
Introduction to Data Visualization

Vetria L. Byrd, PhD
Assistant Professor
Computer Graphics Technology

Summer Research Opportunity Program (SROP)
Purdue University

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PURDUE
POLYTECHNIC



ABOUT THIS TALK

ASSUMPTIONS

Target Audience: Beginners

Pre-requisites: No prior knowledge of visualization

Software Requirements: None

ABOUT THIS TALK

GOALS

1. Provide viewers with an introduction to data visualization
2. Provide a summary of visualization capabilities
3. Identify first steps towards visualizing different types of data

ABOUT THIS TALK

OBJECTIVES

1. Explore the underlying principles of data visualization,
2. Explore the visualization process
3. Explore some visualization applications
4. Explore different types of visualization tools for different types of data

ABOUT THIS TALK

EXPECTED OUTCOMES

By the end of this presentation, viewers will

1. Understand the purpose of visualization
2. Be able to identify their data visualization needs
3. Identify the visualization tools available to assist with visualizing their data

AGENDA

INTRODUCTION TO DATA VISUALIZATION

- Brief Introduction
- Purpose Of Visualization
- High Level Overview
- Visualization Applications
- You've Got Data, Now What?
- Q&A

Introductions

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About Me

Vetria L. Byrd, PhD

Academic Preparation

- Computer Science (PhD, MS)
- Biomedical Engineering (MSMBE)



What I Am Doing Now

Academic Appointment

- Assistant Professor
- Purdue University
- Computer Graphics Technology
- Curriculum Development for New Major in Data Visualization
- Research Focus: Data Visualization

What I've Done



Visualization Initiatives

- BPViz: Broaden Participation in Visualization (2014/2016/2017)
- Research Experience for Undergraduates in Collaborative Data Visualization Applications (2014/2015)



Agent for "Insight"



**What do you think of when
you hear**

Data Visualization?



DATA VISUALIZATIONS

WE'VE ALL SEEN THEM



Internet Users in the World (Based on Region)



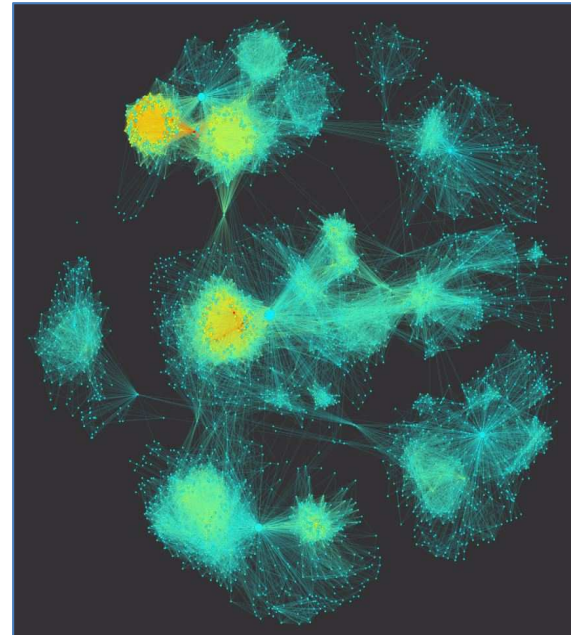
Source: <http://mindymcadams.com/tojou/2011/10-useful-resources-about-data-visualization/>

[Wind Map](http://hint.fm/wind/)

<http://hint.fm/wind/>

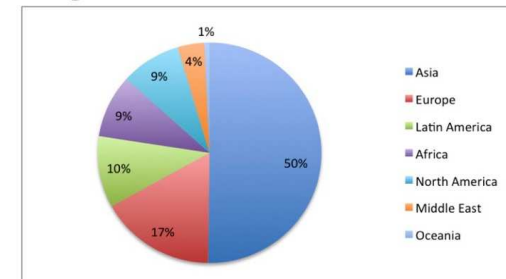
[Prime Number Patterns](https://www.jasondavies.com/primos/)

<https://www.jasondavies.com/primos/>



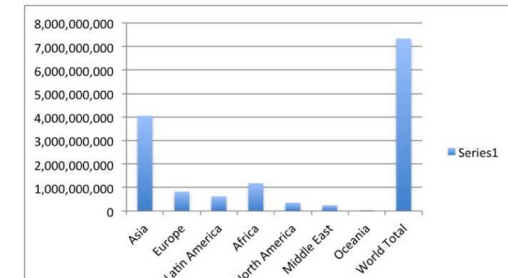
Facebook Network Visualization
Anonymous friend networks
Created by Christine Mintert & Fisher Adalakin
CGT 270 Class Assignment
Data Source:
<http://snap.stanford.edu/data/index.html#socnets>

Percentage of Internet Users in Regions Around the World in 2016

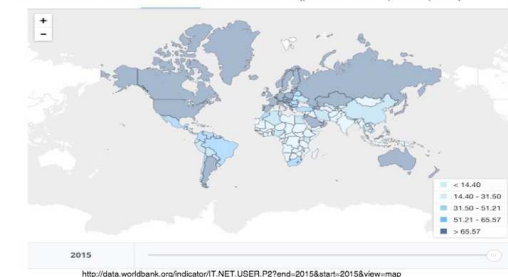


Why those percentages?

It's based on the relative population of the region to the rest of the world!



Internet Users in the World (per 100 people)



Created by Mridhula Venkataramani, CGT 270 class assignment

What is Data Visualization?

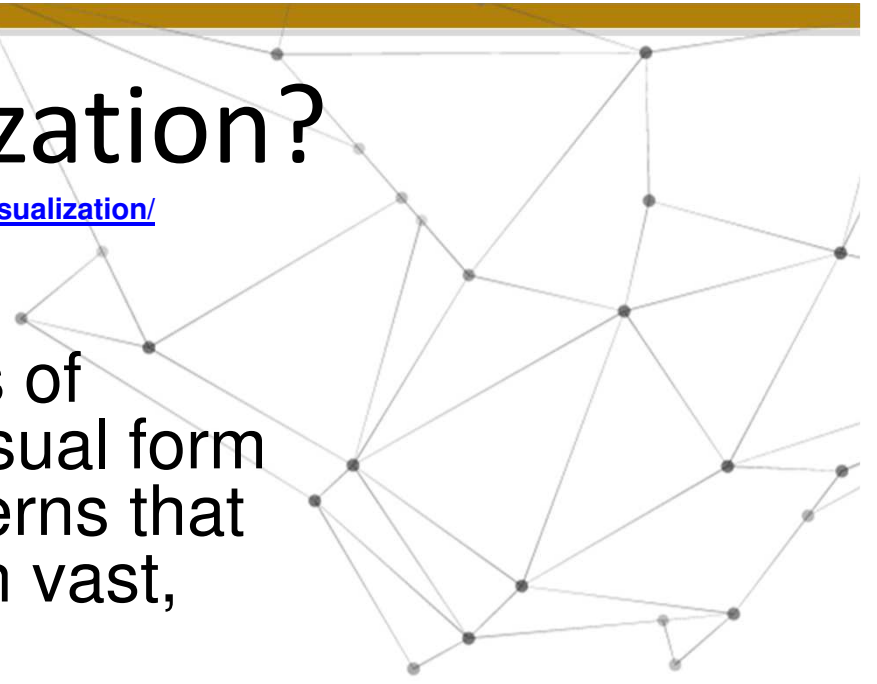


What is Data Visualization?

<http://mindymcadams.com/tojou/2011/10-useful-resources-about-data-visualization/>

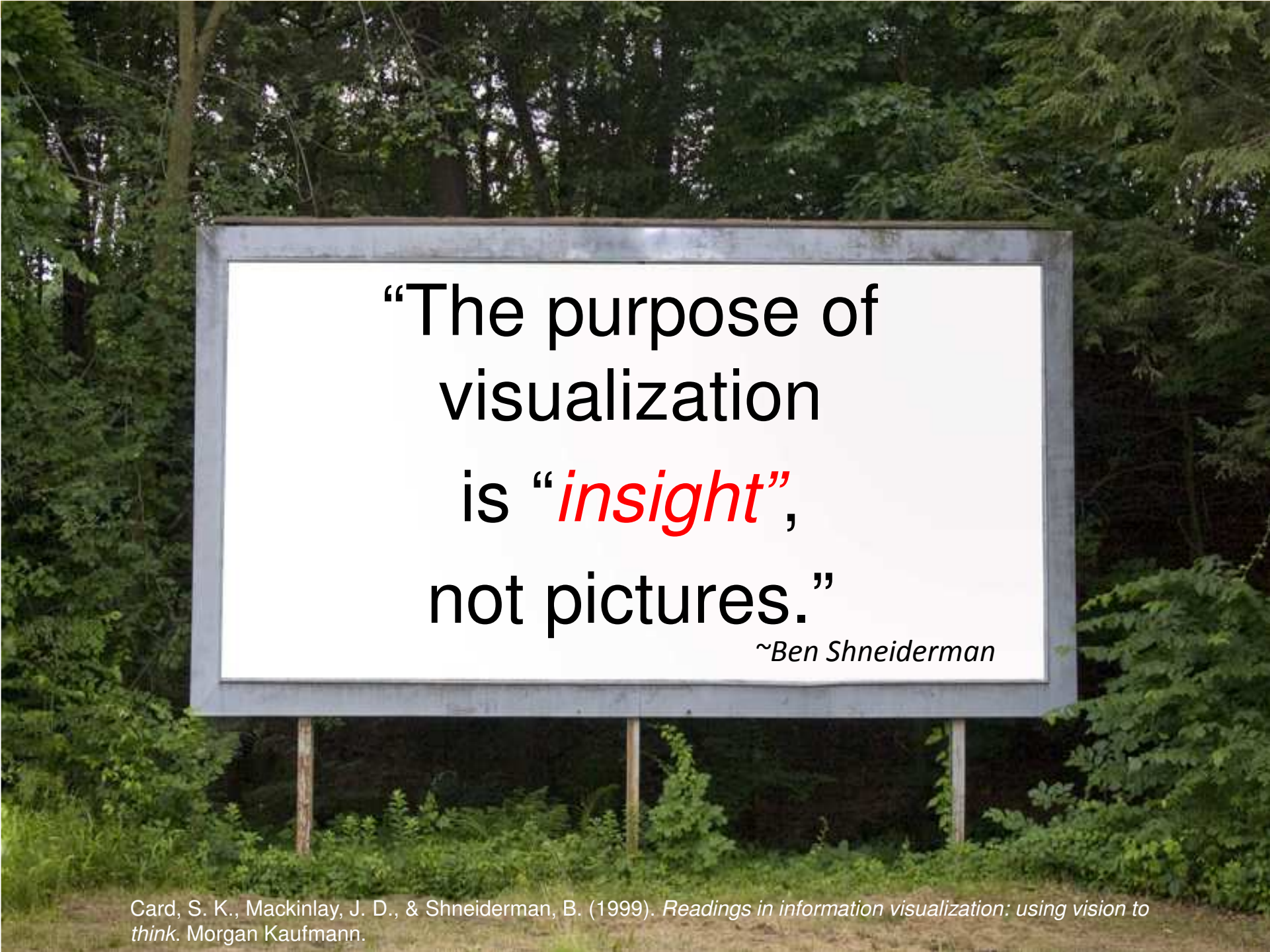
Last accessed 02/27/17

- Representing large amounts of disparate information in a visual form often allows you to see patterns that would otherwise be buried in vast, unconnected data sets. ...
- Visualizations allow you to understand and process enormous amounts of information quickly because it is all represented in a single image or animation.



What is the purpose of Visualization?



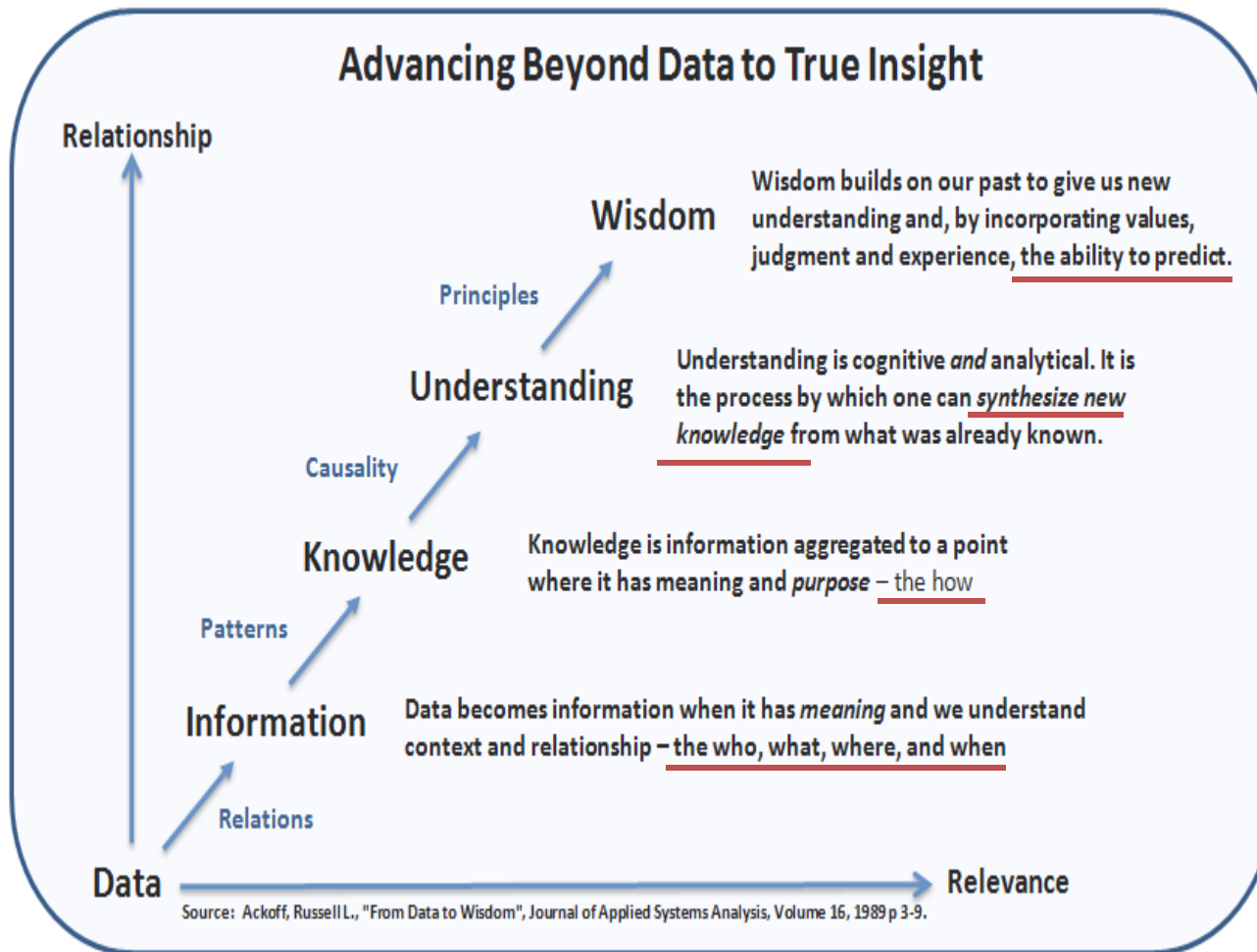
A photograph of a rectangular sign with a white background and a dark border, mounted on three wooden posts. The sign is set against a dense background of green trees and foliage. The text on the sign is centered and reads: "The purpose of visualization is *insight*, not pictures."

