Visual Encoding

ID 413: Information Graphics and Data Visualization
Spring 2016

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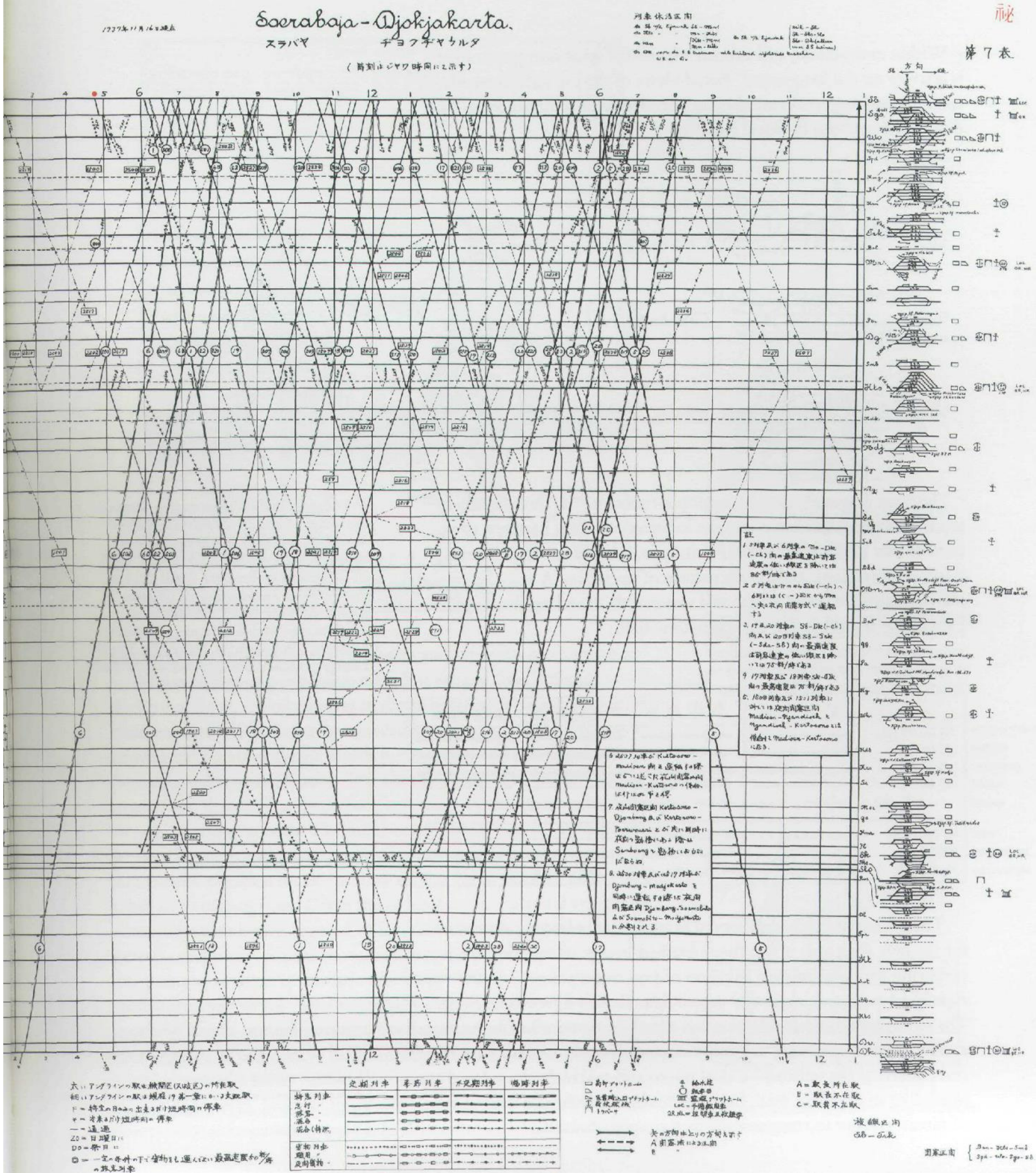
http://info-design-lab.github.io/ID413-DataViz/



1937年11月16日現在
Soerabaja - Djokjakarta.
スラバヤ
ヂョクヂャカルタ
(時刻はジャワ時間にて示す)
列車休泊区間
秘
第7表
方向

