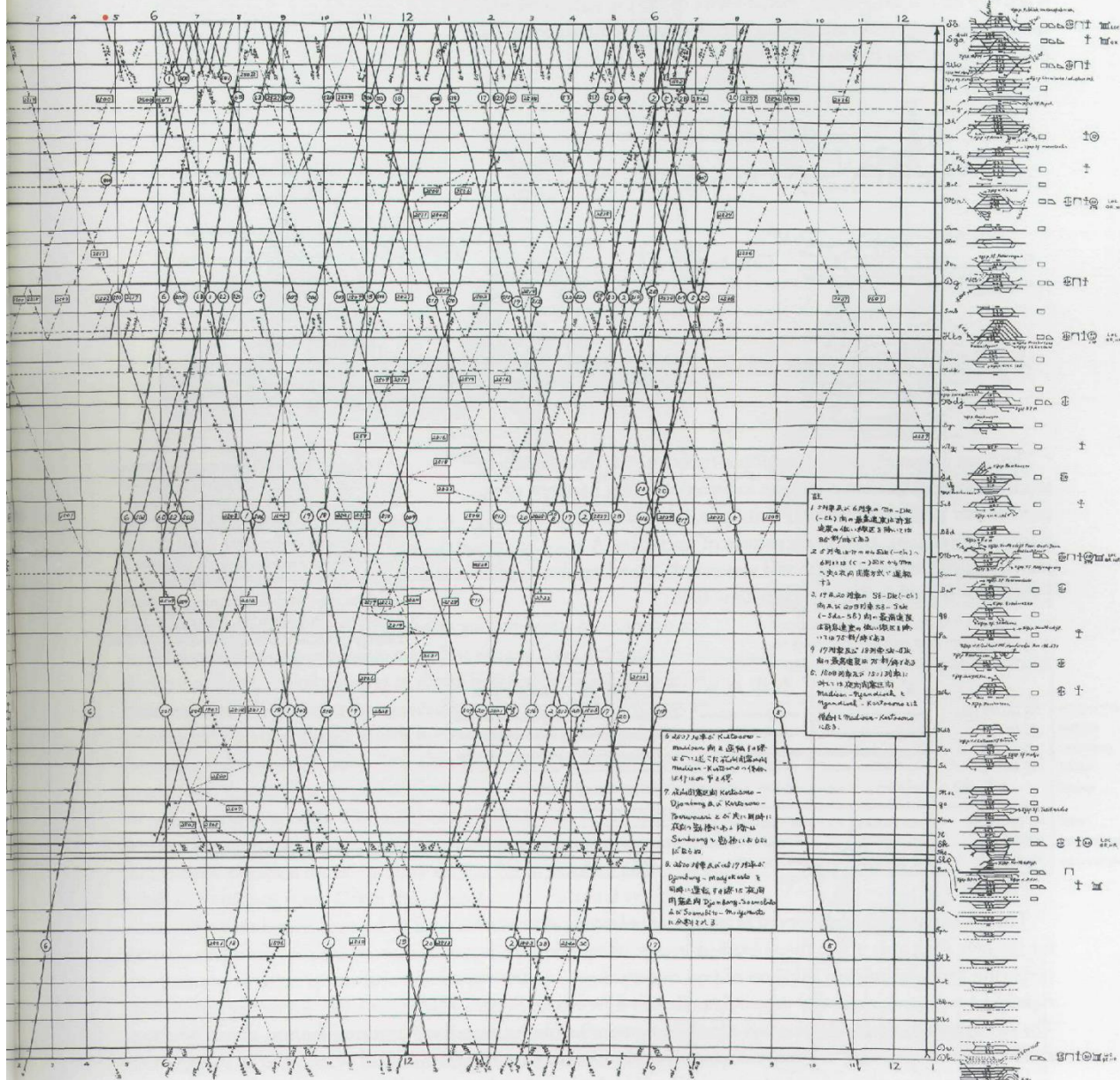


Visual Encoding

ID 413: Information Graphics and Data Visualization
Spring 2016

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venkatra@iitb.ac.in
<http://info-design-lab.github.io/ID413-DataViz/>



◎ 一定の手帳

	定期利率	零存利率	不定期利率	臨時利率
特種利率 銀行、 匯豐、 渣打、 德華(橫濱)				
實收利率 定期、 短期、 活期存款				

$$\text{荆家洼庄} \quad \begin{cases} \beta_{400} = 20.64 - 5.00 \end{cases}$$

akarta.

マタルタ

2示す)

河車休活区画

da 5k 1/2 Egnauk 5k - 75m

da 5k 1/2 " " 75m - 75m

da 5k 1/2 " " 75m - 75m

da 5k 1/2 " " 75m - 75m

da 5k 1/2 " " 75m - 75m

da 5k 1/2 Egnauk

5k - 5k

5k - 5k - 5k

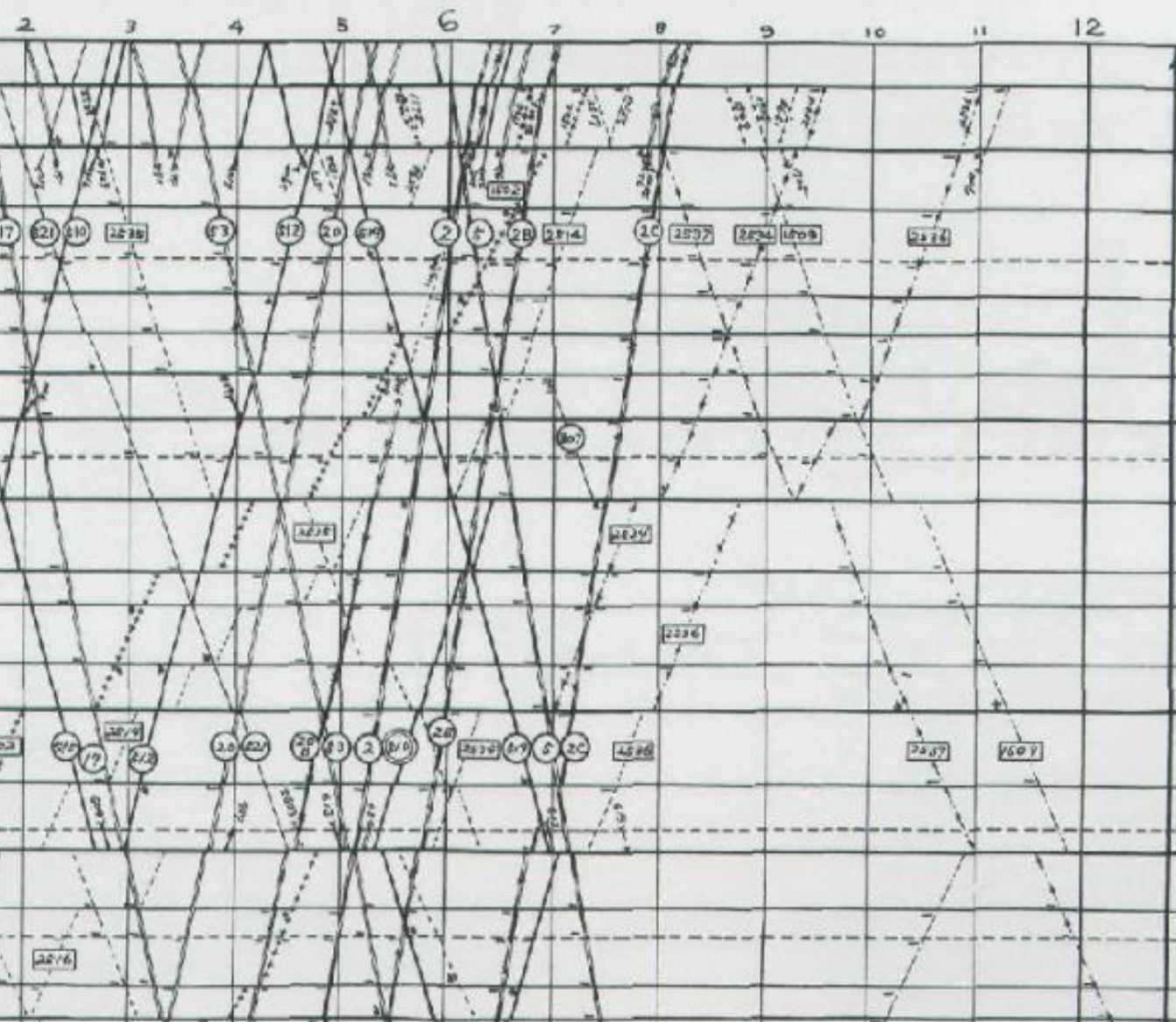
5k - 5k (allman)

5k - 5k (allman)