“The purpose of
visualization
is “*insight*”,
not pictures.”

~Ben Shneiderman

FROM DATA TO WISDOM

Ackoff, Russell L, Journal of Applied Systems Analysis, Volume 16, 1989 p3-9



What is the purpose of Visualization?



What does insight lead to?



INSIGHT LEADS TO

Discovery

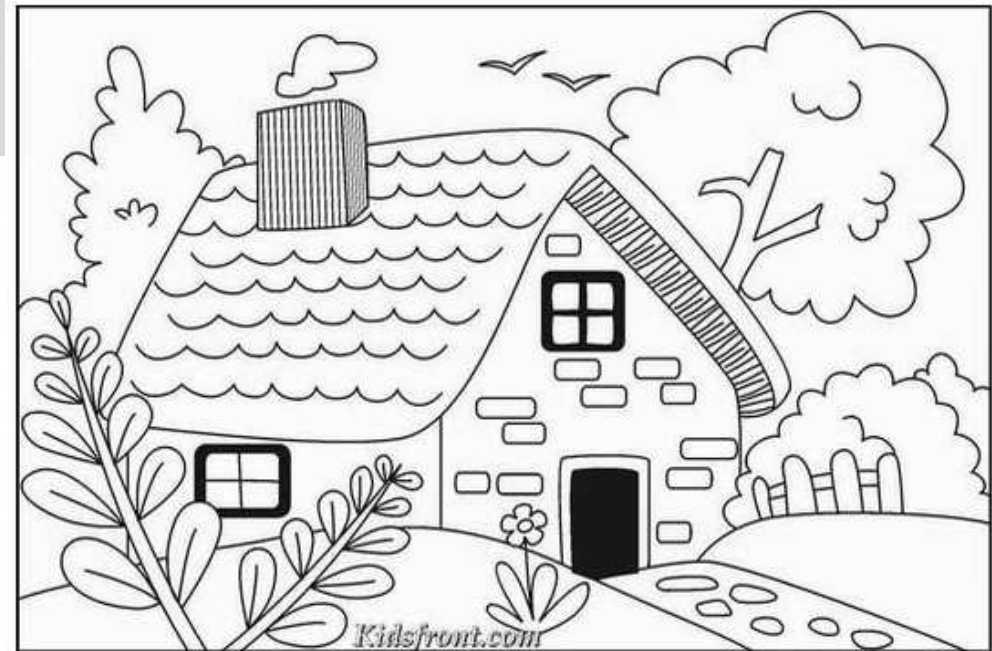
- Visualizing Patterns over time
- Spotting Differences

Decision Making

Analysis of Data

Explanation

Storytelling



INSIGHT LEADS TO

Discovery

- Visualizing Patterns over time
- Spotting Differences

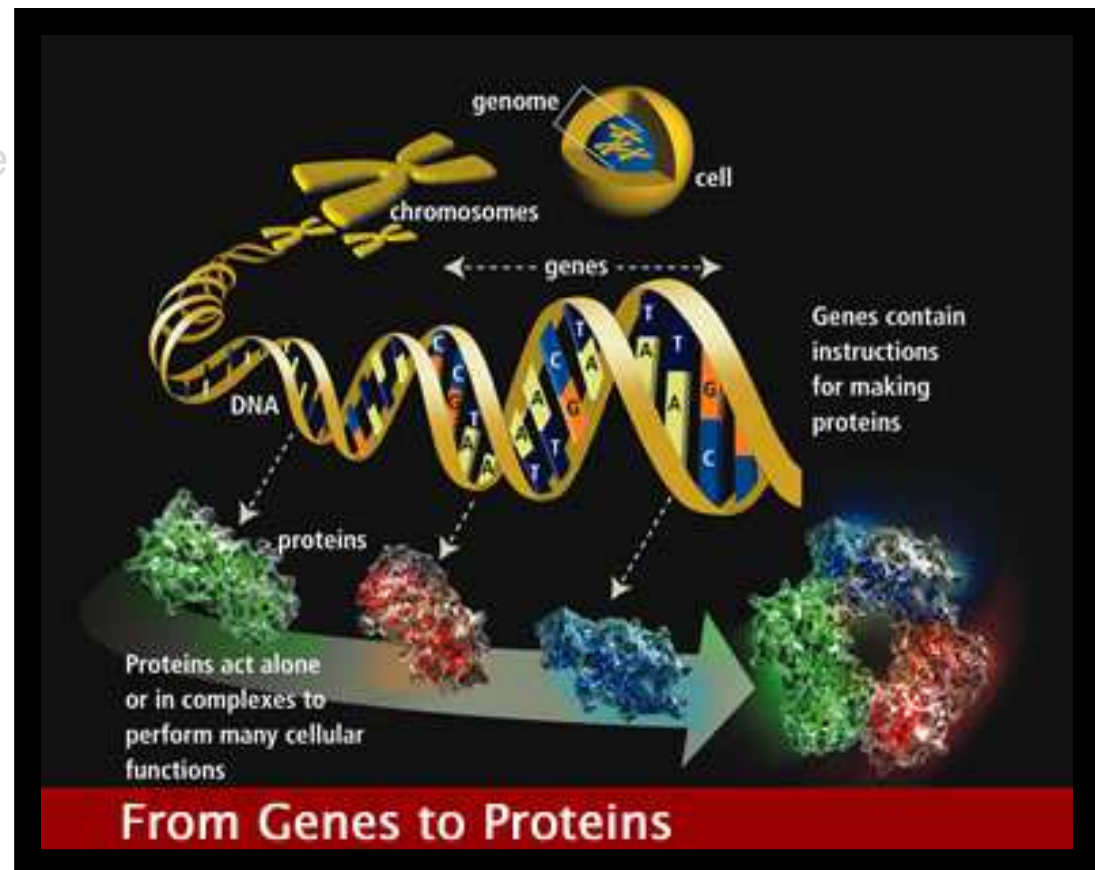
Decision Making

Analysis of Data

Explanation

Storytelling

Allows users to answer questions they didn't know they had



Human Genome Project

<https://pradipjntu.files.wordpress.com/2011/05/molecularmachine.jpg>

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INSIGHT LEADS TO

Discovery

Decision Making

Analysis of Data

Explanation

Storytelling



Katherine Johnson (played by Taraji P. Henson) calculates orbital insertion trajectories for the Mercury program using Euler's method in this scene from the movie Hidden Figures. Credit: TM and © 2017 Twentieth Century Fox Film Corporation. All rights reserved.

INSIGHT LEADS TO

Discovery

- Visualizing Patterns over time
- Spotting Differences

Decision Making

Analysis of Data

Explanation

[Visualizing Spatial Relationships](#)

Storytelling

Muehlenhaus, I. (2012). **Chapter 8, Visualizing Spatial Relationships**, *Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics*, pp 271-326.



Watch the Growth of Walmart and Sam's Club

<http://datafl.ws/197>



Watch the Growth of Target Stores

<http://datafl.ws/198>

INSIGHT LEADS TO

Discovery

- Visualizing Patterns over time
- Spotting Differences

Decision Making

Analysis of Data

Explanation

Storytelling

COVER FEATURE



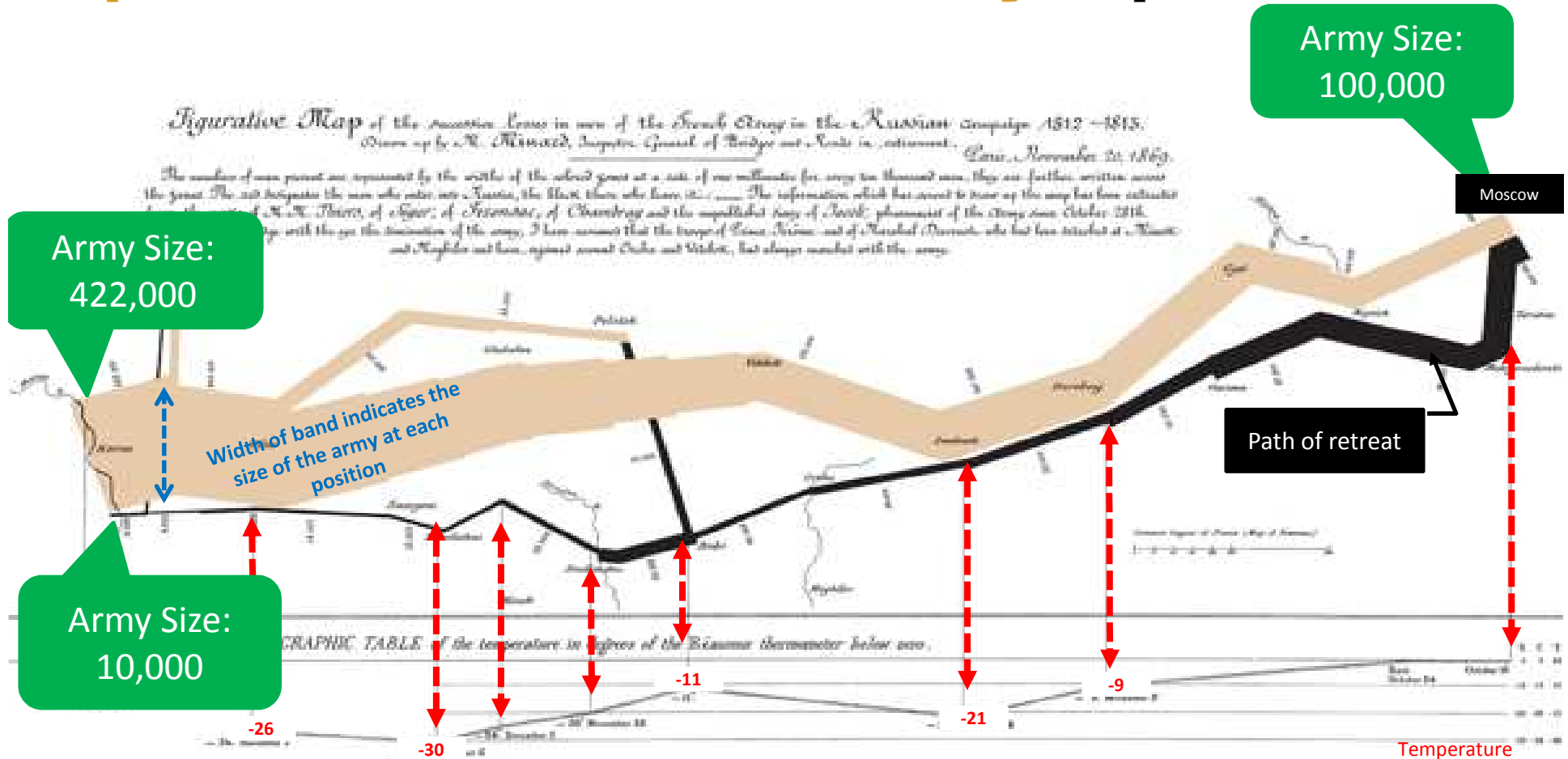
Storytelling:
The Next
Step for
Visualization

Robert Kosara and Jock Mackinlay, *Tableau Software, Seattle*

R. Kosara and J. Mackinlay, "Storytelling: The Next Step for Visualization," in *Computer*, vol. 46, no. 5, pp. 44-50, May 2013.

Story Telling with Visualization

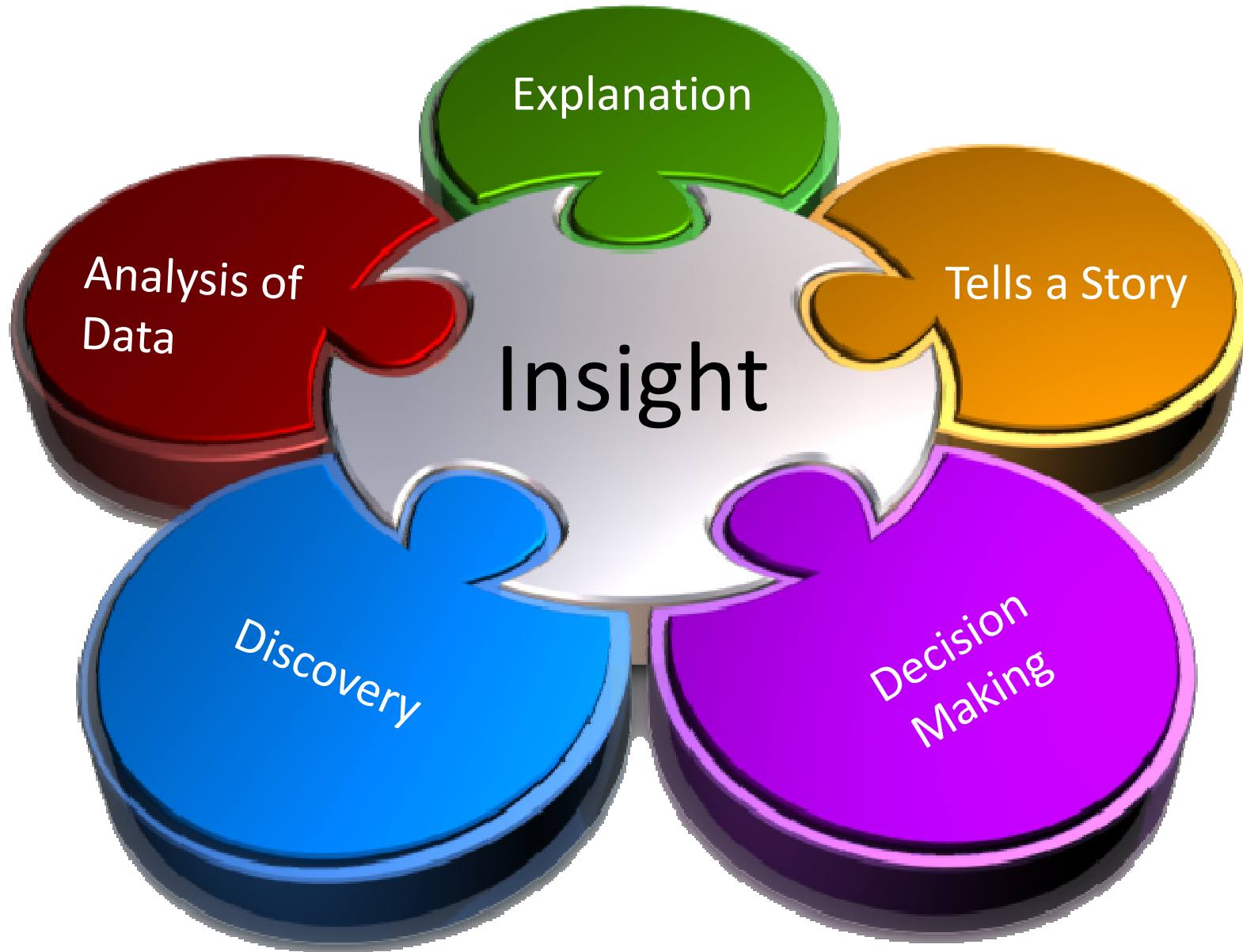
Napoleon's Invasion of Russia in 1812 By Jacque Minard