秘

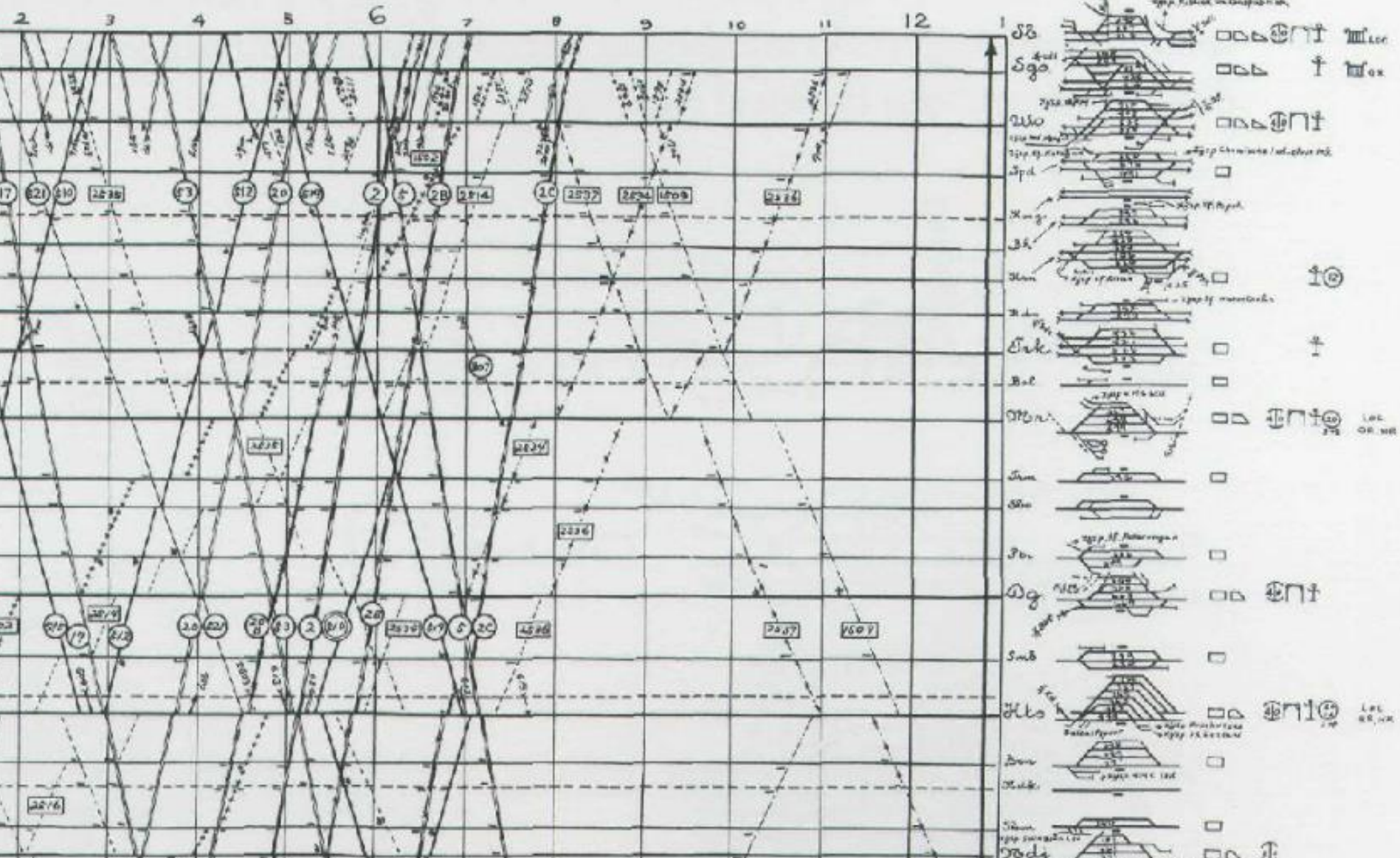
第7表

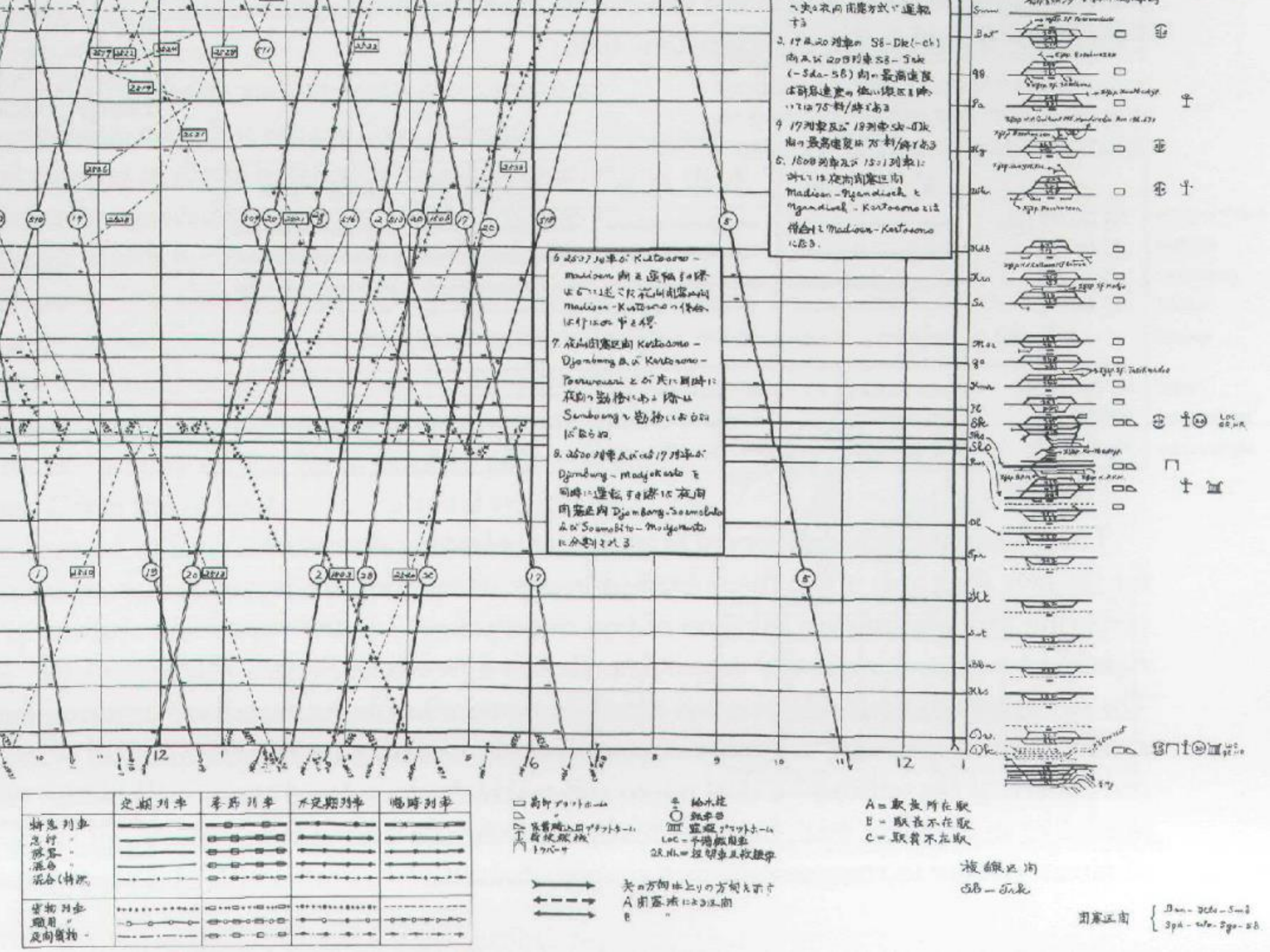
akarta.

タルタ

示す)

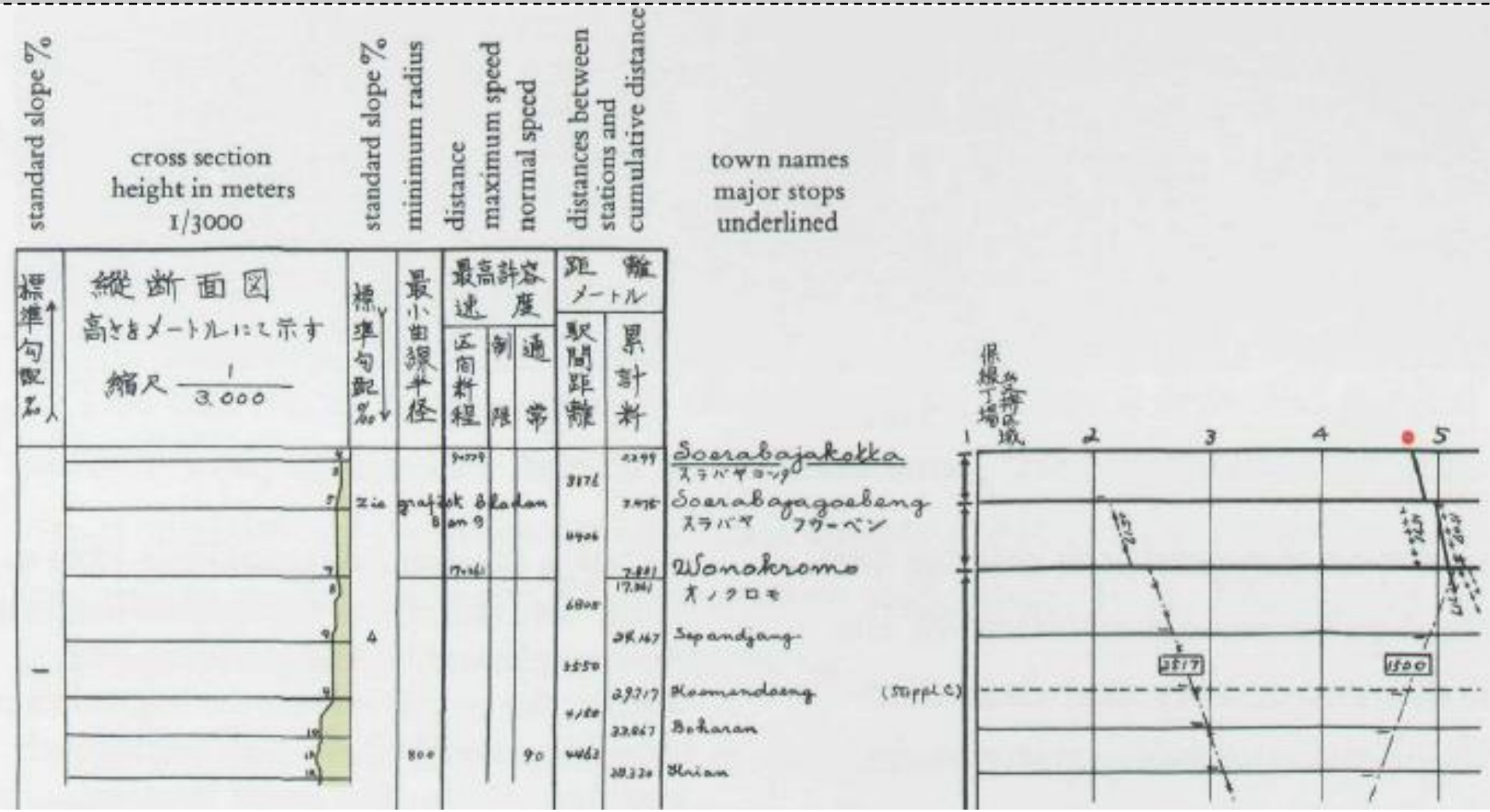
列車休止区間



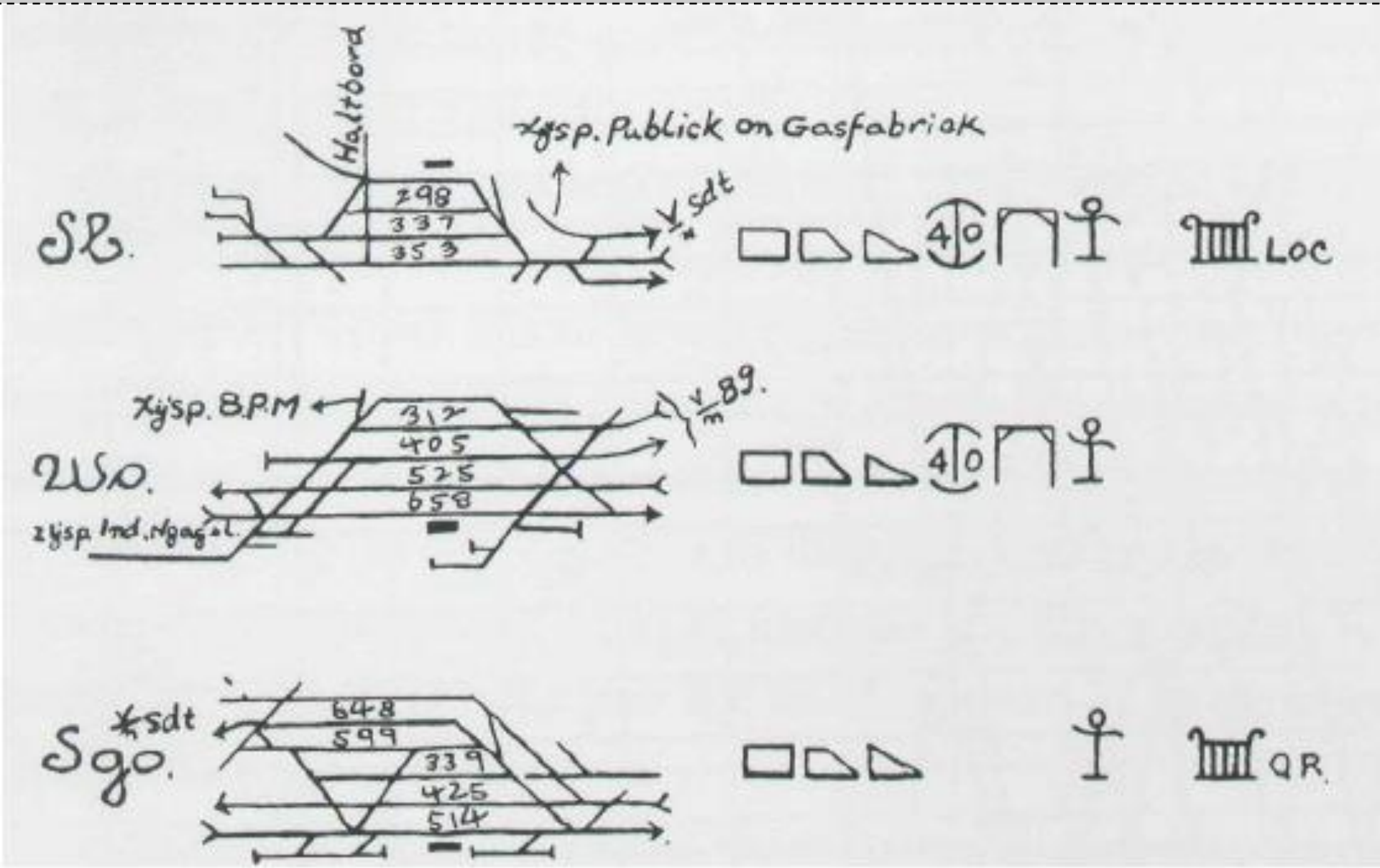


へ夫々夜間閉塞方式で運転する
3. 17及20列車の SB-Dk(-Ch) 間及び2019列車 SB-Tjk (-Sda-SB) 間の最高速度は許容速度の低い区間を除いては75粁/時である
4 17列車及び19列車 Sk-Dk 間の最高速度は75粁/時である
5. 1508列車及び1501列車に対しては夜間閉塞区間 Madioen-Ngandjoek と Ngandjoek-Kertosono とは併合して Madioen-Kertosono になる.
6 2537列車が Kertosono-Madioen 間を運転する際において述べた夜間閉塞区間 Madioen-Kertosono の併合は行われない事とする
7. 夜間閉塞区間 Kertosono-Djombang 及び Kertosono-Poerwoasri とが共に同時に夜間の勤務にある際は Sembong で勤務しなければならぬ.
8. 2500列車及び2517列車が Djombang-Modjokerto を同時に運転する際には夜間閉塞区間 Djombang-Soemobito 及び Soemobito-Modjokerto に分割される
定期列車
季節列車
不定期列車
臨時列車
特急列車
急行
旅客
混合
混合(特殊)
貨物列車
職用
夜間貨物
A = 駅長所在駅
B = 駅長不在駅
C = 駅員不在駅
複線区間
SB – Tjk
閉塞区間

