Lecture 1
Introduction to Data Visualisation

DTS204TC Data Visualisation

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Defining Visualisation

- Computer-based visualisation (vis) systems provide visual representations of datasets designed to help people carry out tasks more effectively.

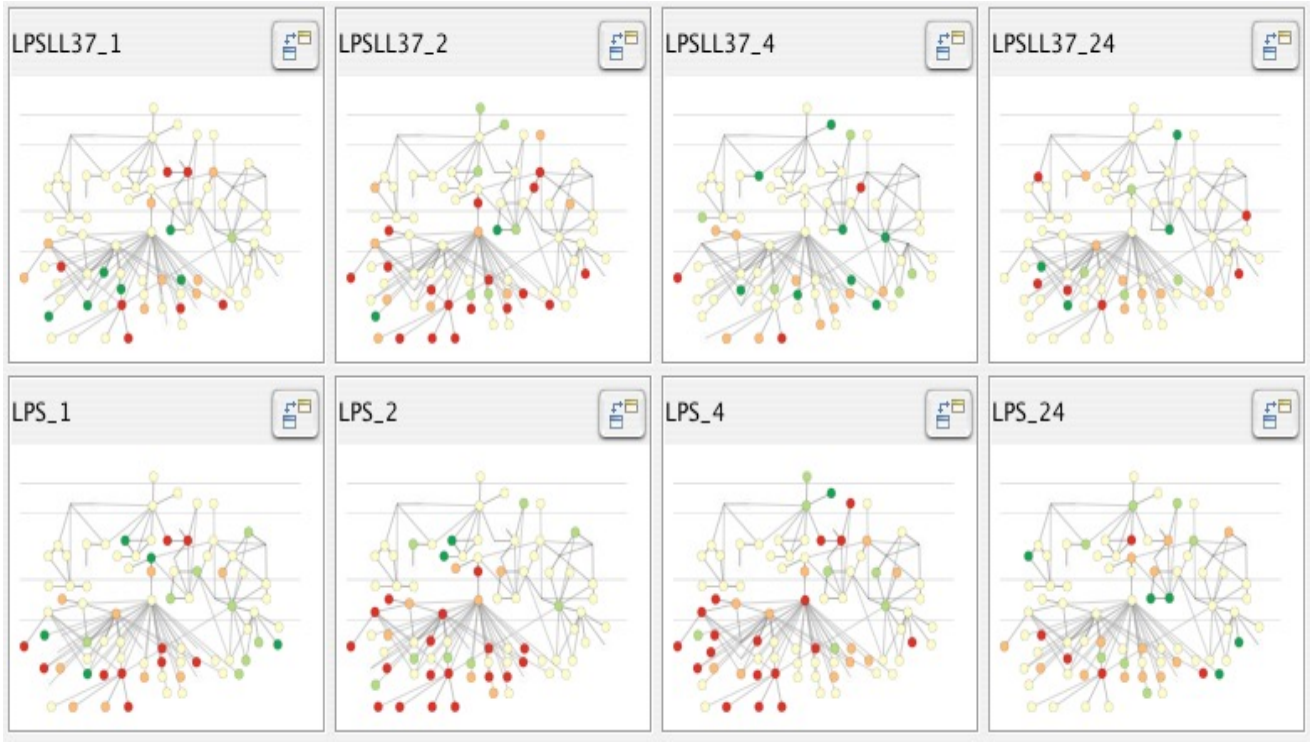
Defining Visualisation

- Computer-based vis systems provide visual representations of datasets designed to help people carry out tasks more effectively.
  - Data management and data analysis

