

DATA VISUALIZATION

CS631

HELLO THERE!

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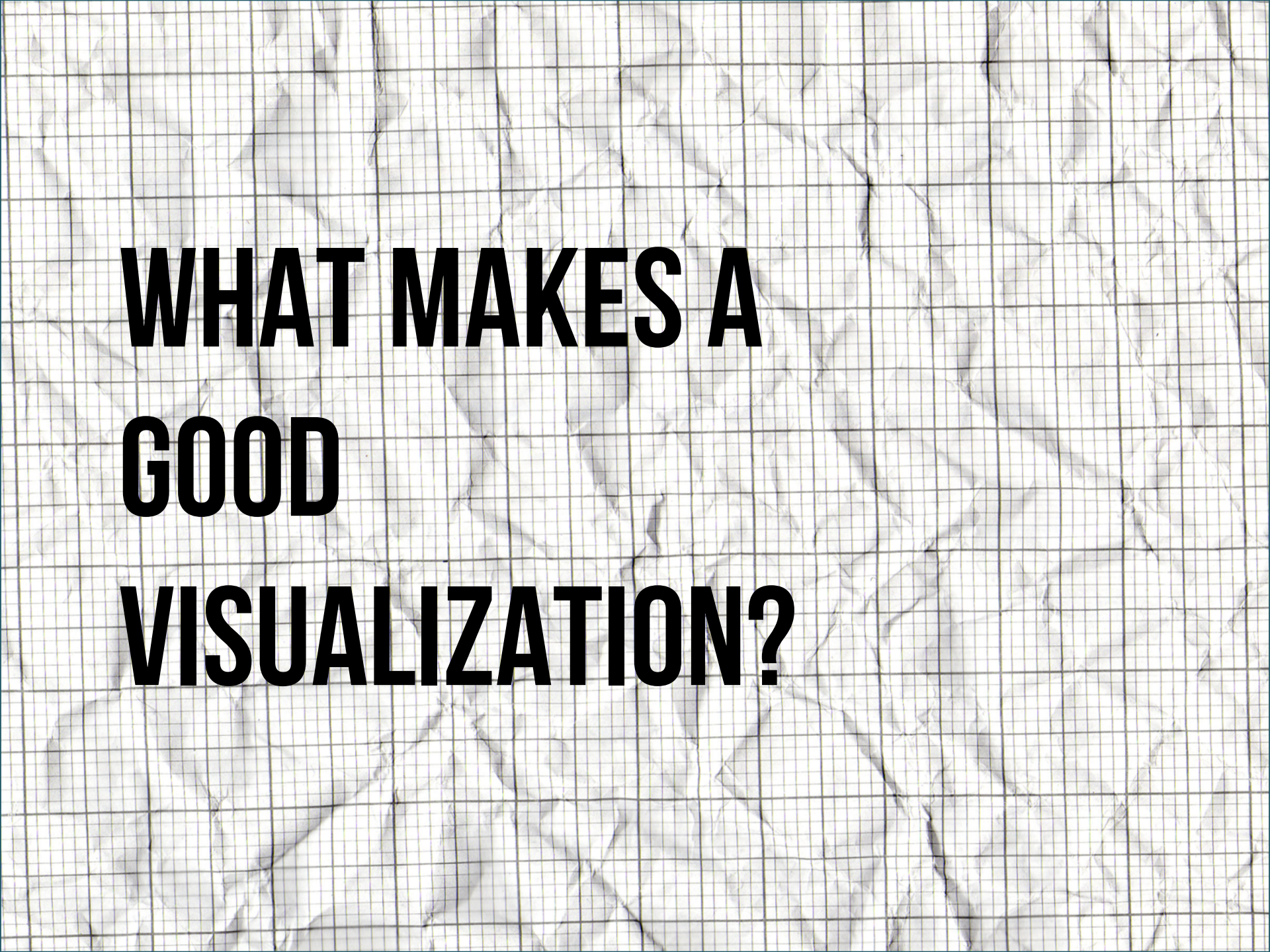
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CS361:
AN INTRODUCTION