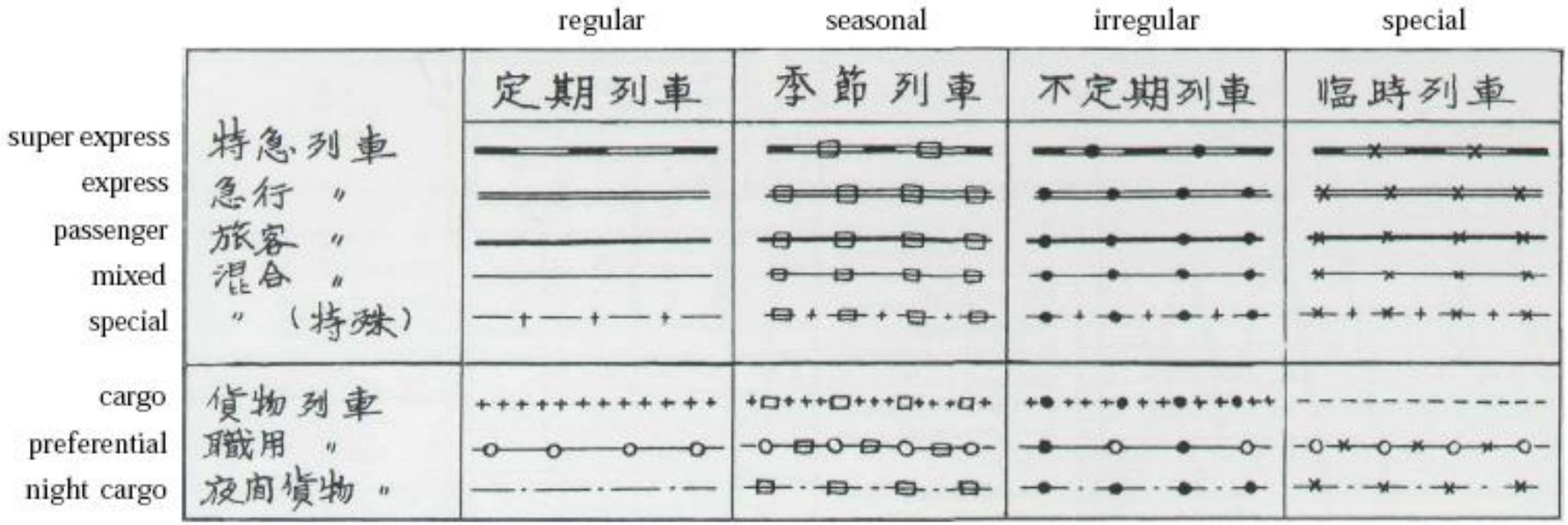
Soerabaja-Djokjakarta rail timetable 1937



Soerabaja-Djokjakarta rail timetable 1937

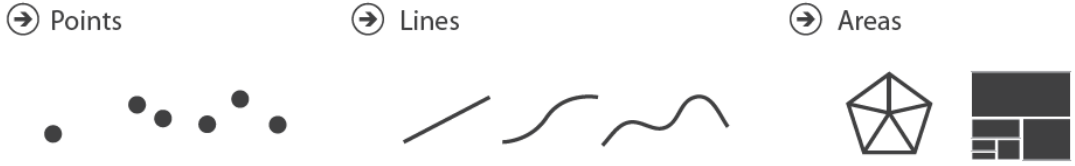


Soerabaja-Djokjakarta rail timetable 1937

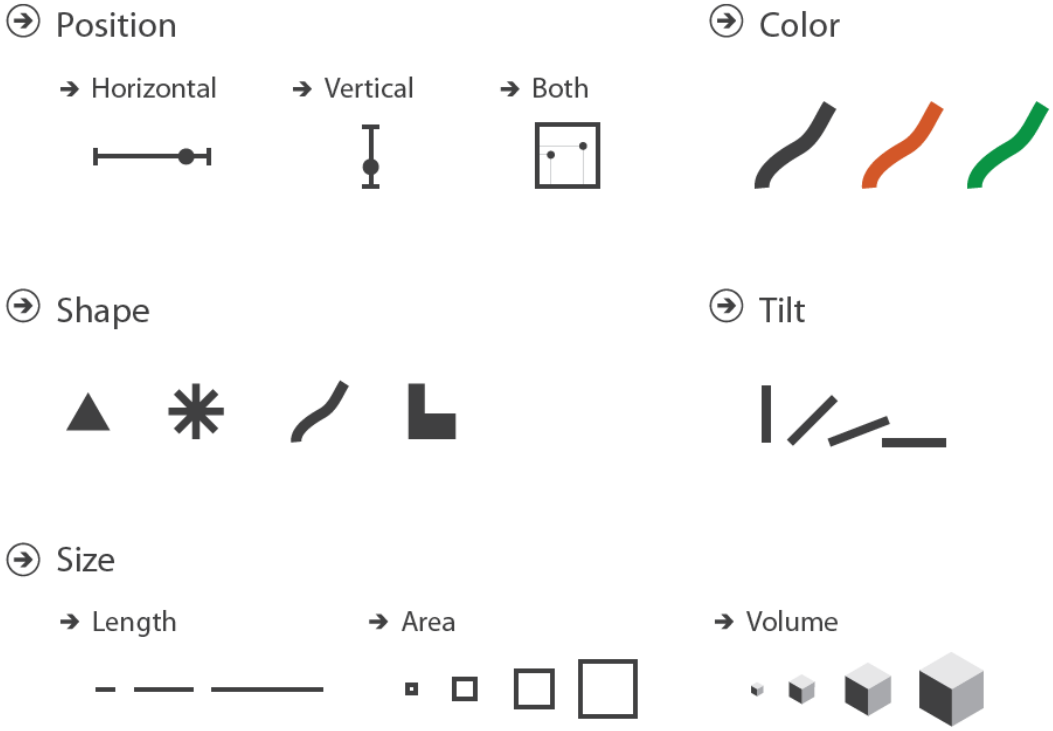


Marks and Channels

- marks
  - geometric primitives



- channels
  - control appearance of marks



- graphical elements in an image
- classified according to number of spatial dimensions required

* adapted from Tamara Munzer's VAD book

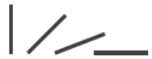
Channels Rankings

Position on common scale

Position on unaligned scale

Length (1D size)

Tilt/angle



Area (2D size)

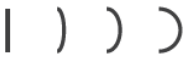
Depth (3D position)

Color luminance

Color saturation

Same

Curvature



Volume (3D size)

