

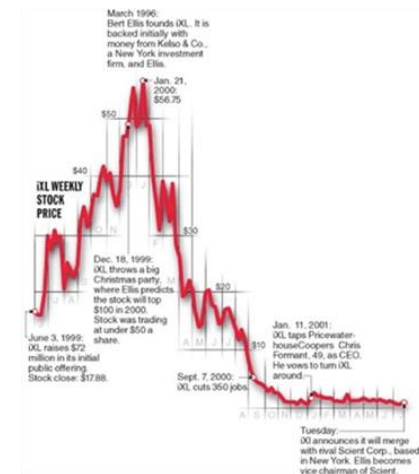
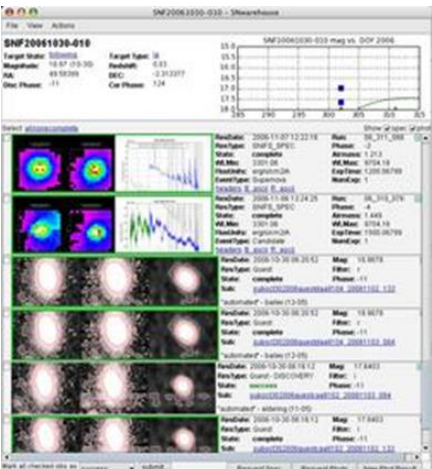
Data Types and Visual Mappings

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[illegible]

Data Types and Visual Mappings

In order to visualize data:

- Map data sets to visual attributes (also known as data encoding)

Process:

1. Classify data types
2. Determine which visual attributes represent data types most effectively

Data Types

- Nominal
- Ordinal
- Quantitative
 - Interval
 - Ratio



Classification of data types: Nominal, ordinal and quantitative

- **N** – Nominal (labels)
 - Fruits: apples, oranges, ...
- **O** – Ordered
 - Quality of meat: Grade A, AA, AAA
- **Q** – Interval (location of zero arbitrary)
 - Dates: Jan 5, 2012; location: (LAT 47 LONG 122)
 - Like a geometric point. Cannot compare directly.
 - Only differences (i.e. intervals) may be compared.
- **Q** – Ratio (zero fixed)
 - Physical measurement: length, mass...
 - Counts and amounts
 - Like a geometric vector, origin is meaningful



[S. S. Stevens, on the theory of scales of measurements, 1946]

Nominal, ordinal and quantitative

- N – Nominal (labels)
 - Operations: =, ne
- O – Ordered
 - Operations: =, ne, <, >, <=, >=
- Q – Interval (location of zero arbitrary)
 - Operations: =, ne, <, >, <=, >=, -
 - Can measure distances or spans
- Q – Ratio (zero fixed)
 - Operations: =, ne, <, >, <=, >=, -, /
 - Can measure ratios or proportions

[S. S. Stevens, on the theory of scales of measurements, 1946]

Exercise

- Which of these data types are nominal, ordinal, or quantitative?

Microsoft Excel - fischer.iris.2.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

A1 fx ID

	A	B	C	D	E	F	G	H	I	J
1	ID	Case	Species_No	Species	Organ	Width	Length			
2	1	1	1	I. Setosa	Petal	2	14			
3	2	1	3	I. Verginica	Petal	24	56			
4	3	1	2	I. Versicolor	Petal	13	45			
5	4	1	1	I. Setosa	Sepal	33	50			
6	5	1	3	I. Verginica	Sepal	31	67			
7	6	1	2	I. Versicolor	Sepal	28	57			
8	7	2	1	I. Setosa	Petal	2	10			
9	8	2	3	I. Verginica	Petal	23	51			
10	9	2	2	I. Versicolor	Petal	16	47			
11	10	2	1	I. Setosa	Sepal	36	46			
12	11	2	3	I. Verginica	Sepal	31	69			
13	12	2	2	I. Versicolor	Sepal	33	63			
14	13	3	1	I. Setosa	Petal	2	16			
15	14	3	3	I. Verginica	Petal	20	52			
16	15	3	2	I. Versicolor	Petal	14	47			
17	16	3	1	I. Setosa	Sepal	31	48			
18	17	3	3	I. Verginica	Sepal	30	65			
19	18	3	2	I. Versicolor	Sepal	32	70			
20	19	4	1	I. Setosa	Petal	1	14			
21	20	4	3	I. Verginica	Petal	19	51			
22	21	4	2	I. Versicolor	Petal	12	40			
23	22	4	1	I. Setosa	Sepal	36	49			
24	23	4	3	I. Verginica	Sepal	27	58			
25	24	4	2	I. Versicolor	Sepal	26	58			
26	25	5	1	I. Setosa	Petal	2	13			
27	26	5	3	I. Verginica	Petal	17	45			
28	27	5	2	I. Versicolor	Petal	10	33			
29	28	5	1	I. Setosa	Sepal	32	44			
30	29	5	3	I. Verginica	Sepal	25	49			
31	30	5	2	I. Versicolor	Sepal	23	50			
32	31	6	1	I. Setosa	Petal	2	16			

fischer.iris

Ready

Sepal and petal lengths and widths for three species of iris [Fisher 1936]