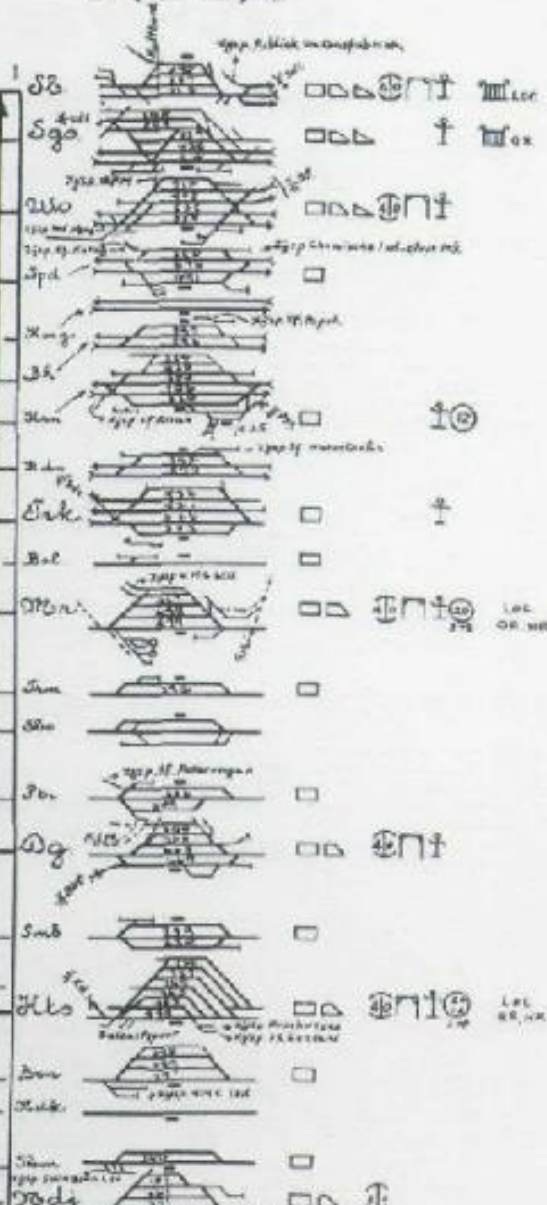
5k - 5k (allman)

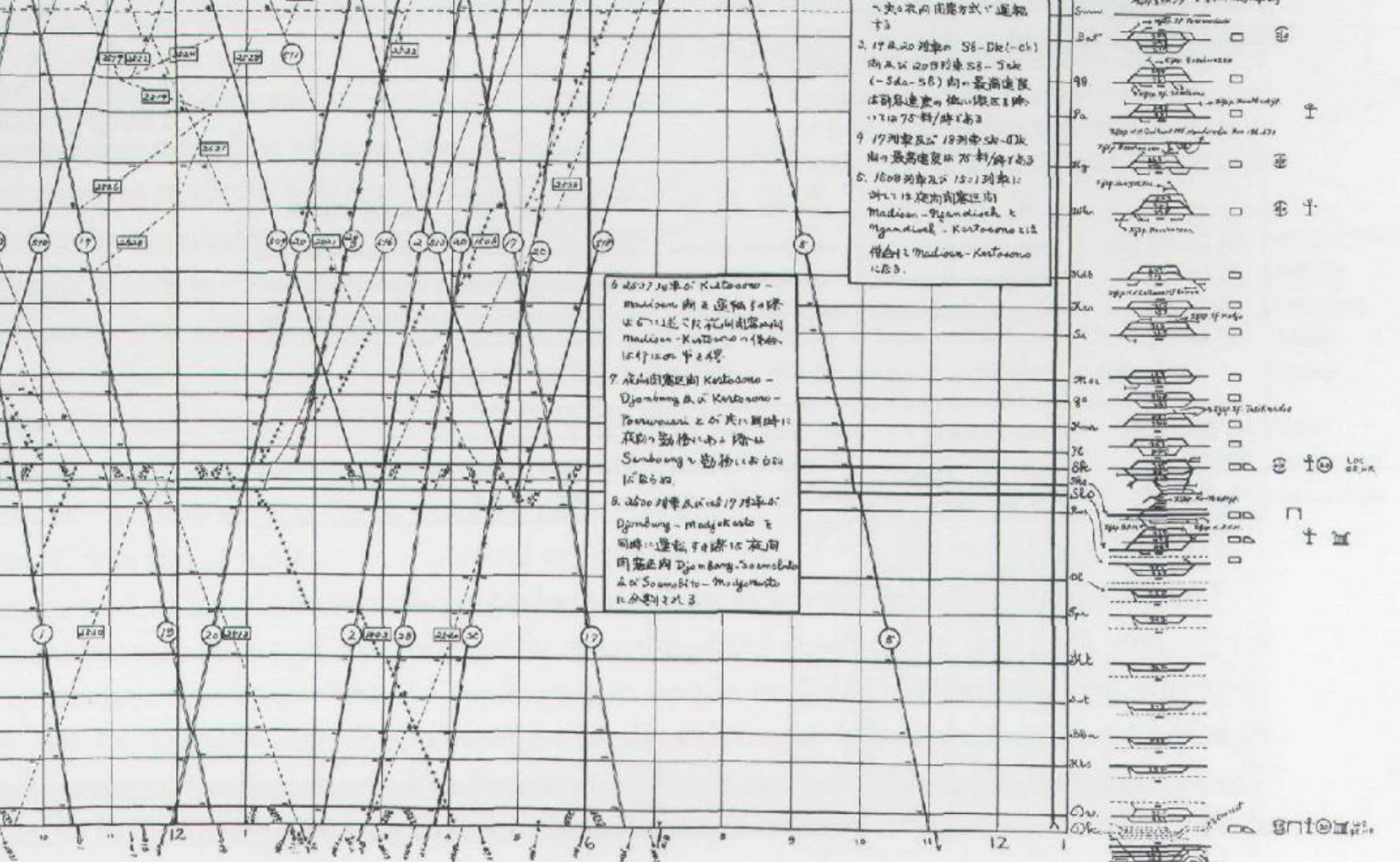
秘

第7表



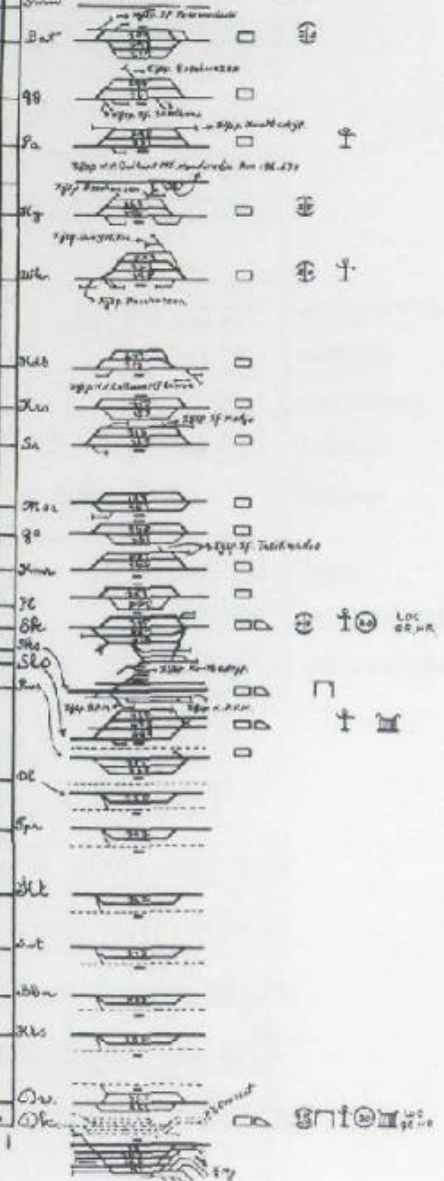
SE 方向 → SW





1. 17及20列車の 58-Dk(-Ch)
 向及 20列車 58-Jsk
 (-5da-58) 向の最高速度
 は時速100kmの低い線区に降
 下して75km/時である
 2. 17列車及び 19列車 58-Dk
 向の最高速度は75km/時である
 3. 18列車及び 15列車 15-Jsk
 向の最高速度は75km/時である
 4. 18列車及び 15列車 15-Jsk
 向の最高速度は75km/時である
 5. 18列車及び 15列車 15-Jsk
 向の最高速度は75km/時である

6. 20列車及び 17列車の
 Madison-Kartasono間の
 最高速度は75km/時である
 Madison-Kartasono間の
 最高速度は75km/時である
 7. 18列車及び 15列車の
 Djombang-Kartasono間の
 最高速度は75km/時である
 Djombang-Kartasono間の
 最高速度は75km/時である
 8. 20列車及び 17列車の
 Djombang-Madagaskar間の
 最高速度は75km/時である
 Djombang-Madagaskar間の
 最高速度は75km/時である



	定期列車	季節列車	不定期列車	臨時列車
特急列車	—	—	—	—
急行	—	—	—	—
普通	—	—	—	—
混合(特快)	—	—	—	—
貨物列車	—	—	—	—
臨時貨物	—	—	—	—

□ 前年プロパティ
 1. 前年プロパティ
 2. 前年プロパティ
 3. 前年プロパティ
 4. 前年プロパティ
 5. 前年プロパティ
 6. 前年プロパティ
 7. 前年プロパティ
 8. 前年プロパティ
 9. 前年プロパティ
 10. 前年プロパティ
 11. 前年プロパティ
 12. 前年プロパティ