Same

Spatial region

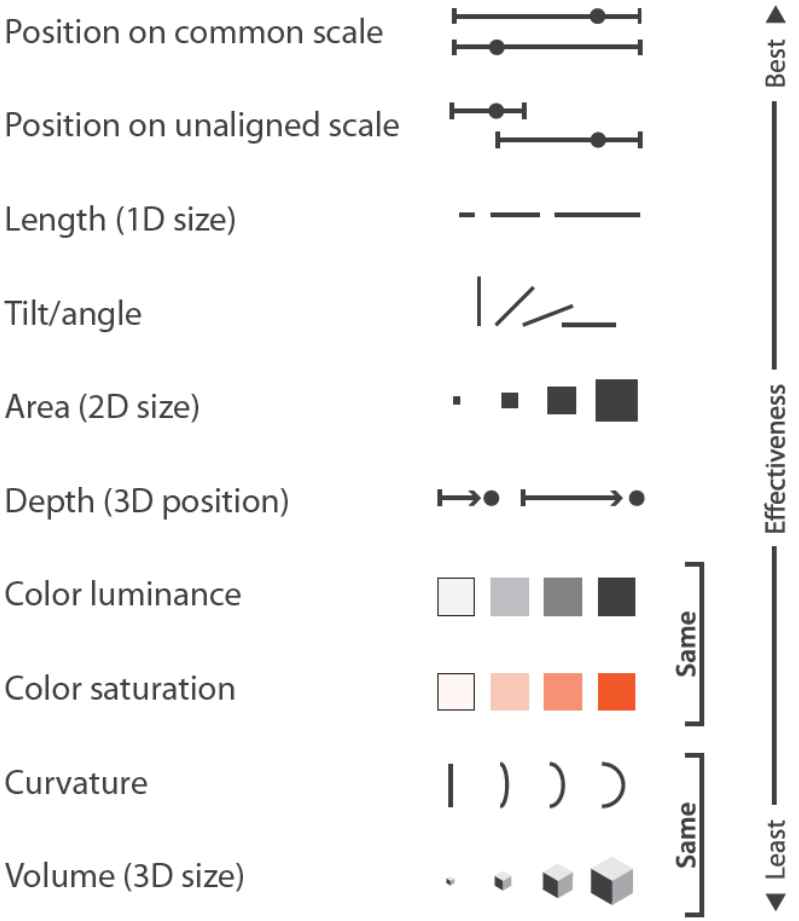
Color hue

Motion

Shape

Channels Rankings

Magnitude Channels: Ordered Attributes

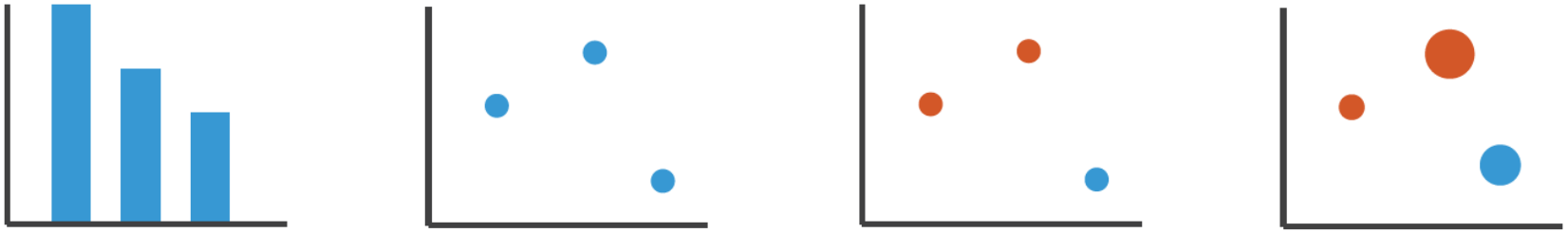


Identity Channels: Categorical Attributes

- effectiveness principle
  - encode most important attributes with highest ranked channels
- expressiveness principle
  - match channel and data characteristics

Encoding visually with marks and channels

- analyze idiom structure
  - as combination of marks and channels



Encoding visually with marks and channels

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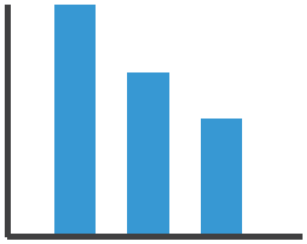


1:
vertical position

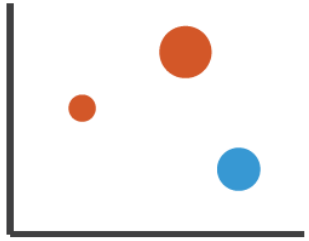
mark: line

2:
vertical position
horizontal position

mark: point

3:
vertical position
horizontal position
color hue

mark: point

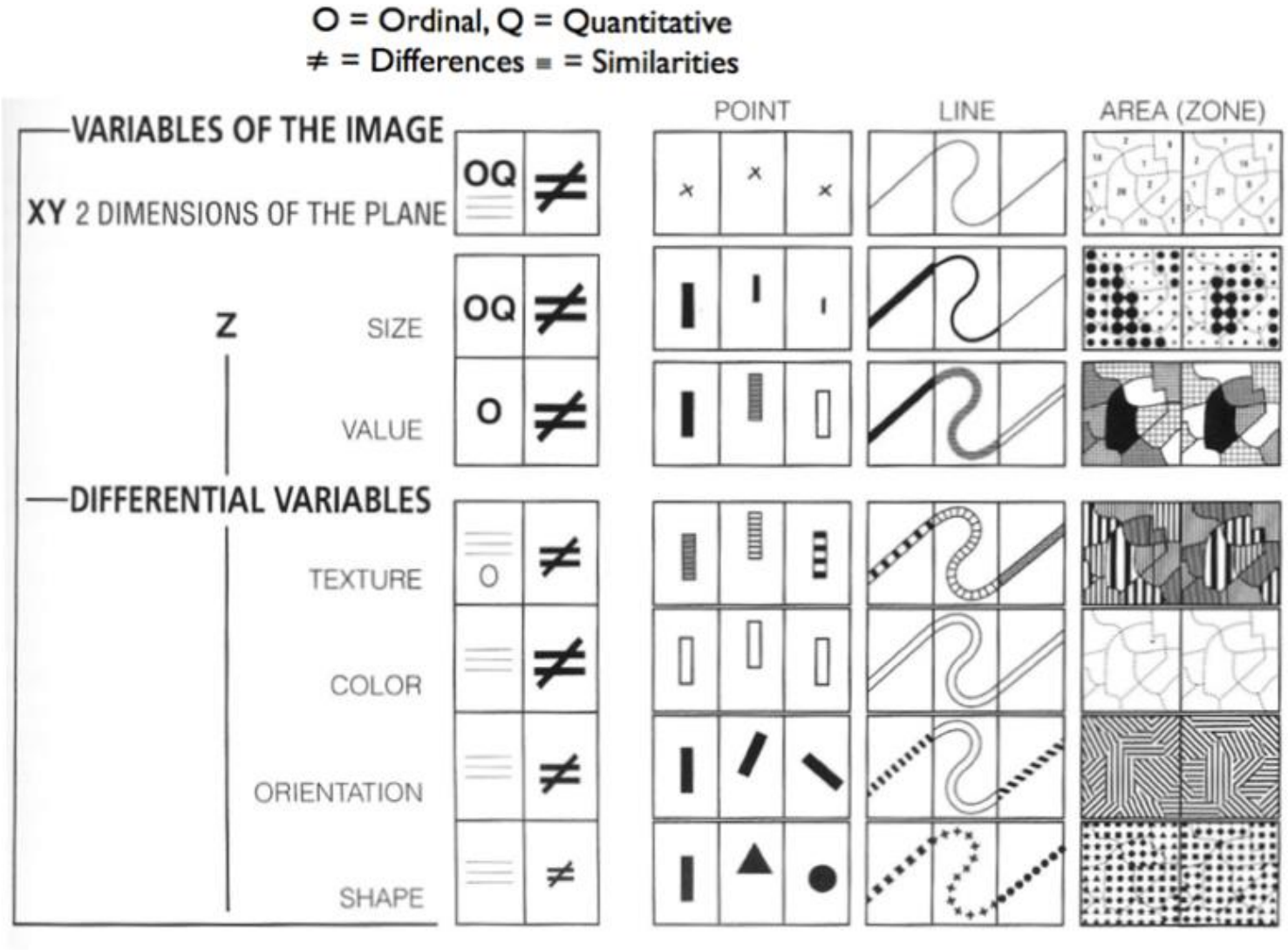


4:
vertical position
horizontal position
color hue
size (area)

mark: point

Where do rankings come from?

Jacques Bertin 1967



Semiology of Graphics [J. Bertin, Esri Press, 2011]

William Cleveland and Robert McGill 1984

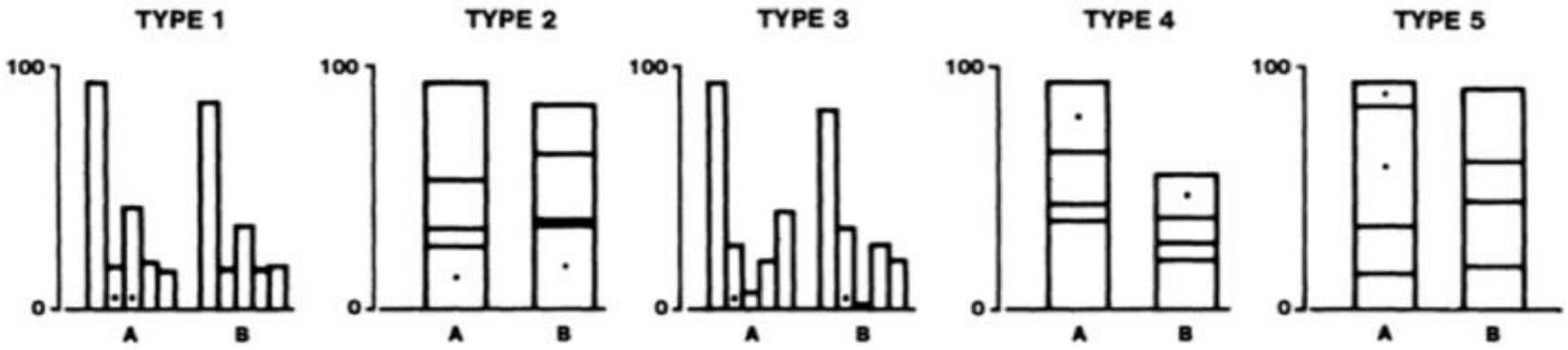


Figure 4. Graphs from position–length experiment.