Hans Rosling's 200 Countries, 200 Years, 4 minutes

[The Joy of Stats - BBC Four](#)





FOUR TYPES OF VISUALIZATIONS

GEORGES GRINSTEIN (KEYNOTE PRESENTATION)

- **Exploratory**
 - Have no hypotheses about the data
 - Explore data interactively as undirected searches
- **Confirmatory**
 - Have specific hypotheses about the data
 - Goal-oriented examination of the hypotheses
- **Presentation**
 - Facts to be presented are fixed a priori
 - Select appropriate presentation techniques
- **Interactive**
 - Interactions with a pre-defined animation

Visualization Applications

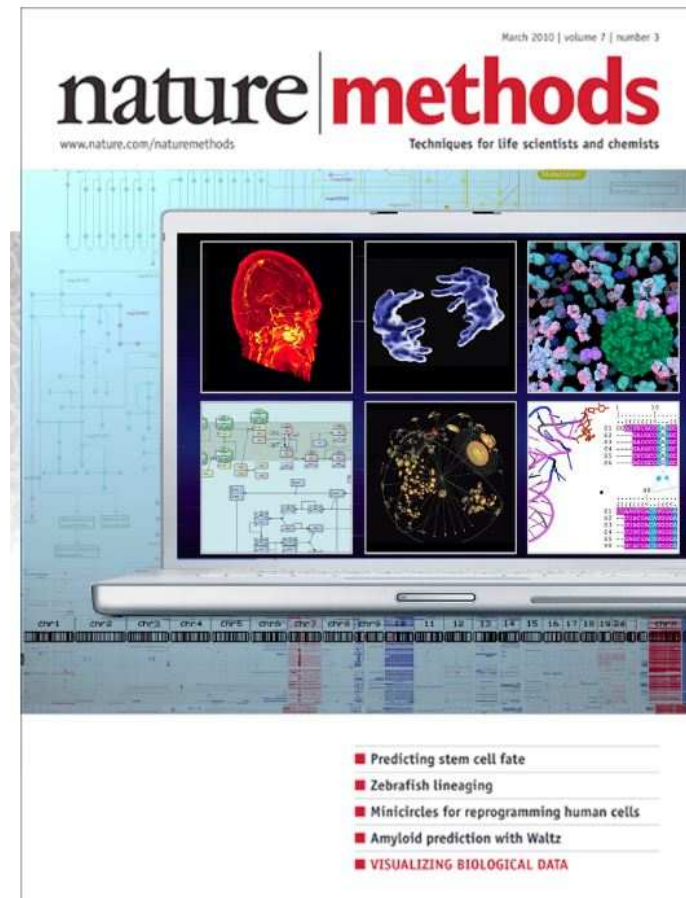
Why is visualization important?



Visualization Applications

Biovisualization (BioVis)

The visualization of
biological data;
Often grouped with
computer animation



March 2010 | volume 7 | number 3

Visualization Applications

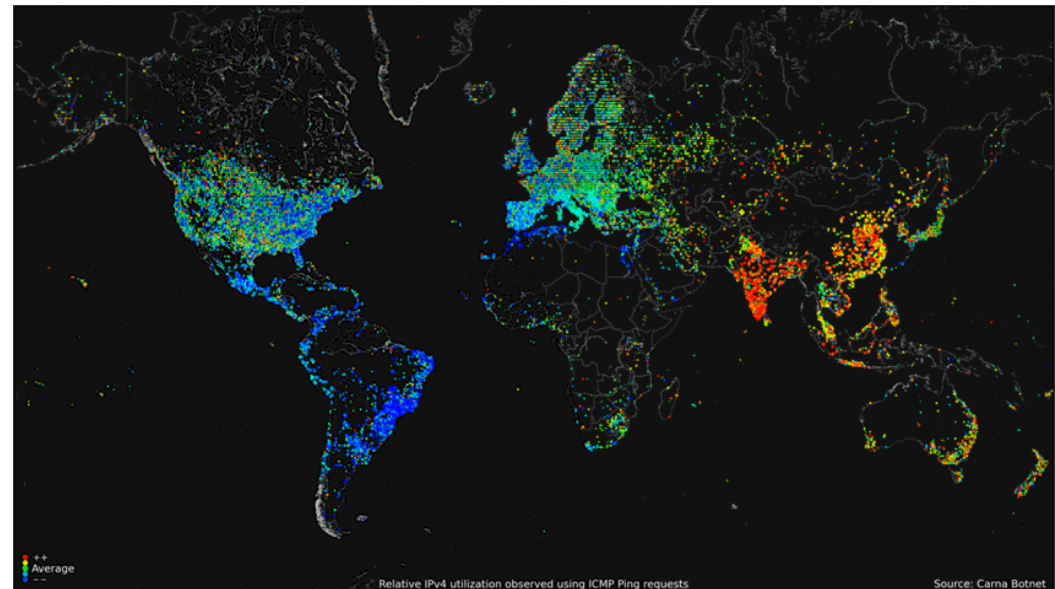
Information Visualization (InfoVis)

Interdisciplinary

Study of the “visual
representation of
large-scale collections
of non-numerical
information



Social Media Data
Survey Data
Observed Data



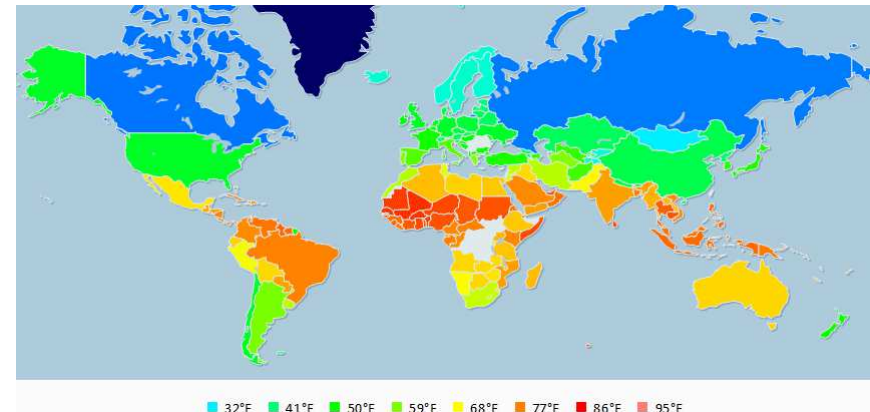
Internet Usage

Source: <http://www.cerne.net/wp-content/uploads/2013/03/internet.gif>

Visualization Applications

Geographic Visualization

Communicates geospatial information in ways that, when combined with human understanding, allow for data exploration and decision-making processes.



MacEachren, A.M. and Kraak, M.J. 1997 Exploratory cartographic visualization: advancing the agenda. *Computers & Geosciences*, 23(4), pp. 335-343. Jiang, B., and Li, Z. 2005. Editorial: Geovisualization: Design, Enhanced Visual Tools and Applications. *The Cartographic Journal*, 42(1), pp. 3-4 [MacEachren, A.M.](#) 2004. Geovisualization for knowledge construction and decision support. *IEEE computer graphics and applications*, 24(1), pp.13-17

Visualization Applications

Scientific Visualization (SciVis)

Primarily concerned with the visualization of three-dimensional phenomena

Emphases on realistic renderings of volumes, surfaces, illumination sources, etc.

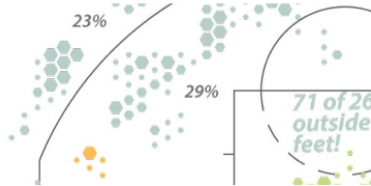
Image Source:

<http://www.sci.utah.edu/the-institute/highlights/24-research-highlights/cibc-highlights/253-top-scientific-visualization-research-problems.html>

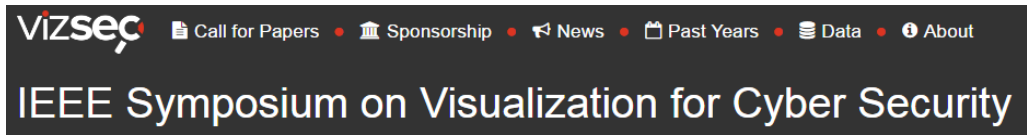




Visualization in Data Science (VDS at IEEE VIS 2017)



BPVIZ
Broadening Participation
in Visualization
Vetria Byrd, Organizer
BPViz'17 in conjunction with
IEEE VIS, October 2017,
Phoenix, AZ



IEEE VIS 2017 Arts Program

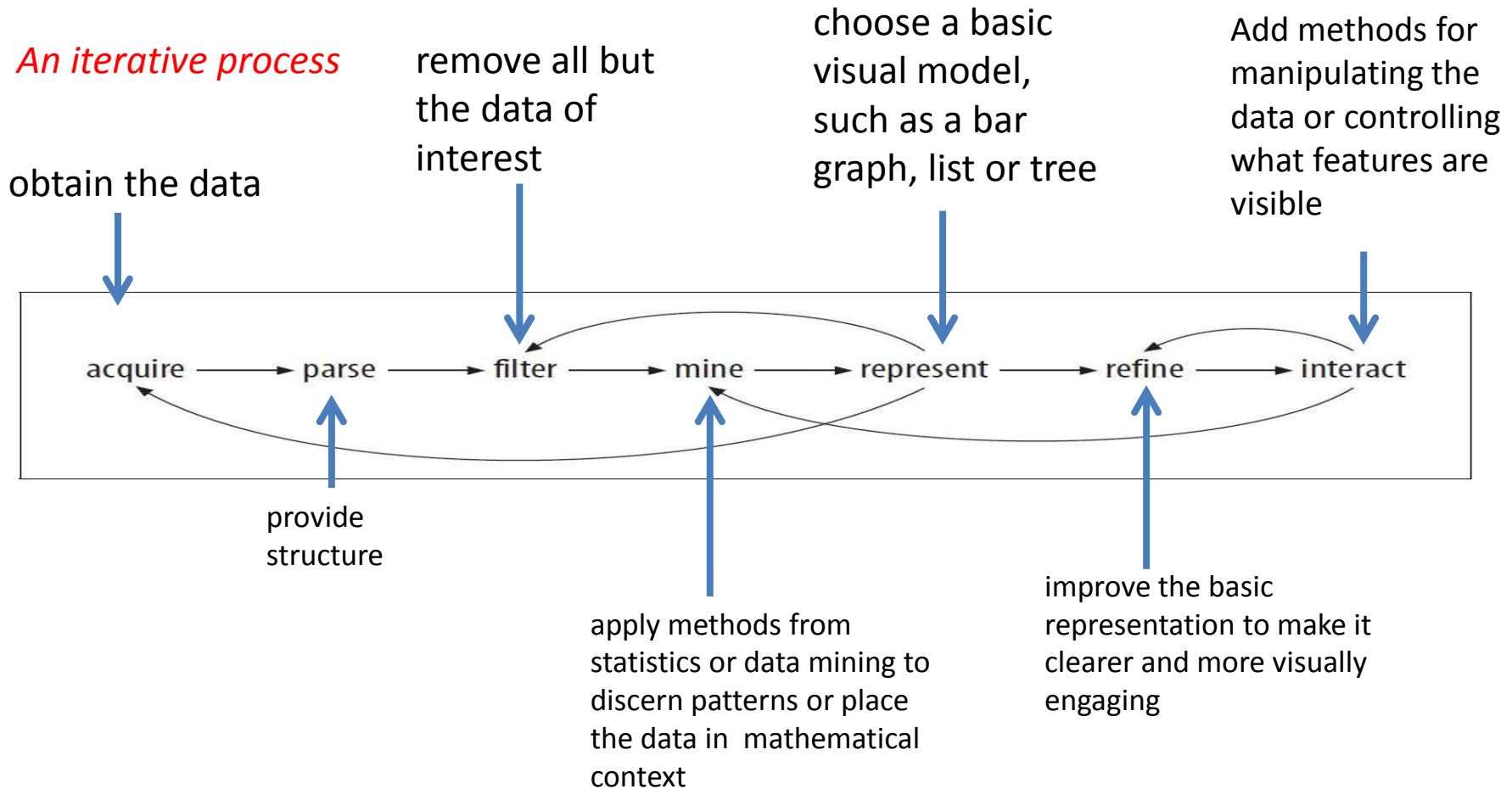


Data Visualization Process

High Level Overview



Data Visualization Process



Adopted from Visualizing Data: Exploring and Explaining Data with the Processing Environment by Ben Fry, O'Reilly (p 15)