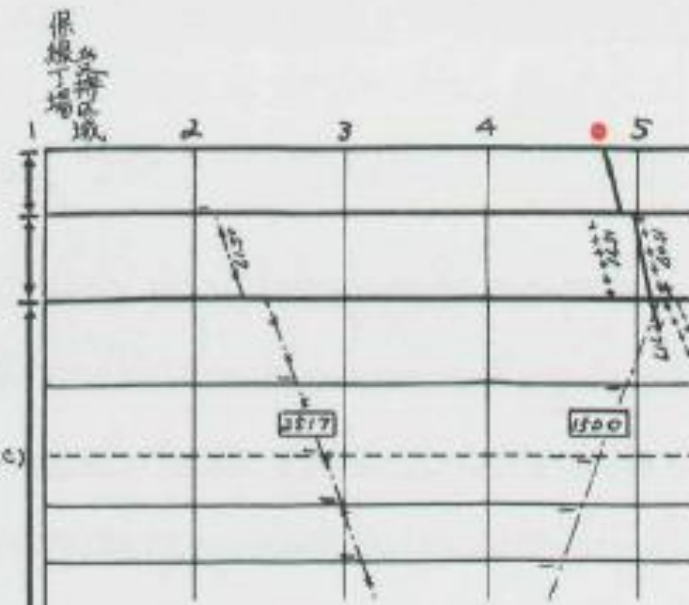
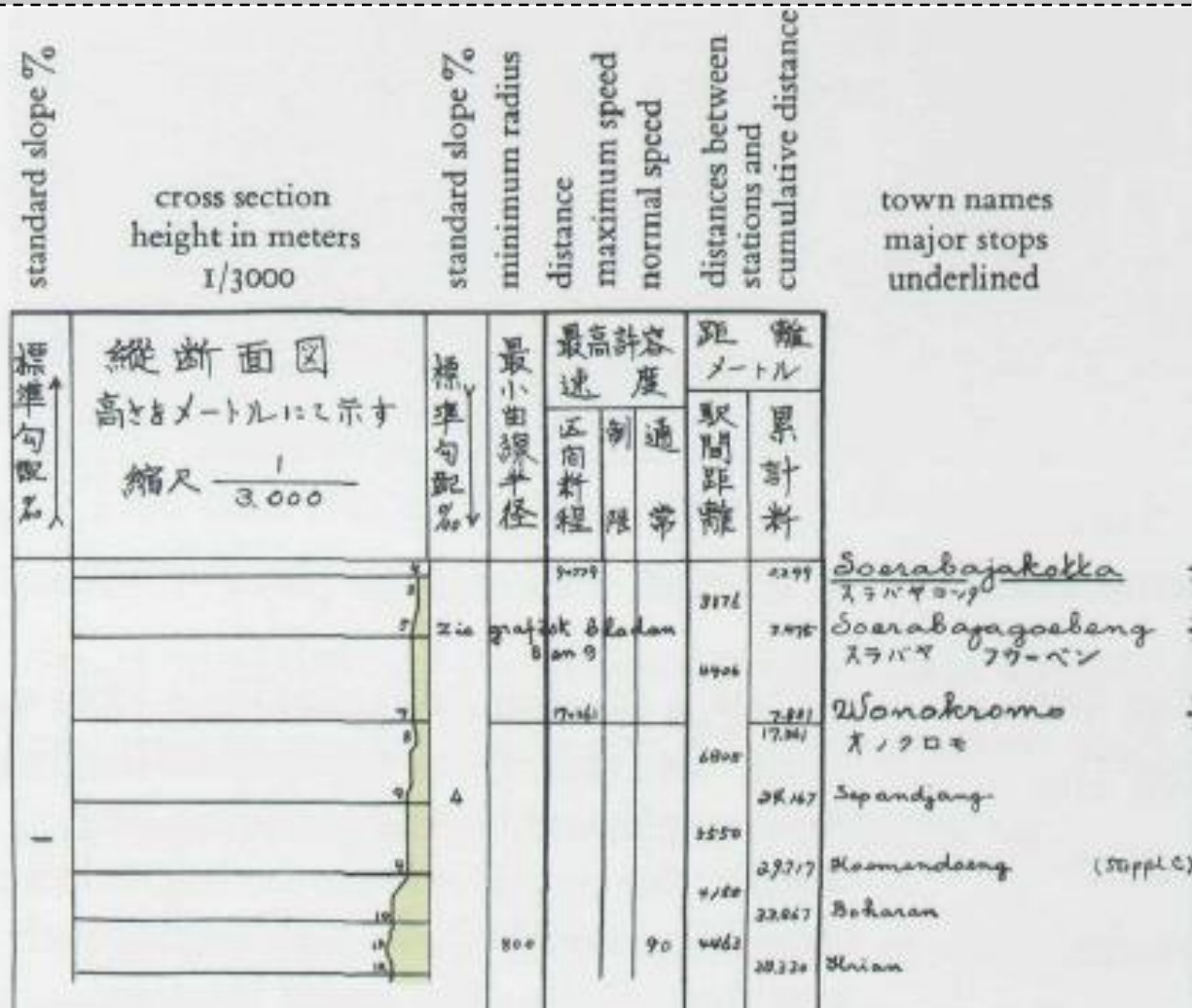
A = 取長所在駅
 B = 駅長不在駅
 C = 駅員不在駅

複線区間
 SB-Jsk

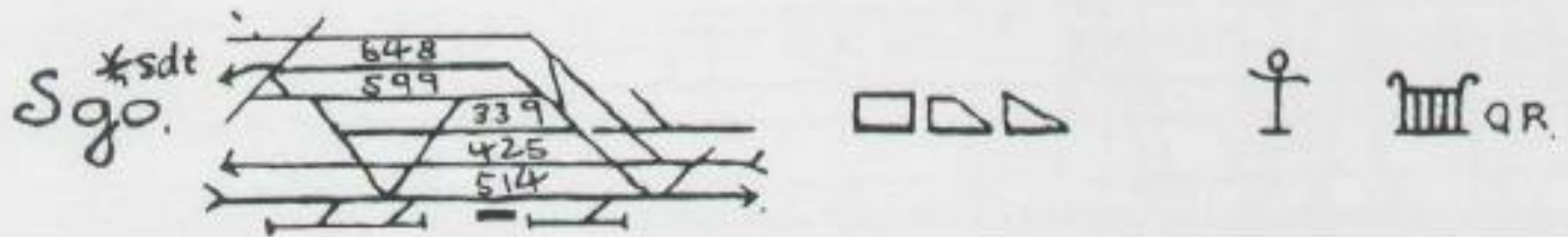
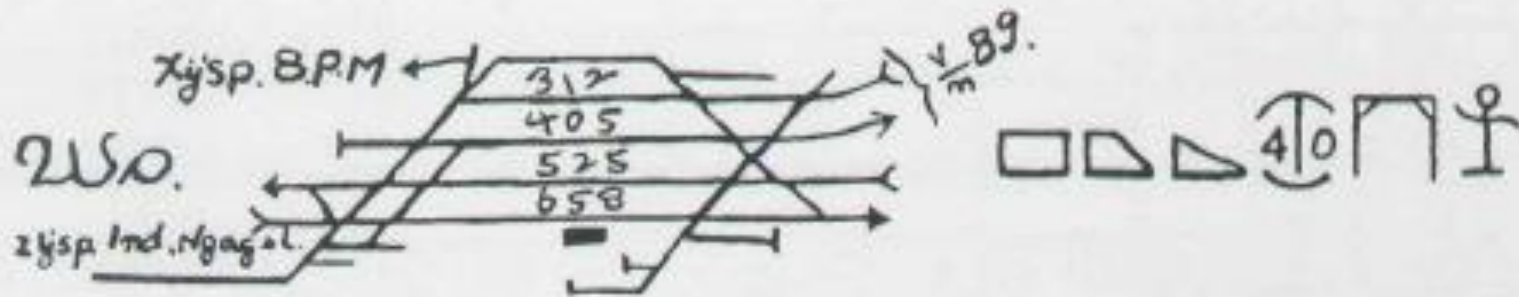
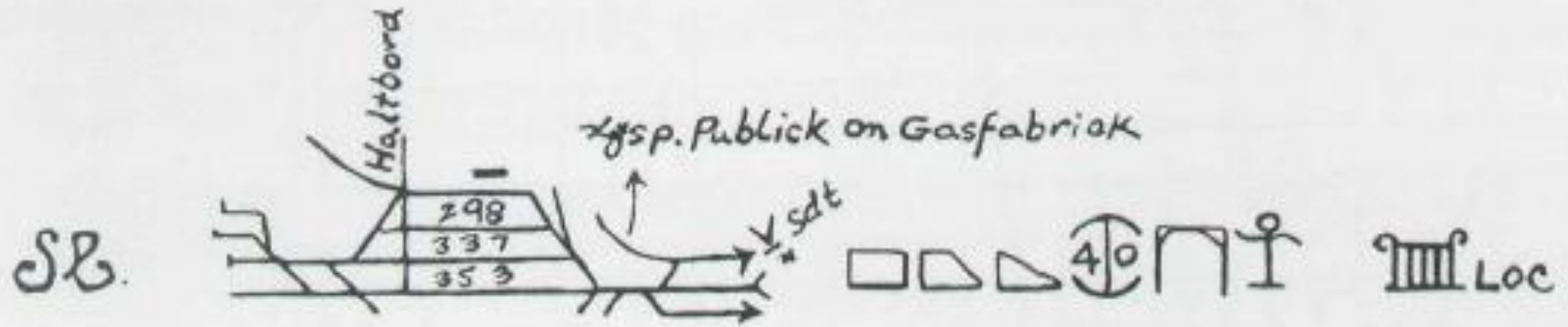
矢の方向は上りの方向を示す
 A 前線区間の方向
 B "

