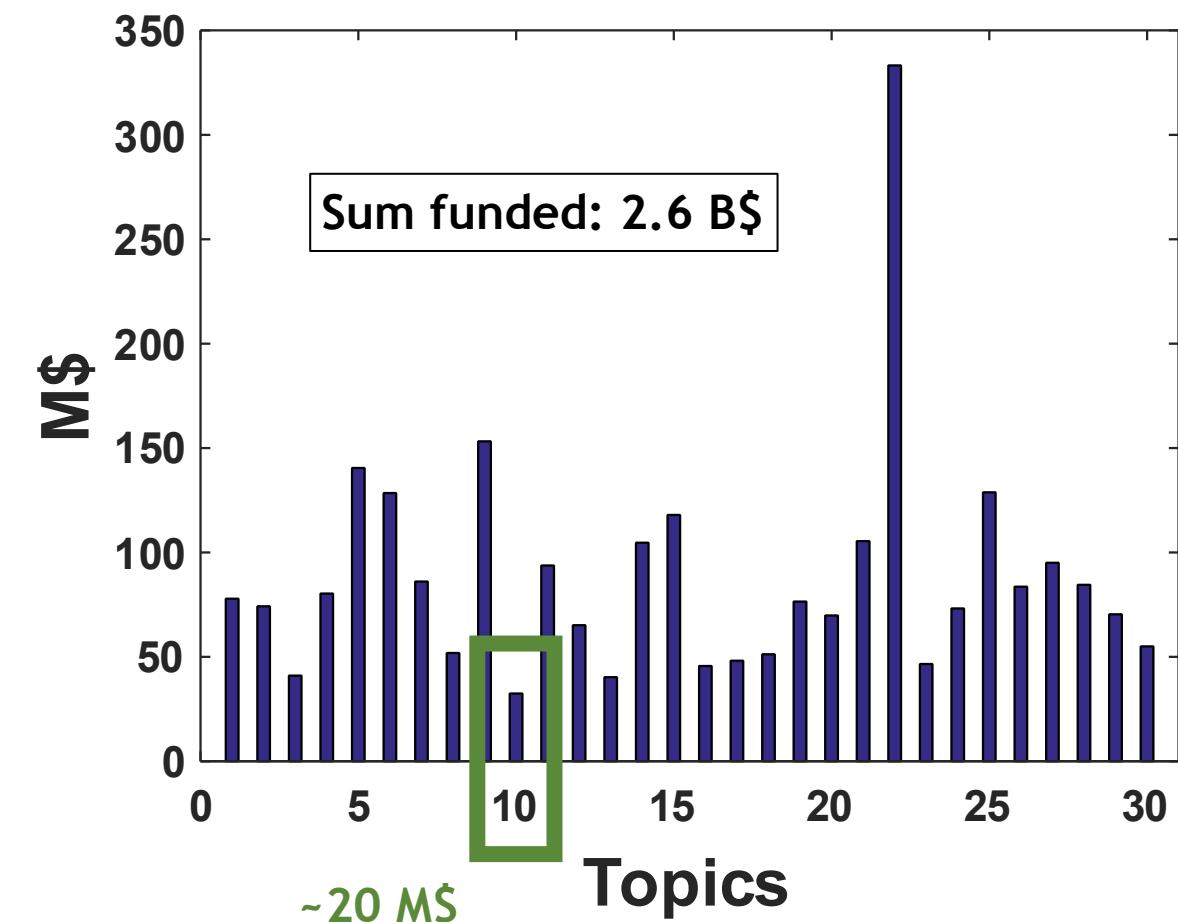
Topic table:

	Topic 1	Topic 2	Topic 3	...	Topic 29	Topic 30
Doc 1	0.2	0.1	0.02	...	0.1	0.5
⋮	⋮	⋮	⋮	⋮	⋮	⋮
Doc 5284	0.3	0.1	0.01	...	0.1	0.1

Topic 1: behavior social female male animal species individuals
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Money generated by each topic over all the grants