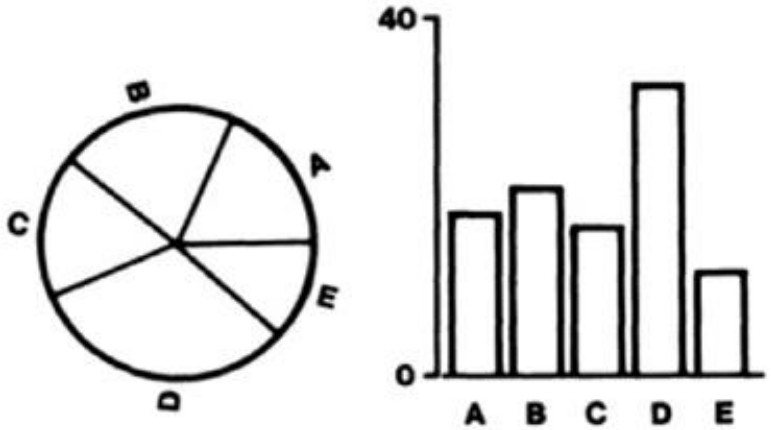
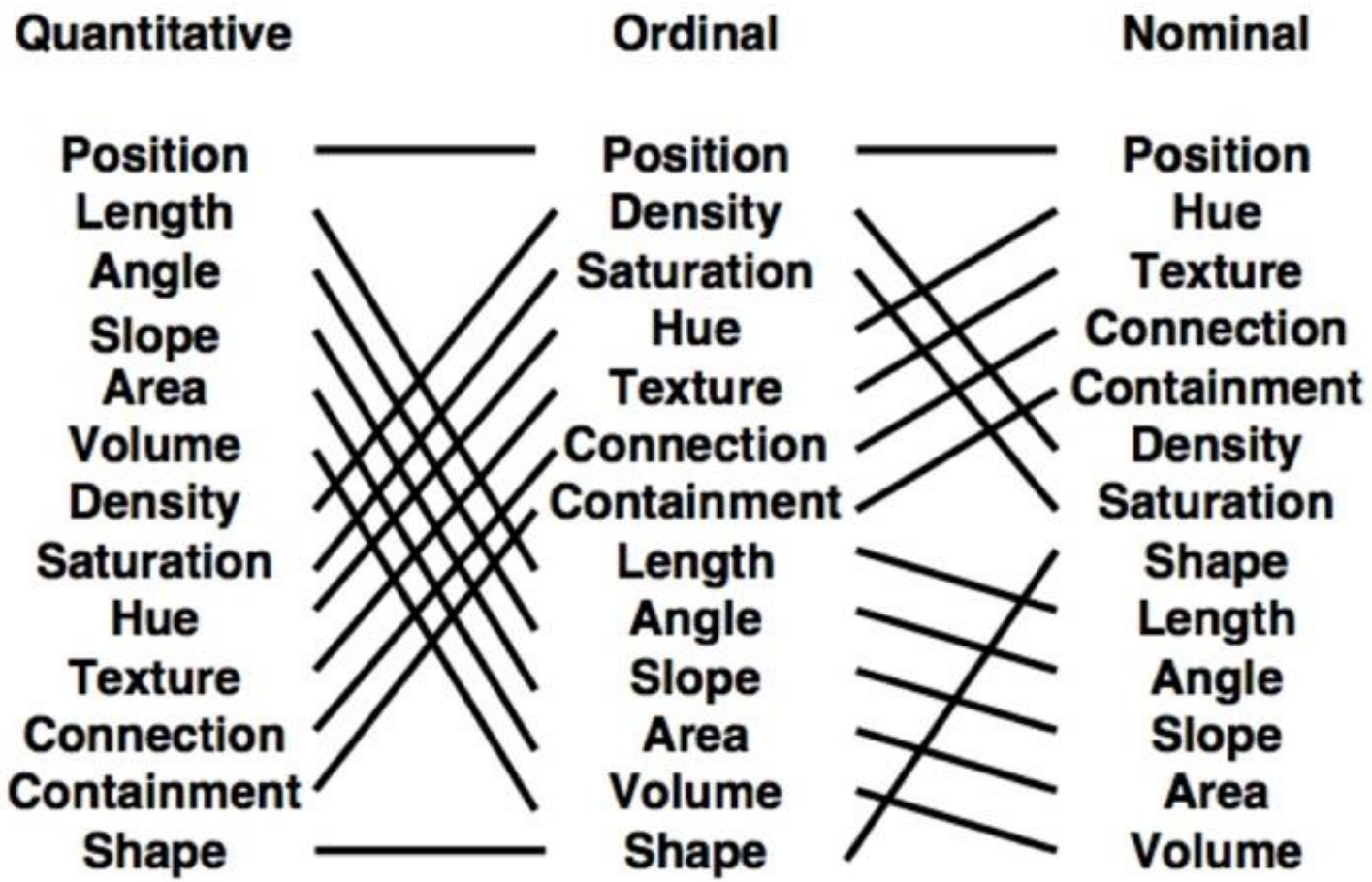


Figure 3. Graphs from position–angle experiment.

William S. Cleveland; Robert McGill ,"Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods." 1984

Jock Mackinlay 1986



[Mackinlay, Automating the Design of Graphical Presentations of Relational Information, ACM TOG 5:2, 1986]

Jeffrey Heer and Michael Bostock 2010

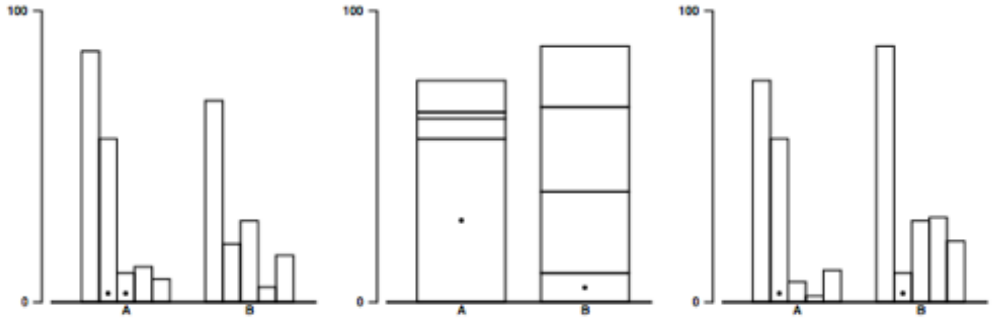


Figure 1: Stimuli for judgment tasks T1, T2 & T3. Subjects estimated percent differences between elements.

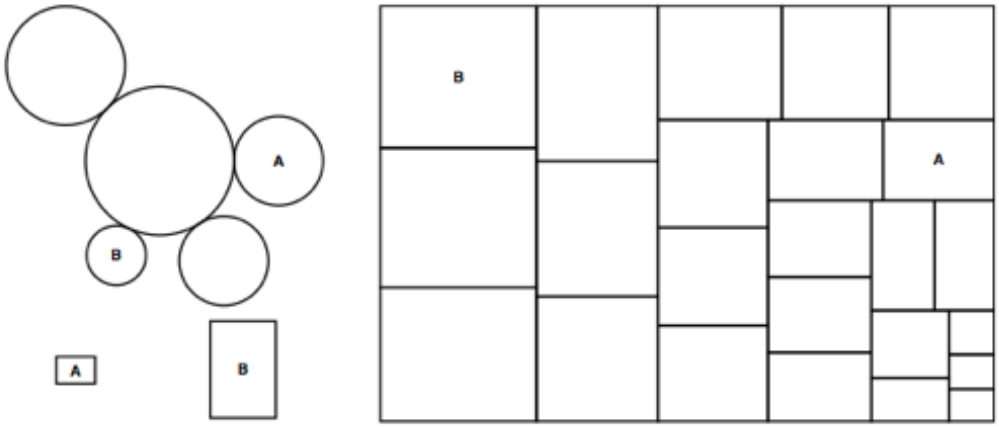
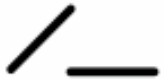
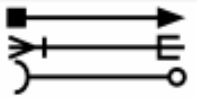


Figure 2: Area judgment stimuli. Top left: Bubble chart (T7), Bottom left: Center-aligned rectangles (T8), Right: Treemap (T9).

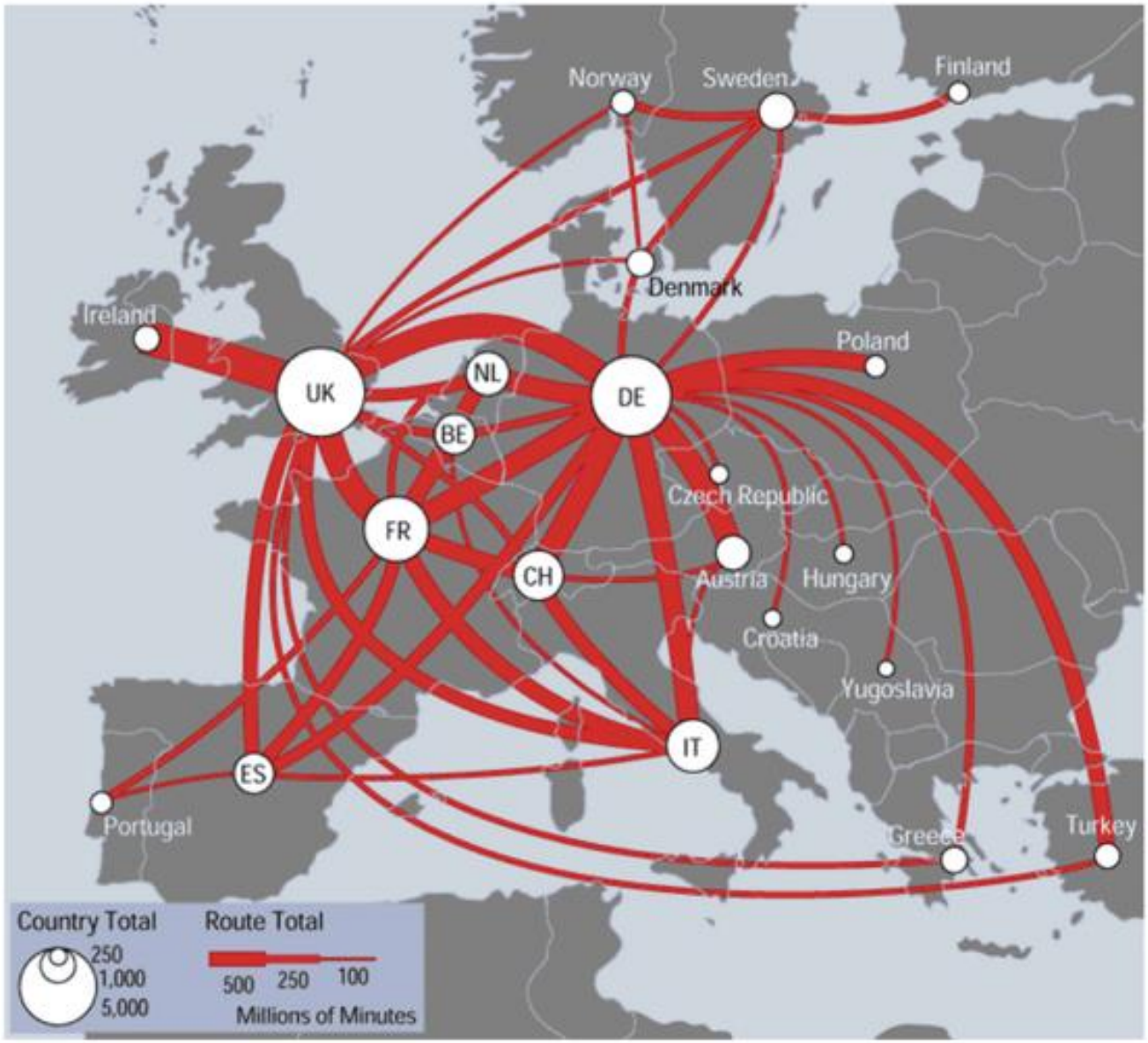
Crowdsourcing Graphical Perception: Using Mechanical Turk to Assess Visualization Design. Jeffrey Heer, Michael Bostock. ACM Human Factors in Computing Systems (CHI), 2010.