閉塞区間 { Jan - Jsk - 5m
 3m - 4m - 5m - 6m

Soerabaja-Djakarta rail timetable 1937



Soerabaja-Djakarta rail timetable 1937



Soerabaja-Djokjakarta rail timetable 1937

		regular	seasonal	irregular	special
		定期列車	季節列車	不定期列車	臨時列車
super express	特急列車				
express	急行 "				
passenger	旅客 "				
mixed	混合 "				
special	" (特殊)				
cargo	貨物列車				
preferential	職用 "				
night cargo	夜間貨物 "				

Marks and Channels

- marks

- geometric primitives

➞ Points



➞ Lines



➞ Areas



- channels

- control appearance of marks

➞ Position

➞ Horizontal



➞ Vertical



➞ Both



➞ Color



➞ Shape



➞ Tilt



➞ Size

➞ Length



➞ Area



➞ Volume



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

* adapted from Tamara Munzner's VAD book

Channels Rankings

Position on common scale



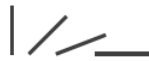
Position on unaligned scale



Length (1D size)



Tilt/angle



Area (2D size)



Depth (3D position)



Color luminance



Color saturation



Curvature



Volume (3D size)



Same

Same

Spatial region



Color hue



Motion




Shape



Channels Rankings

➔ Magnitude Channels: **Ordered** Attributes

Position on common scale 

Position on unaligned scale 

Length (1D size) 

Tilt/angle 

Area (2D size) 

Depth (3D position) 

Color luminance 

Color saturation 

Curvature 

Volume (3D size) 

Same

Same

Best


Effectiveness

Least

➔ Identity Channels: **Categorical** Attributes

Spatial region 

Color hue 

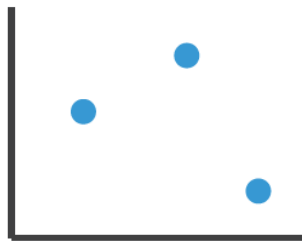
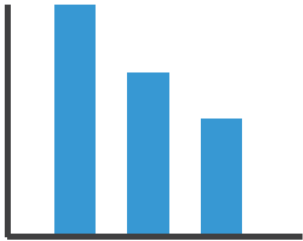
Motion 

Shape 

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

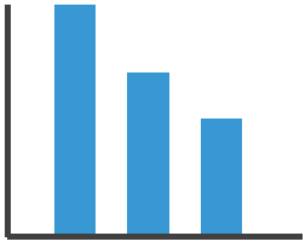
Encoding visually with marks and channels

- analyze idiom structure
 - as combination of marks and channels



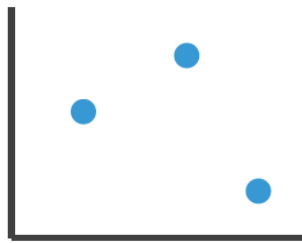
Encoding visually with marks and channels

- analyze idiom structure
 - as combination of marks and channels



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

O = Ordinal, Q = Quantitative
 ≠ = Differences = = Similarities

VARIABLES OF THE IMAGE			POINT	LINE	AREA (ZONE)
XY 2 DIMENSIONS OF THE PLANE					
Z	SIZE	OQ ≠			
	VALUE	O ≠			
DIFFERENTIAL VARIABLES					
	TEXTURE	O ≠			
	COLOR	≠			
	ORIENTATION	≠			
	SHAPE	≠			

William Cleveland and Robert McGill 1984

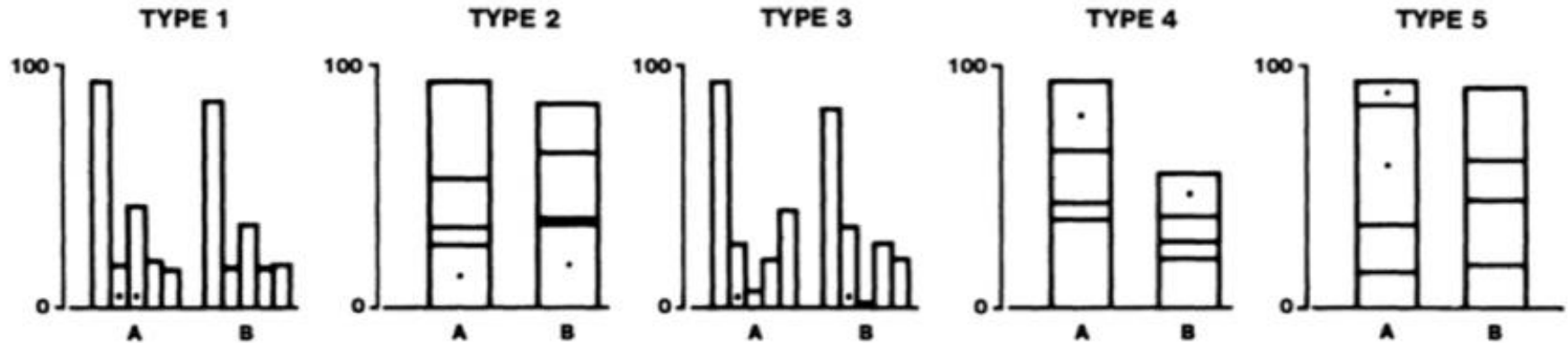


Figure 4. Graphs from position-length experiment.

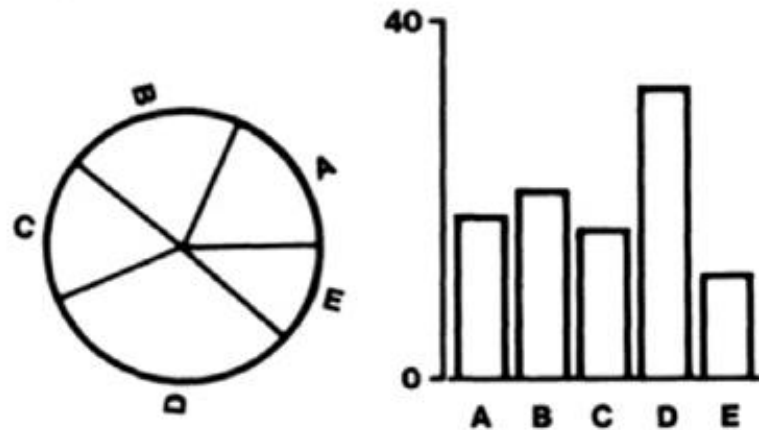
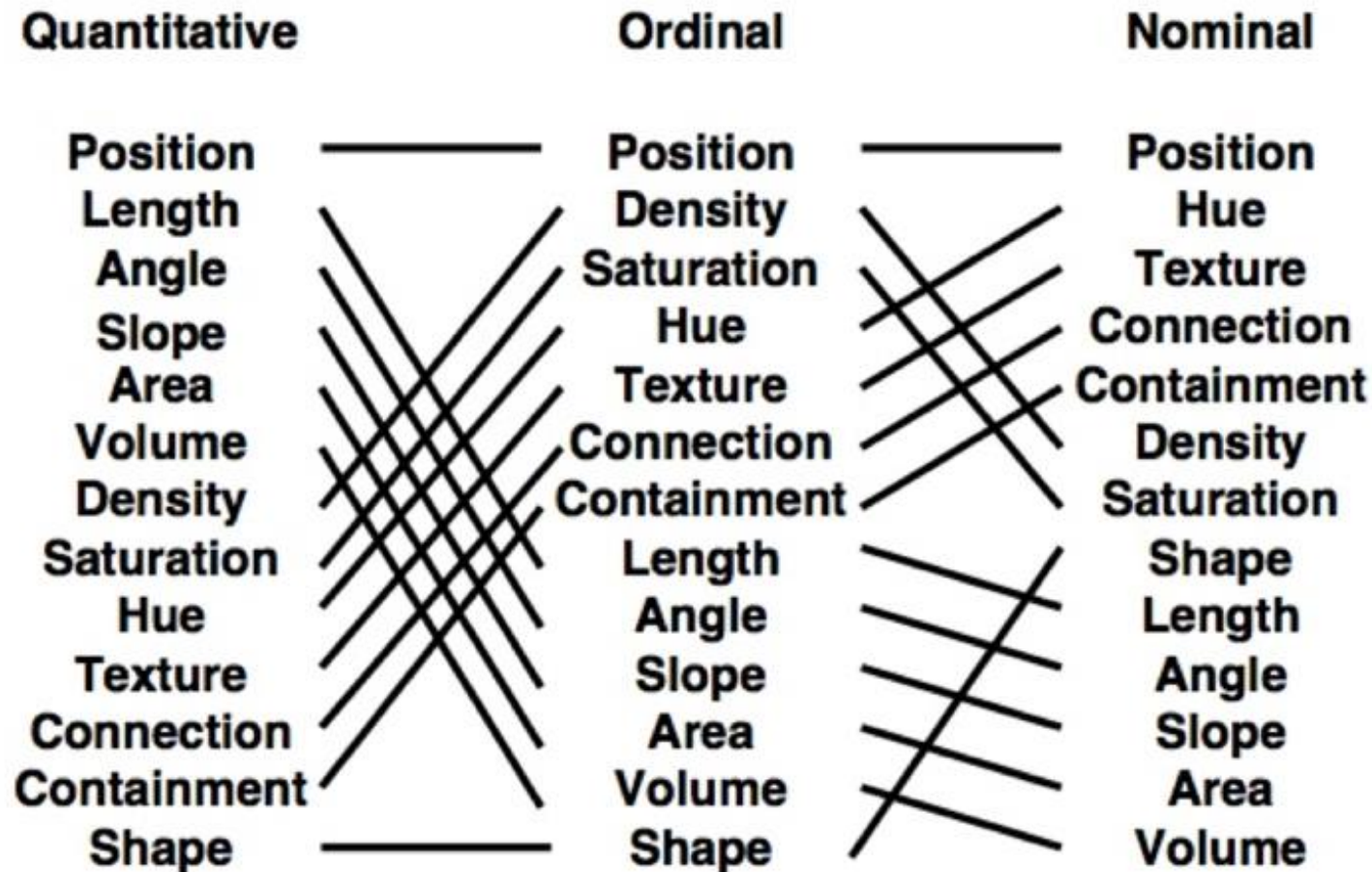