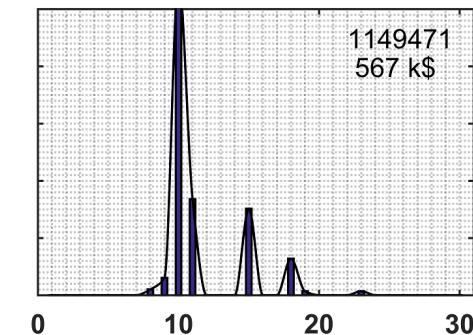
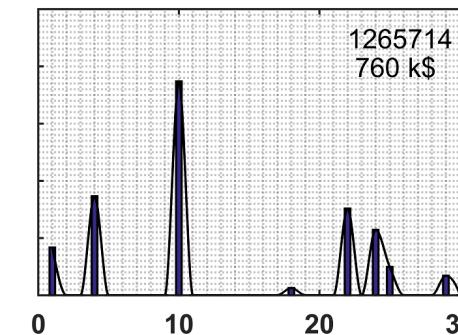
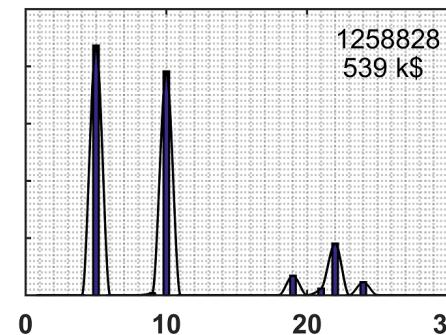
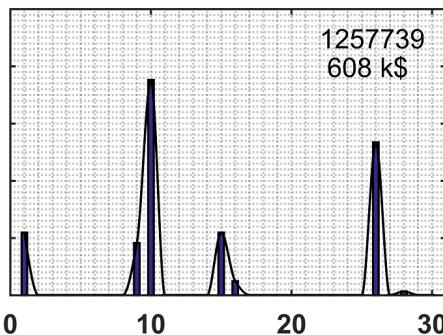
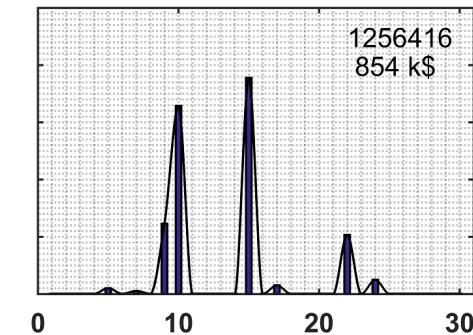
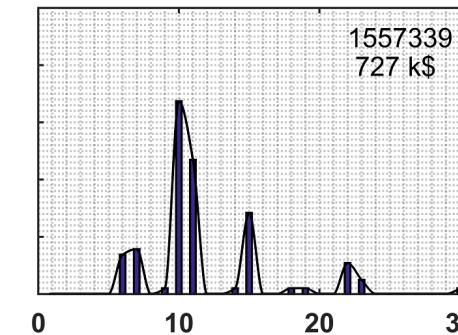
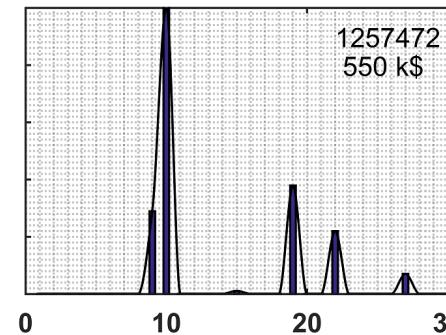
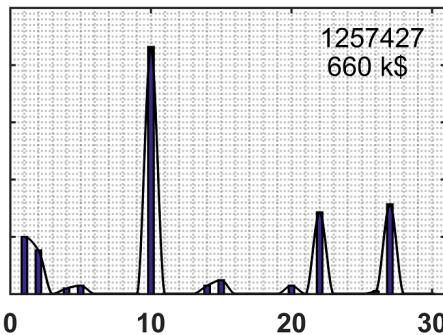
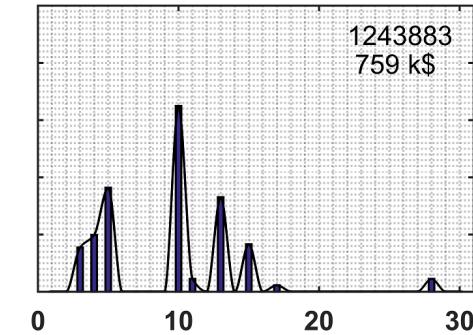
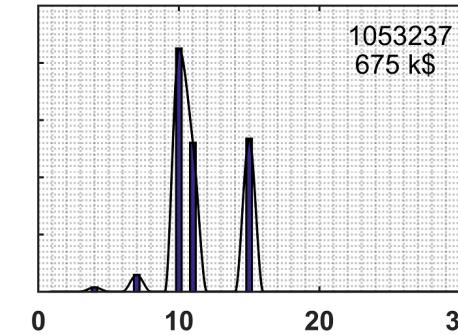
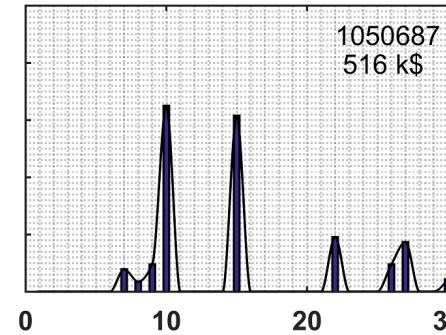
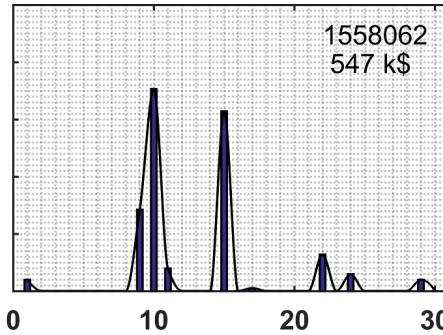
Biological Science (BIO) after 2015, above 100 k\$



