Information Visualization

Daniel Gonçalves, Sandra Gama

03

Marks, Channels & Color

Get Ready…

http://etc.ch/6ty7

01

VISUAL FUNDAMENTALS

Find “3”

189285710985784012974275364986418576 20

Find “3”

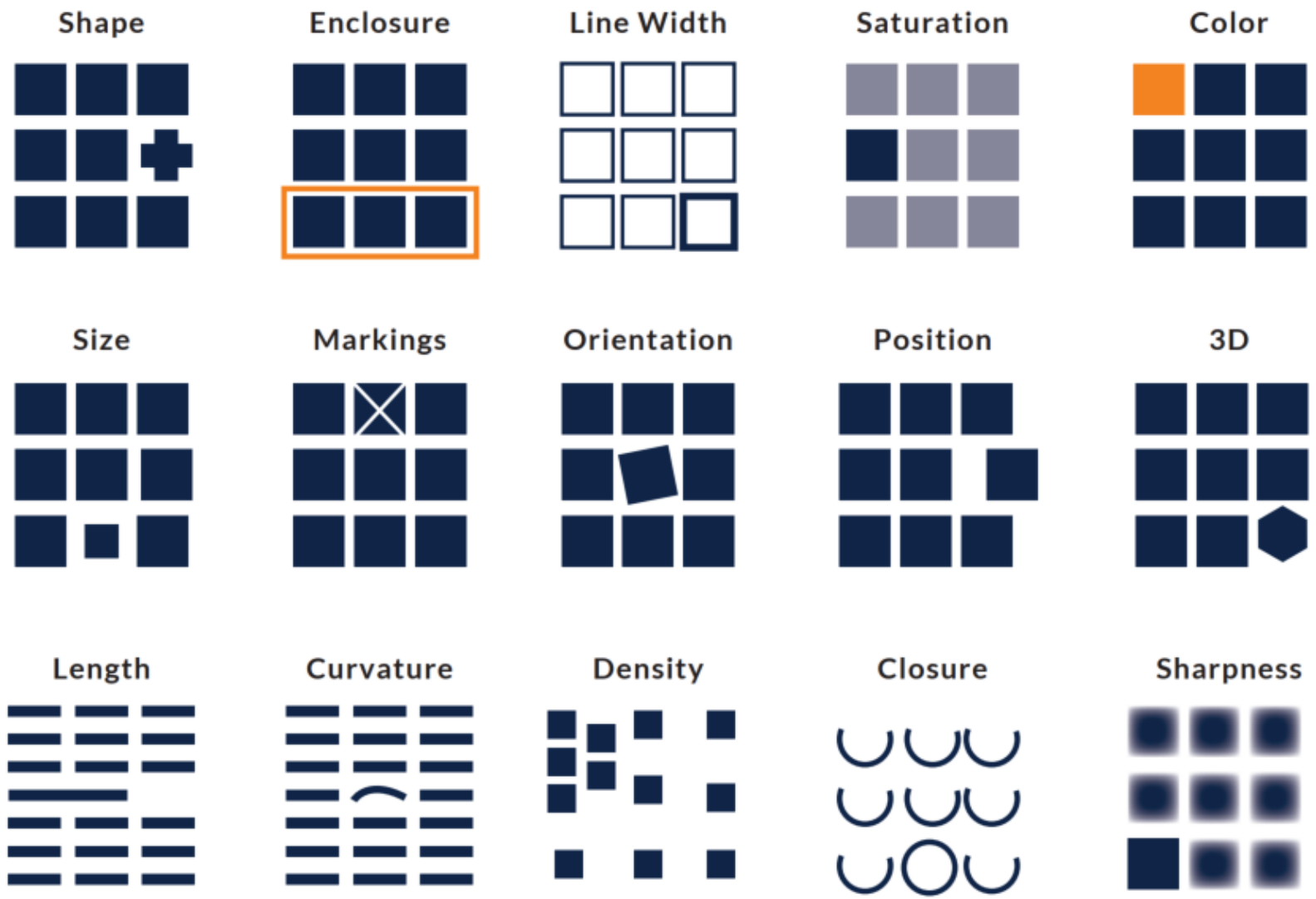
189285710985784012974275364986418576 20

Direct Poll

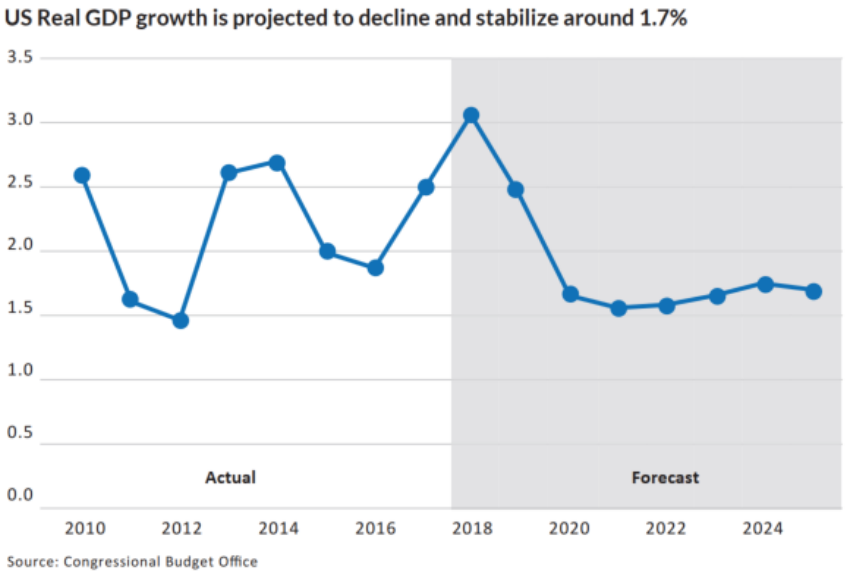
Let’s play a game!

https://bit.ly/3qA6oki