Figure 3. Graphs from position-angle experiment.



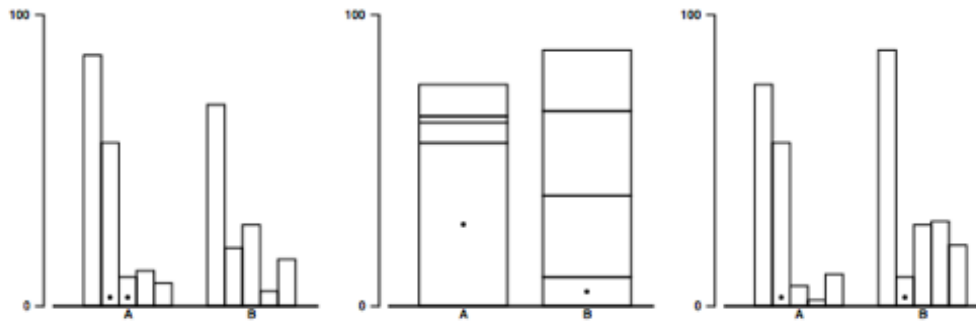


Figure 1: Stimuli for judgment tasks T1, T2 & T3. Subjects estimated percent differences between elements.

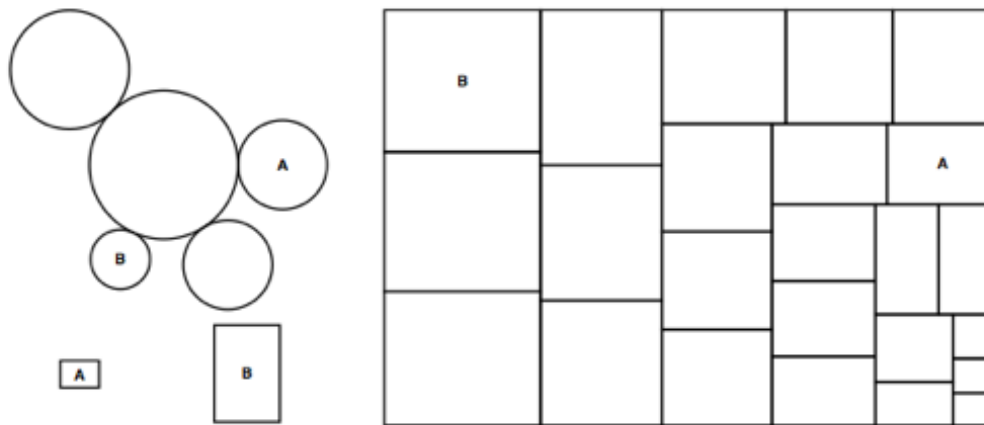



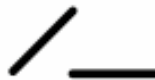








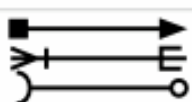



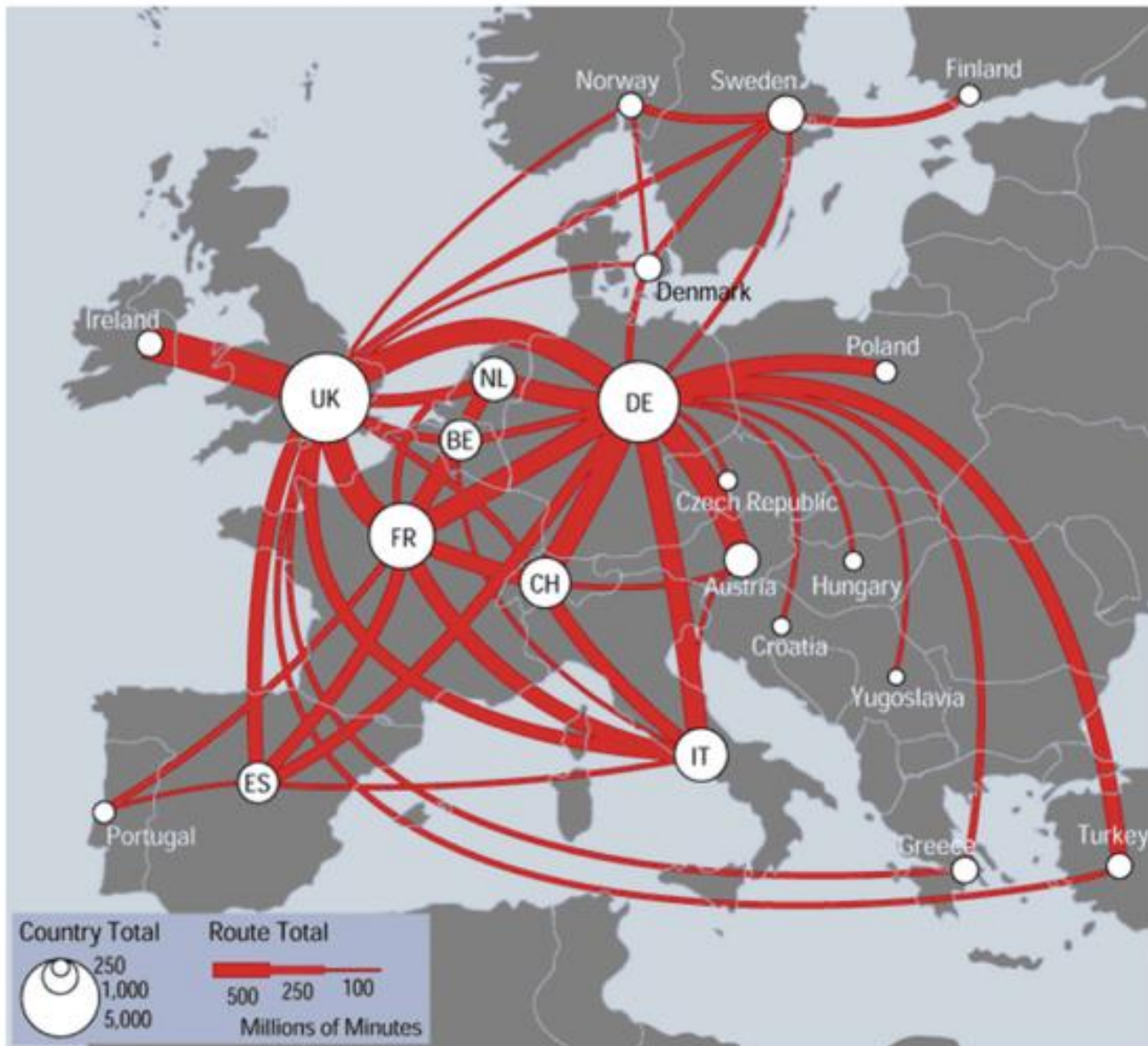
Figure 2: Area judgment stimuli. Top left: Bubble chart (T7), Bottom left: Center-aligned rectangles (T8), Right: Treemap (T9).

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		

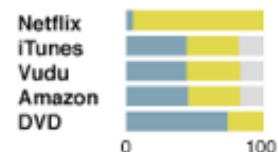
Discriminability: Can channel differences be discerned?