Data Panel

ID	Function	LPSLL37_1	LPSLL37_1_pvals	LPSLL37_2	LPSLL37_24	LPSLL37_24_pvals
IRAK2	Kinase	2.367	0.251	1.337	-1.553	
NFKB2	Transcription factor	-1.14	0.972	-1.03	1.303	0.807
CXCL2	Chemokine	1.853	0.376	4.111	-1.019	0.745
CHUK	Kinase	-1.376	0.373	2.232	1.194	0.387
IL13	Cytokine	-5.961		2.139	-1.236	0.601
RELA	Transcription factor	-1.077	0.564	-1.169	1.943	0.594
IKBKB	Kinase	1.167	0.29	1.421	-1.907	0.286
CCL4	Chemokine	1.254	0.878	-1.052	1.499	0.761
MAP3K7		1.01	0.956	-1.096	1.222	0.8
ICAM1	Adhesion	1.184	0.669	1.537	1.392	0.671
IRF1	Transcription factor	-1.013	0.519	1.416	1.081	0.995
CXCL3	Chemokine	1.7	0.905	1.092	-1.598	0.521
IL12B	Cytokine	-2.448	0.042	-1.473	-2.109	0.08
CCL11	Chemokine	-1.338	0.349	-1.995	-1.785	0.129
MAP3K7IP1	Adaptor					
IFNG	Cytokine	-1.15	0.801	1.075	1.053	0.521

[Cerebral: Visualizing Multiple Experimental Conditions on a Graph with Biological Context. Barsky, Munzner, Gardy, and Kincaid. IEEE TVCG (Proc. InfoVis) 14(6):1253-1260, 2008.]



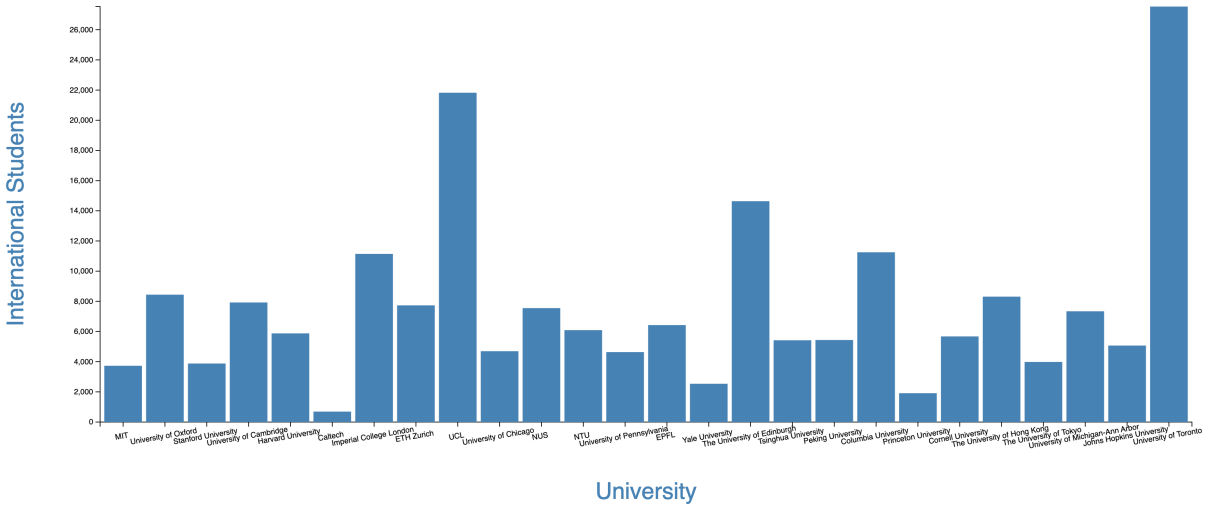
Defining Visualisation

- Computer-based vis systems provide visual representations of datasets designed to help people carry out tasks more effectively.
  - People: Visualisation is suitable when there is a need to augment human capabilities rather than replace people with computational decision-making methods.
    - vis is not necessary when fully automatic solution exists and is trusted
    - Many analysis problems are ill-specified
    - Possibilities
      - long-term use for end users (ex: exploratory analysis of scientific data)
      - presentation of known results (ex: published papers)
      - …