Plenty are preattentive!



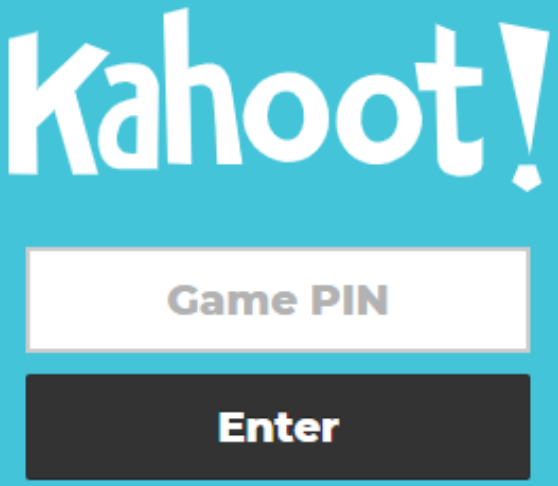
Use them in Viz!



02

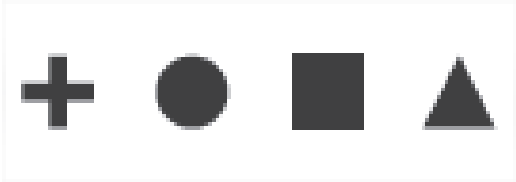
MARKS

Dimensional Troubles…



There are, of course, variants

A 0D mark needs not be circular



An 1D mark needs not be a simple line

Direct Poll

03

CHANNELS

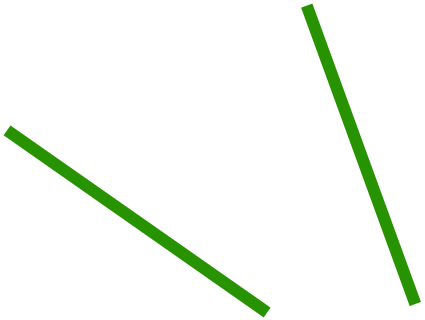
(Some) Channels

Where is one the double of the other?