Don't believe it? Check the profiles

Human verification is an essential part in any probabilistic, non deterministic process.

Topic 10 ranks 1st in 60 documents.



Don't believe it? Check it in your browser

Human verification is an essential part in any probabilistic, non deterministic process.
Topic 10 ranks 1st in 60 documents.



Evolution of dispersal and pollination in ecologically dominant grasses

Awarded Amount to Date: \$639,217.00



Functional, Genomic, and Evolutionary Analysis of Chemical Courtship Signals in Euglossine Bees

Awarded Amount to Date: \$735,887.00



Control of lipid metabolism and muscle hypertrophy by PPARs in Gray catbird annual life cycle

Awarded Amount to Date: \$592,051.00



Functional roles of FERONIA, LORELEI and relative proteins in regulating pollen-pistil interaction

Awarded Amount to Date: \$686,000.00

⋮



Intercellular Signaling in Pollen Tube Reception

Awarded Amount to Date: \$600,000.00



INSPIRE Track 1: What is Normal Milk? Sociocultural, Evolutionary, Environmental, and Microbial Aspects of Human Milk Composition

Awarded Amount to Date: \$950,000.00



Resin to Propolis: Biological origins and role in honey bee social immunity and health

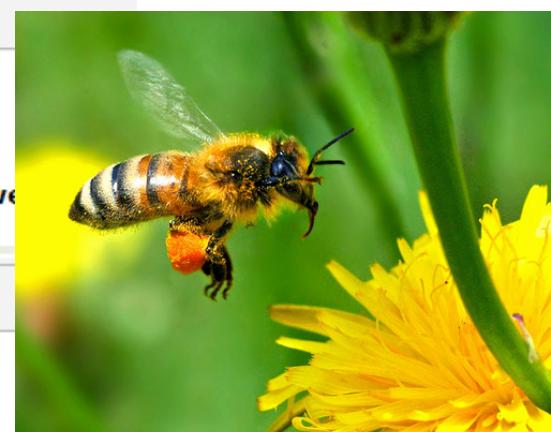
Awarded Amount to Date: \$635,976.00



The role of post-pollination interactions in structuring co-flowering plant communities

Awarded Amount to Date: \$654,641.00

⋮



How do topics overlap?

For each documents we sum the overlapping (minimum) probability between the considered topic and all the other topics. We then sum over all the documents.