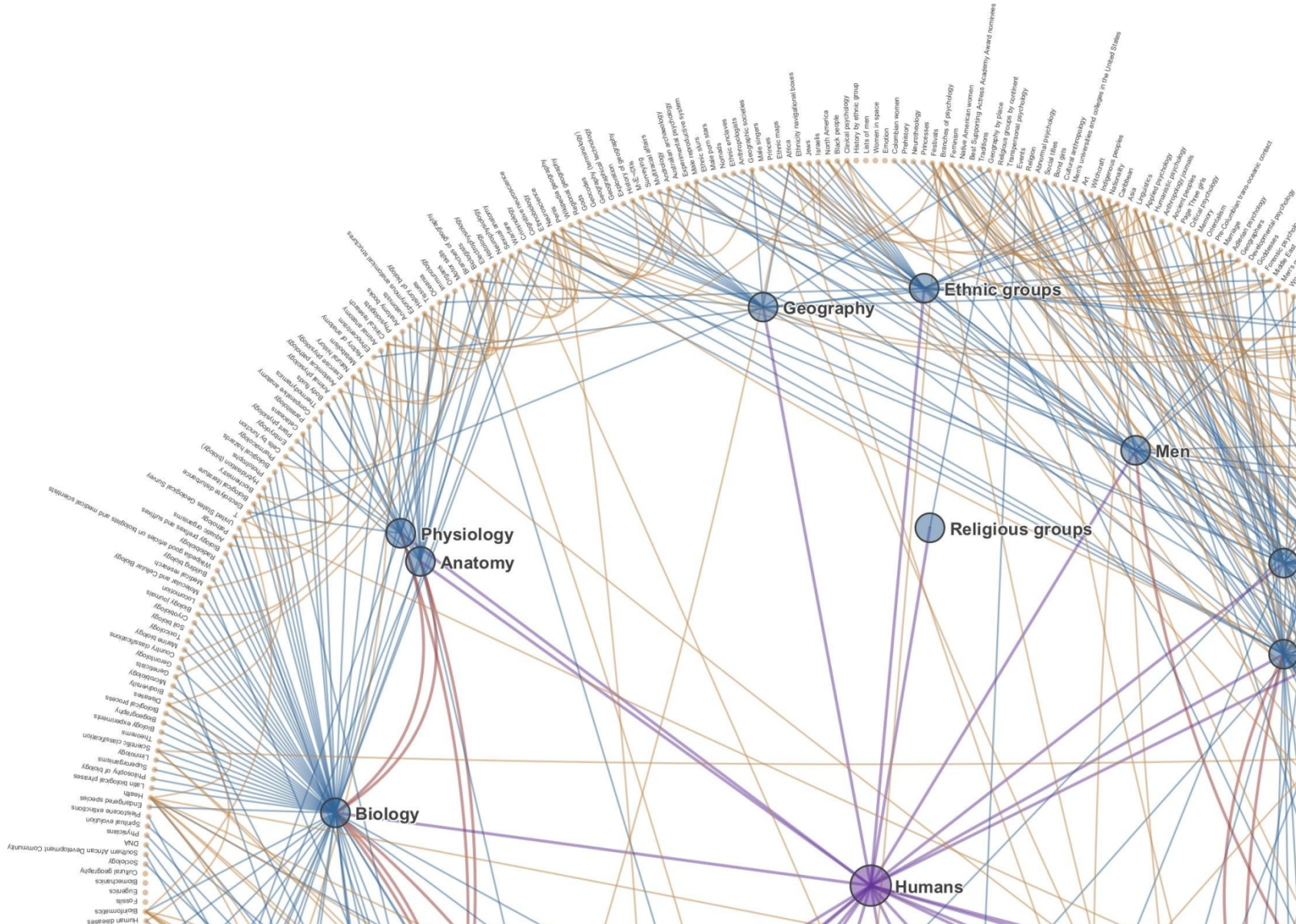
**WHAT MAKES A
GOOD
VISUALIZATION?**

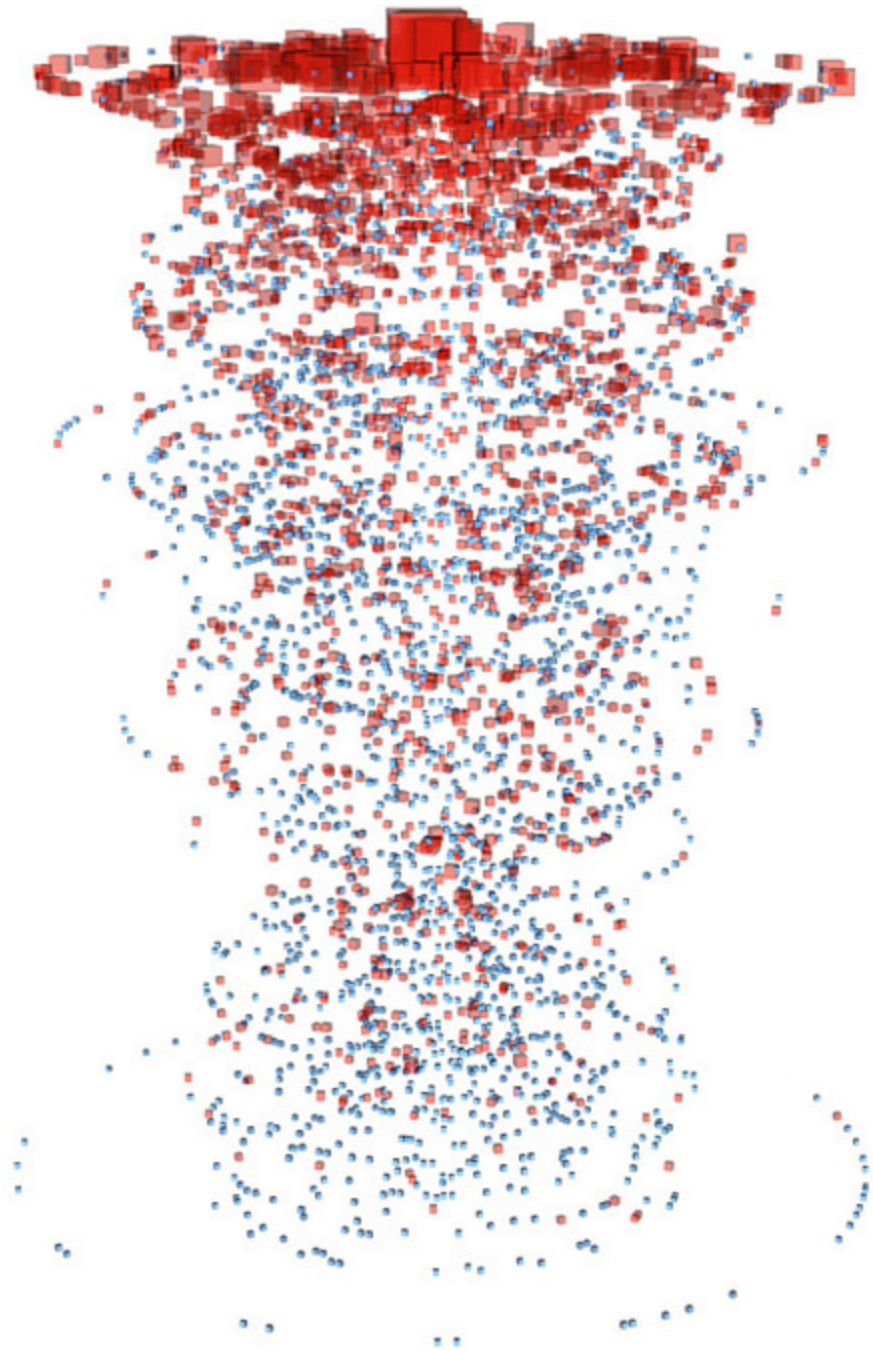
**HOW CAN I MAKE MY
DATA VISUALLY
EXCELLENT?**

**HOW CAN I BEST
COMMUNICATE MY
VISUAL DATA?**

let's talk...

WHAT THIS CLASS IS NOT ABOUT...







LIBERAL
PROGRESSIVE

CONSERVATIVE
TRADITIONAL



TRADE: fair trade SUPPORT: workers GOAL: personal freedom FOCUS: society

FOCUS: individual GOAL: economic freedom SUPPORT: employers TRADE: free trade

ECONOMY: regulated economy, business & industry = **TAX AND SPEND**

ECONOMY: de-regulated economy, business & industry = **DON'T TAX AND SPEND**

SOCIETY & CULTURE

"The world can be improved" (UTOPIANISM)
INCLUSIVE MULTICULTURAL EVOLVING

SOCIETY & CULTURE

"The world is fine as it is" (PRESERVATION)
EXCLUSIVE NATIONALISTIC CONSERVATIVE

ADULT

URBAN

FULFILLED ADULT



VOCATION

ADULT

RURAL

SELF-RELIANT ADULT



VOCATION

BUILDS CHARACTER

SELF-DEFENCE
MORALITY
DISCIPLINE

BELIEFS

RELIGION: scientific, non-organized, unconventional
RIGHTS: others must observe
CRIMINALS: social and economic victims
HOMELESS: downtrodden, victims of the system
SOCIETY: "ONE FOR ALL AND ALL FOR ONE"