A

B

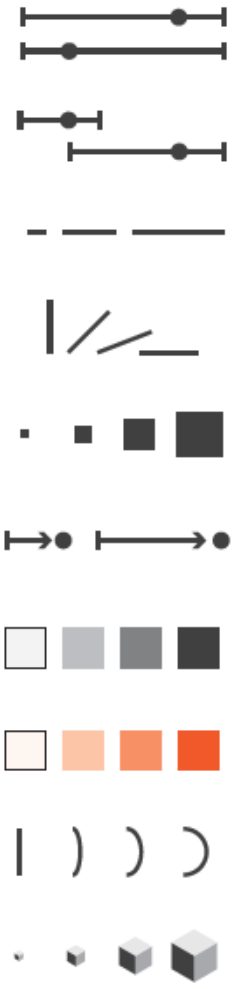
C



Applicability

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)



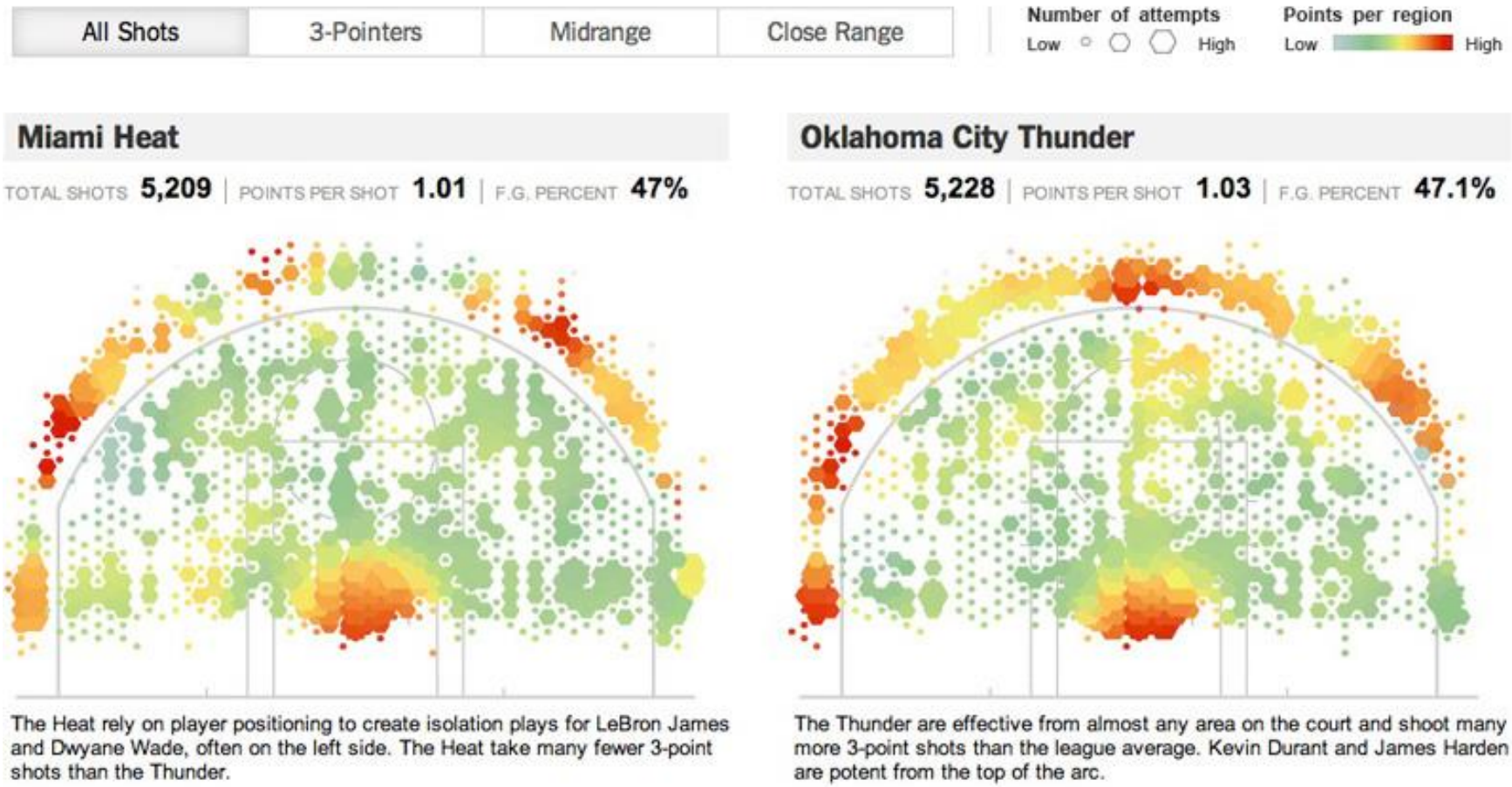
Identity Channels: Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape

Breakout!