Visualization Process

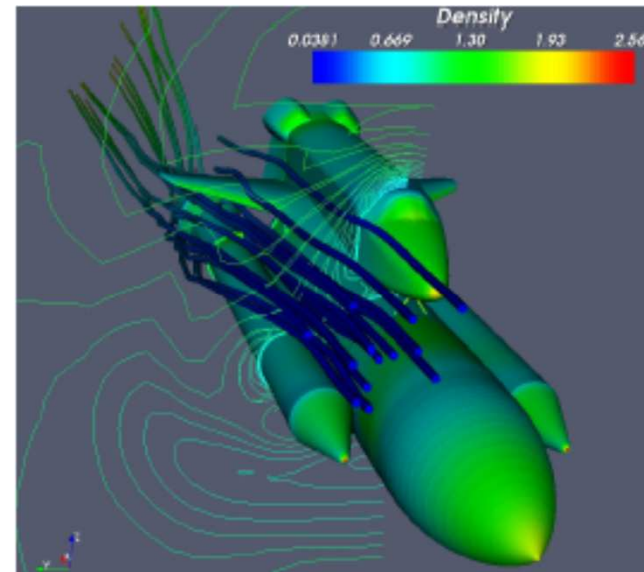
Taking raw data and converting it to a form that is viewable and understandable to humans.

```
0265640 132304 133732 032051 037334 024721 035013 052226 001662
0265650 025537 064663 054606 043294 074076 124153 135216 126614
0265700 144210 056426 044700 042650 165230 137037 003655 006254
0265720 134453 124327 176005 027034 107614 170774 073702 067274
0265740 072451 007735 147620 051064 157435 113057 155356 114603
0265760 107204 102316 171451 046040 120223 001774 030477 046673
0265800 171317 116055 155117 134444 167210 041405 147127 050505
0265820 004137 046472 124015 134360 173550 053517 044635 021135
0265840 070176 047705 113754 175477 105532 076515 177366 056333
0265860 041023 074017 127113 003214 037025 037640 066171 123424
0265900 067701 037406 140000 165341 072410 100032 125455 056646
0265920 006716 071402 055672 132571 105645 170073 050376 072117
0265940 024451 007424 114200 077733 024434 012546 172404 102345
0265960 040223 050170 055164 164634 047154 126525 112514 032315
0265980 016041 176055 042766 025015 176314 017234 110060 014515
0266020 117156 030746 154234 125001 151144 163706 136237 164376
0266040 137955 062276 161755 115466 005322 132567 073216 002855
0266060 171466 126161 117155 065763 016177 014460 112765 055527
0266080 003767 175367 104754 036436 172172 150750 043643 145410
0266100 072074 000007 040627 070552 175011 002151 125132 140214
0266120 060115 014356 015164 067027 120206 070242 030055 131334
0266140 170601 170106 040437 127277 124446 136631 041462 116321
0266160 020243 005602 004146 121574 124651 005634 071331 102070
0266180 157504 160307 166330 074251 024520 114433 167273 030635
0266200 133614 106171 144160 010552 007365 026416 160716 100413
0266220 026630 007210 000630 121224 075033 140754 000737 003276
0266240 114060 042647 104475 110537 066716 104754 075447 112254
0266260 030374 144251 077734 015157 002513 173526 035531 150003
0266280 146207 015135 024446 130101 072457 040764 165513 156412
0266300 166410 067251 156160 106406 136770 030516 064740 022032
0266320 142166 123707 175121 071170 076357 037233 031136 015232
0266340 075074 015744 044055 102230 110063 033350 052765 172463
```

Visualization Process

There are several steps between raw data and a finished visualization

```
0265640 132304 133732 032051 037334 024721 035013 052226 001662
0265650 025537 064663 054606 043294 074076 124153 135216 126614
0265700 144210 056426 044700 042550 165230 137037 003655 006254
0265720 134453 124327 176005 027034 107634 170774 073702 067294
0265740 072451 007735 147620 051064 157435 113057 155356 114605
0265760 107204 102316 171451 046040 120223 001774 030477 046673
0265800 171317 116055 155117 139444 167210 091405 147127 050505
0265820 004137 046472 124015 134360 173550 053517 044635 021135
0265840 070176 047705 113754 175477 105532 076515 172366 056333
0265860 041023 074017 127113 033214 037025 037640 065171 123424
0265900 067701 037406 140000 165341 072410 100032 125455 056646
0265920 006716 071402 055672 132571 105645 170073 050376 072117
0265940 024451 007424 114200 077733 024434 012546 172404 102945
0265960 090223 050170 055164 169634 047154 126525 112514 032315
0265980 016041 176055 042766 025015 176314 017234 110050 014515
0266020 117156 030746 154234 125001 151144 163706 136237 164376
0266040 137055 062276 161755 115466 005322 132567 073216 002855
0266060 171466 126161 117155 055763 016177 014460 112765 055527
0266080 003767 175367 104754 036436 172172 150750 043643 145410
0266100 072074 000607 040627 070552 175011 002151 125132 140214
0266120 060115 014356 015164 057027 120206 070242 030055 131334
0266140 170601 170106 040437 127277 124446 135631 041462 116321
0266160 020243 005602 004146 121574 124651 005634 071331 102070
0266180 157504 160307 166330 079251 024520 114433 167273 030635
0266200 133614 106171 144160 010552 007365 026416 160716 100413
0266220 026630 007210 000630 121224 075033 140754 000737 003276
0266240 114050 042647 104475 110537 066716 104754 075447 112254
0266260 030374 144251 077734 015157 002513 173526 035531 150003
0266280 146207 015135 024446 130101 072457 040764 165513 156412
0266300 166410 067251 156160 106406 136770 030516 064740 022032
0266320 142166 123707 175121 071170 076357 037233 031136 015232
0266340 075074 015744 044055 102230 110063 033350 052765 172463
```



Why do we care?
I just want a pretty picture!



What does the pretty picture mean?



<http://news.mit.edu/2015/automating-big-data-analysis-1016>

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A Pretty Picture is Nothing without Meaning.

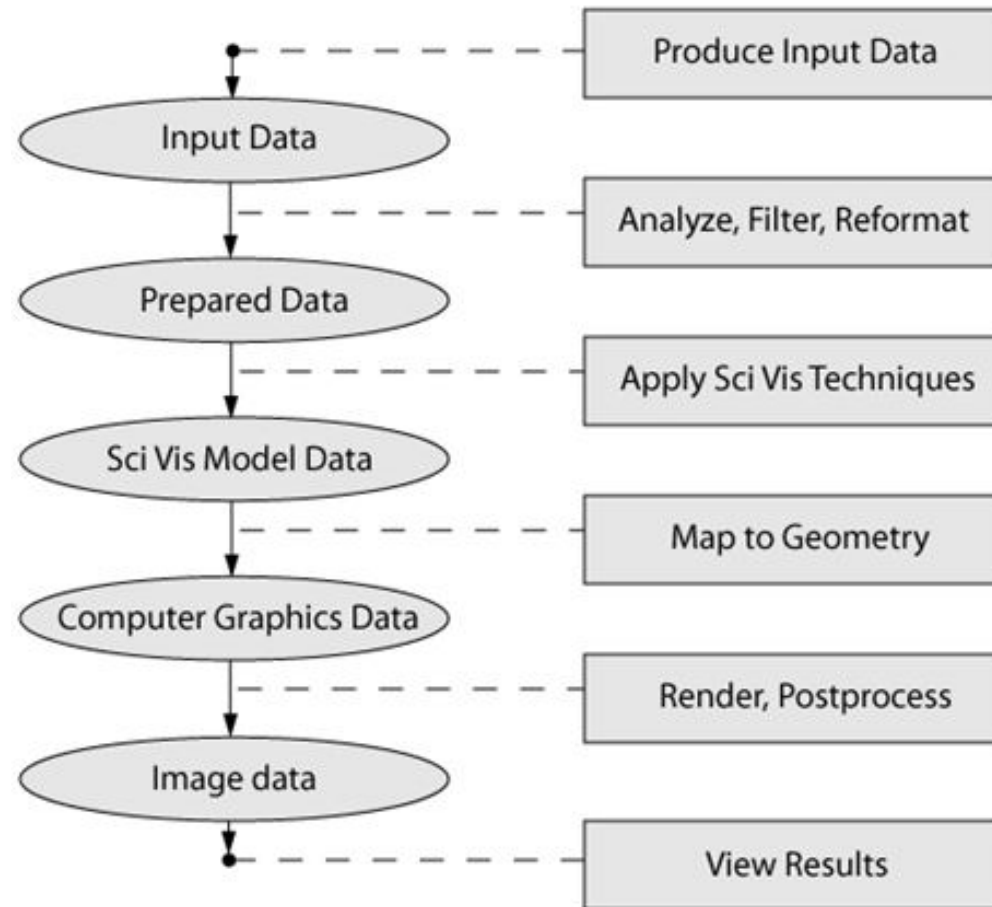
PURDUE
POLYTECHNIC



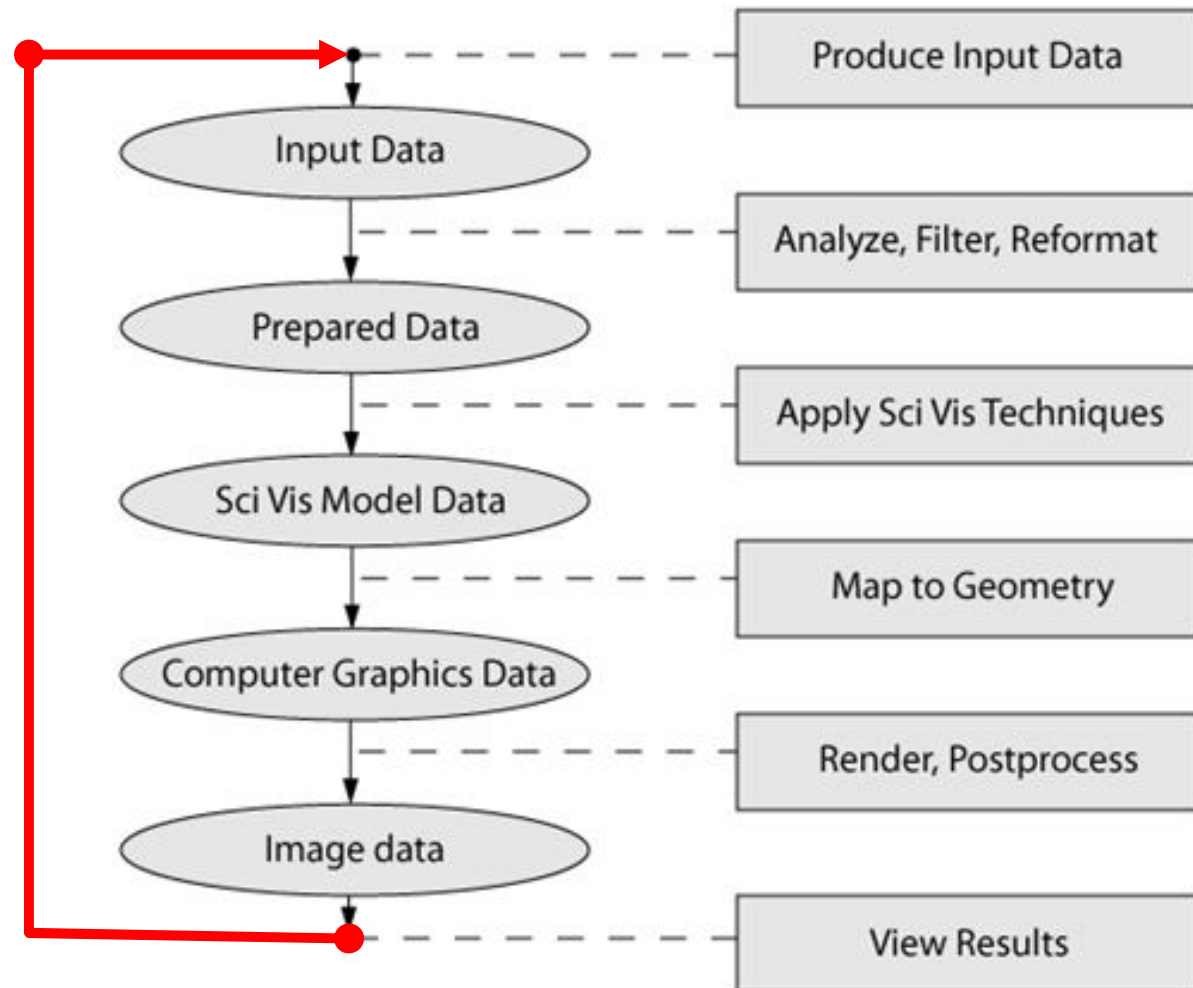
Scientific Visualization Pipeline



What's Missing?



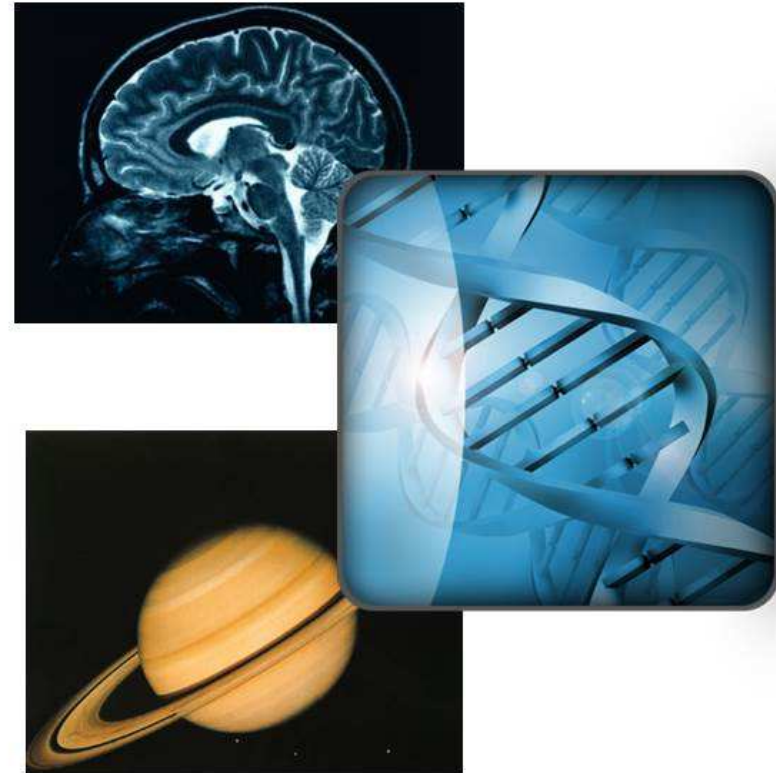
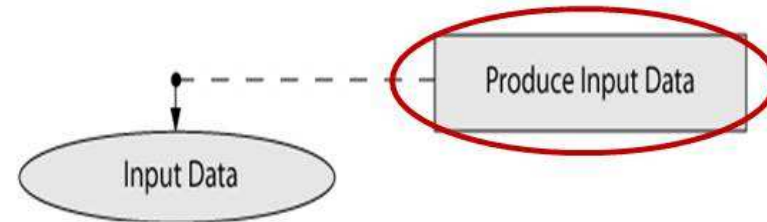
Scientific Visualization Pipeline



Scientific Visualization Pipeline: Step 1 . . .