PROTECT MINORITIES

BELIEFS

RELIGION: theistic, organized, conventional
RIGHTS: others must not interfere
CRIMINALS: choose to be criminals
HOMELESS: no work ethic, no sense of shame
SOCIETY: "SURVIVAL OF THE FITTEST"

IMMIGRATION CONTROL

EQUALITY is opportunity
FREEDOM is the chance to achieve or fail
but which is best?
FREEDOM

VOTES FOR:

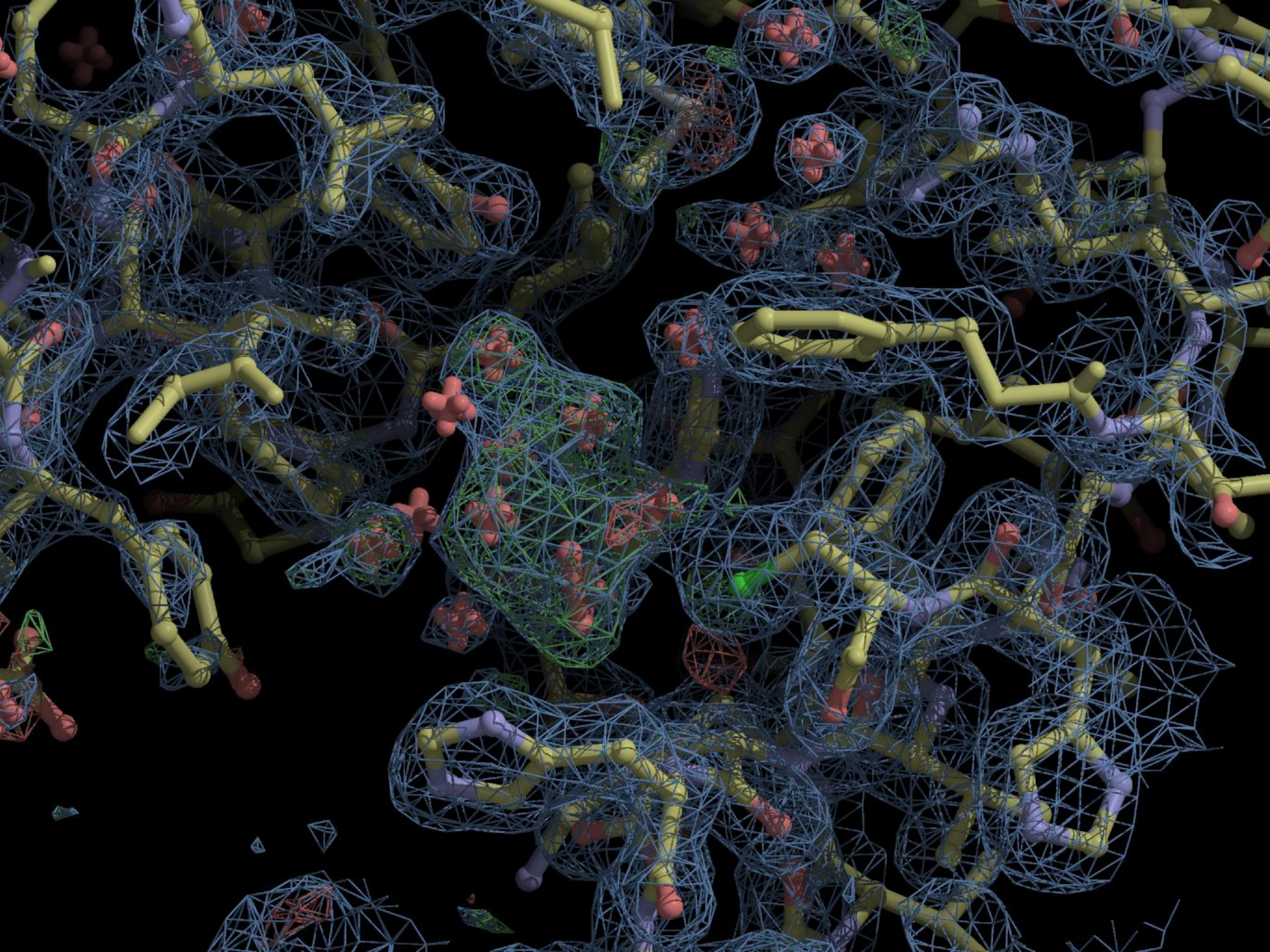
AGGRESSION MILITANCY UPHOLDING ORDER HELPING THOSE WHO STRONG ROLE MODEL

OPENNESS
EMPATHY
REFLECTION
CREATES POTENTIAL

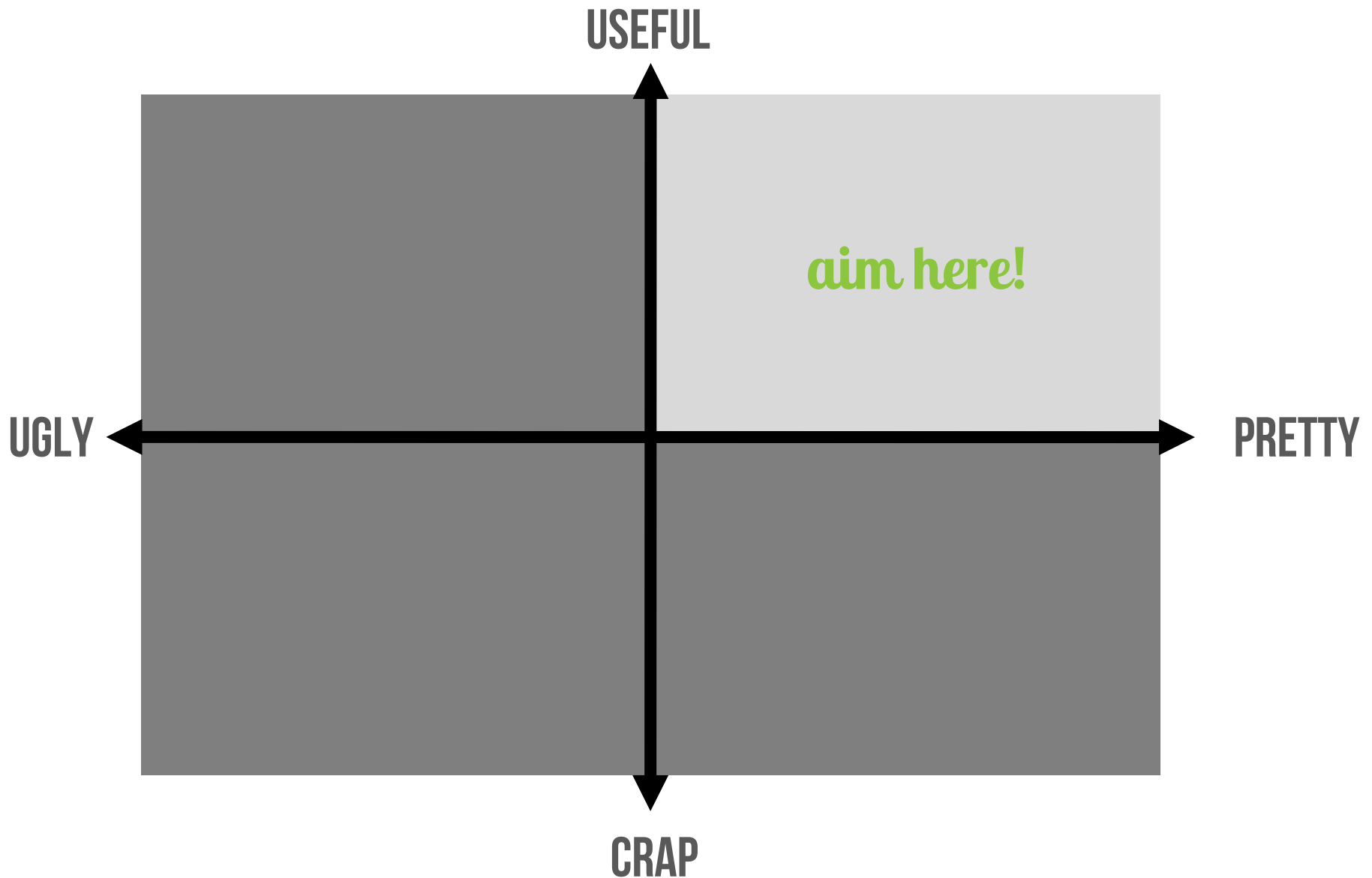
EQUALITY is a level playing field
FREEDOM is freedom from power, abuse and inequality
but which is best?
EQUALITY