1. Encodings Here?

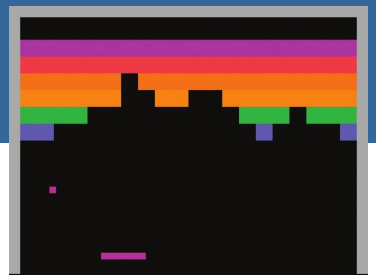
http://www.nytimes.com/interactive/2012/06/11/sports/basketball/nba-shot-analysis.html



The Heat rely on player positioning to create isolation plays for LeBron James and Dwyane Wade, often on the left side. The Heat take many fewer 3-point shots than the Thunder.

The Thunder are effective from almost any area on the court and shoot many more 3-point shots than the league average. Kevin Durant and James Harden are potent from the top of the arc.

2. How would you encode it?



Item Type	*Quantity*
Features	3
Bugs	5
User Stories	6

What are the different attribute types?

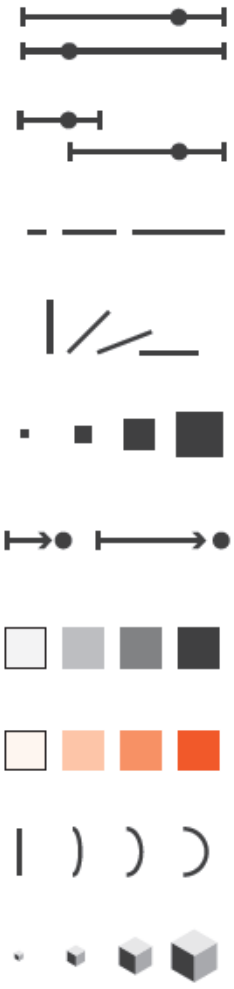
Which channels would you choose for each?

Sketch a vis using those channels

Applicability

Magnitude Channels: Ordered Attributes

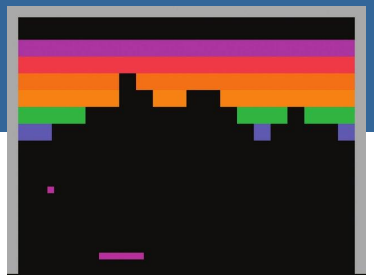
- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)



Identity Channels: Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape

Time to Break Out



Discuss among yourselves

Fill in the questionnaire

(images and links for sketching there)