Properties and Best Uses of Visual Encodings

Example	Encoding	Ordered	Useful values	Quantitative	Ordinal	Categorical	Relational
	position, placement	**yes**	**infinite**	Good	Good	Good	Good
1, 2, 3; A, B, C	text labels	**optional** (alphabetical or numbered)	**infinite**	Good	Good	Good	Good
	length	**yes**	**many**	Good	Good		
	size, area	**yes**	**many**	Good	Good		
	angle	**yes**	medium/few	Good	Good		
	pattern density	**yes**	few	Good	Good		
	weight, boldness	**yes**	few		Good		
	saturation, brightness	**yes**	few		Good		
	color	no	few (< 20)			Good	
	shape, icon	no	medium			Good	
	pattern texture	no	medium			Good	
	enclosure, connection	no	**infinite**			Good	Good
	line pattern	no	few				Good
	line endings	no	few				Good
	line weight	**yes**	few		Good		

Noah Iliinsky • ComplexDiagrams.com/properties • 2012-06

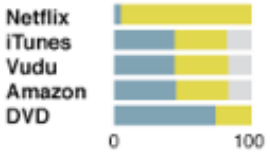
Discriminability: Can channel differences be discerned?



Streaming the Box Office

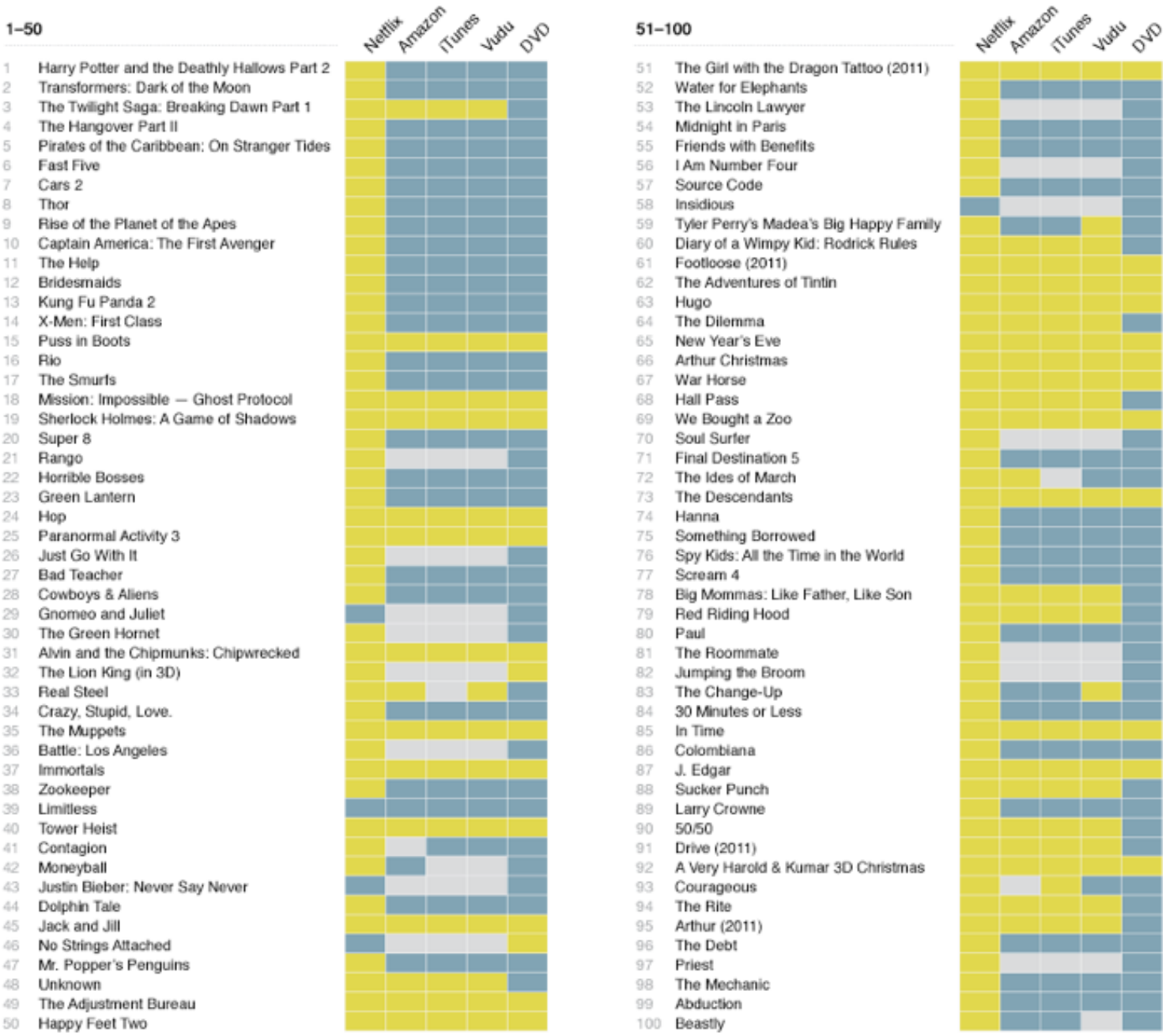
Top 100 in 2011

AVAILABLE
NOT AVAILABLE
PURCHASE ONLY



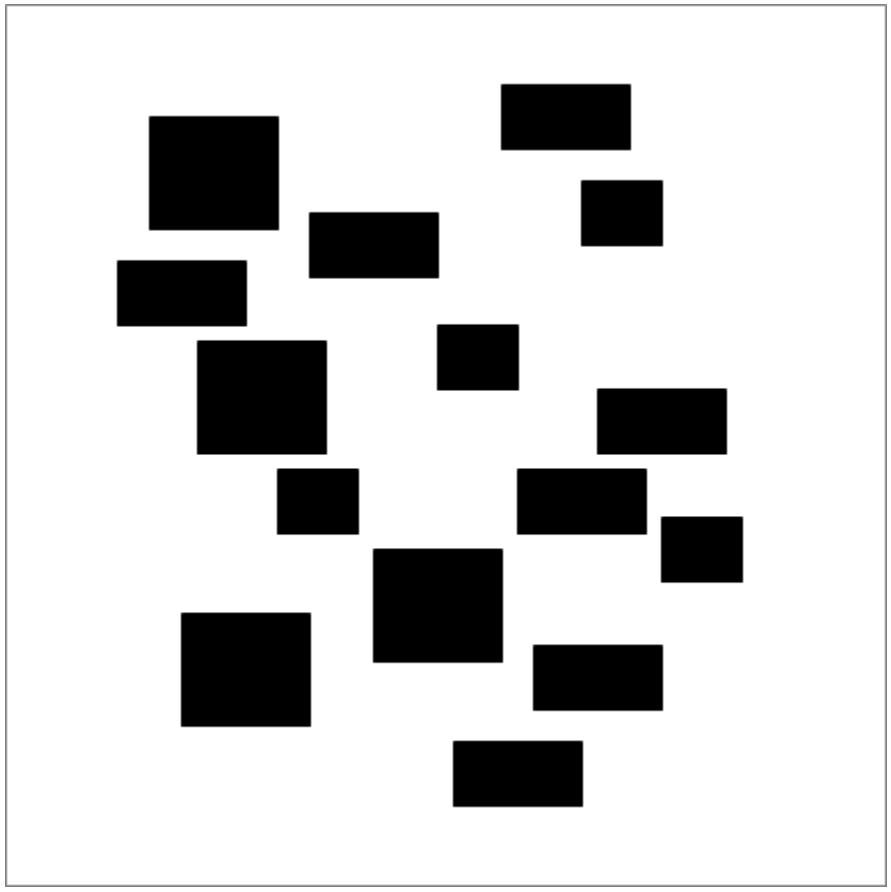
Tristan Louis compiled a list of the top 100 movies at the box office, according to Box Office Mojo, that were available streaming. This is a graphical version of that list.

Source: Tristan Louis
By: Nathan Yau



Separability vs. Integrality

Below is a scatter plot where the height is mapped to one data variable and the width to another. Can you spot all the rectangles with the same width?