DIPLOMACY PACIFISM





WHAT THIS CLASS IS ABOUT...



[HTTP://CSLU.OHSU.EDU/~BEDRICKS/COURSES/CS631/](http://CSLU.OHSU.EDU/~BEDRICKS/COURSES/CS631/)

SAKAI

DATA CAMP

CLASS FORMAT

HOMEWORK

FINAL PROJECT

DATA POINTS – NATHAN YAU

VISUALIZE THIS – NATHAN YAU

VISUALIZATION ANALYSIS AND DESIGN – TAMARA MUNZER

WHY IS VISUALIZATION IMPORTANT?

sight

touch



computer network



USB key



hard disk

hearing/smell

pocket calculator



taste

**“IF INFORMATION IS PRESENTED ORALLY,
PEOPLE REMEMBER ABOUT 10%... THAT
NUMBER GOES UP BY 65% IF YOU ADD A
PICTURE.”**

**“IF INFORMATION IS PRESENTED ORALLY,
PEOPLE REMEMBER ABOUT 10%... THAT
NUMBER GOES UP BY 65% IF YOU ADD A
PICTURE.”**



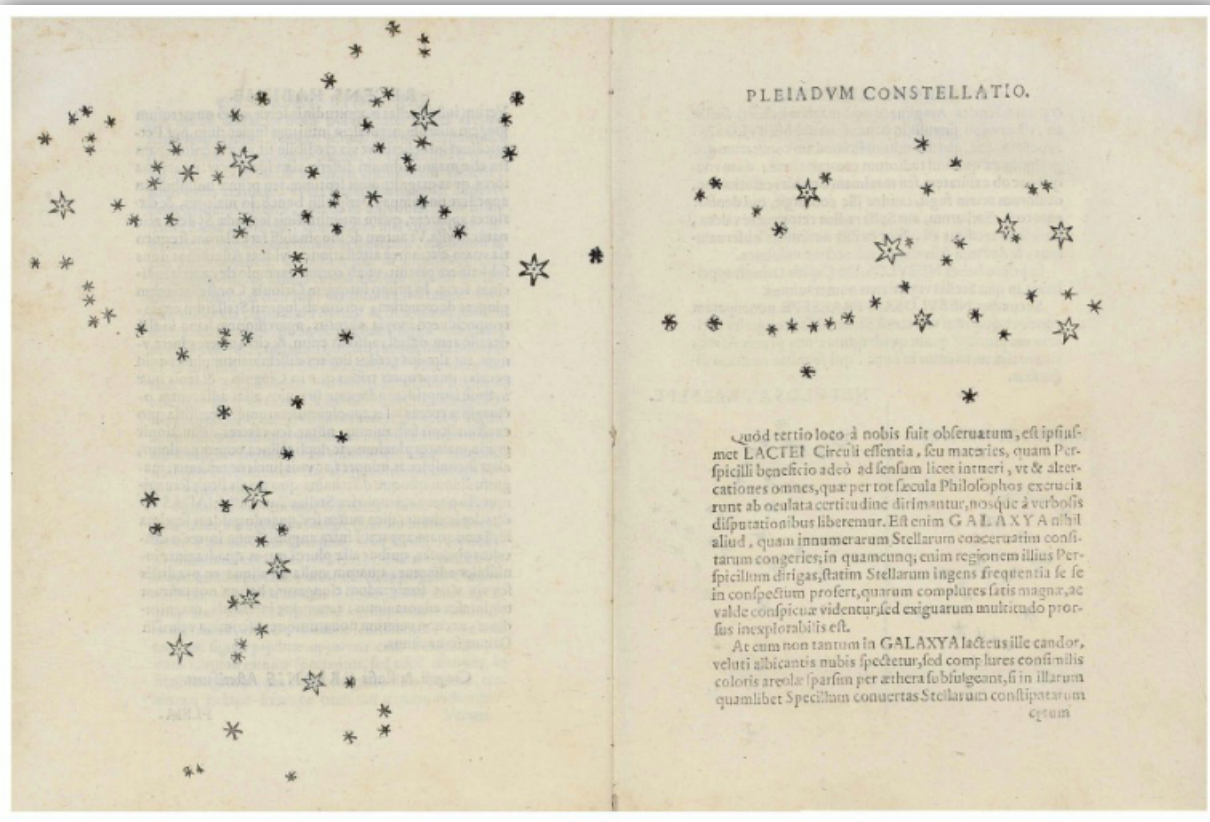
John Medina





WHY IS VISUALIZATION IMPORTANT **IN SCIENCE?**

OCULATA CERTITUDINE



PLEIADVM CONSTELLATIO.

quod tertio loco à nobis fuit obferuatum, est ipfiusmet LACTEI Circuli effentia, feu materies, quam Perfpicilli beneficio adeò ad fenfum licet intreri, vt & altercationes omnes, quæ per tot fecula Philofophos exercuerunt ab oculata certitudine dirimantur, nosq; à verbolis difputationibus liberemur. Est enim GALAXYA nihil aliud, quam innumerarum Stellarum coaceruatum confiftarum congeries, in quamcumq; enim regionem illius Perfpicillum dirigas, ftatim Stellarum ingens frequentia fe fe in confpectum proferat, quarum complures fatis magna, ac valde confpicua videntur, fed exiguarum multitudine profus inexplorabilis eft.