Produce Data

Simulated Data
Images
Numerical
Some measured value
Observed Phenomena



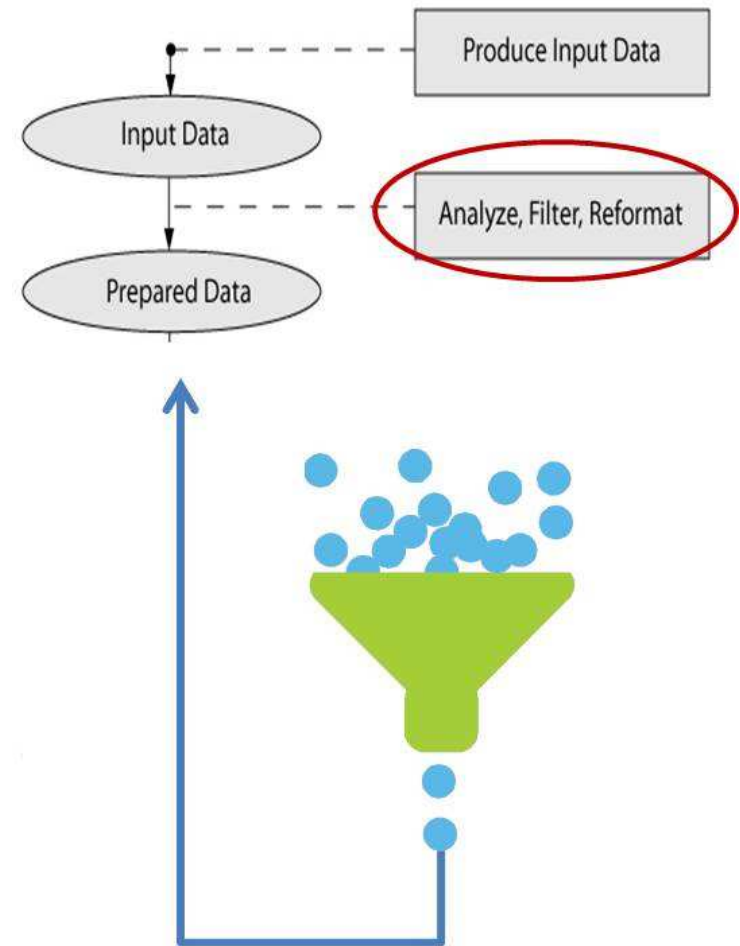
Scientific Visualization Pipeline: Step 2 . . .

Analyze, Filter, Reformat

Cleaning up the data

- Removing noise
- Replacing missing values
- Clamping values to be within a specific range of interest

Performing operations
to yield more useful
data



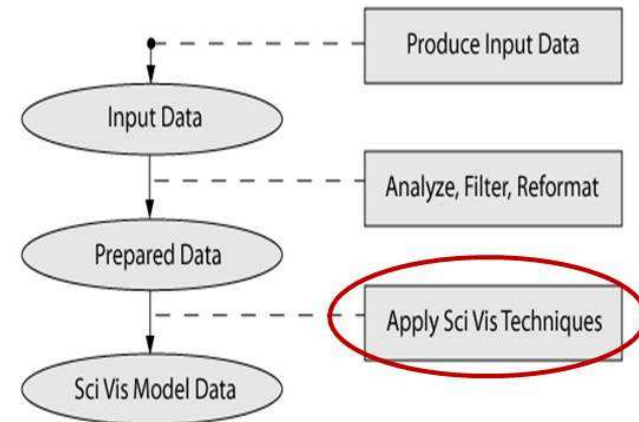
Adopted from

<http://www.bu.edu/tech/research/training/tutorials/introduction-to-scientific-visualization-tutorial/the-scientific-visualization-pipeline/>

Scientific Visualization Pipeline: Step 3

Apply SciVis Techniques

- Converts raw information into something more understandable
- Visually extracting meaning from a scientific data set using various techniques



Contour



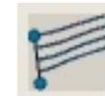
Clip



Threshold



Glyphs



Streamlines

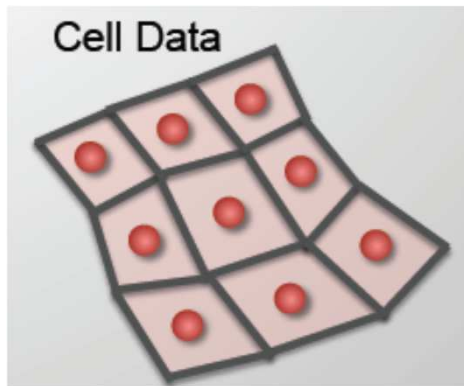
Adopted from

<http://www.bu.edu/tech/research/training/tutorials/introduction-to-scientific-visualization-tutorial/the-scientific-visualization-pipeline/>

Scientific Visualization Pipeline

Step 4 . . .

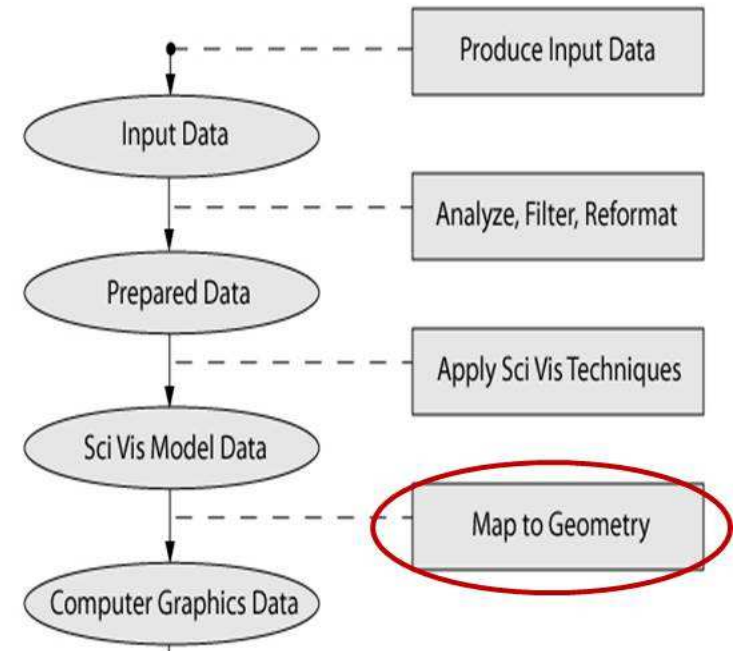
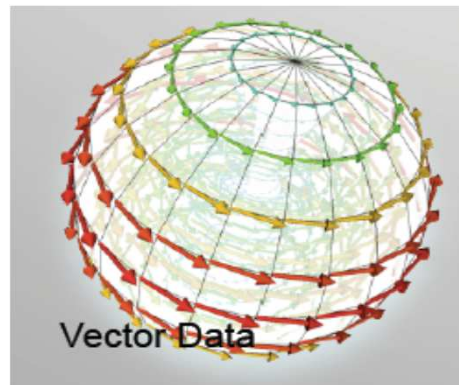
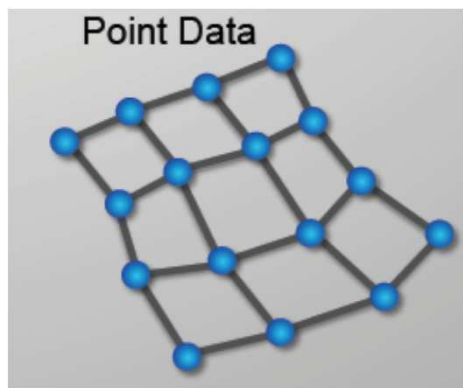
Map to Geometry



Scalars, vectors,
tensors

1D, 2D, 3D

Mesh

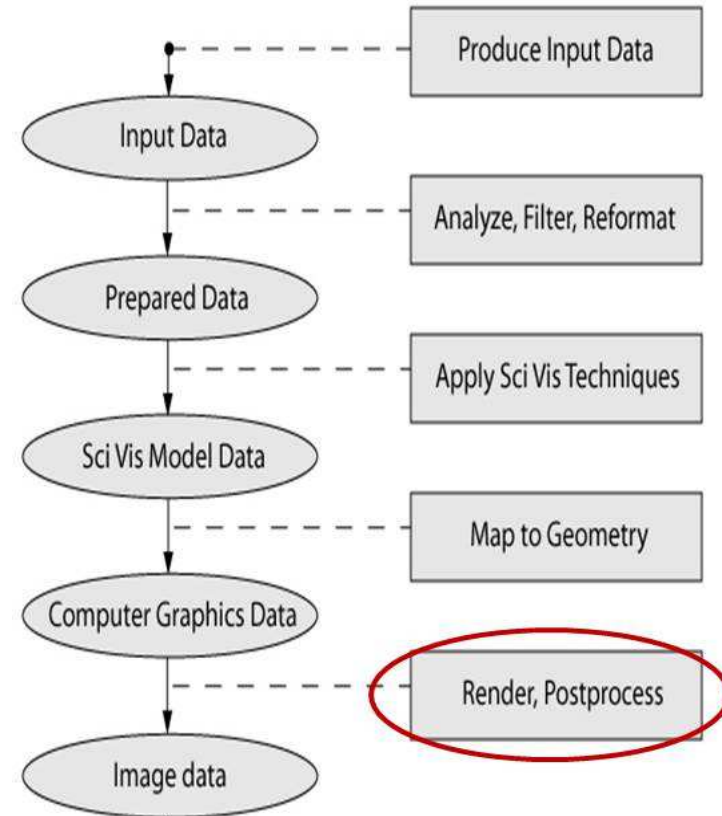
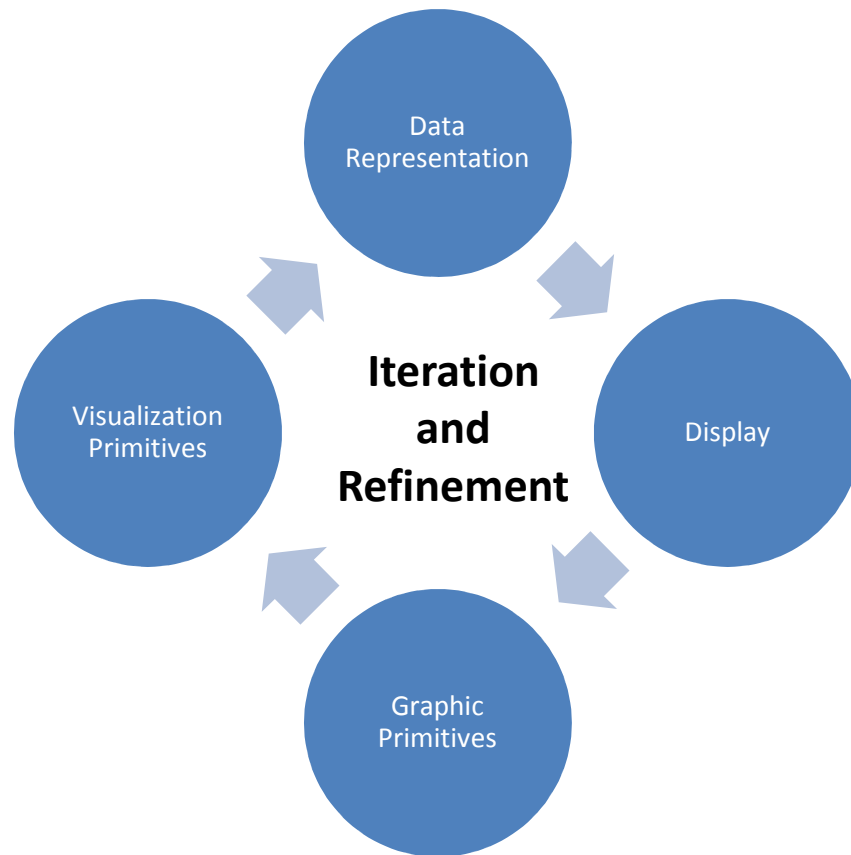


Adopted from

<http://www.bu.edu/tech/research/training/tutorials/introduction-to-scientific-visualization-tutorial/the-scientific-visualization-pipeline/>

Scientific Visualization Pipeline: Step 5 . . .

Render, Post Process

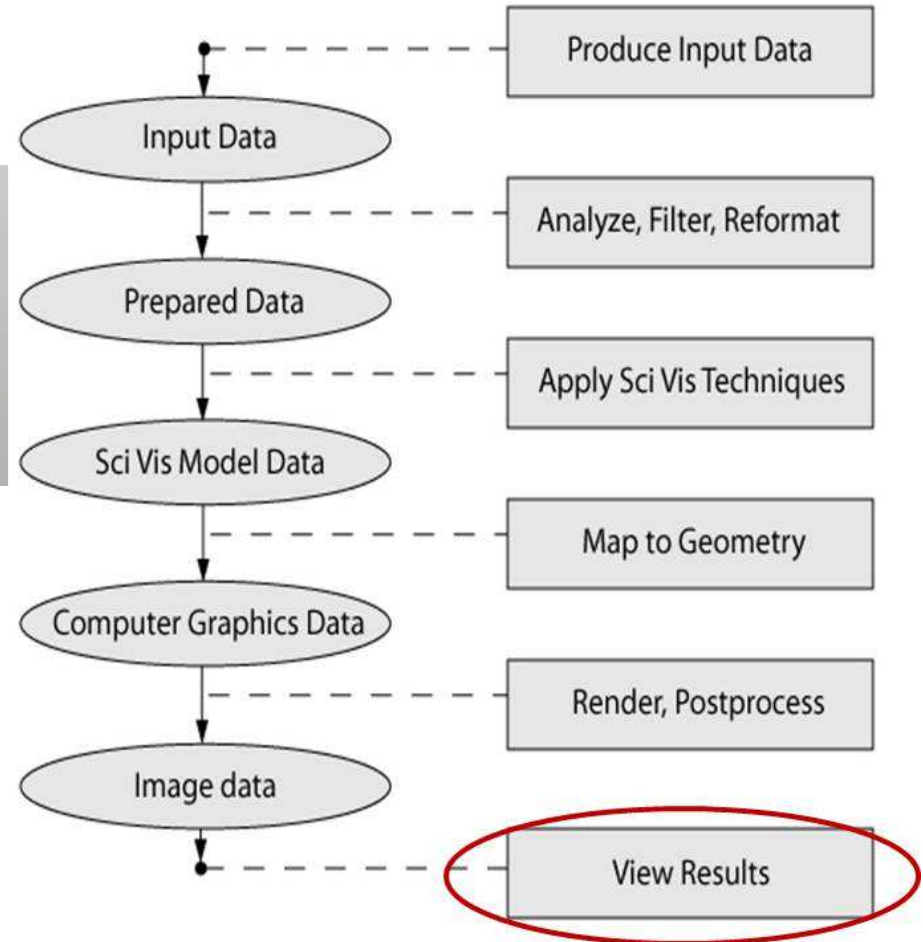
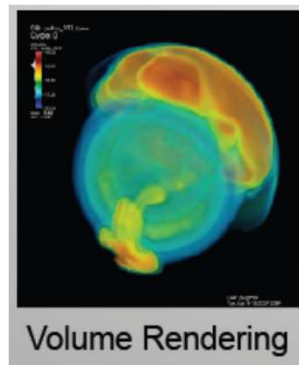
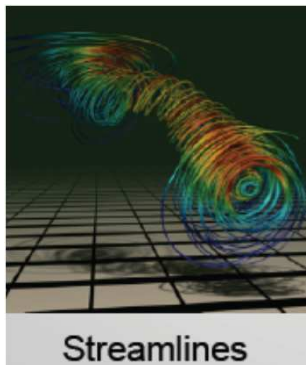
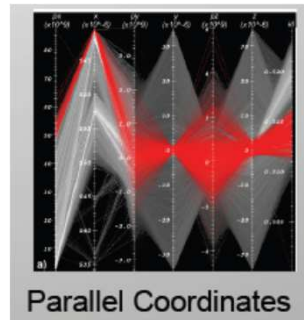
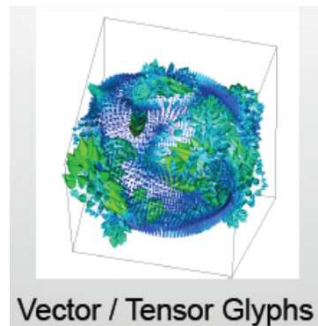
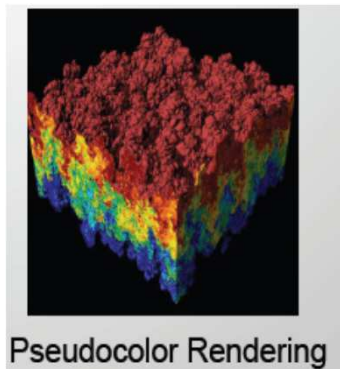


