What's Visualisation and why do it?

Visualisation (Vis) allows people to analyse data when they don't know exactly what question to ask in advance

Based on Chapter 1 of "Visualisation, Analysis and Design"

Back one step…

What do we mean by data?

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More complex than one might think!

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Big Data, Little Data, No Data, Christine Borgman

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“Data” includes, at a minimum, digital observation, scientific monitoring, data from sensors, metadata, model output and scenarios, qualitative or observed behavioural data, visualizations, and statistical data collected for administrative or commercial purposes. Data are generally viewed as input to the research process.

Fox and Harris Data Science Journal Vol 12, 10 Feb 2013

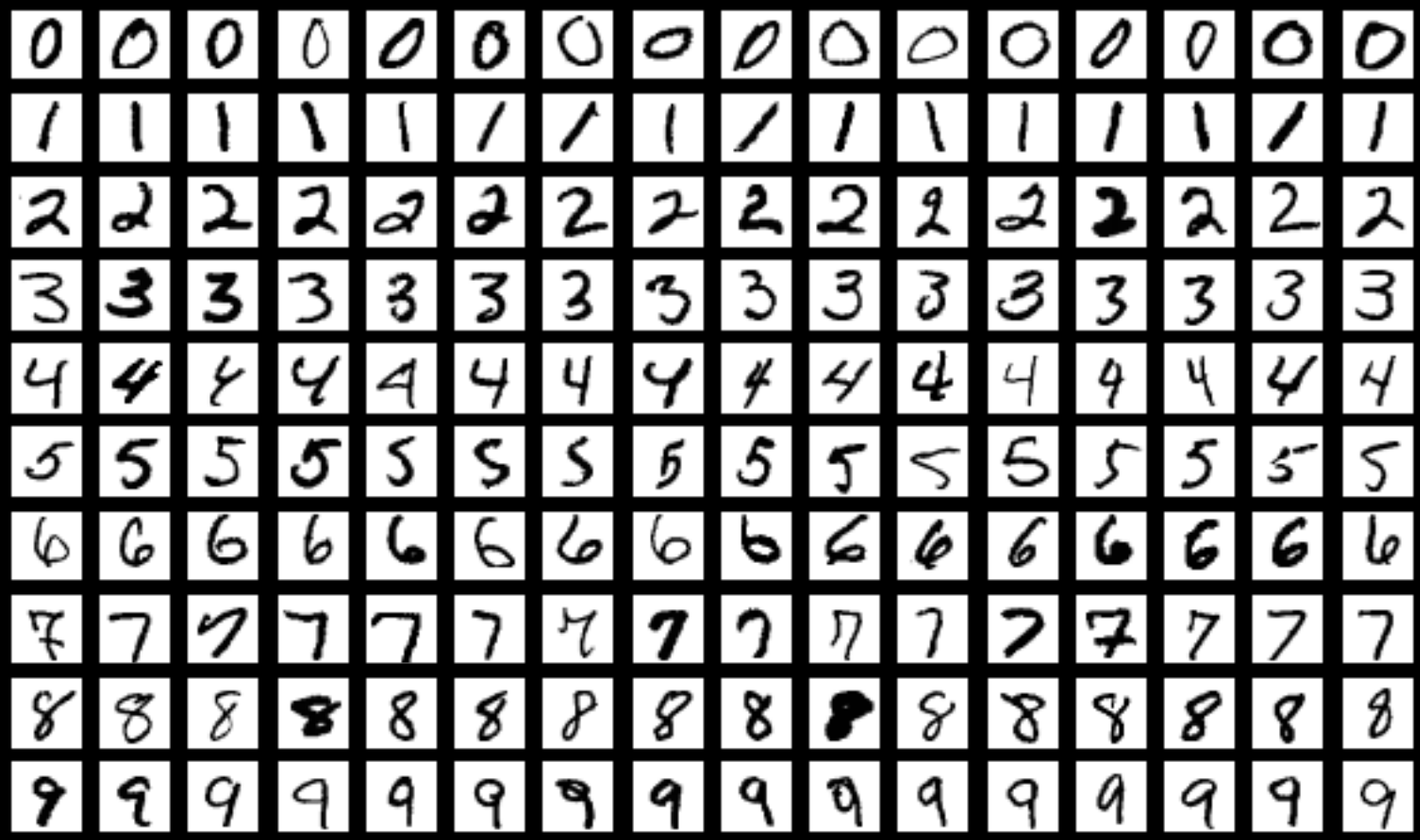
More colloquially

Data (for visualisation) is that which can be stored electronically….