Do it ONCE PER BREAKOUT GROUP

https://bit.ly/3BB3imf

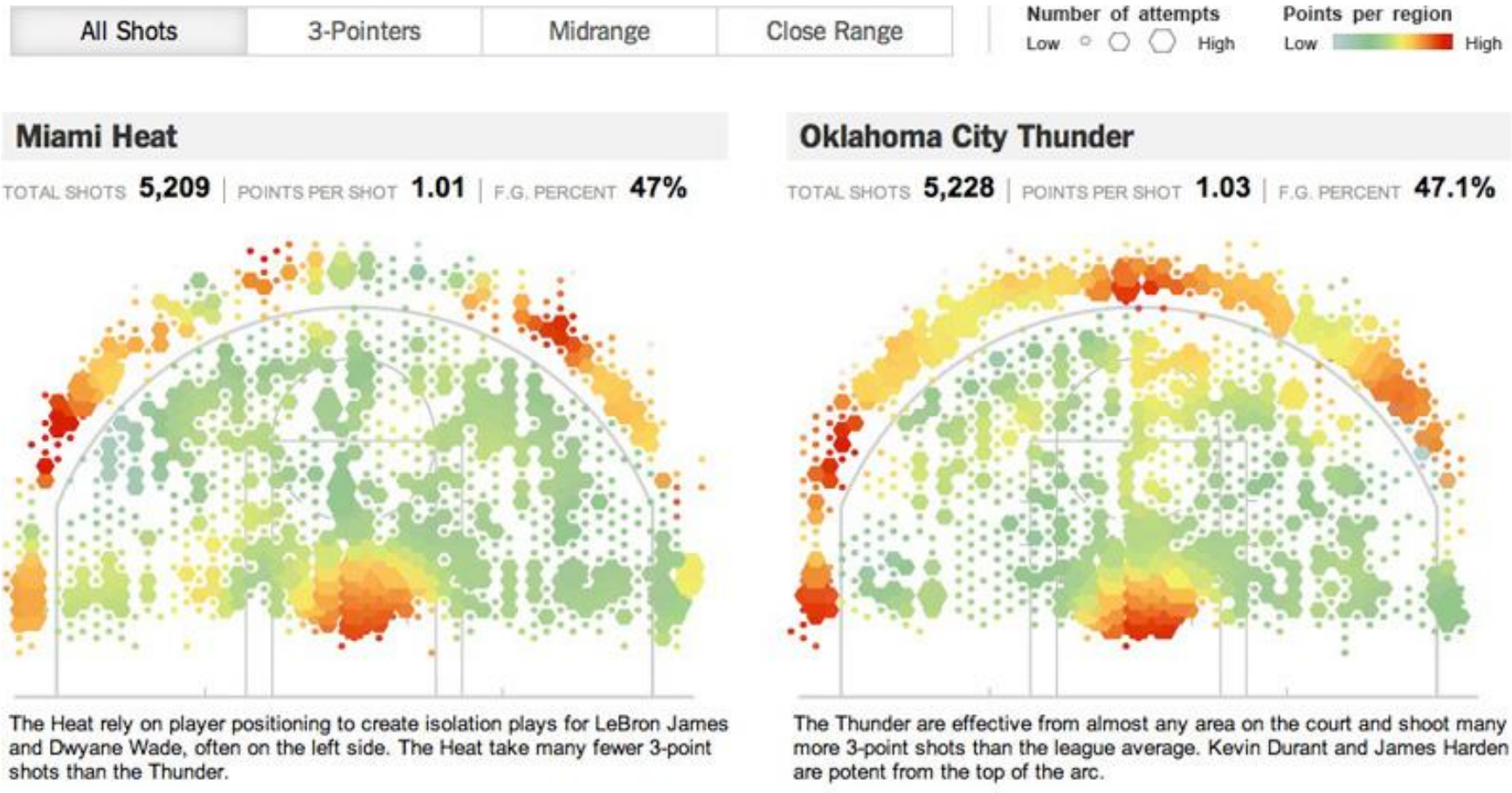
Report back in 10 minutes!

10:00

https://bit.ly/3BB3imf

Encodings Here?

http://www.nytimes.com/interactive/2012/06/11/sports/basketball/nba-shot-analysis.html



Attribute	Channel
Shot location	Position
Number of attempts	Size
Points per Region	Color

Many variants possible

http://www.targetprocess.com/articles/visual-encoding.html

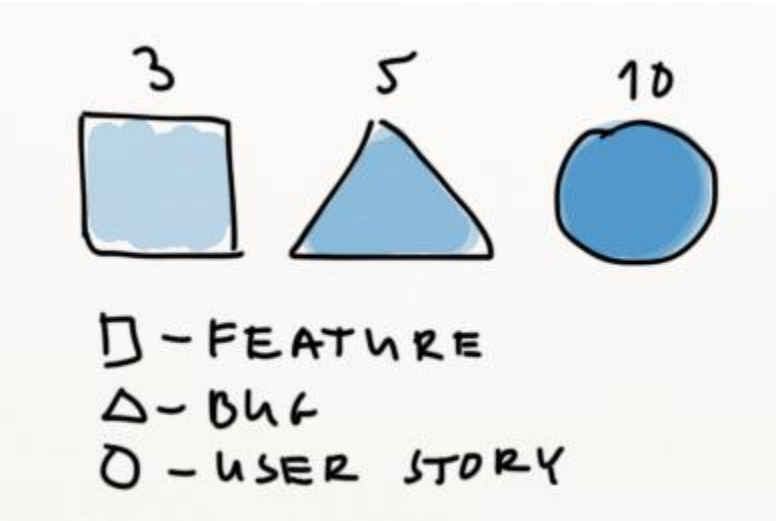
Item Type	*Quantity*
Features	3
Bugs	5
User Stories	6