Adopted from

<http://www.bu.edu/tech/research/training/tutorials/introduction-to-scientific-visualization-tutorial/the-scientific-visualization-pipeline/>

Scientific Visualization Pipeline: Step 6 . . .

View Results



Adopted from

<http://www.bu.edu/tech/research/training/tutorials/introduction-to-scientific-visualization-tutorial/the-scientific-visualization-pipeline/>

Questions?

Next: The Importance of Data Visualization



Why is Data Visualization Important?



Why should you care about Visualization?

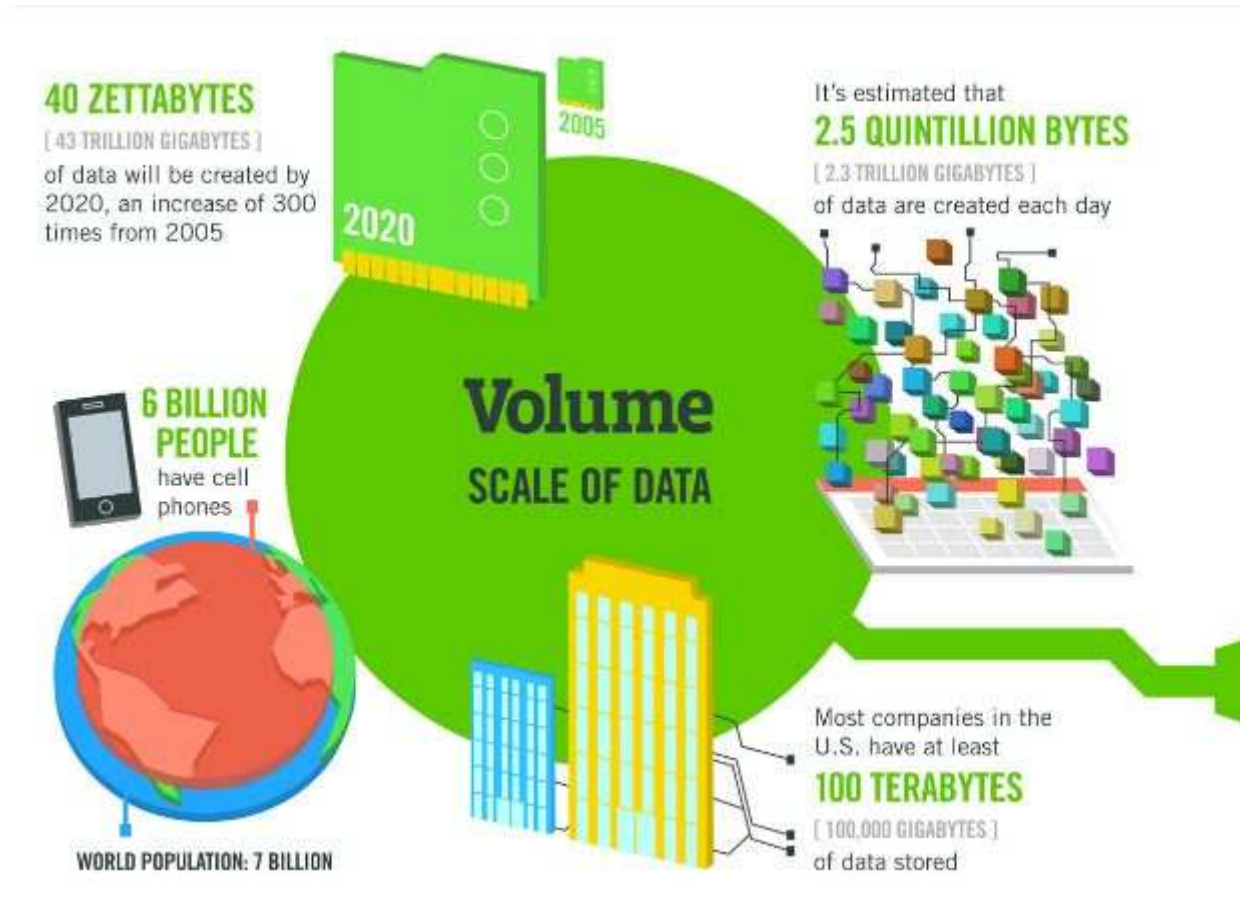


Data is Everywhere!

PURDUE
POLYTECHNIC



The Four V's of Big Data



<https://www-01.ibm.com/software/data/bigdata/images/4-Vs-of-big-data.jpg>

The Four V's of Big Data

The New York Stock Exchange captures
1 TB OF TRADE INFORMATION
during each trading session



By 2016, it is projected
there will be
18.9 BILLION NETWORK CONNECTIONS
— almost 2.5 connections
per person on earth



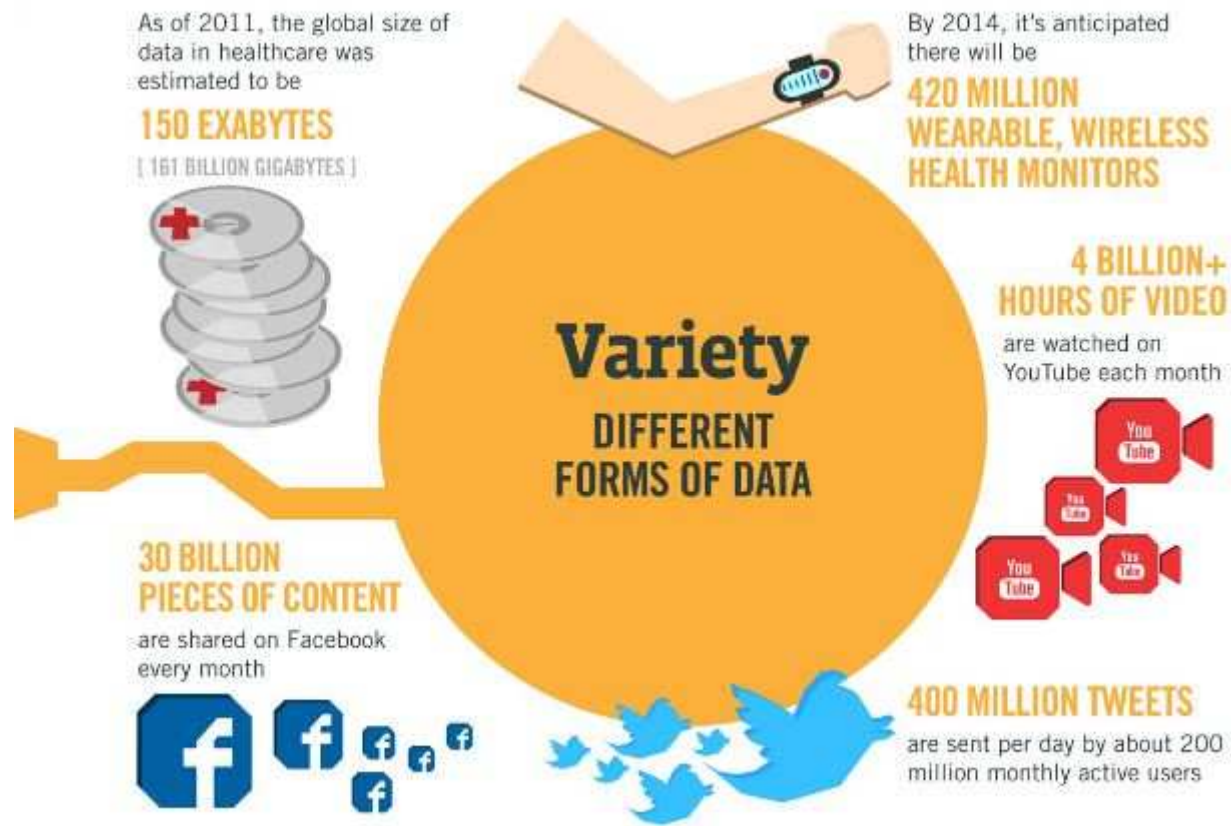
Modern cars have close to
100 SENSORS
that monitor items such as
fuel level and tire pressure

Velocity
ANALYSIS OF
STREAMING DATA



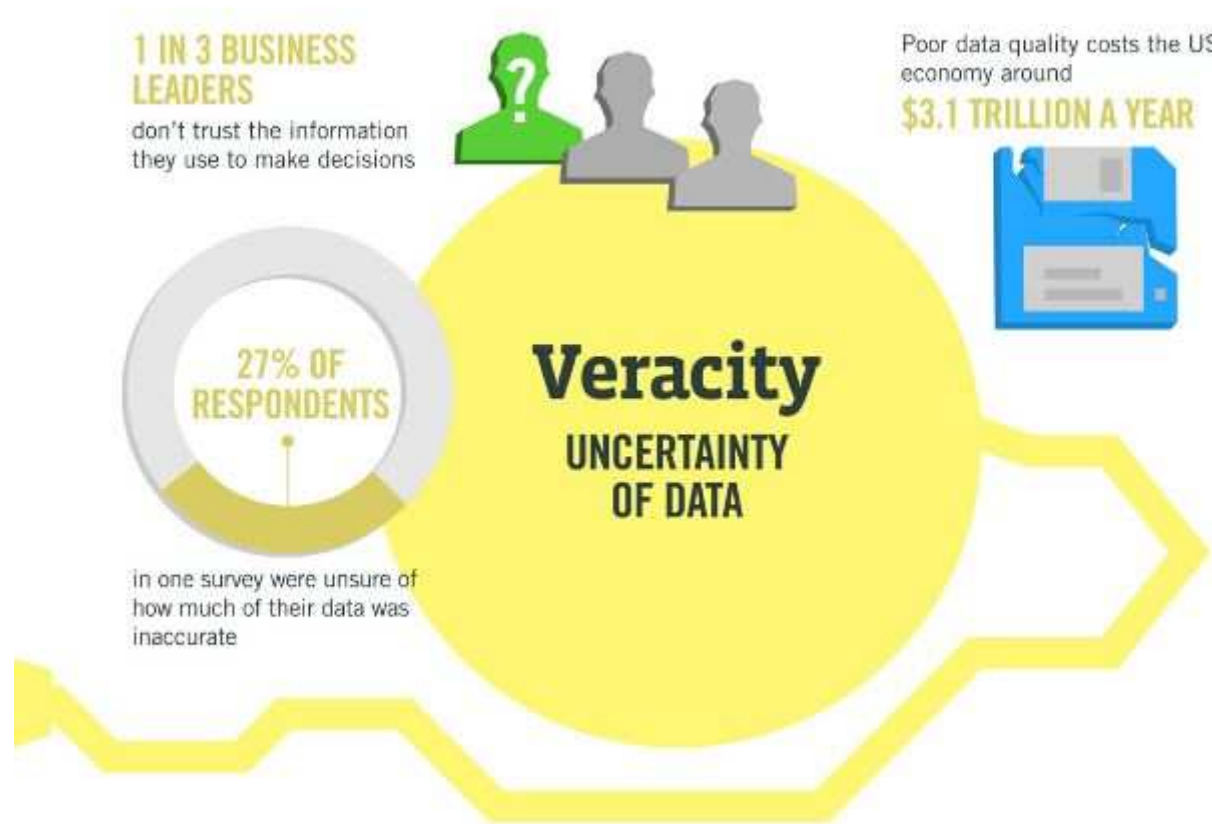
<https://www-01.ibm.com/software/data/bigdata/images/4-Vs-of-big-data.jpg>