Sometimes don’t need Vis

Many cases where a statistical analysis or using Machine Learning is sufficient

Example MNIST Data Set



By Josef Steppan - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=64810040

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analysis problems are ill specified

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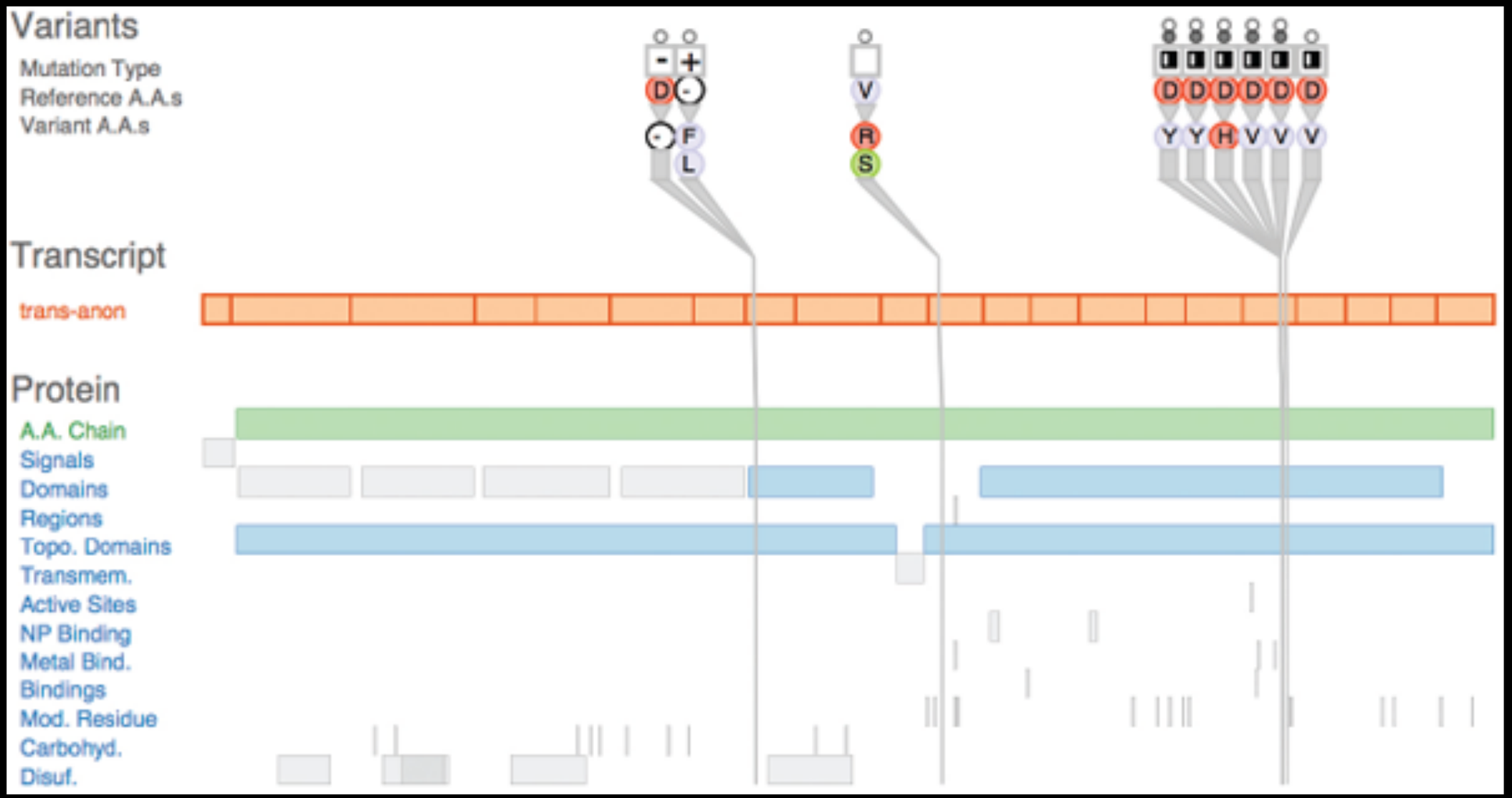
Augment human capabilities rather than replace humans

Vis can be..

For long term use - visualisations that are updated and used again and again

For short term/one off use - understanding something about the data; telling a story

Long term use



Genomic sequences - showing variation

Joel A. Ferstay, Cydney B. Nielsen, and Tamara Munzner. "Variant View: Visualizing Sequence Variants in Their Gene Context." *IEEE Transactions on Visualization Computer Graphics (Proc. InfoVis 13)* 19:12 (2013), 2546–2555. *(page 4)*

Why Computational tools?