Streaming the Box Office

Top 100 in 2011

■ AVAILABLE
■ NOT AVAILABLE
■ PURCHASE ONLY



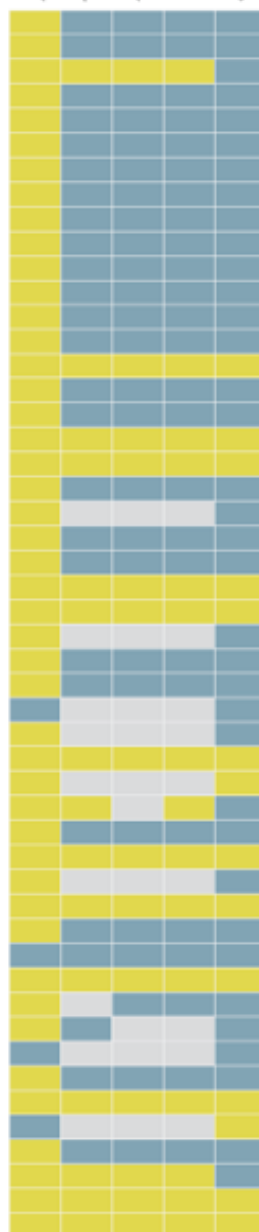
Tristan Louis compiled a list of the top 100 movies at the box office, according to Box Office Mojo, that were available streaming. This is a graphical version of that list.

Source: Tristan Louis
By: Nathan Yau

1-50

- 1 Harry Potter and the Deathly Hallows Part 2
- 2 Transformers: Dark of the Moon
- 3 The Twilight Saga: Breaking Dawn Part 1
- 4 The Hangover Part II
- 5 Pirates of the Caribbean: On Stranger Tides
- 6 Fast Five
- 7 Cars 2
- 8 Thor
- 9 Rise of the Planet of the Apes
- 10 Captain America: The First Avenger
- 11 The Help
- 12 Bridesmaids
- 13 Kung Fu Panda 2
- 14 X-Men: First Class
- 15 Puss in Boots
- 16 Rio
- 17 The Smurfs
- 18 Mission: Impossible — Ghost Protocol
- 19 Sherlock Holmes: A Game of Shadows
- 20 Super 8
- 21 Rango
- 22 Horrible Bosses
- 23 Green Lantern
- 24 Hop
- 25 Paranormal Activity 3
- 26 Just Go With It
- 27 Bad Teacher
- 28 Cowboys & Aliens
- 29 Gnomeo and Juliet
- 30 The Green Hornet
- 31 Alvin and the Chipmunks: Chipwrecked
- 32 The Lion King (in 3D)
- 33 Real Steel
- 34 Crazy, Stupid, Love.
- 35 The Muppets
- 36 Battle: Los Angeles
- 37 Immortals
- 38 Zookeeper
- 39 Limitless
- 40 Tower Heist
- 41 Contagion
- 42 Moneyball
- 43 Justin Bieber: Never Say Never
- 44 Dolphin Tale
- 45 Jack and Jill
- 46 No Strings Attached
- 47 Mr. Popper's Penguins
- 48 Unknown
- 49 The Adjustment Bureau
- 50 Happy Feet Two

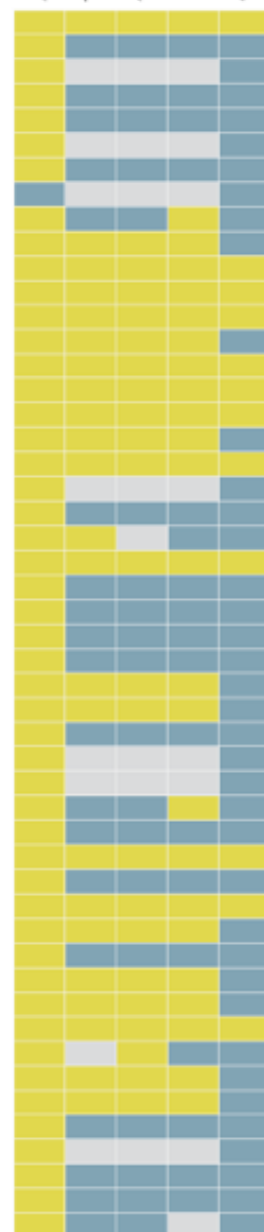
Netflix Amazon iTunes Vudu DVD



51-100

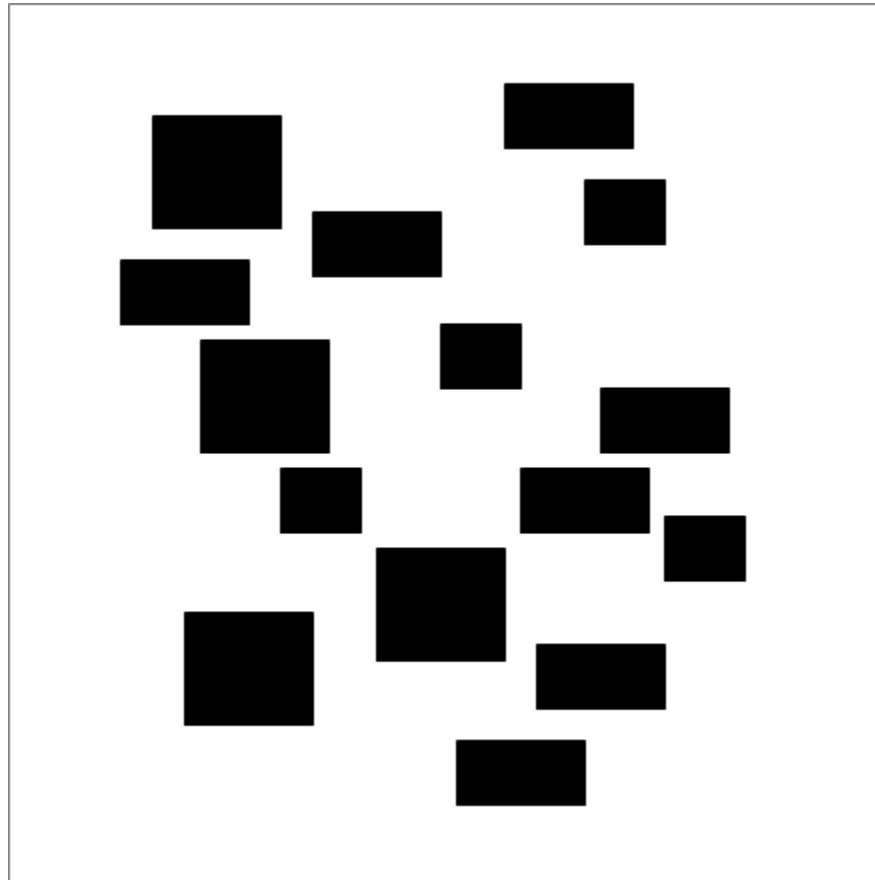
- 51 The Girl with the Dragon Tattoo (2011)
- 52 Water for Elephants
- 53 The Lincoln Lawyer
- 54 Midnight in Paris
- 55 Friends with Benefits
- 56 I Am Number Four
- 57 Source Code
- 58 Insidious
- 59 Tyler Perry's Madea's Big Happy Family
- 60 Diary of a Wimpy Kid: Rodrick Rules
- 61 Footloose (2011)
- 62 The Adventures of Tintin
- 63 Hugo
- 64 The Dilemma
- 65 New Year's Eve
- 66 Arthur Christmas
- 67 War Horse
- 68 Hall Pass
- 69 We Bought a Zoo
- 70 Soul Surfer
- 71 Final Destination 5
- 72 The Ides of March
- 73 The Descendants
- 74 Hanna
- 75 Something Borrowed
- 76 Spy Kids: All the Time in the World
- 77 Scream 4
- 78 Big Mommas: Like Father, Like Son
- 79 Red Riding Hood
- 80 Paul
- 81 The Roommate
- 82 Jumping the Broom
- 83 The Change-Up
- 84 30 Minutes or Less
- 85 In Time
- 86 Colombiana
- 87 J. Edgar
- 88 Sucker Punch
- 89 Larry Crowne
- 90 50/50
- 91 Drive (2011)
- 92 A Very Harold & Kumar 3D Christmas
- 93 Courageous
- 94 The Rite
- 95 Arthur (2011)
- 96 The Debt
- 97 Priest
- 98 The Mechanic
- 99 Abduction
- 100 Beastly