The Four V's of Big Data



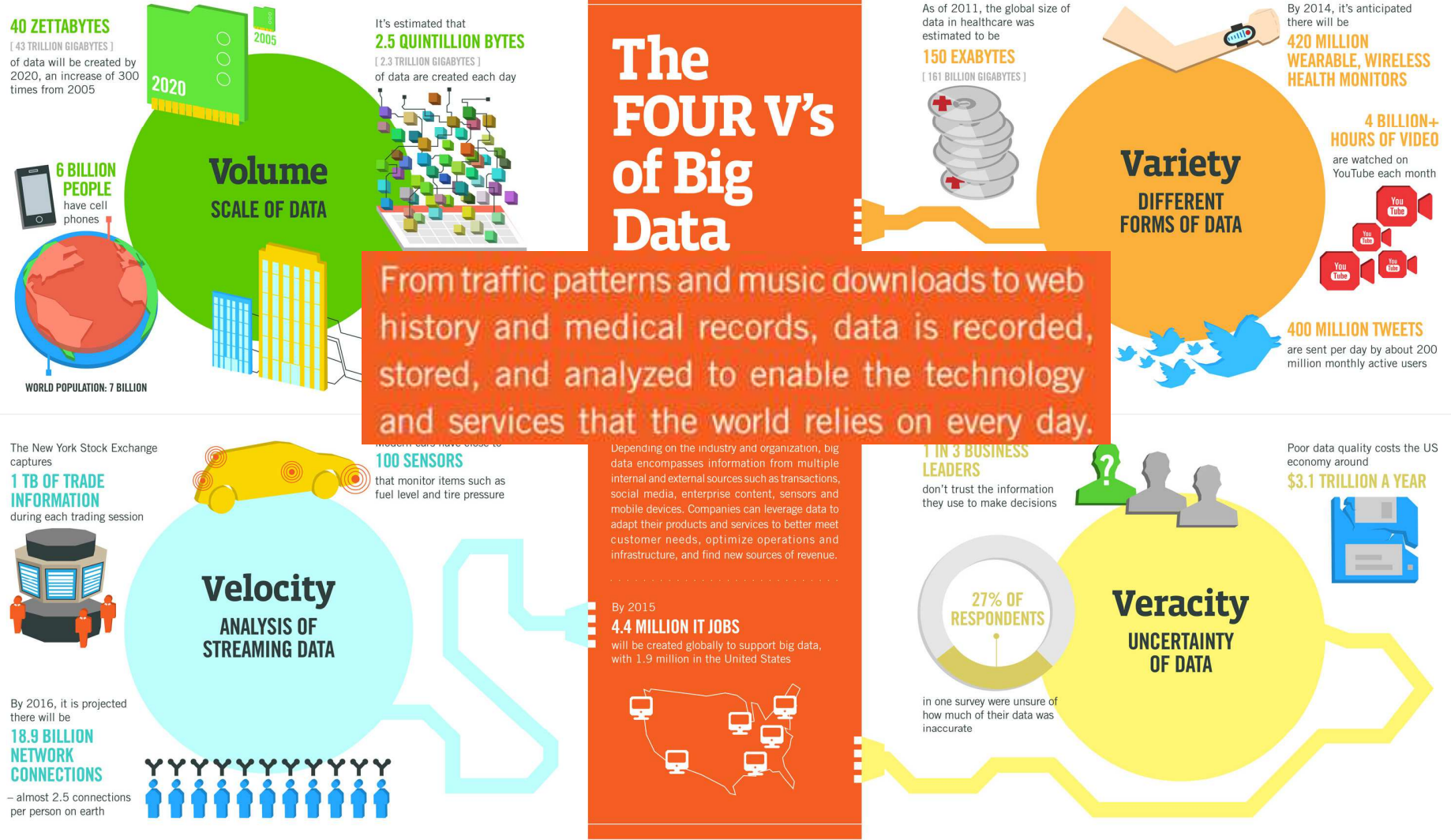
<https://www-01.ibm.com/software/data/bigdata/images/4-Vs-of-big-data.jpg>

The Four V's of Big Data



<https://www-01.ibm.com/software/data/bigdata/images/4-Vs-of-big-data.jpg>

IBM Big Data Platform



Sources: McKinsey Global Institute, Twitter, Cisco, Gartner, EMC, SAS, IBM, MEPTec, QAS



<https://www-01.ibm.com/software/data/bigdata/images/4-Vs-of-big-data.jpg>

Why Should You Care About Visualization

Regardless of major, research interest, or academic background, at some point you will visualize some type of data.

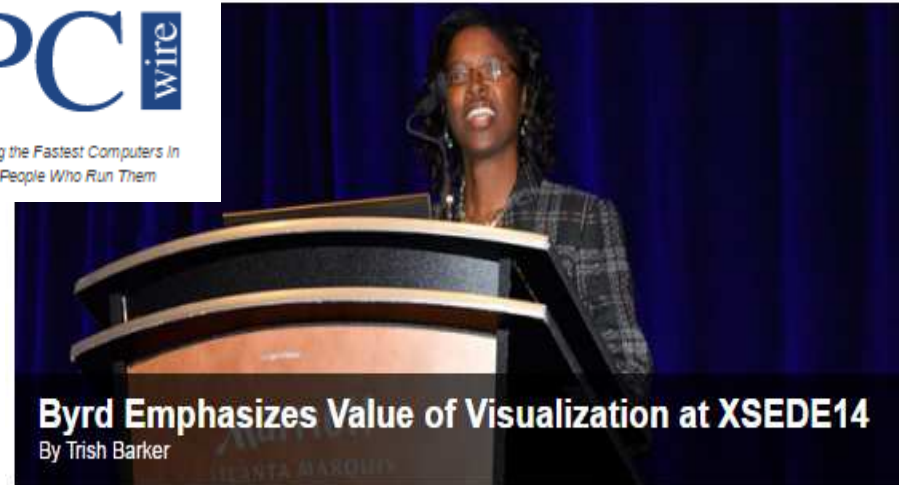
~ Vetrica Byrd

WHY SHOULD YOU CARE?

- There is a demand for
- people who understand the visualization process
 - is able to transform raw complex data into a visual representation
 - that does not overwhelm.

HPC wire

Since 1987 - Covering the Fastest Computers In the World and the People Who Run Them



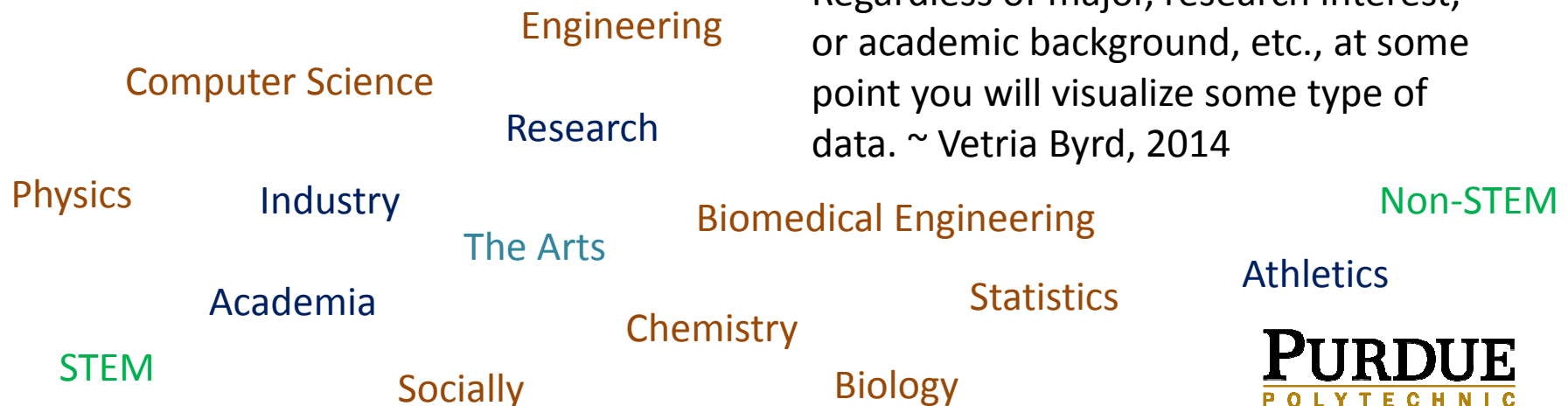
Byrd Emphasizes Value of Visualization at XSEDE14

By Trish Barker

<https://www.hpcwire.com/2014/07/31/byrd-emphasizes-value-visualization-xse14/>

July 31, 2014

Regardless of major, research interest, or academic background, etc., at some point you will visualize some type of data. ~ Vetricia Byrd, 2014



You've Got Data

Now What?

PURDUE
POLYTECHNIC



YOU'VE GOT DATA

NOW WHAT?

Questions

1. What does the data look like?
2. What needs to be communicated?
3. What are you interested in utilizing the resulting visualization(s) for
 - ✓ Analysis of data
 - ✓ Explanation
 - ✓ Communication (Storytelling)
 - ✓ Discovery
 - ✓ Decision Making
4. What has been done before?
5. [Where do I start?](#)

<https://www.labnol.org/software/find-right-chart-type-for-your-data/6523/>

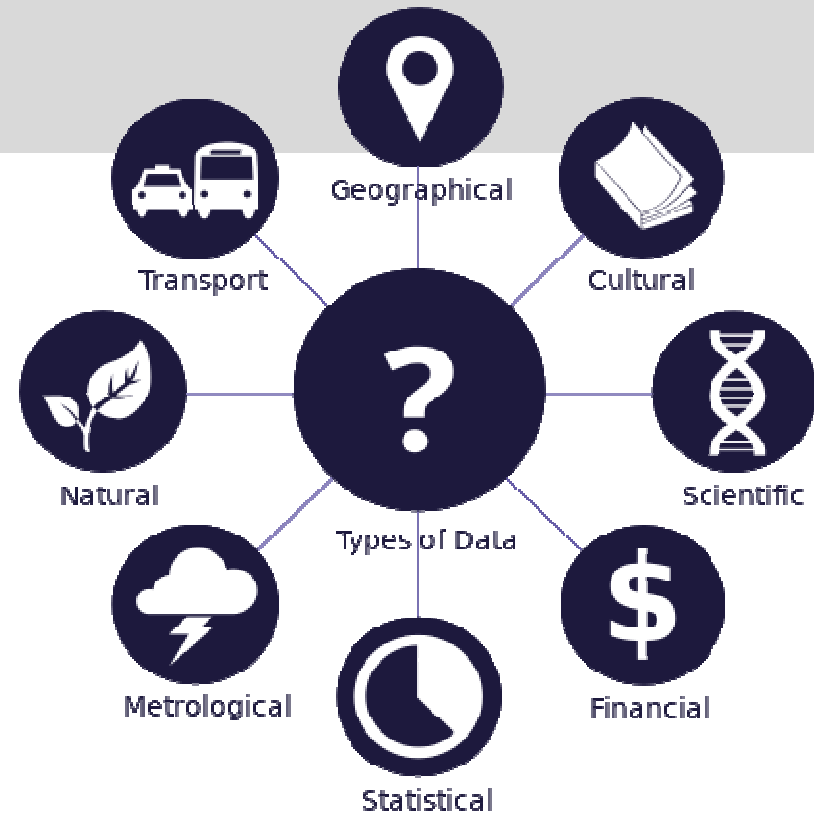


Image Source: Types of data. Translation of document hosted by João Batista Netoat
https://commons.wikimedia.org/wiki/File:Data_types_-_pt_br.svg

More types of data: Biological, Social Media, Network Data, Survey Data, Cybersecurity, Temporal, Image data, Topical, . . . this is NOT an exhaustive list

Visualization is a Process



RESOURCES

A STARTING POINT: OPEN SOURCE VISUALIZATION TOOLS

Information Visualization

- Gephi
- Tableau (not open source, but student version is free)

Scientific Visualization

- ParaView
- VisIt

Geo Visualization

- ARC GIS
- D3.js

Cyber Security Visualization

- Survey of Security Visualization
- Survey of Cybersecurity Visualization

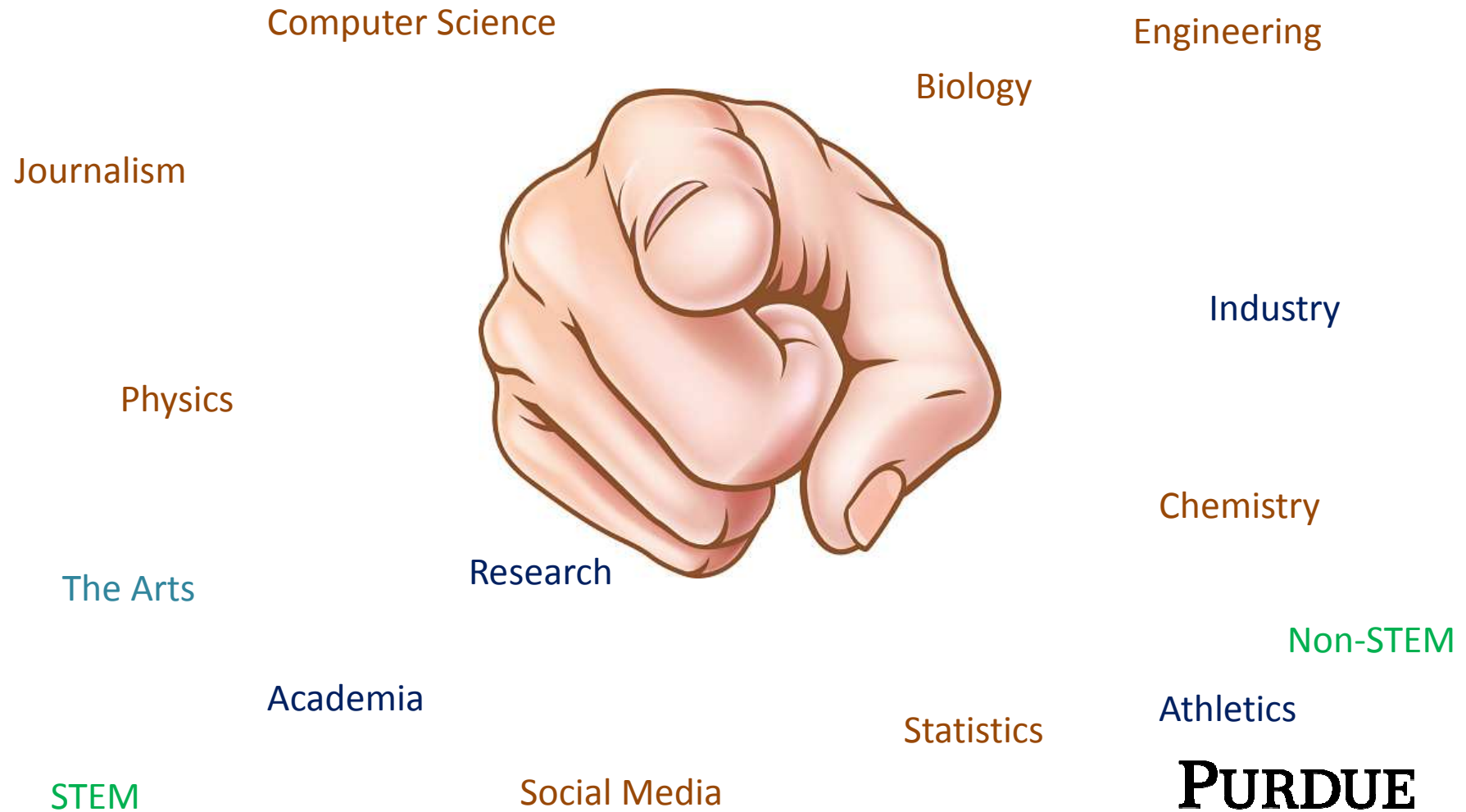
Why Should You Care About Visualization?