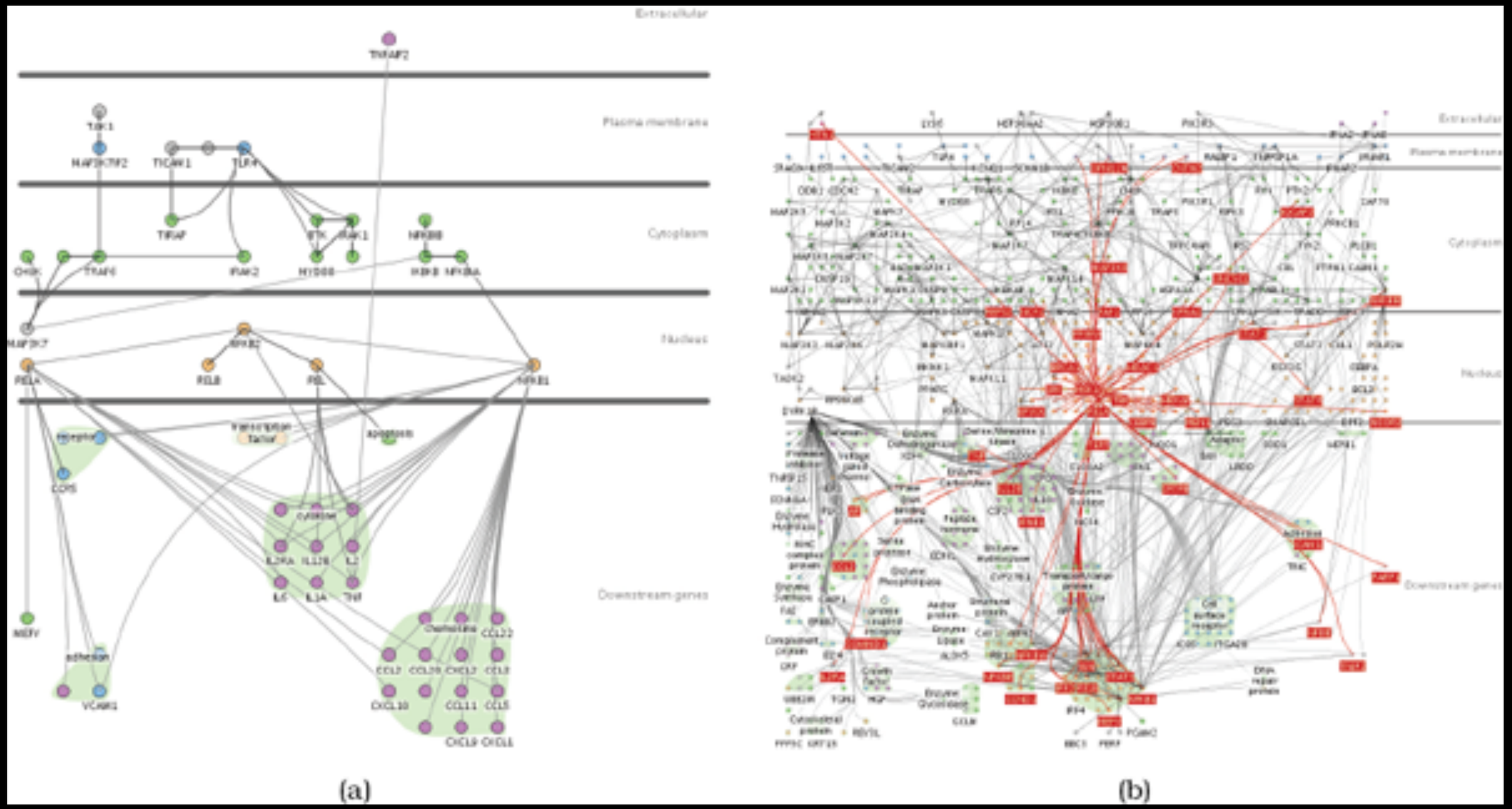
Mona Chalabi and Charles Minard did it by hand!

Need to visualise

Large/Complex data sets

Variable data sets

Quickly and in an exploratory fashion



Could be done by hand

Too hard to do by hand!

Aaron Barsky, Jennifer L. Gardy, Robert E. Hancock, and Tamara Munzner. “Cerebral: A Cytoscape Plugin for Layout of and Interaction with Biological Networks Using Subcellular Localization Annotation.” *Bioinformatics* 23:8 (2007), 1040–1042. *(pages 5, 6, 295)*

Why Vision?

Able to absorb large amounts of information in parallel.