Item Type	Orientation Hue Shape Texture Position
Quantity	Orientation Length Position Density Area Depth Saturation Luminance

Possible Channels

http://www.targetprocess.com/articles/visual-encoding.html

Item Type	*Quantity*
Features	3
Bugs	5
User Stories	6

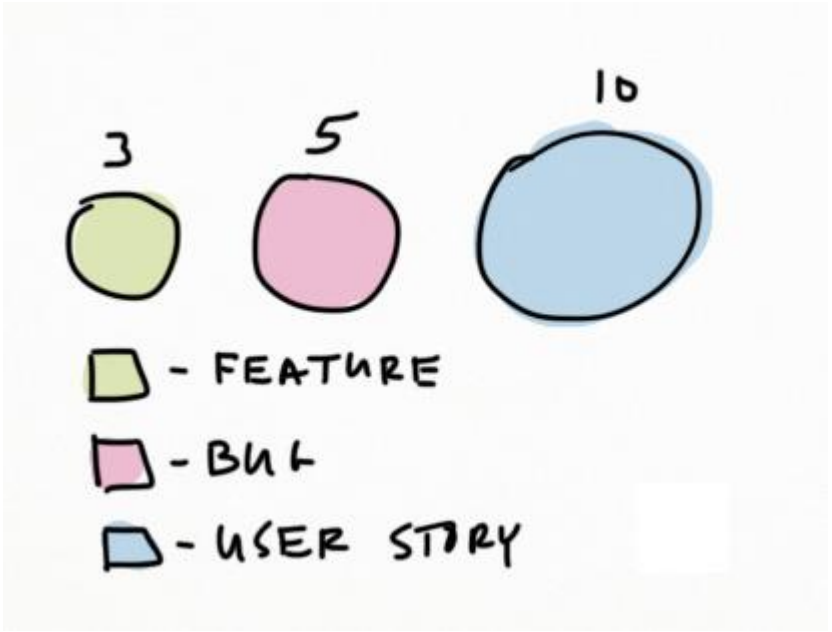


Item Type	Orientation Hue Shape Texture Position
Quantity	Orientation Length Position Density Area Depth Saturation Luminance

Possible Channels

http://www.targetprocess.com/articles/visual-encoding.html

Item Type	*Quantity*
Features	3
Bugs	5
User Stories	6



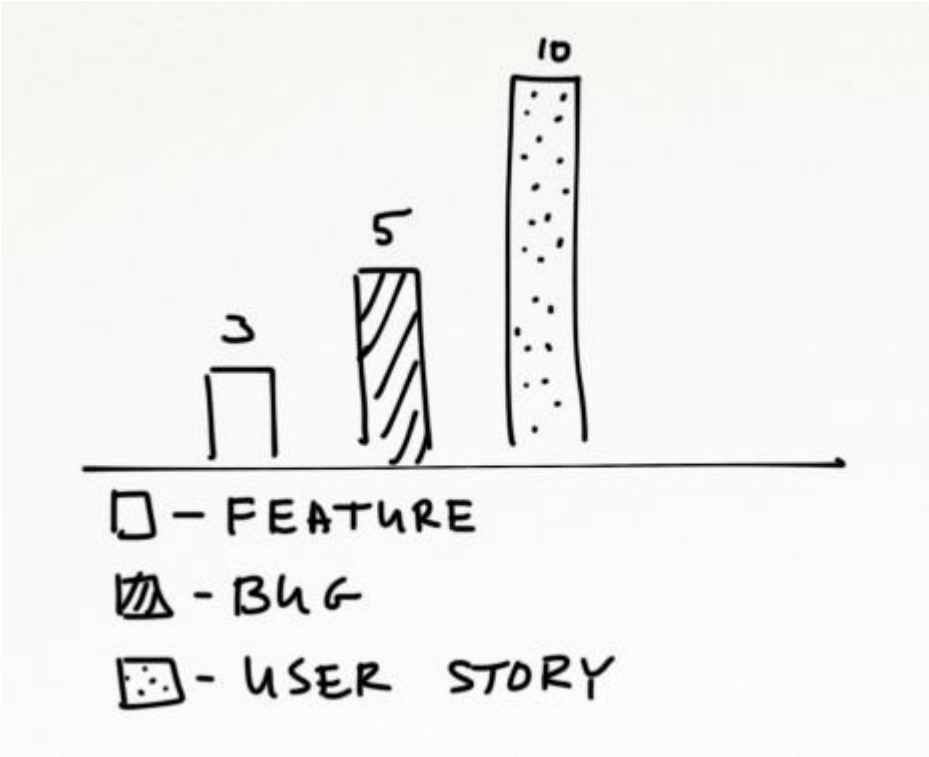
Item Type	Orientation
	Hue
	Shape
	Texture
	Position
Quantity	Orientation
	Length
	Position
	Density
	Area
	Depth
	Saturation
	Luminance