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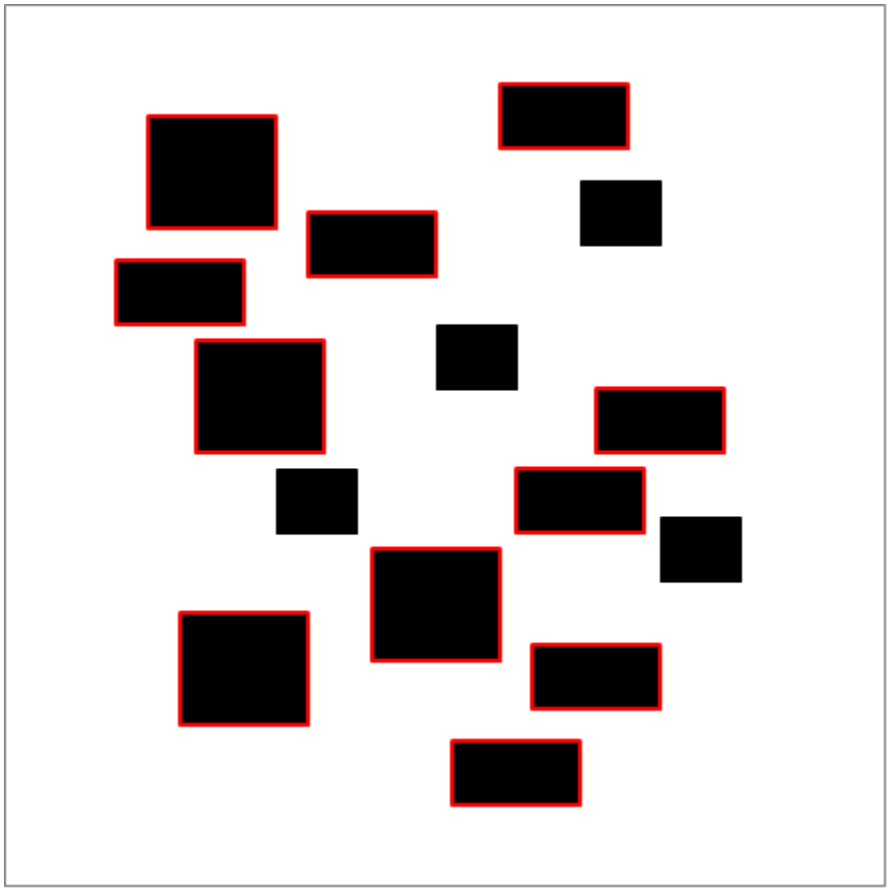

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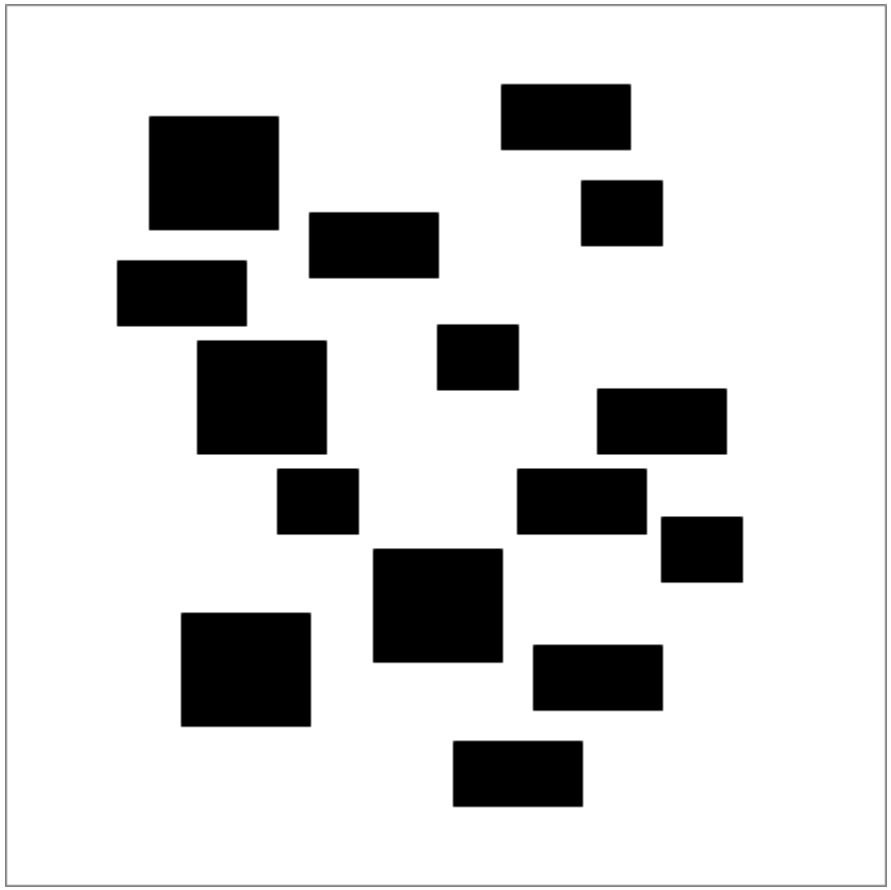

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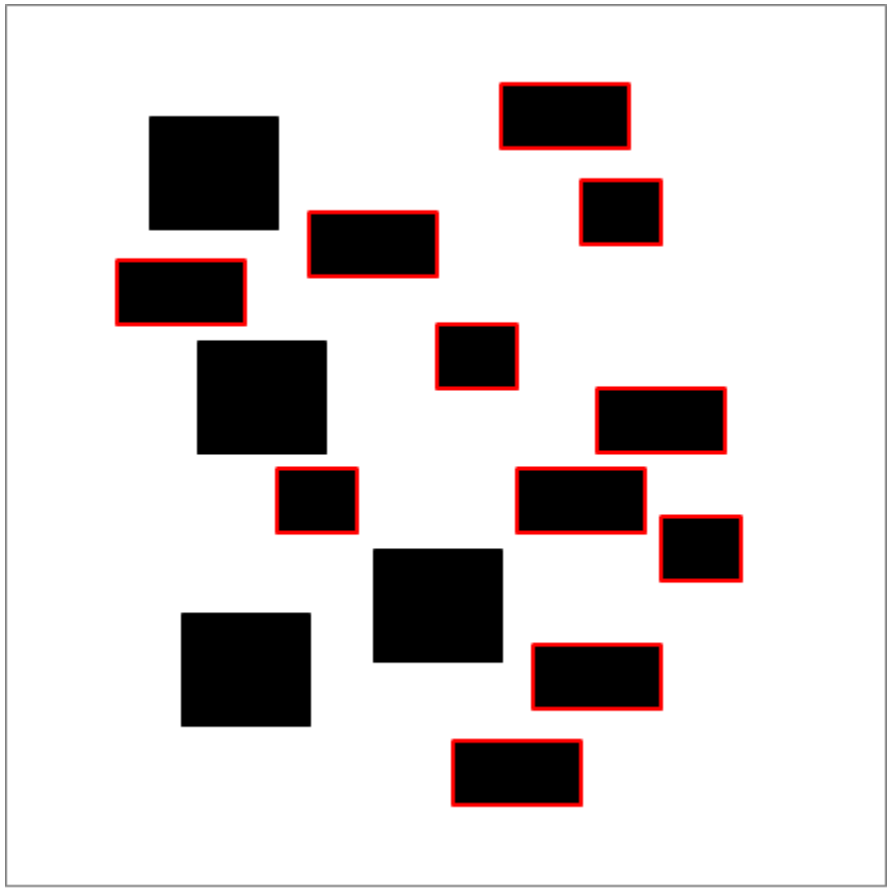
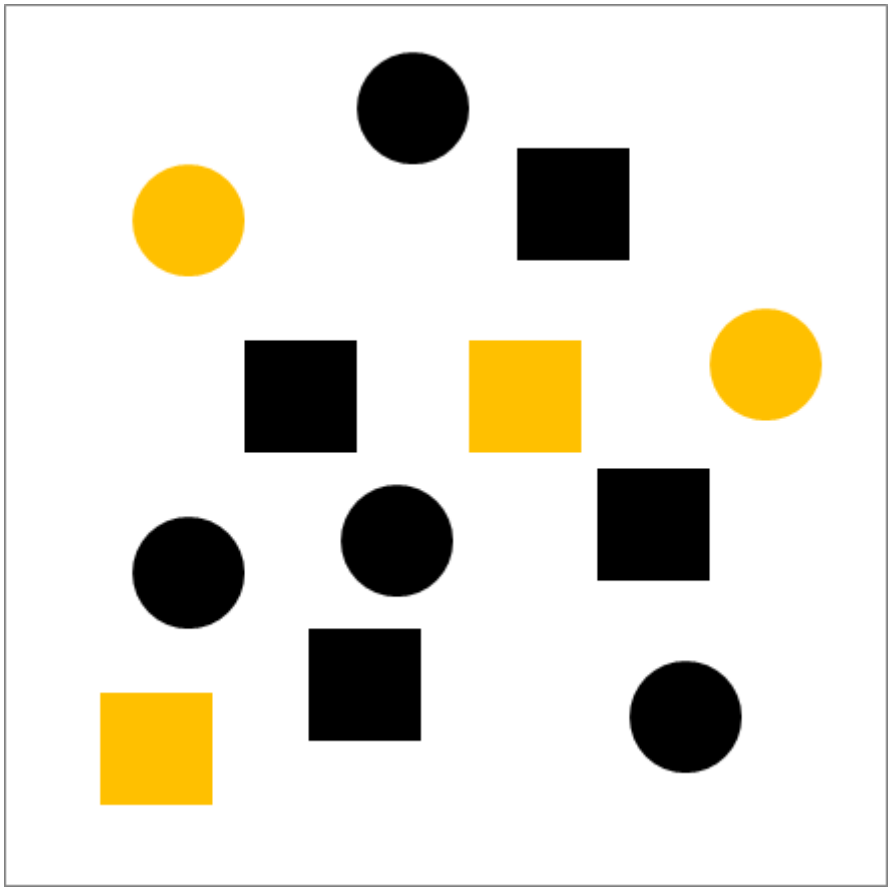


Separability vs. Integrality

On the contrary, you can more easily spot yellow or black dots. And you can also spot circles or squares. Shape and colour are more separable than width and height.