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Example - Visual Pop-out

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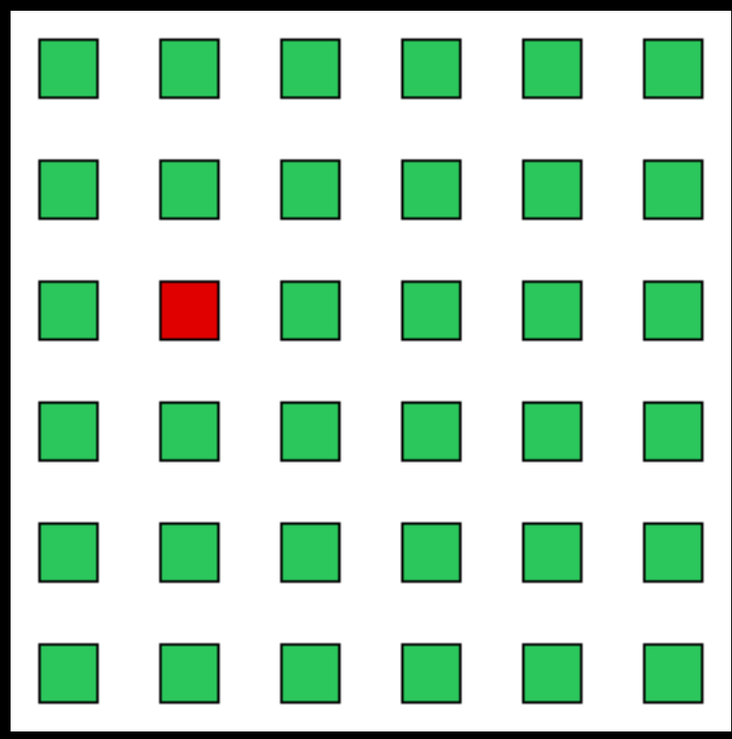

By Head 21:20, 24 August 2007 (UTC) (self-drawn) [Public domain], via Wikimedia Commons

Other senses?

Sound - sequence-based, not parallel

Listen to individual voices in a choir (for example)

Why do we need to look at data in detail?

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Need to check if summary statistics are right.