Microsoft Excel - fischer.iris.2.colored.xls

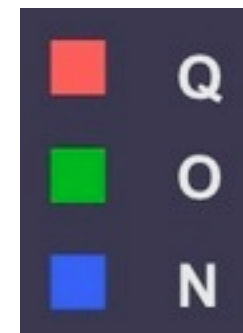
File Edit View Insert Format Tools Data Window Help Type a question for help

H270 fx

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fischer.iris

Ready



[slide adapted from Maneesh Agrawala]

Mapping Data Types to Visual Attributes

Bertin's Visual Attributes

- Position
 - Size
 - Value
 - Texture
 - Color
 - Orientation
 - Shape
- Note: Bertin does not consider 3D or time; Card and Mackinlay extend the number of variables

LES VARIABLES DE L'IMAGE											
POINTS			LIGNES			ZONES					
XY 2 DIMENSIONS DU PLAN											
Z TAILLE											
VALEUR											
LES VARIABLES DE SÉPARATION DES IMAGES											
GRAIN											
COULEUR											
ORIENTATION											
FORME											

Bertin, *Semiology of Graphics*, 1967, 1983

Bertins' "Levels of Organization"

Position

N	O	Q
---	---	---

Size

N	O	Q
---	---	---

Value

N	O	Q
---	---	---

Texture

N	o	
---	---	--

Color

N		
---	--	--

Orientation

N		
---	--	--

Shape

N		
---	--	--

N Nominal

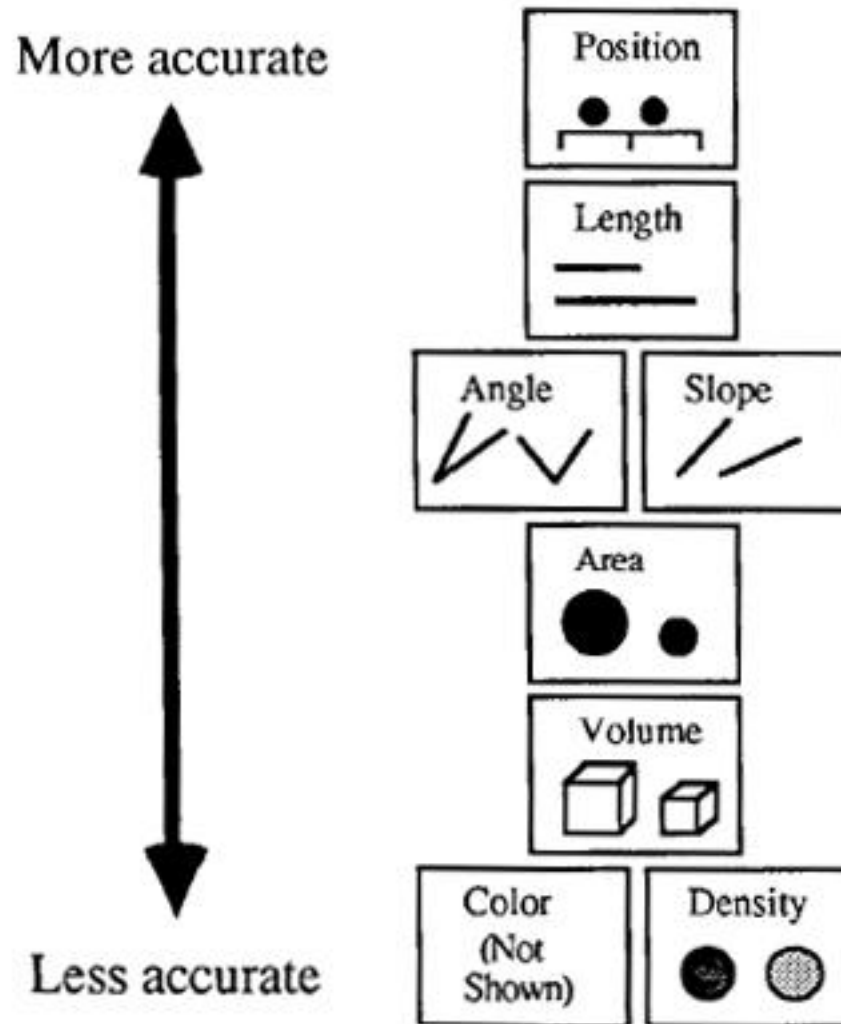
O Ordered

Q Quantitative

Note: $Q < O < N$

Note: Bertin actually breaks visual variables down into differentiating (\neq) and associating (\equiv)

Perceptual properties



Mackinlay, APT (A Presentation Tool), 1986

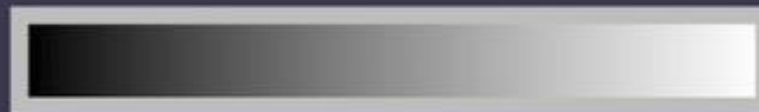
Information in color and value

Value is perceived as ordered

∴ Encode ordinal variables (O)



∴ Encode continuous variables (Q) [not as well]



Hue is normally perceived as unordered

∴ Encode nominal variables (N) using color