Defining Visualisation

- Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.
  - External representation: replace cognition with perception

	university	country	city	region	student_facu	international	faculty_count
2	MIT	United State	Cambridge	North Ameri	4	3730	3,065
3	University of	United Kingd	Oxford	Europe	3	8442	6,708
4	Stanford Uni	United State	Stanford	North Ameri	3	3879	4,725
5	University of	United Kingd	Cambridge	Europe	4	7925	5,800
6	Harvard Univ	United State	Cambridge	North Ameri	5	5877	4,646
7	Caltech	United State	Pasadena	North Ameri	2	692	968
8	Imperial Coll	United Kingd	London	Europe	5	11143	8,000
9	ETH Zurich	Switzerland	ZvºrIch	Europe	7	7733	2,719
10	UCL	United Kingd	London	Europe	5	21824	7,195
11	University of	United State	Chicago	North Ameri	6	4696	2,703
12	NUS	Singapore	Singapore	Asia	7	7551	4,288
13	NTU	Singapore	Singapore	Asia	6	6091	3,812
14	University of	United State	Philadelphia	North Ameri	4	4636	5,154
15	EPFL	Switzerland	Lausanne	Europe	6	6426	1,767
16	Yale Univers	United State	New Haven	North Ameri	2	2537	5,391
17	The Universi	United Kingd	Edinburgh	Europe	7	14637	4,832
18	Tsinghua Un	China (Mainl	Beijing	Asia	6	5420	6,174
19	Peking Unive	China (Mainl	Beijing	Asia	6	5436	5,302
20	Columbia Un	United State	New York Cit	North Ameri	4	11252	7,087
21	Princeton Un	United State	Princeton	North Ameri	8	1912	1,050
22	Cornell Unive	United State	Ithaca	North Ameri	8	5675	2,843
23	The Universi	Hong Kong S.	Hong Kong	Asia	7	8311	2,944
24	The Universi	Japan	Tokyo	Asia	6	3983	4,473
25	University of	United State	Ann Arbor	North Ameri	6	7341	7,132
26	Johns Hopkin	United State	Baltimore	North Ameri	3	5070	4,855
27	University of	Canada	Toronto	North Ameri	8	27536	9,881
28							
29							



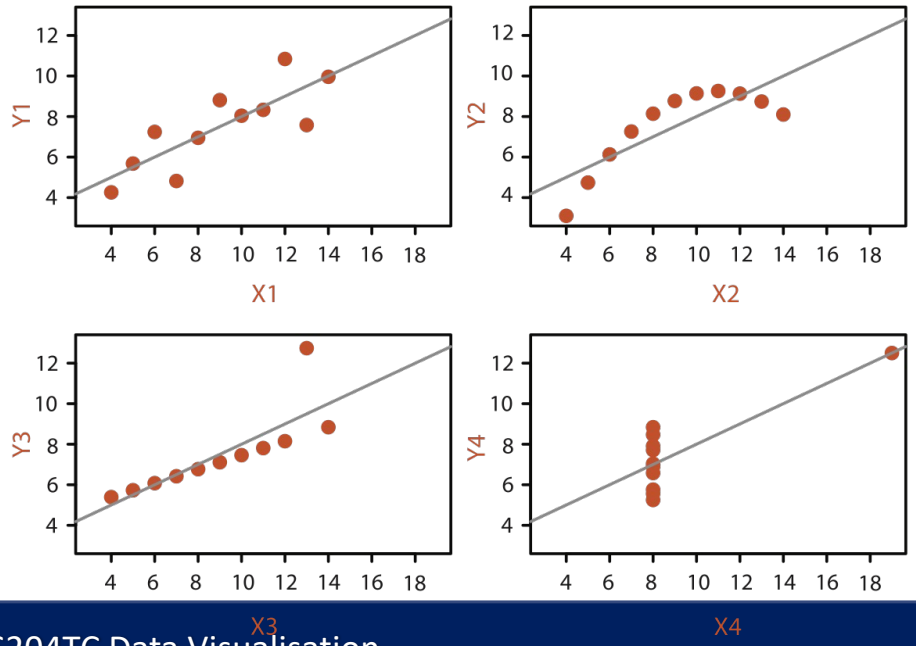
Defining Visualisation

- Computer-based visualisation systems provide visual representations of datasets designed to help people carry out tasks more effectively.
  - Why vision?
    - human visual system is high-bandwidth channel to brain
    - sound: lower bandwidth and different semantics
    - touch/haptics: impoverished record/replay capacity
    - taste, smell: no viable record/replay devices