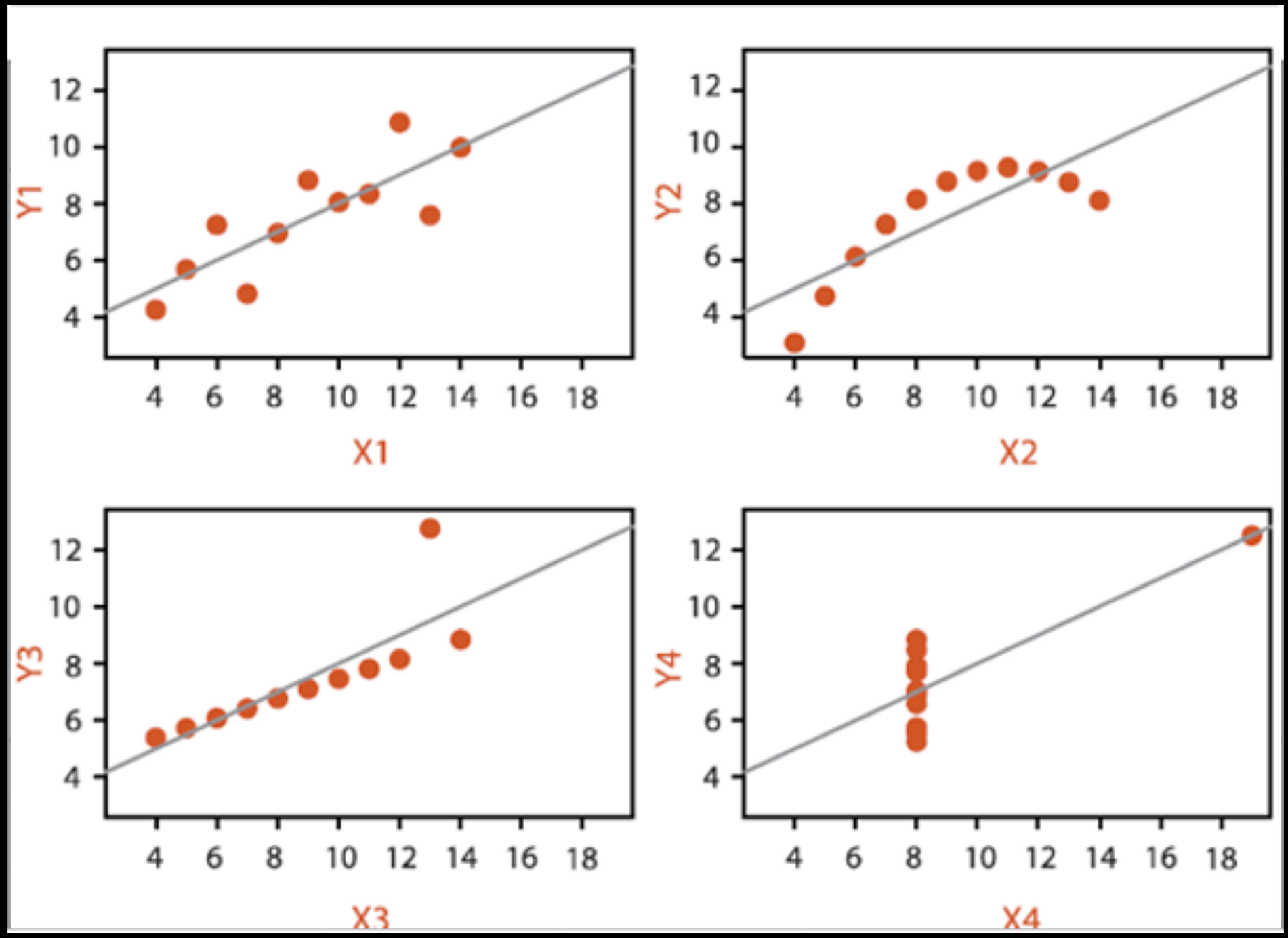
Anscombe's Quartet

Anscombe's Quartet: Raw Data

	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
	10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
	8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
	13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
	9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
	11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
	14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
	6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
	4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
	12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
	7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
	5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89
Mean	9.0	7.5	9.0	7.5	9.0	7.5	9.0	7.5
Variance	10.0	3.75	10.0	3.75	10.0	3.75	10.0	3.75
Correlation	0.816		0.816		0.816		0.816	

F.J. Anscombe. "Graphs in Statistical Analysis." *American Statistician* 27 (1973), 17–21. *(pages 7, 8, 19)*

Anscombe's Quartet



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Interaction

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But can also interact by writing new code

Vis Idiom

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Examples of idioms

Scatter plots

Bar plots

Pie Charts (please don’t)

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Huge possible number of Idioms

See for example Information is Beautiful

Tasks

No one visualisation does everything

Task - what is the purpose of the visualisation?

Journalism or telling a story?

Exploring data?

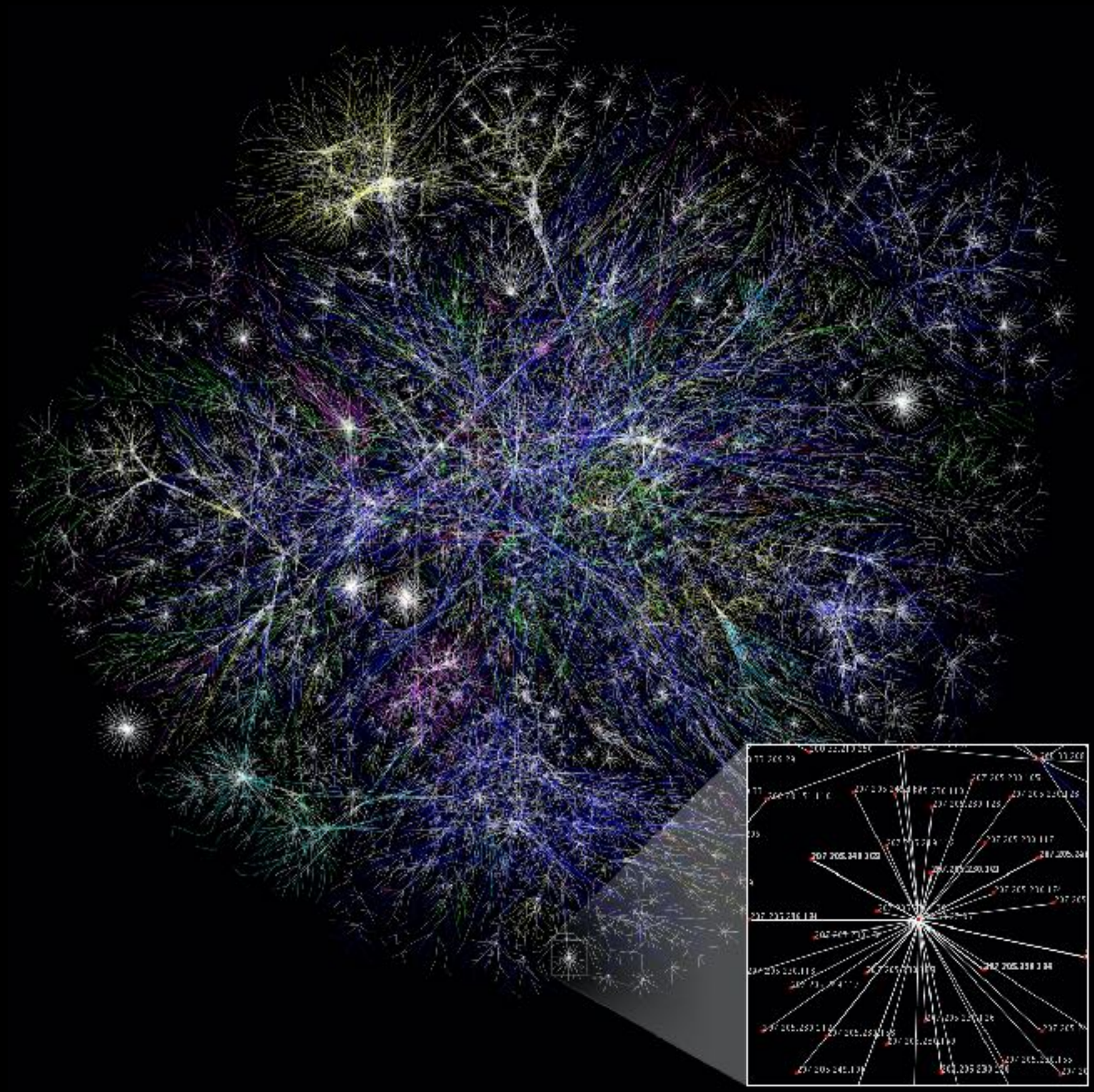
Testing hypotheses?