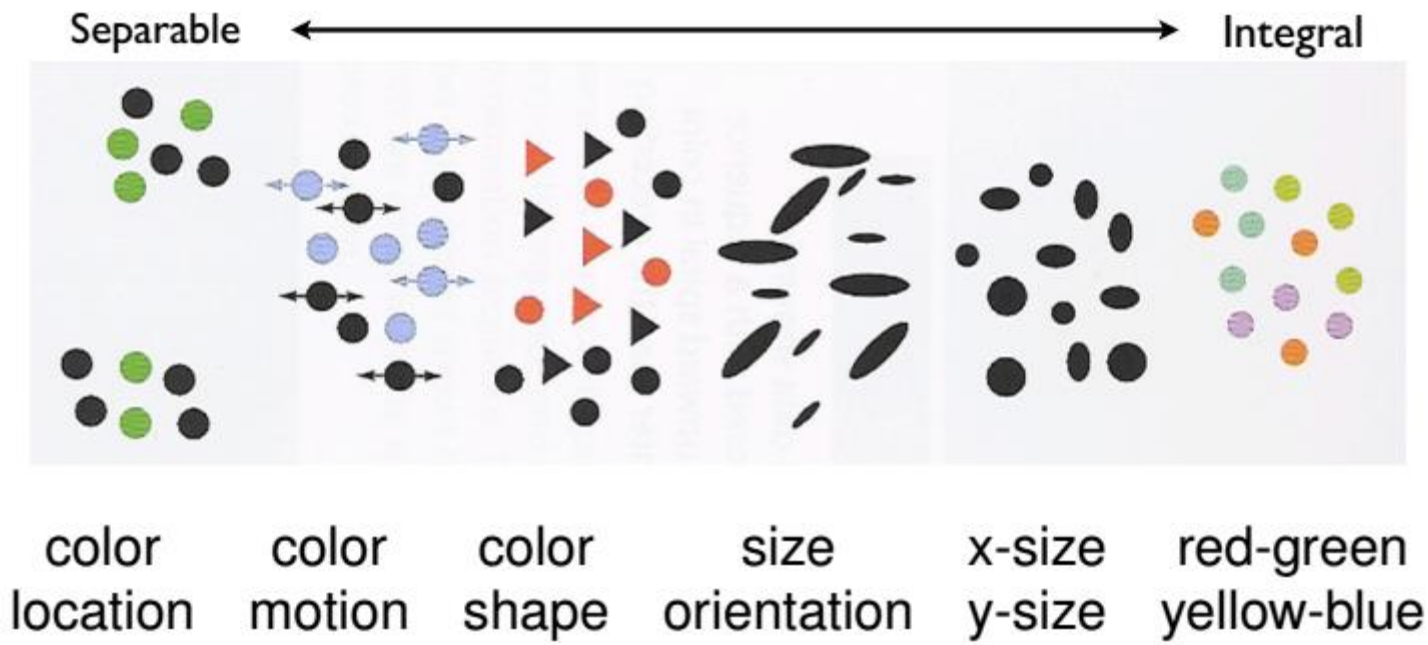


Separability vs. Integrality

- The choice of which visual features are used in conjunction to encode the various data features greatly affects the way their are perceived
- All features influence each other to some extent but some more than others. For instance, if you use colour and size to encode two data variables, the way colour is perceived will be affected by the size of the object
- Two data variabes are integral when they are perceived holistically, that is, it’s hard to visually decode the value of one independently from the other

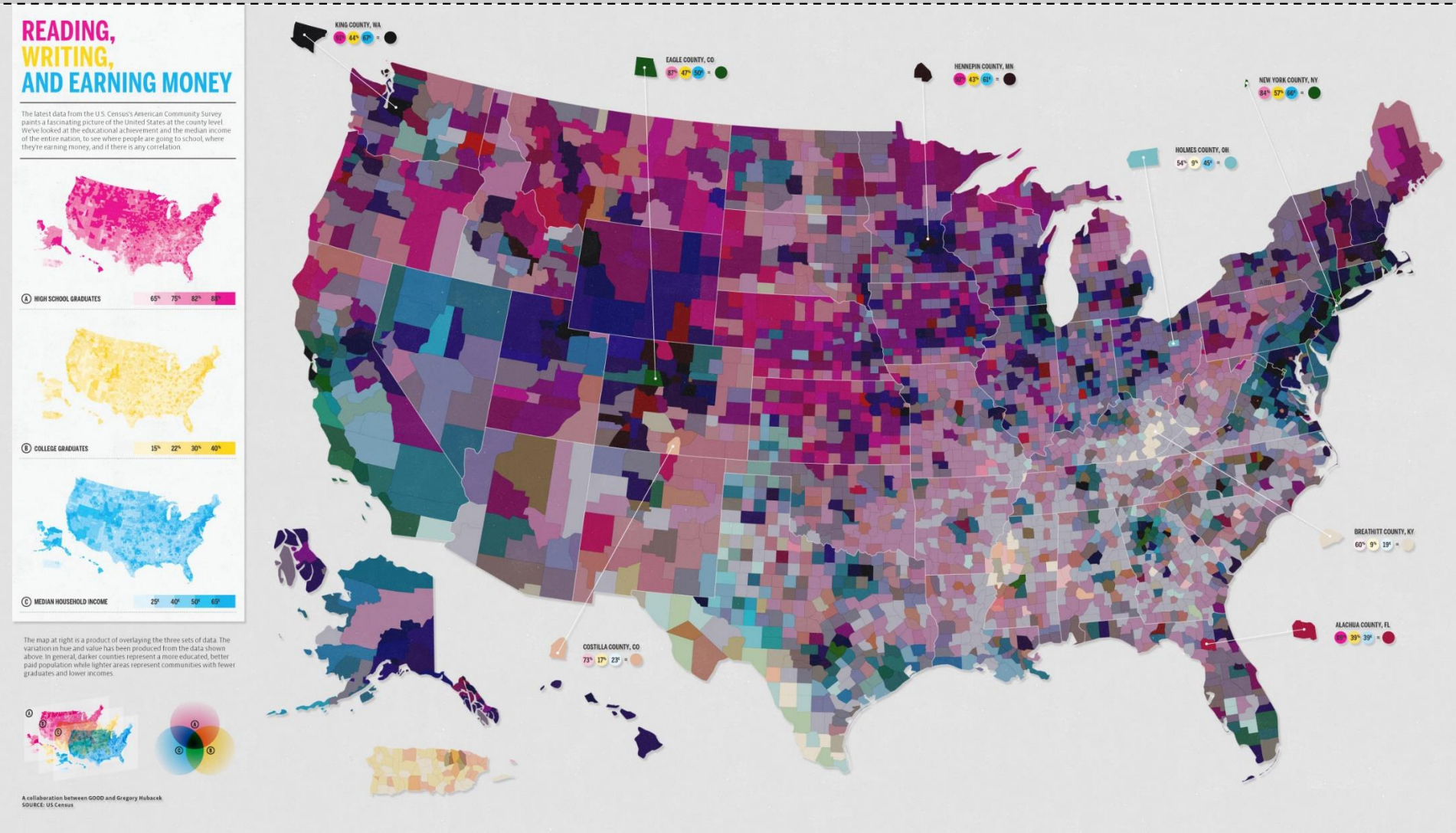
Separability vs. Integrality

Colin Ware ordered the dimensions from the most separable on the left, to the most integral on the right



Ware, "Information Visualization"

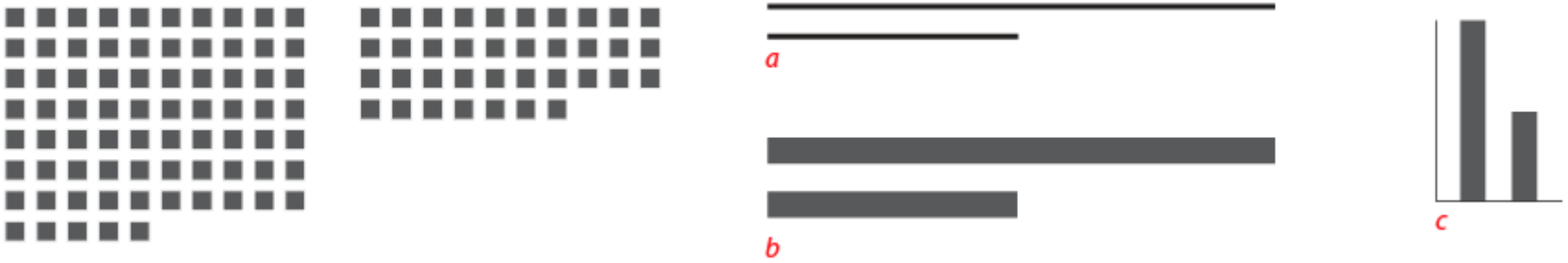
Separability vs. Integrality



Encoding semantics

Graphical Code		Semantics
Small shapes defined by closed contour, texture, color, shaded solid.		Object, idea, entity, node.
Spatially ordered graphical objects.		Related information or a sequence. In a sequence the left-to-right ordering convention borrows from the western convention for written language.
Graphical objects in proximity.		Similar concepts, related information.
Graphical objects having the same shape, color, or texture.		Similar concepts, related information.
Size of graphical object Height of graphical object.		Magnitude, quantity, importance.
Shapes connected by contour.		Related entities, path between entities.
Thickness of connecting contour.		Strength of relationship.
Color and texture of connecting contour.		Type of relationship.
Shapes enclosed by a contour, or a common texture, or a common color.		Contained entities. Related entities.
Nested regions, partitioned regions.		Hierarchical concepts.
Attached shapes.		Parts of a conceptual structure.

Class exercise: Communicate Two Quantities - 75 and 37



45 Ways to Communicate Two Quantities - Santiago Ortiz

Class exercise: Encode

- Small, medium, large
- 10, 20, 30, 15, 30, 45 (Rupees)
- Coffee, Tea
- Hot, Cold
- With sugar, without sugar
- With milk, without milk