Netflix Amazon iTunes Vudu DVD



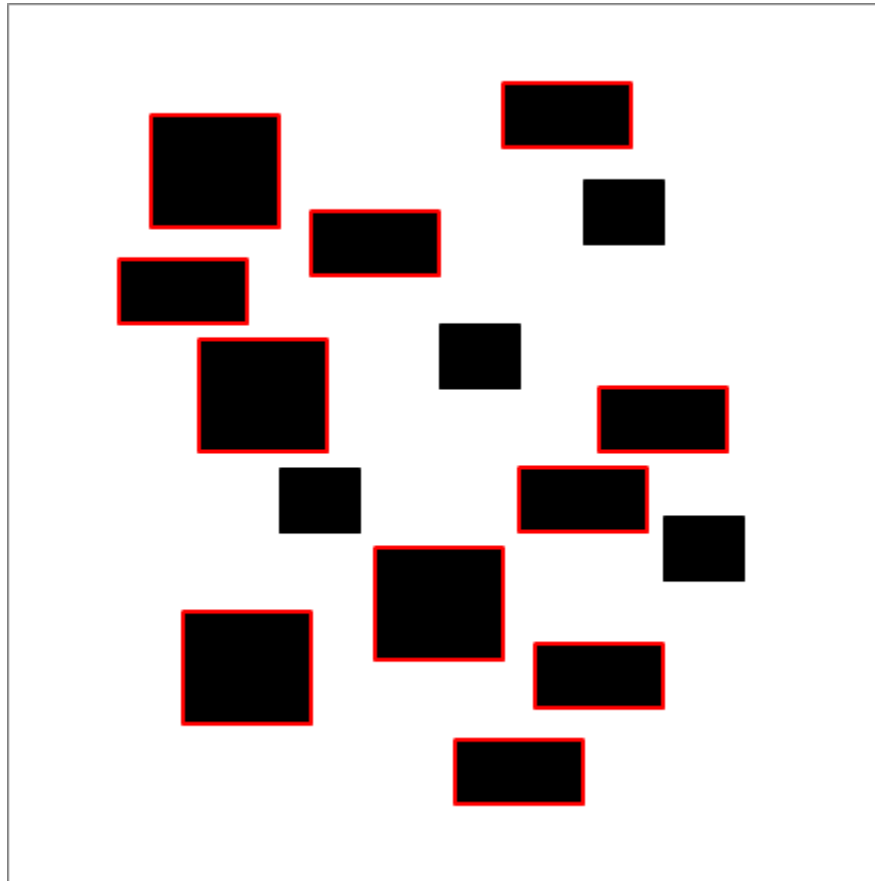
Separability vs. Integrality

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?



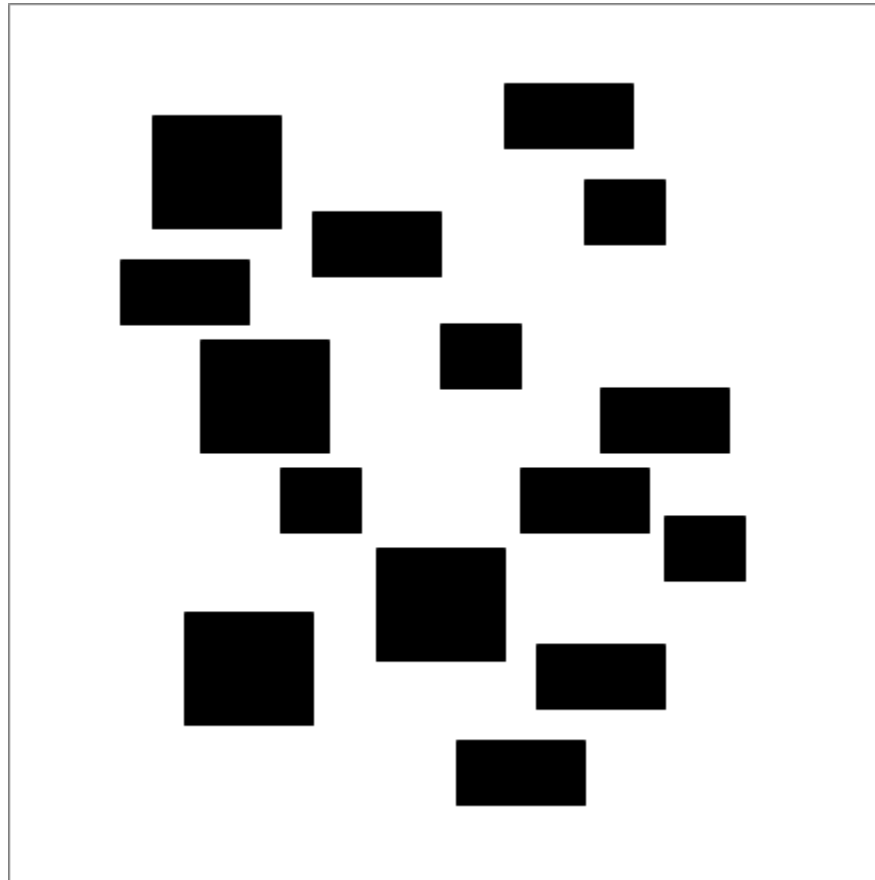
Separability vs. Integrality

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?



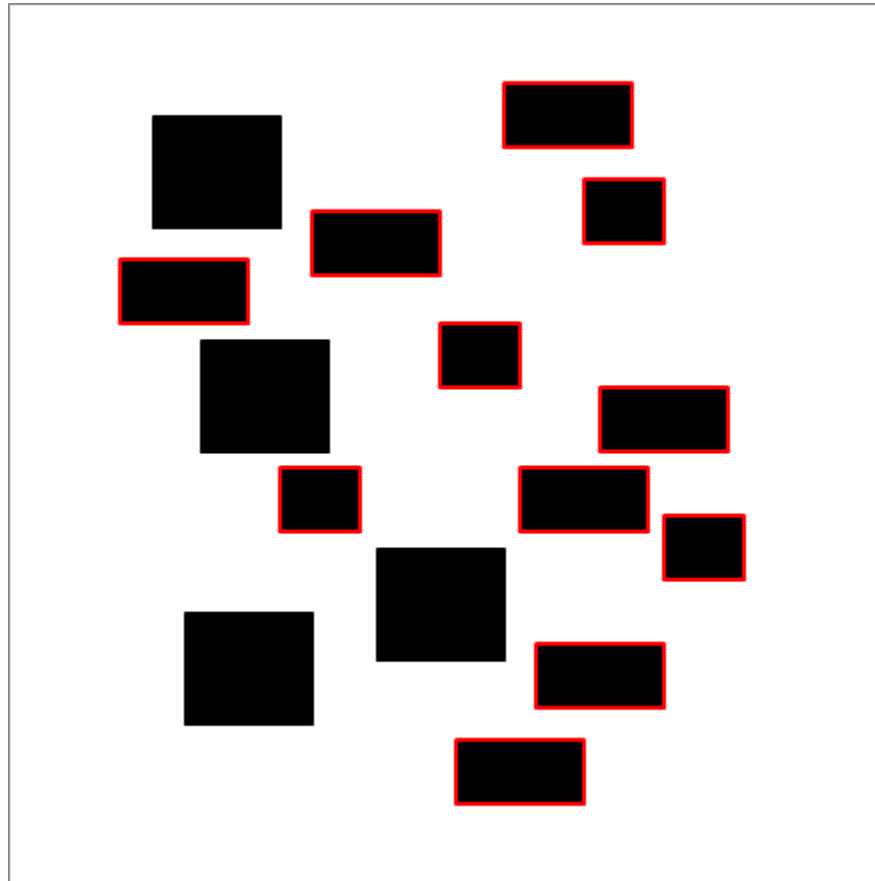
Separability vs. Integrality

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 height?



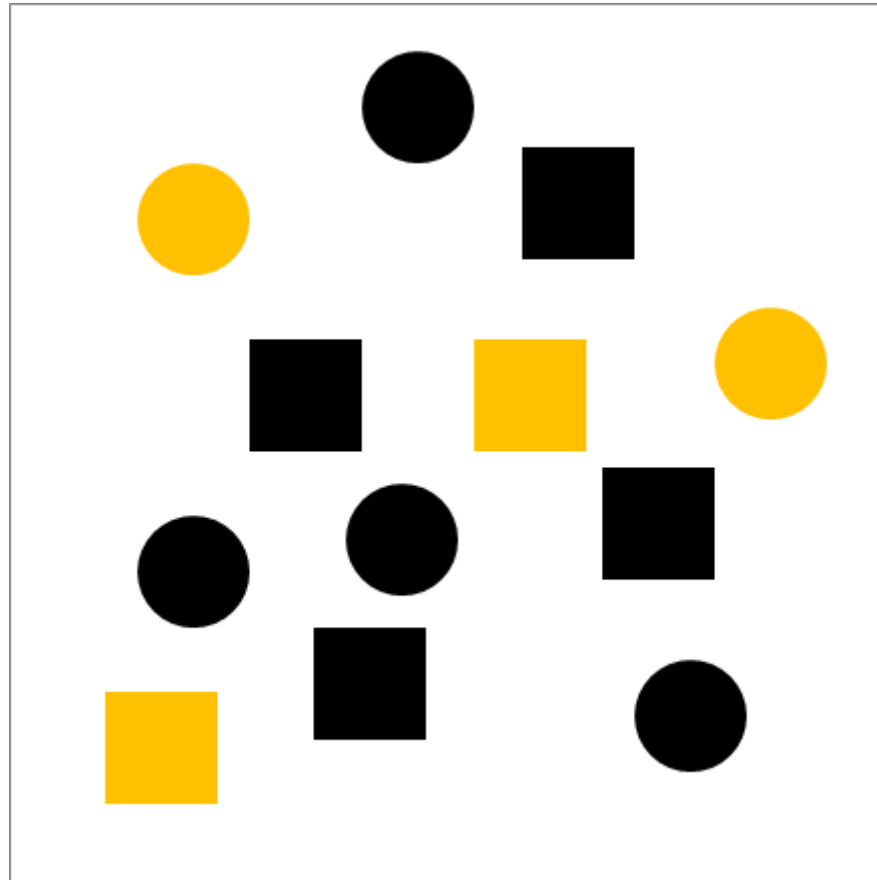
Separability vs. Integrality

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 height?