At cum non tantum in GALAXYA lacteus ille candor, veluti albicantis nubis fpectetur, fed complures confimilis coloris areolæ fparfim per æthera fubfulgeant, fi in illarum quamlibet fpecillum conuertas Stellarum confiftarum æquum

OBSERVAT. SIDEREAE

Ori. * * * * * Occ.

Stella occidentalis maior, ambae tamen vultu confpicua, ac splendida vtraque dilatabat à Ioue fcrupulis penitus duobus; tertia quoque Stellula apparere cepit hora tertia prius minime confpecta, quæ ex parte orientali Iouem febre tangebat, etiamque admodum exigua. Omnes fuerunt in eadem recta, & fecundum Eclipticæ longitudinem coordinatae.

Die decimatercia priusquam à me quatuor confpecta fuerunt Stellulae in hac ad Iouem conftitutione. Erant quatuor principales, & vna orientalis; lineam proximam



13 January

* * * * * Occ.

lineam (media enim occiditalem pupulum à recta Septentrionem versus defcebat. Aberratio orientalis à Ioue minuta duo; reliquarum, & Iouis interpedines erant fingulae vnius tantum minuti. Stellæ omnes eandem præfehebant magnitudinem; ac licet exigua, laetiffima tamen erant, ac fixis criffem magnitudinis longe fperidiores.

Die decimaquinta, hora noctis tertia in proximam habitudine quatuor Stellæ ad Iouem,



15 January

* * * * * Occ.

omnes; ac in eadem proximam recta linea difpofitæ; quæ enim tertia à Ioue numerabatur proximam

WHY TELL A STORY?



DATA DOES NOT SPEAK FOR ITSELF...

Bazinga

YOU SPEAK FOR YOUR DATA



**“WHEN WE MAKE A VISUALIZATION FROM
OUR DATA, WE ARE TELLING A STORY, *AND A
GOOD STORY HELPS US GAIN INSIGHTS.*”**



THE GOOD...

MULTIVARIATE, MULTISOURCE

WIDTH → SIZE OF ARMY

LINE LOCATION → LATITUDE/LONGITUDE

COLOR → MOVEMENT

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. MIMAZD, Inspecteur Général des Ponts et Chaussées en retraite Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. CHIERI, de LÉGER, de FEZENSAC, de CHAMBRAY et le journal inédit de JACOB, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilew et qui rejoignent vers Orscha et Witebsk, avaient toujours marché avec l'armée.

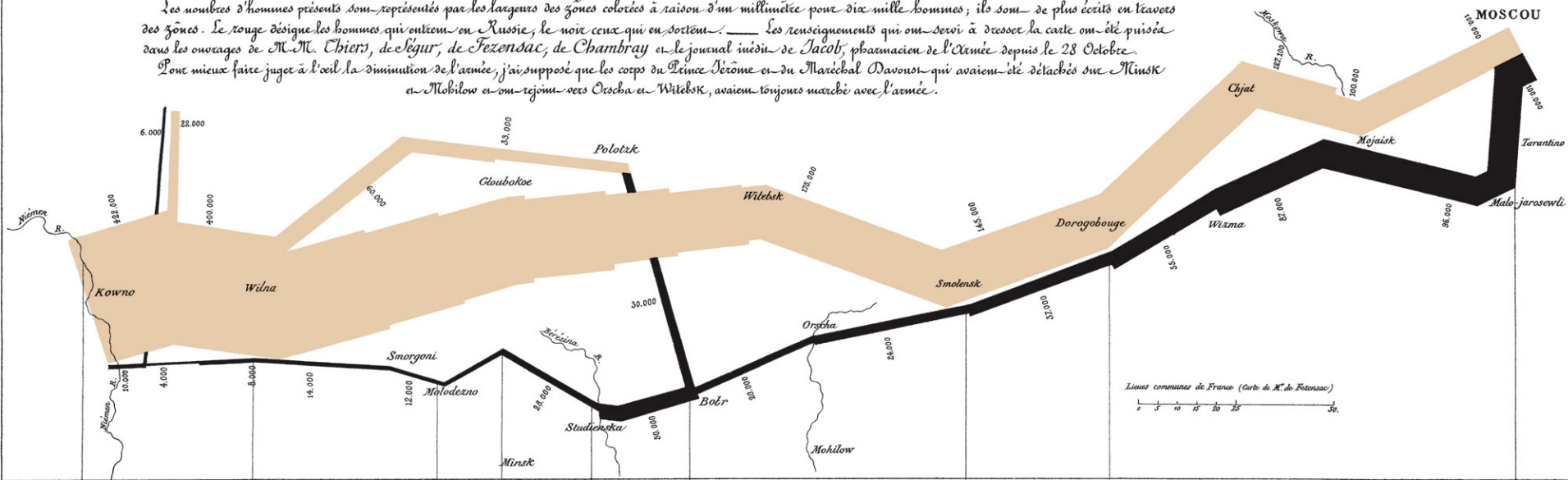
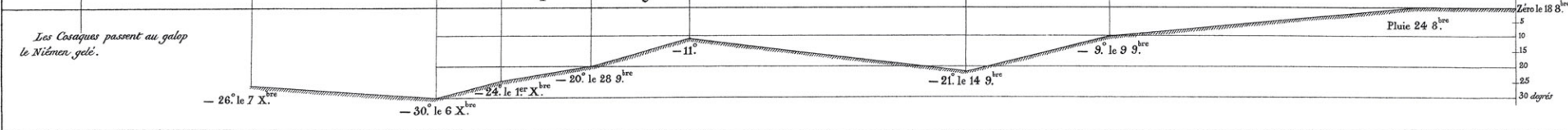


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



Les Cosaques passent au galop le Niémen gelé.

Auq. par Regnier, 8. Par. S^{te} Marie St O^{de} à Paris.

Imp. Lit. Regnier et Douard.