- There is a demand for people
 - Who understand the visualization process and
 - Is able to transform raw complex data into a visual representation that
 - Does not overwhelm.

What does this person look like?



THIS PERSON LOOKS LIKE YOU!



ANATOMY OF A DATA SCIENTIST

The era of Big Data has created a talent gap for people who can pull actionable insights out of raw data. The data scientist—called “the sexiest job of the 21st century” by *Harvard Business Review*—is in demand, with a 15,000% jump in job posts between 2011–2012. In the US, the average salary for these sought-after scientists is around \$100,000.

So what makes a good data scientist?



WHAT MAKES A GOOD DATA SCIENTIST?

- Degreed In Geek
- Problem Solving Prowess
- Mathlete
- Suit-Able
- Insight Whisperer
- Quantastic
- Curiouser and Curiouser
- Agile and Adaptive

<http://www.houghtoncdsa.org/liberal-arts-data-science-seriously/>

Sources:

www.indeed.com/jobtrends?q=%22Data+Scientist%22&l=%5D&relative=1

<http://management.fortune.cnn.com/2013/05/10/big-data-jobs/>

<http://hbr.org/2012/10/data-scientist-the-sexiest-job-of-the-21st-century/ar/1>

[www.nytimes.com/2013/04/14/education/edlife/universities-offer-courses-in-a-hot-new-field-data-science.html?_r=2&](http://www.nytimes.com/2013/04/14/education/edlife/universities-offer-courses-in-a-hot-new-field-data-science.html?_r=2&www-01.ibm.com/software/data/infosphere/data-scientist/)

www-01.ibm.com/software/data/infosphere/data-scientist/

www.fico.com

www.indeed.com/salary?q1=data+scientist&l1=&tm=1

www.payscale.com/research/US/Job=Data_Scientist_%2F_Engineer/Salary

WHAT MAKES A GOOD DATA SCIENTIST?

- **Degreed In Geek** – It doesn't hurt to have a background and hands on experience in data visualization

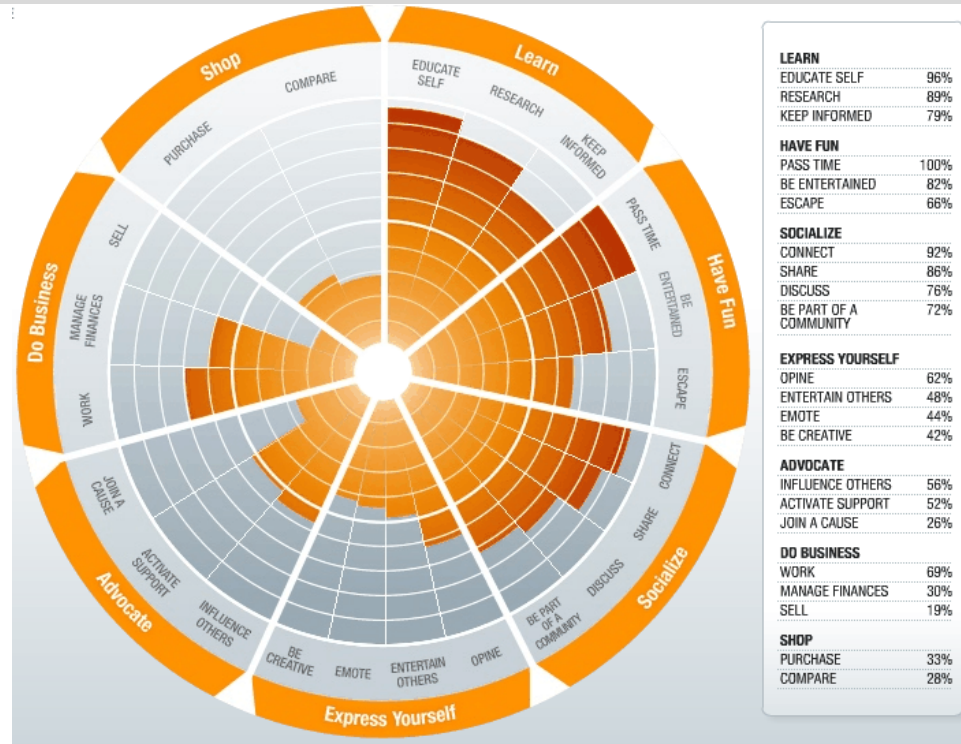


Image Source: <https://www.pinterest.com/pin/213076626089856136/>

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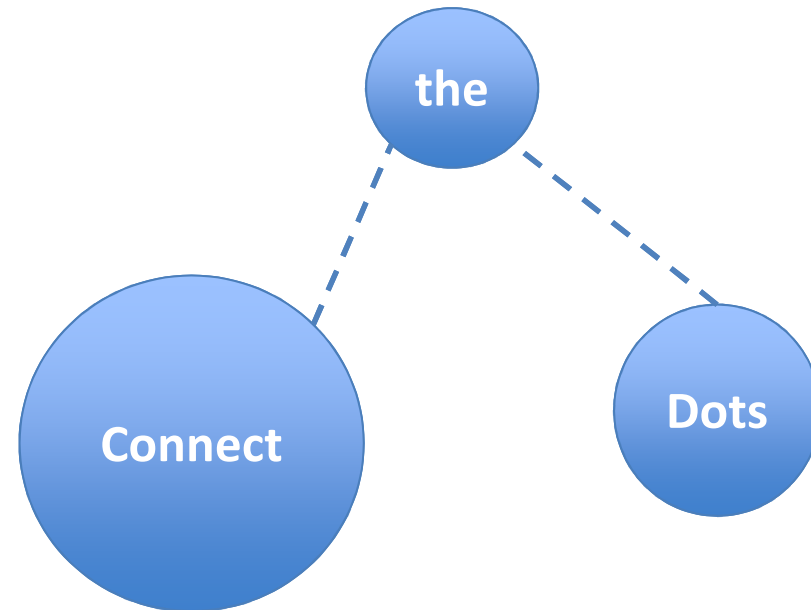
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www.fico.com
www.indeed.com/salary?q1=data+scientist&l1=&tm=1
www.payscale.com/research/US/Job=Data_Scientist_%2F_Engineer/Salary

PURDUE
POLYTECHNIC

WHAT MAKES A GOOD DATA SCIENTIST?

- **Problem Solving Prowess** – A problem solver at heart who's able to devise creative solutions to real-world problems.
- Knows how to define those problems precisely, spot elusive patterns and connect the dots



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www.payscale.com/research/US/Job=Data_Scientist_%2F_Engineer/Salary

WHAT MAKES A GOOD DATA SCIENTIST?

- **Mathlete**
- Strong math skills are table stakes

Do NOT let this scare you!

There is a visualization component.



<http://ignatiansolidarity.net/blog/2015/06/22/jv-reflects-a-picture-is-worth-a-thousand-words/>

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www.payscale.com/research/US/Job=Data_Scientist_%2F_Engineer/Salary

PURDUE
POLYTECHNIC

WHAT MAKES A GOOD DATA SCIENTIST?

- **Suit-Able** – Has the know-how and finesse to be a business leader.
- Today, data scientists can lead from the backroom to the boardroom



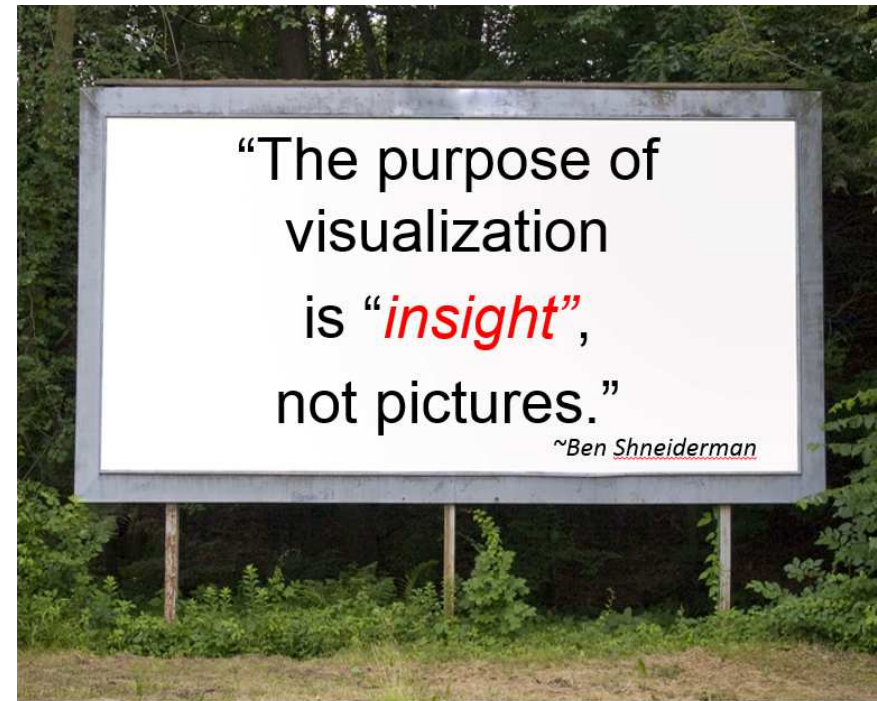
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www.payscale.com/research/US/Job=Data_Scientist_%2F_Engineer/Salary

WHAT MAKES A GOOD DATA SCIENTIST?

- **Insight Whisperer** – Can develop unique insights, apply them to solve problems and explain them to people without overwhelming them



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www.payscale.com/research/US/Job=Data_Scientist_%2F_Engineer/Salary

WHAT MAKES A GOOD DATA SCIENTIST?

- **Quantastic** – successful data scientists come not only from math backgrounds, but also from many other fields.
- They have programming skills or
- The ability to learn programming languages and represent concepts via computer code



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www.payscale.com/research/US/Job=Data_Scientist_%2F_Engineer/Salary

WHAT MAKES A GOOD DATA SCIENTIST?

- **Curiouser and Curiouser** – Critical Thinking and a relentlessly inquisitive nature are at the center of an analytic mindset

*When you're
CURIOUS
you find lots
of interesting
things to do.
- Walt Disney*

LegacyTravel.com/travelquotes

<http://www.houghtoncdsa.org/liberal-arts-data-science-seriously/>

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PURDUE
POLYTECHNIC

WHAT MAKES A GOOD DATA SCIENTIST?

- **Agile and Adaptive** – versatile enough to apply their expertise to multiple industries, from retail to banking, insurance to government, healthcare to airlines

The possibilities are endless!

<http://www.houghtoncdsa.org/liberal-arts-data-science-seriously/>

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Data Scientists

Places for Employment

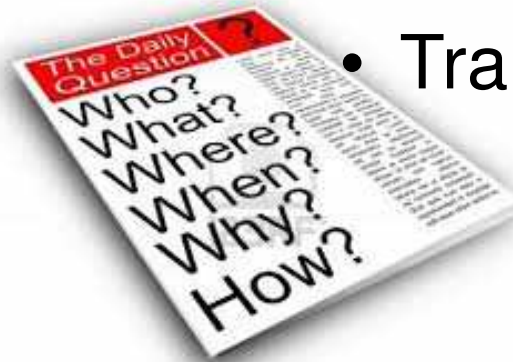
- Government agencies
- Science Institutes
- Retail Companies (that analyze large amounts of data to drive their business)
 - Amazon
 - Target
 - Netflix



Data Scientists

Additional Fields of Employment

- Healthcare
- Journalism
- Biotech
- Finance
- Insurance
- Hospitality
- Manufacturing
- Transportation



WANT MORE?

https://keshif.me/demo/VisTools?utm_content=26335725&utm_medium=social&utm_source=twitter

430 Data-Visualization Tools

Highlights

★★★	8
★★	37
★	90

Features

Charting	256
Web-based	242
Design focused	61
Spreadsheet	55
Infographics	33
Statistical	32
Color	31
Scientific	24

Data Types

Multivariate	150
Time	136
Geographical	118
Network	52
Text	21

Data Processing

Aggregate	14
Filter	12
Advanced	12
Formula	8
Convert	8
Programming	7
Clean	6
Yes	5
Extract	5
Scrape	4
Transform	3

Cost

Free	241
Paid	71
Free & Paid	33

Data-Visualization Tools

- Keshif**: Charting + Web-based + JavaScript + Graphical Interface
- D3.JS**: Charting + Web-based + JavaScript
- Tableau Public**: Charting + Statistical + Infographics + Web-based + Scripting + Graphical Interface
- ColorBrewer 2.0**: Color + Web-based + Graphical Interface
- NodeXL**: Charting + Graphical Interface
- Leaflet.js**: Charting + Web-based + JavaScript
- RStudio**: Charting + Statistical + Web-based + R
- alteryx**: Charting + Statistical + Graphical Interface + R
- Trifacta**: Charting + Web-based + Graphical Interface + Scripting
- Crossfilter**: Web-based + JavaScript
- dc.js**: Charting + Web-based + JavaScript
- Trifacta Data Wrangler**: Charting + Web-based + Graphical Interface + Y

Main

Categorized	342
Active	291
Open-Source	184

Tags

Platform	23
d3	23
Excel	10
Business Intelligence	10
Storytelling	8
PDF	5
VIS2015	4
Vega	4
Technology	4
jQuery	4
SVG	3
Mockups	3
Journalism	3
iOS	3
Faceted Browsing	3

Programming

Graphical Interface	123
JavaScript	89
R	20
Python	20
Scripting	12
HTML	10
Java	8
RESTful API	6
Ruby	5
SQL	4
JSON	4
PHP	3
Scala	2
Processing	2
Other	2

ⓘ Data is public at [Google Sheets](#). [Contribute to this open resource!](#) For info, contact [@adilyalcin](#)
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Questions?

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Vetria L. Byrd

Assistant Professor

Computer Graphics Technology

vlbyrd@purdue.edu

<https://polytechnic.purdue.edu/profile/vbyrd>

<http://web.ics.purdue.edu/~vbyrd/>



@VByrdPhD, @BPViz

Purdue Polytechnic Institute



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Thank You Image Source:

<http://careerconfidential.com/category/thank-you-notes/>

<http://careerconfidential.com/wp-content/uploads/2015/02/ThankYou2.jpg>