Effectiveness

Once you've decided upon the task

Did it do the job?

Visualisations can be beautiful - but not effective!



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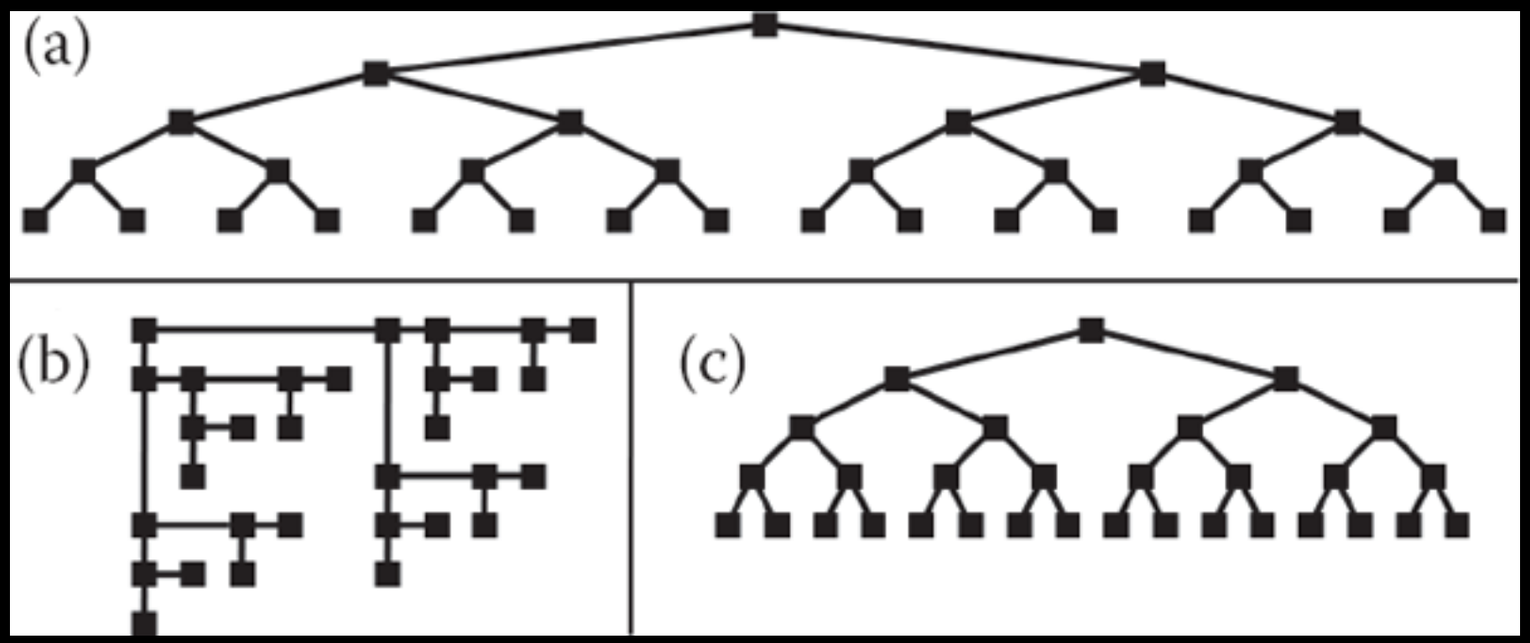