$$O_{i,j} = \sum_{j,d} \min(P_i, P_j) * m_d$$

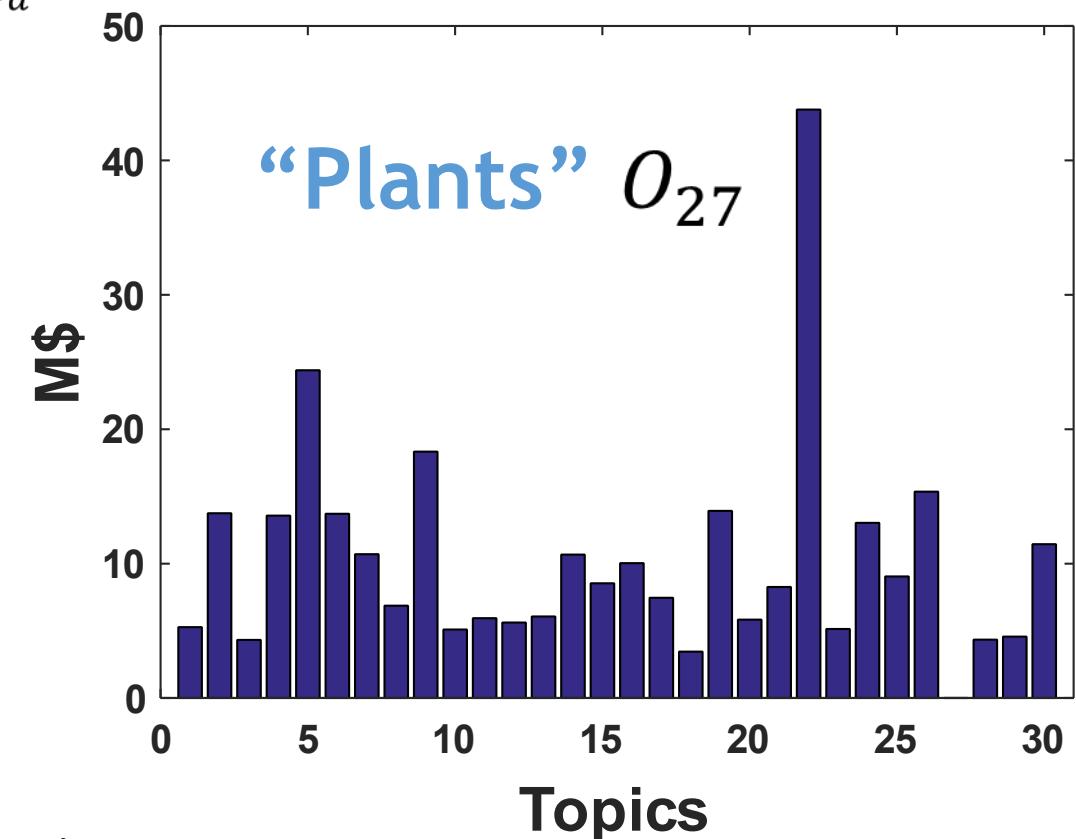
Topic 27: “Plants” has generated 95 M\$ overlapped with:

Topic 22: “Education” for 44 M\$

Topic 5: “Cell” for 24 M\$

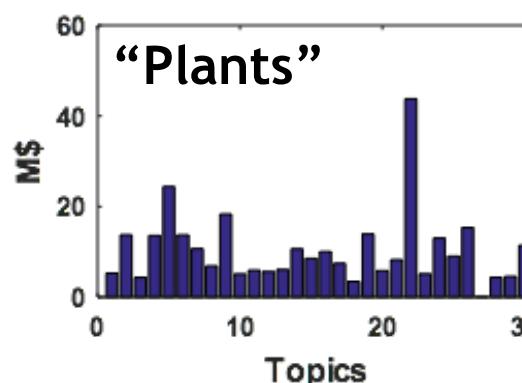
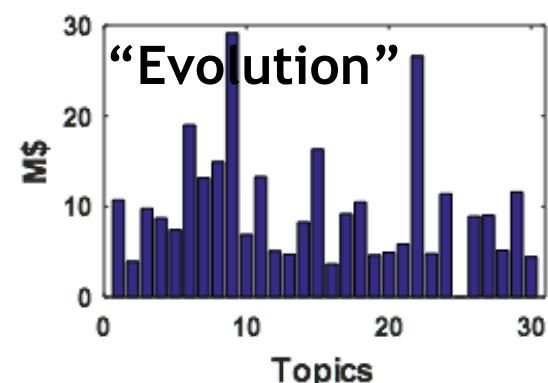
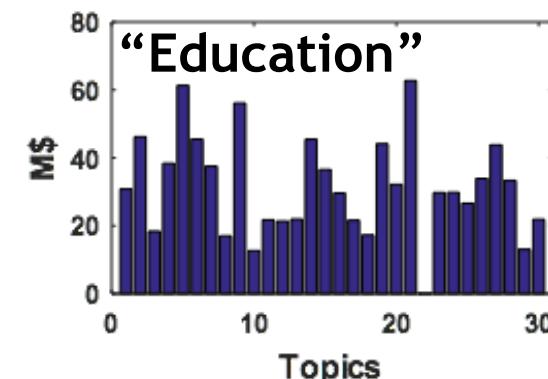
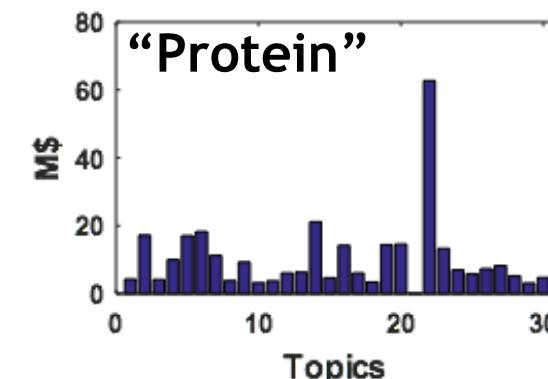
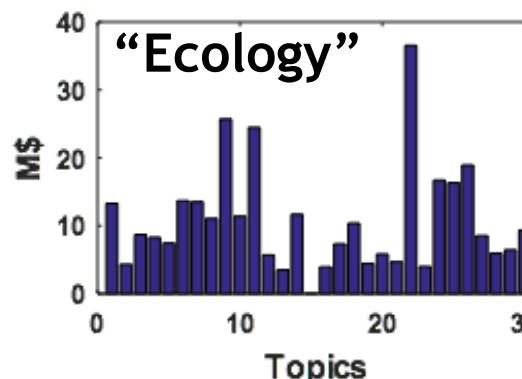
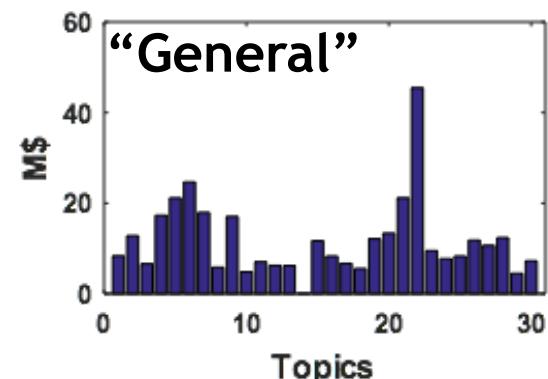
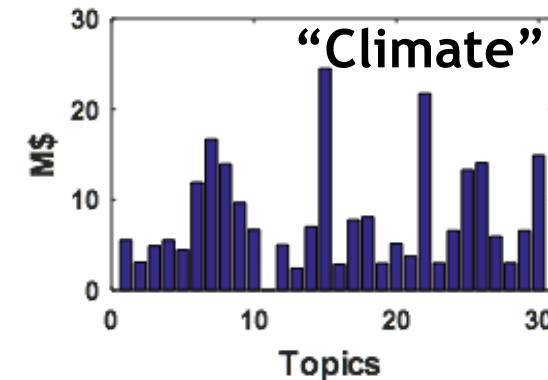
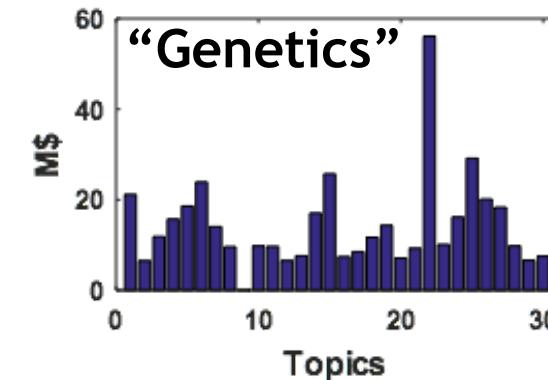
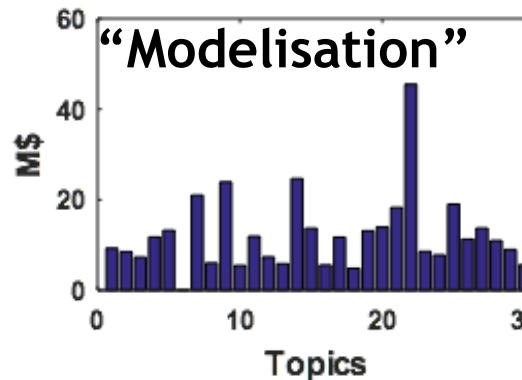
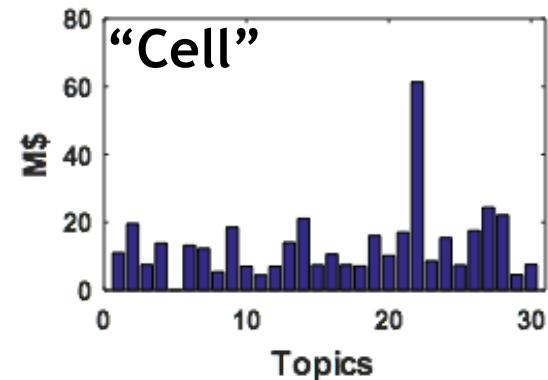
Topic 9: “Genetics” for 18 M\$

⋮



Note: $O_{i,i}$ is the total amount of money generated by the topic i . ($O_{i,i} = M_i$)
We set this quantity to zero for a better display of the overlapping topics.

Topics overlap



Topics overlap primary with
“Education” and then between each
other.