LOCATION LABELS, DATES, NUMBERS

TEMPERATURE

Ségur *La Campagne de Russie, Mémoires d'un Aide de Camp de L'Empereur Napoléon I*

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

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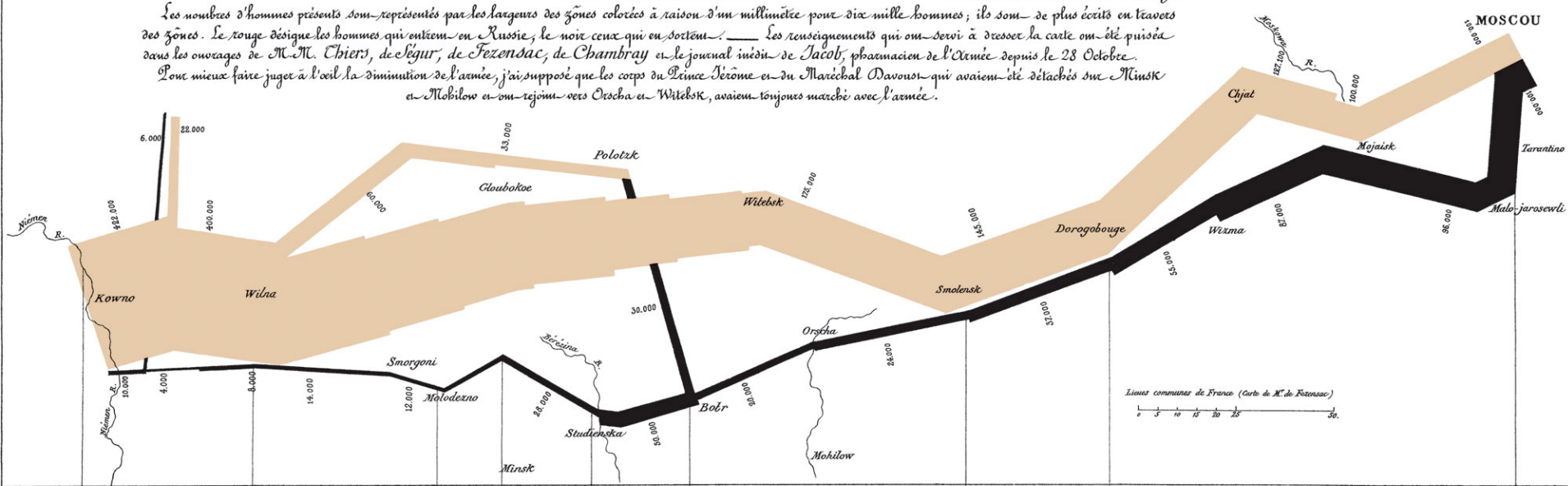
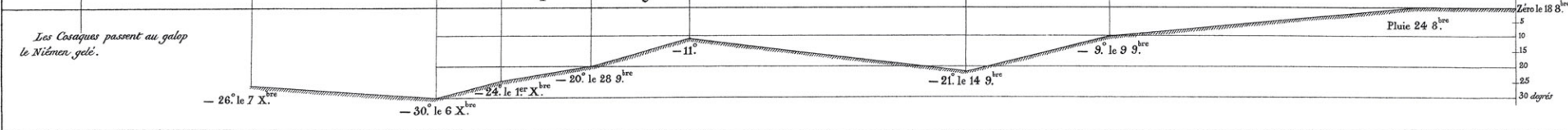


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



Auq. par Regnier, 8. Par. S^{te} Marie St O^{de} à Paris.

Imp. Lit. Regnier et Douard.

THE BAD...



BLACK HOLE DIET PLANS

PIGS IN SPACE: EFFECT OF ZERO GRAVITY AND AD LIBITUM FEEDING ON WEIGHT GAIN IN CAVIA PORCELLUS



SPACE-EXES

Colin B. Purrington

6673 College Avenue, Swarthmore, PA 19081 USA

ABSTRACT:

One ignored benefit of space travel is a potential elimination of obesity, a chronic problem for a growing majority in many parts of the world. In theory, when an individual is in a condition of zero gravity, weight is eliminated. Indeed, in space one could conceivably follow ad libitum feeding and never even gain an gram, and the only side effect would be the need to upgrade one's stretchy pants("exercise pants"). But because many diet schemes start as very good theories only to be found to be rather harmful, we tested our predictions with a long-term experiment in a colony of Guinea pigs (*Cavia porcellus*) maintained on the International Space Station. Individuals were housed separately and given unlimited amounts of high-calorie food pellets. Fresh fruits and vegetables were not available in space so were not offered. Every 30 days, each Guinea pig was weighed. After 5 years, we found that individuals, on average, weighed nothing. In addition to weighing nothing, no weight appeared to be gained over the duration of the protocol. If space continues to be gravity-free, and we believe that assumption is sound, we believe that sending the overweight — and those at risk for overweight — to space would be a lasting cure.

INTRODUCTION:

The current obesity epidemic started in the early 1960s with the invention and proliferation of elastane and related stretchy fibers, which released wearers from the rigid constraints of clothes and permitted monthly weight gain without the need to buy new outfits. Indeed, exercise today for hundreds of million people involve only the act of wearing stretchy pants in public, presumably because the constrictive pressure forces fat molecules to adopt a more compact tertiary structure (Xavier 1965).

Luckily, at the same time that fabrics became stretchy, the race to the moon between the United States and Russia yielded a useful fact: gravity in outer space is minimal to nonexistent. When gravity is zero, objects cease to have weight. Indeed, early astronauts and cosmonauts had to secure themselves to their ships with seat belts and sticky boots. The potential application to weight loss was noted immediately, but at the time travel to space was prohibitively expensive and thus the issue was not seriously pursued. Now, however, multiple companies are developing cheap extra-orbital travel options for normal consumers, and potential travelers are also creating news ways to pay for products and services that they cannot actually afford. Together, these factors open the possibility that moving to space could cure overweight syndrome quickly and permanently for a large number of humans.

We studied this potential by following weight gain in Guinea pigs, known on Earth as fond of ad libitum feeding. Guinea pigs were long envisioned to be the "Guinea pigs" of space research, too, so they seemed like the obvious choice. Studies on humans are of course desirable, but we feel this current study will be critical in acquiring the attention of granting agencies.

MATERIALS AND METHODS:

One hundred male and one hundred female Guinea pigs (*Cavia porcellus*) were transported to the International Space Laboratory in 2010. Each pig was housed separately and deprived of exercise wheels and fresh fruits and vegetables for 48 months. Each month, pigs were individually weighed by duct-taping them to an electronic balance sensitive to 0.0001 grams. Back on Earth, an identical cohort was similarly maintained and weighed. Data was analyzed by statistics.

RESULTS:

Mean weight of pigs in space was 0.0000 +/- 0.0002 g. Some individuals weighed less than zero, some more, but these variations were due to reaction to the duct tape, we believe, which caused them to be alarmed push briefly against the force plate in the balance. Individuals on the Earth, the control cohort, gained about 240 g/month (p = 0.0002). Males and females gained a similar amount of weight on Earth (no main effect of sex), and size at any point during the study was related to starting size (which was used as a covariate in the ANCOVA). Both Earth and space pigs developed substantial dewlaps (double chins) and were lethargic at the conclusion of the study.