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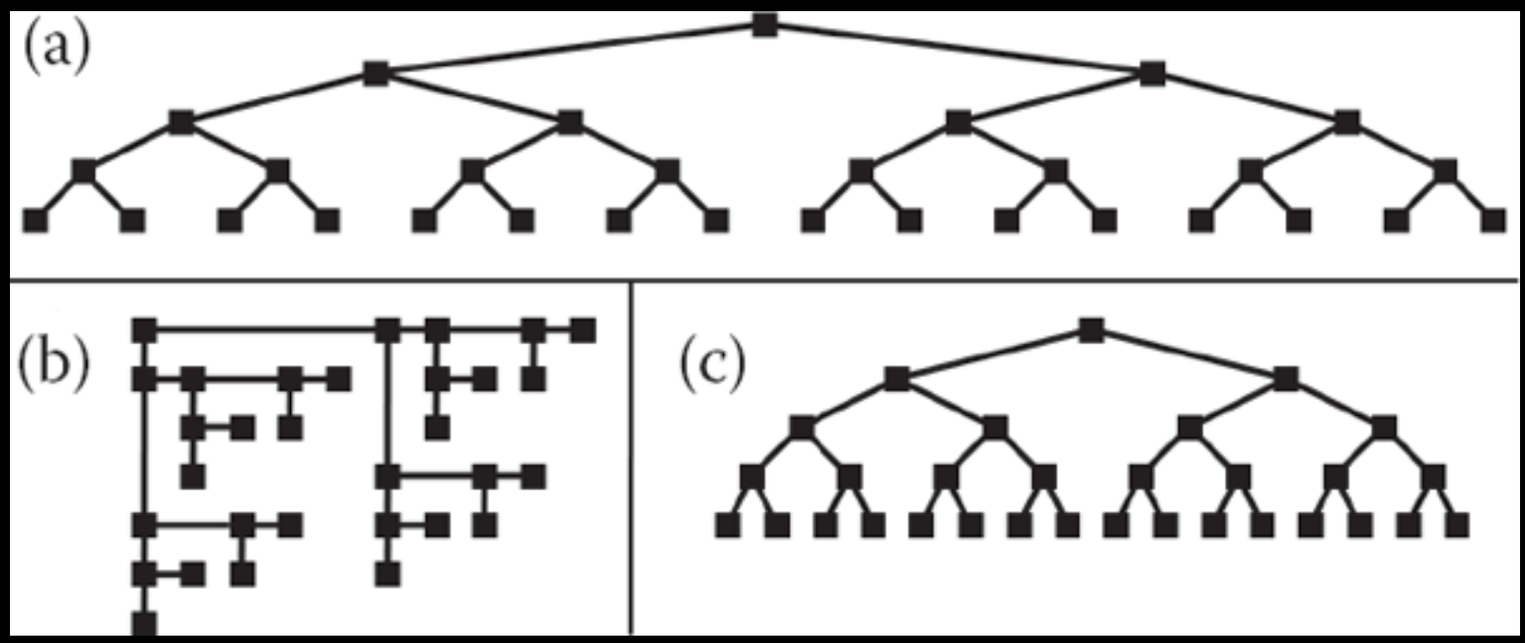

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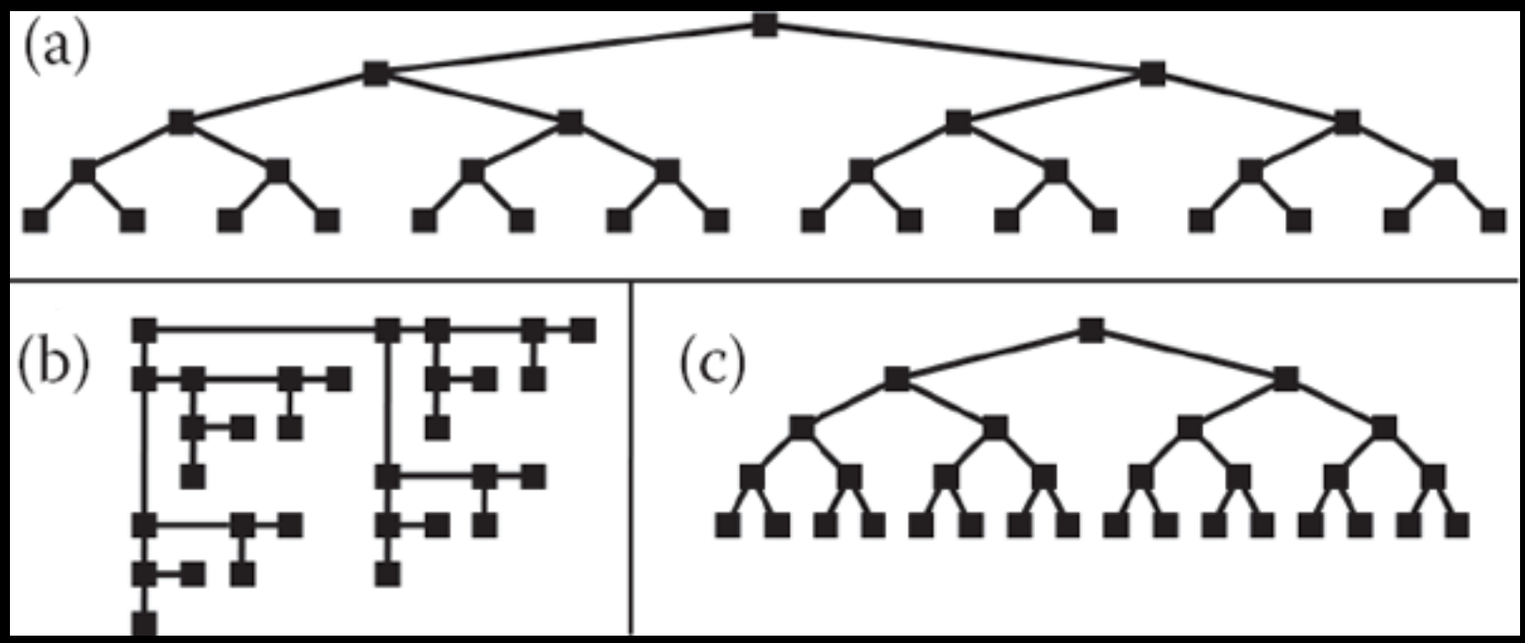
High Info. Density (but can't tell tree order)