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.

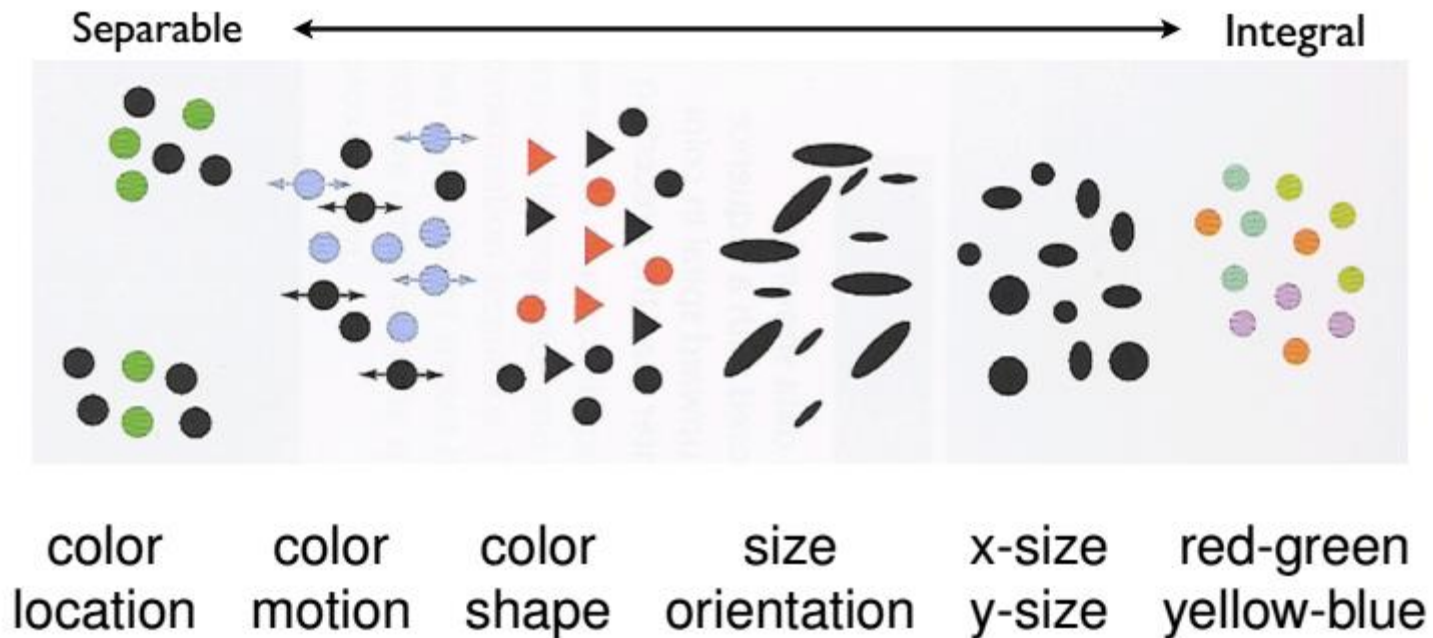


Separability vs. Integrality

- The choice of which visual features are used in conjunction to encode the various data features greatly affects the way they 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 variables 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

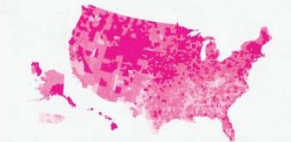
Colin Ware ordered the dimensions from the most separable on the left, to the most integral on the right



Separability vs. Integrality

READING, WRITING, AND EARNING MONEY

The latest data from the U.S. Census's American Community Survey paints a fascinating picture of the United States at the county level. We've looked at the educational achievement and the median income of the entire nation, to see where people are going to school, where they're earning money, and if there is any correlation.



A HIGH SCHOOL GRADUATES 65% 75% 82% 88%



B COLLEGE GRADUATES 15% 22% 30% 40%

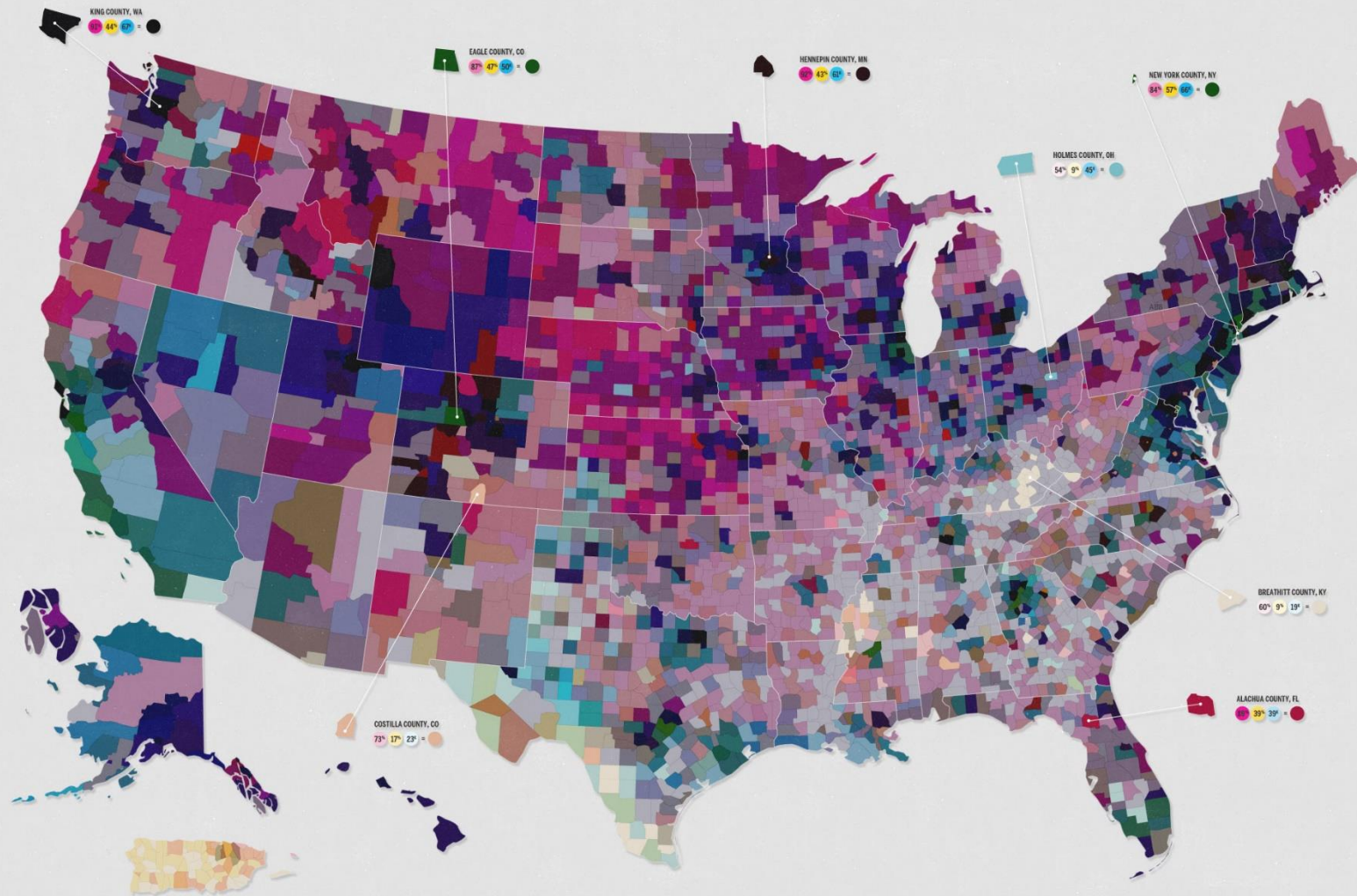


C MEDIAN HOUSEHOLD INCOME 25% 40% 50% 65%

The map at right is a product of overlaying the three sets of data. The variation in hue and value has been produced from the data shown above. In general, darker counties represent a more educated, better paid population while lighter areas represent communities with fewer graduates and lower incomes.



A collaboration between GOOD and Gregory Hebrack
SOURCE: US Census



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

75, 37

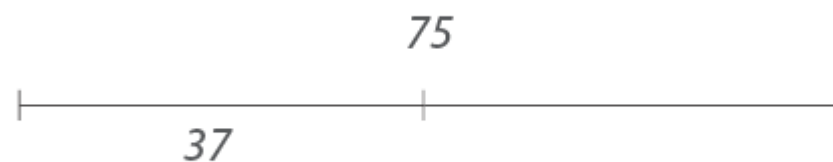
a



b



c



a

b



c

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