Defining Visualisation

- Computer-based visualisation systems provide visual representations of datasets designed to help people carry out tasks more effectively.
- Difference between vis and statics: vis represents all the data and presents more details
  - statics methods lose information, details matter

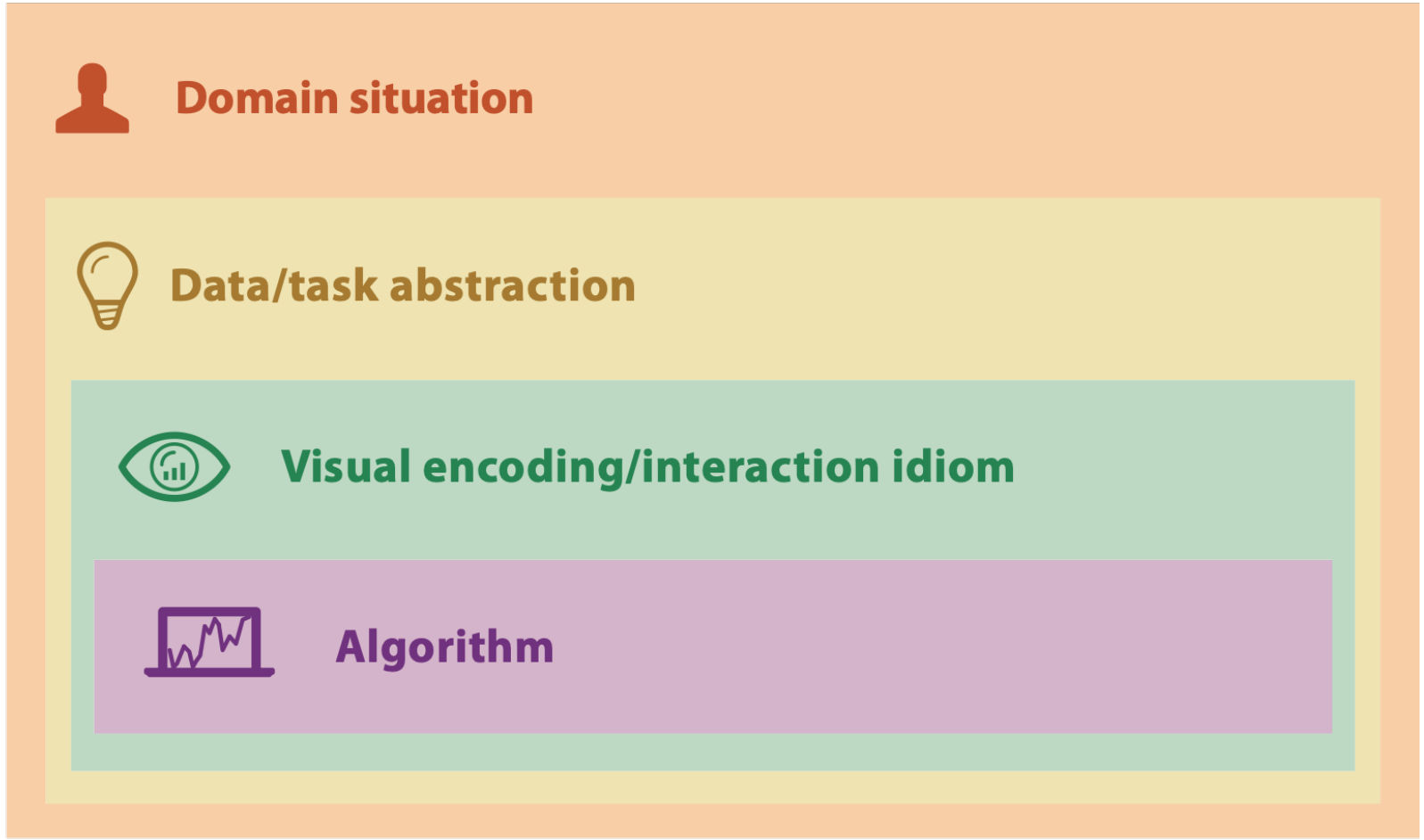
Identical statistics	
x mean	9
x variance	10
y mean	7.5
y variance	3.75
x/y correlation	0.816