CONCLUSIONS:

Our view that weight and weight gain would be zero in space was confirmed. Although we have not replicated this experiment on larger animals or primates, we are confident that our result would be mirrored in other model organisms. We are currently in the process of obtaining necessary human trial permissions, and should have our planned experiment initiated within 80 years, pending expedited review by local and Federal IRBs.

ACKNOWLEDGEMENTS:

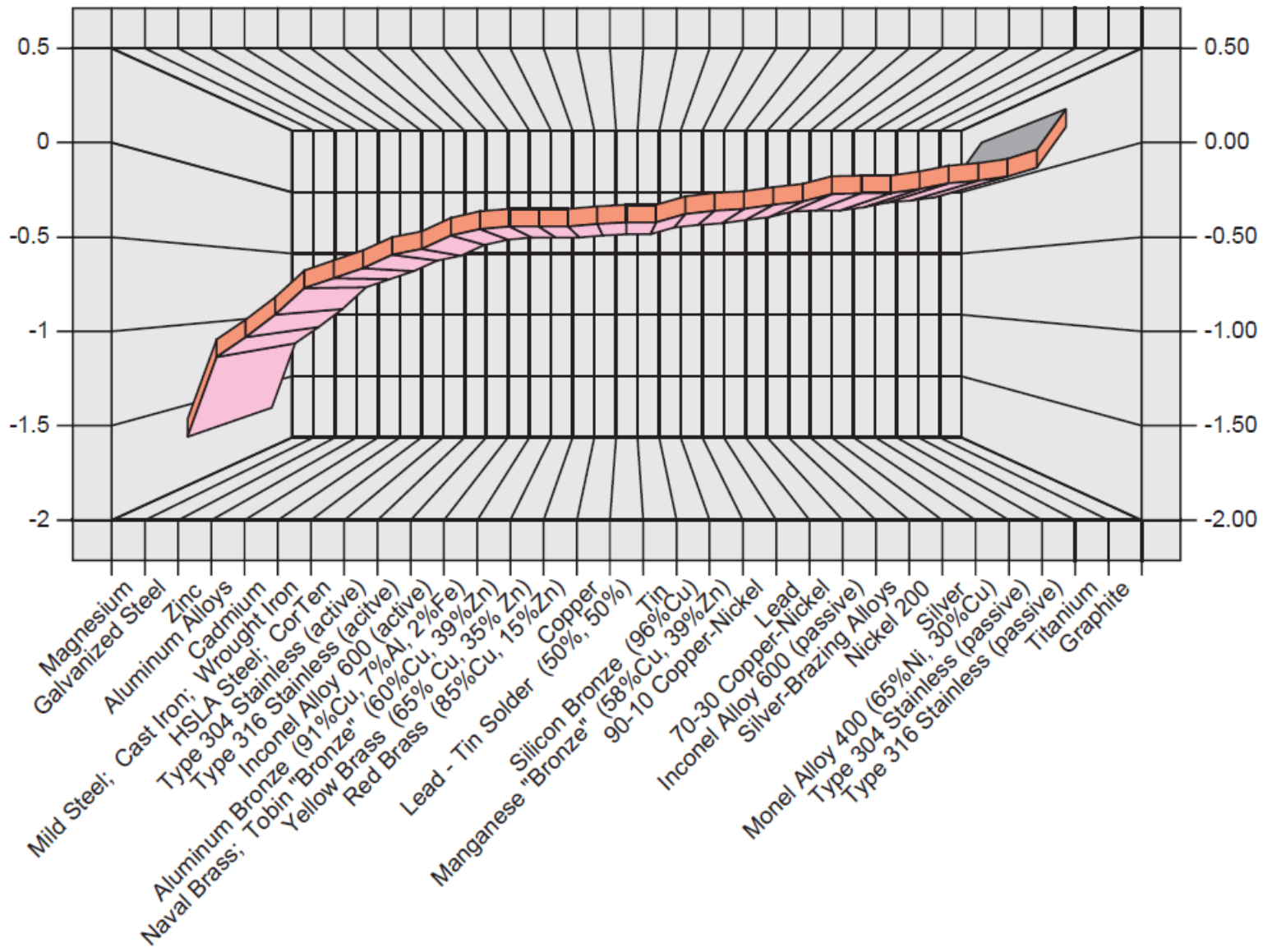
I am grateful for generous support from the National Research Foundation, Black Hole Diet Plans, and the High Fructose Sugar Association. Transport flights were funded by SPACE-EXES, the consortium of wives divorced from insanely wealthy space-flight startups. I am also grateful for comments on early drafts by Mañana Athletic Club, Corpus Christi, USA. Finally, sincere thanks to the Cuy Foundation for generously donating animal care after the conclusion of the study.

LITERATURE CITED:

- NASA. 1982. Project STS-XX: Guinea Pigs. Leaked internal memo.
- Sekulić, S.R., D. D. Lukač, and N. M. Naumović. 2005. The Fetus Cannot Exercise Like An Astronaut: Gravity Loading Is Necessary For The Physiological Development During Second Half Of Pregnancy. Medical Hypotheses. 64:221-228
- Xavier, M. 1965. Elastane Purchases Accelerate Weight Gain In Case-control Study. Journal Of Obesity. 2:23-40.



THE UGLY.





BEFORE YOU BEGIN, ASK YOURSELF:

WHAT QUESTION ARE YOU ASKING YOUR DATA?

**WHAT ARE YOU TRYING TO SAY ABOUT YOUR
DATA?**

THE FIRST RULE OF DATA VIZ:

Know Thy Data

A globe is shown in the background, rendered in a light gray color. It is covered with various characters and symbols from different alphabets, including Latin letters like 'W', 'I', 'A', 'L', 'S', 'R', 'E', 'U', 'O', 'F', 'G', 'H', 'K', 'M', 'N', 'P', 'Q', 'T', 'V', 'X', 'Y', 'Z', and numbers like '1', '2', '3', '4', '5', '6', '7', '8', '9', '0'. There are also some non-Latin characters, such as 'ウイ' and '維'. The globe is slightly tilted and has a soft shadow beneath it.

EXPLORATORY DATA ANALYSIS (EDA) IS AN APPROACH TO ANALYZING DATA SETS TO SUMMARIZE THEIR MAIN CHARACTERISTICS, OFTEN WITH VISUAL METHODS.