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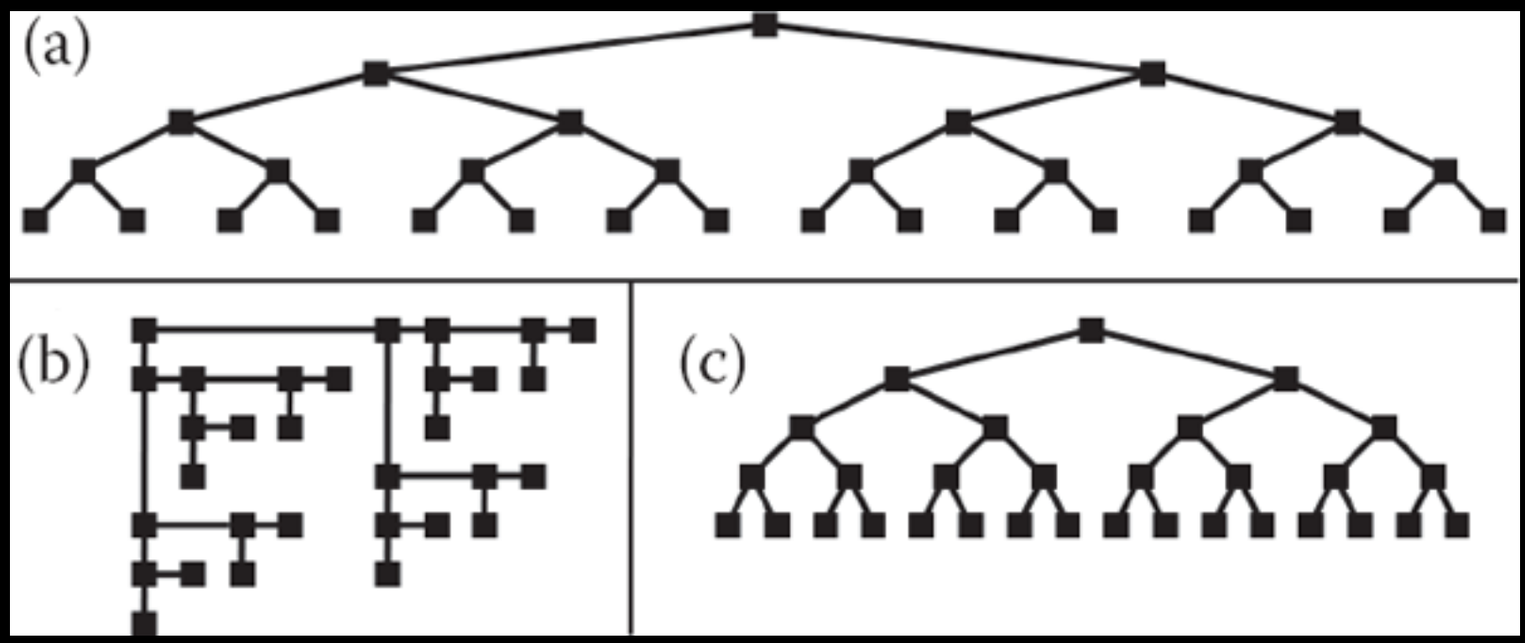

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