Challenges and Limitations

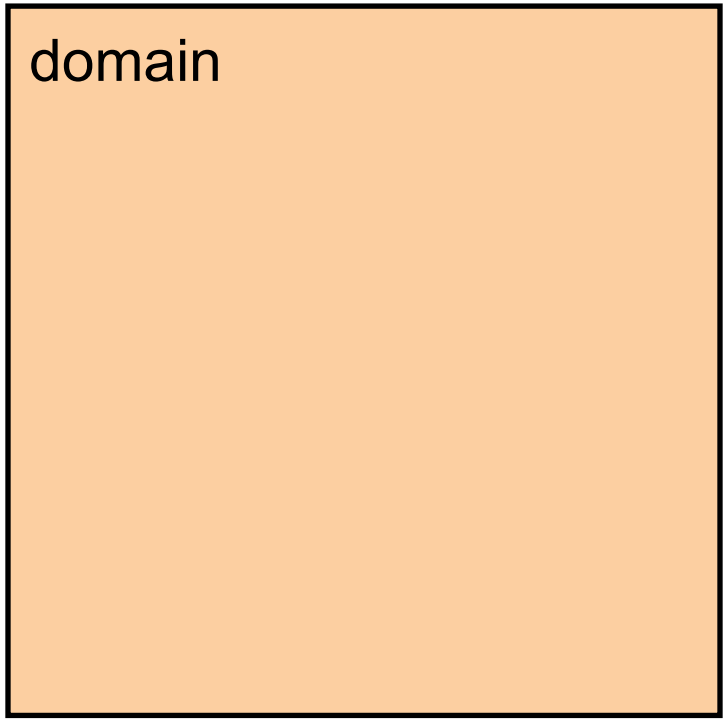
- computational limits
  - computation time, system memory
- display limits
  - pixels are precious & most constrained resource
  - **information density**: ratio of space used to encode info vs unused whitespace
    - trade off between clutter and wasting space
    - find sweet spot between dense and sparse
- human limits
  - human time, human memory, human attention

Nested Model



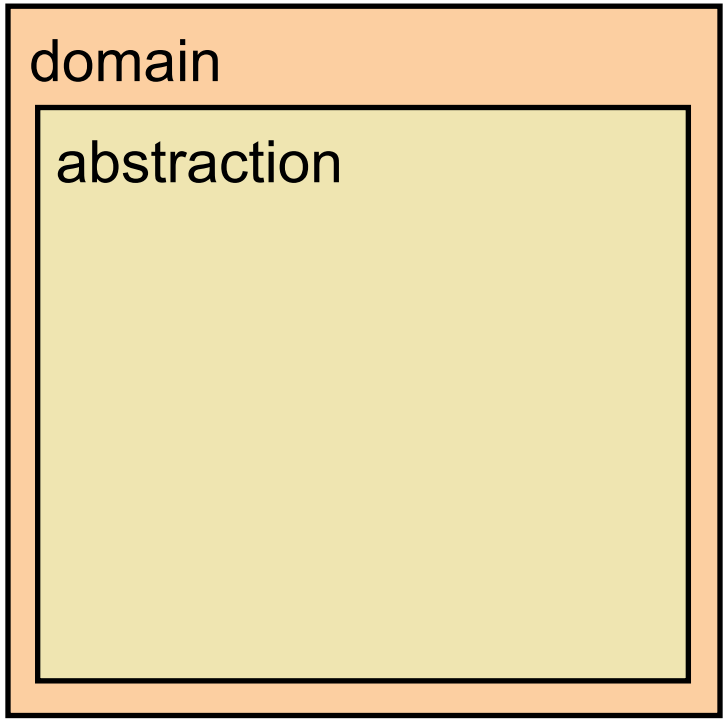
Nested Model

- *Domain situation*
  - who are the target users?