If we need a short suggestion of what exploratory data analysis is, I would suggest that

1. It is an attitude, AND
2. A flexibility, AND
3. Some graph paper (or transparencies, or both).

No catalog of techniques can convey a willingness to look for what can be seen, whether or not anticipated. Yet this is at the heart of exploratory data analysis. The graph paper—and transparencies—are there, not as a technique, but rather as a recognition that the picture-examining eye is the best finder we have of the wholly unanticipated.

A	B	C	D	E	F	G	H
xA	yA	xB	yB	xC	yC	xD	yD
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.1	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.1	4	5.39	8	5.56
12	10.84	12	9.13	12	8.15	8	7.91
7	4.82	7	7.26	7	6.42	8	6.89
5	5.68	5	4.74	5	5.73	19	12.5

MEAN

MEDIAN

STANDARD DEVIATION

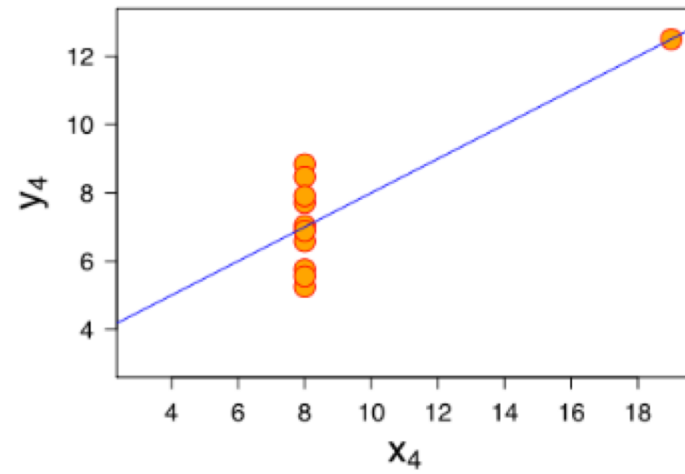
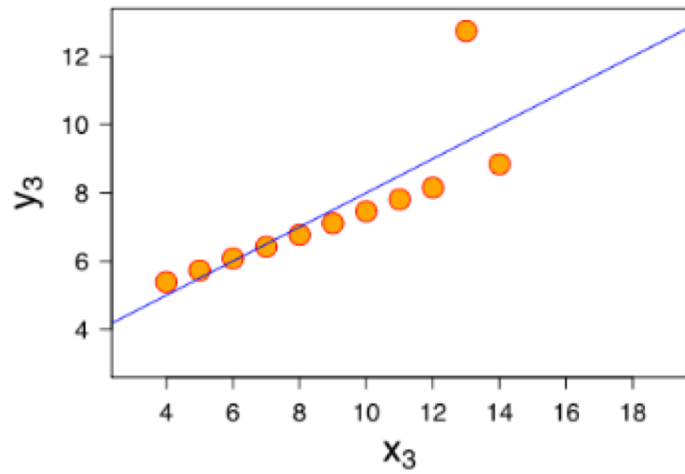
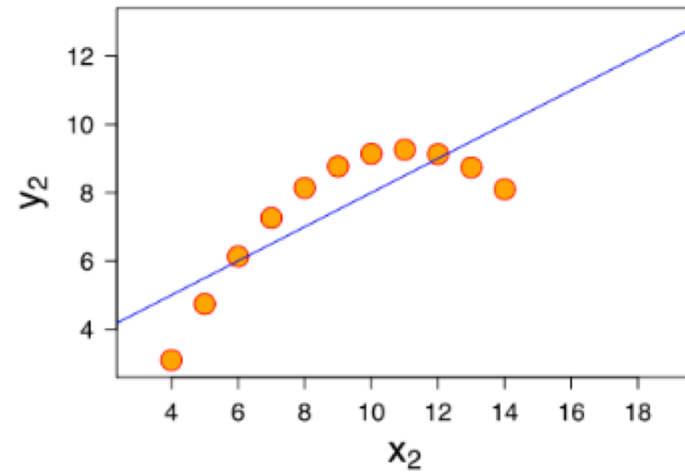
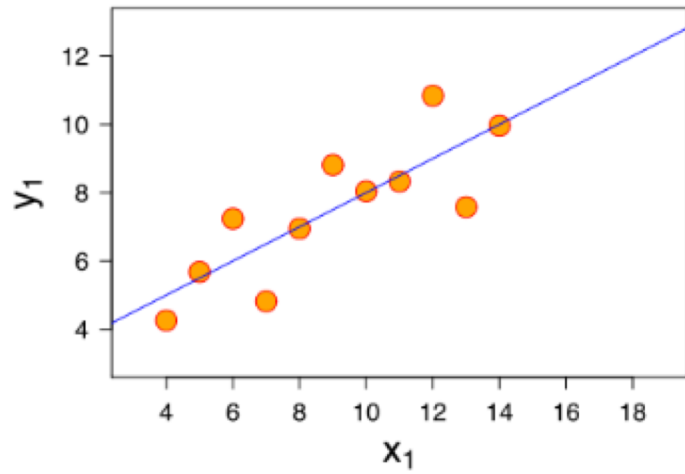
VARIANCE

CORRELATION

SLOPE

INTERCEPT

	xA	yA	xB	yB	xC	yC	xD	yD
	10	8.04	10	9.14	10	7.46	8	6.58
	8	6.95	8	8.14	8	6.77	8	5.76
	13	7.58	13	8.74	13	12.74	8	7.71
	9	8.81	9	8.77	9	7.11	8	8.84
	11	8.33	11	9.26	11	7.81	8	8.47
	14	9.96	14	8.1	14	8.84	8	7.04
	6	7.24	6	6.13	6	6.08	8	5.25
	4	4.26	4	3.1	4	5.39	8	5.56
	12	10.84	12	9.13	12	8.15	8	7.91
	7	4.82	7	7.26	7	6.42	8	6.89
	5	5.68	5	4.74	5	5.73	19	12.5
Mean	9.00	7.50	9.00	7.50	9.00	7.50	9.00	7.50
Median	9.00	7.58	9.00	8.14	9.00	7.11	8.00	7.04
Correlatio	0.816		0.816		0.816		0.817	
Slope	0.500		0.500		0.500		0.500	
Intercept	3.000		3.001		3.002		3.002	
Std Deviat	3.317	2.032	3.317	2.032	3.317	2.030	3.317	
Variance	11	4.127	11	4.128	11	4.123	11	





DATA EXPLORATION EXERCISE

LOGIN TO SAKAI

BIT.LY/CS36 1A

DATA EXPLORATION EXERCISE

LOGIN TO SAKAI

BIT.LY/CS36 1A

NATHAN'S HOT DOG EATING COMPETITION

LOGIN TO SAKAI

BIT.LY/CS631B

Nathan's Hot Dog Eating Contest Results, 1981 - 2011