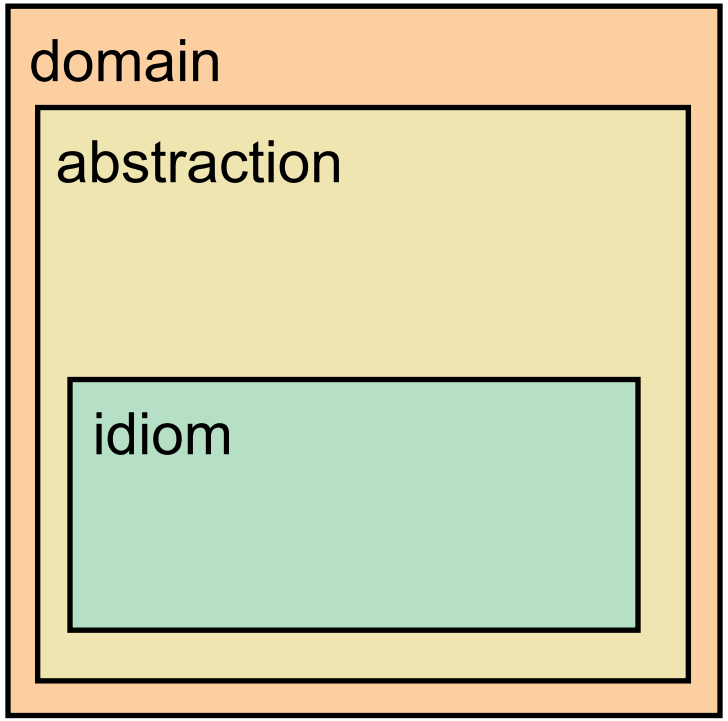
Nested Model

- *Abstraction*
  - what is shown? data abstraction
  - why is the user looking at it? task abstraction



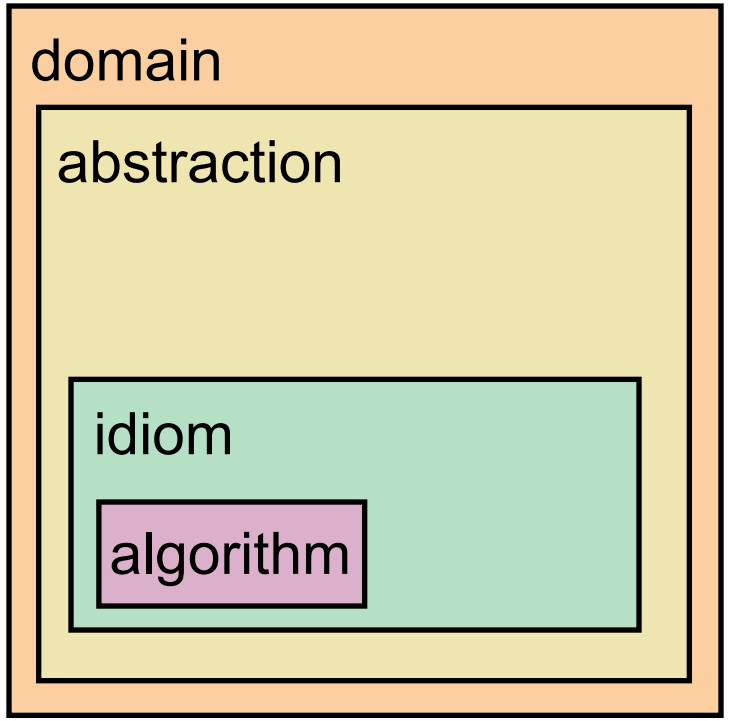
Nested Model

- *Idiom*
  - How is it shown?
    - Visual encoding idiom: how to draw
    - Interaction: how to manipulate



Nested Model

- *Algorithm*



Nested Model

- *Domain situation*
  - who are the target users?
- *Abstraction*
  - what is shown? data abstraction
  - why is the user looking at it? task abstraction
- *Idiom*
  - How is it shown?
    - Visual encoding idiom: how to draw
    - Interaction: how to manipulate
- *Algorithm*