Possible Channels

http://www.targetprocess.com/articles/visual-encoding.html

Item Type	*Quantity*
Features	3
Bugs	5
User Stories	6

Item Type	Orientation Hue Shape Texture Position
Quantity	Orientation Length Position Density Area Depth Saturation Luminance

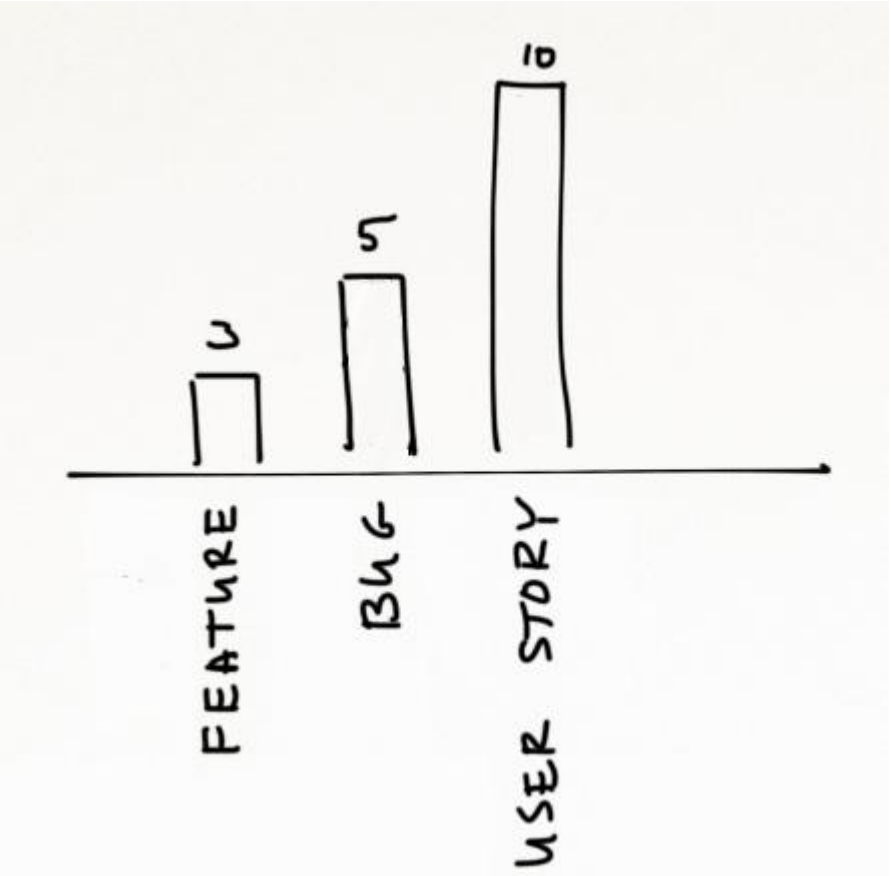


Possible Channels

http://www.targetprocess.com/articles/visual-encoding.html

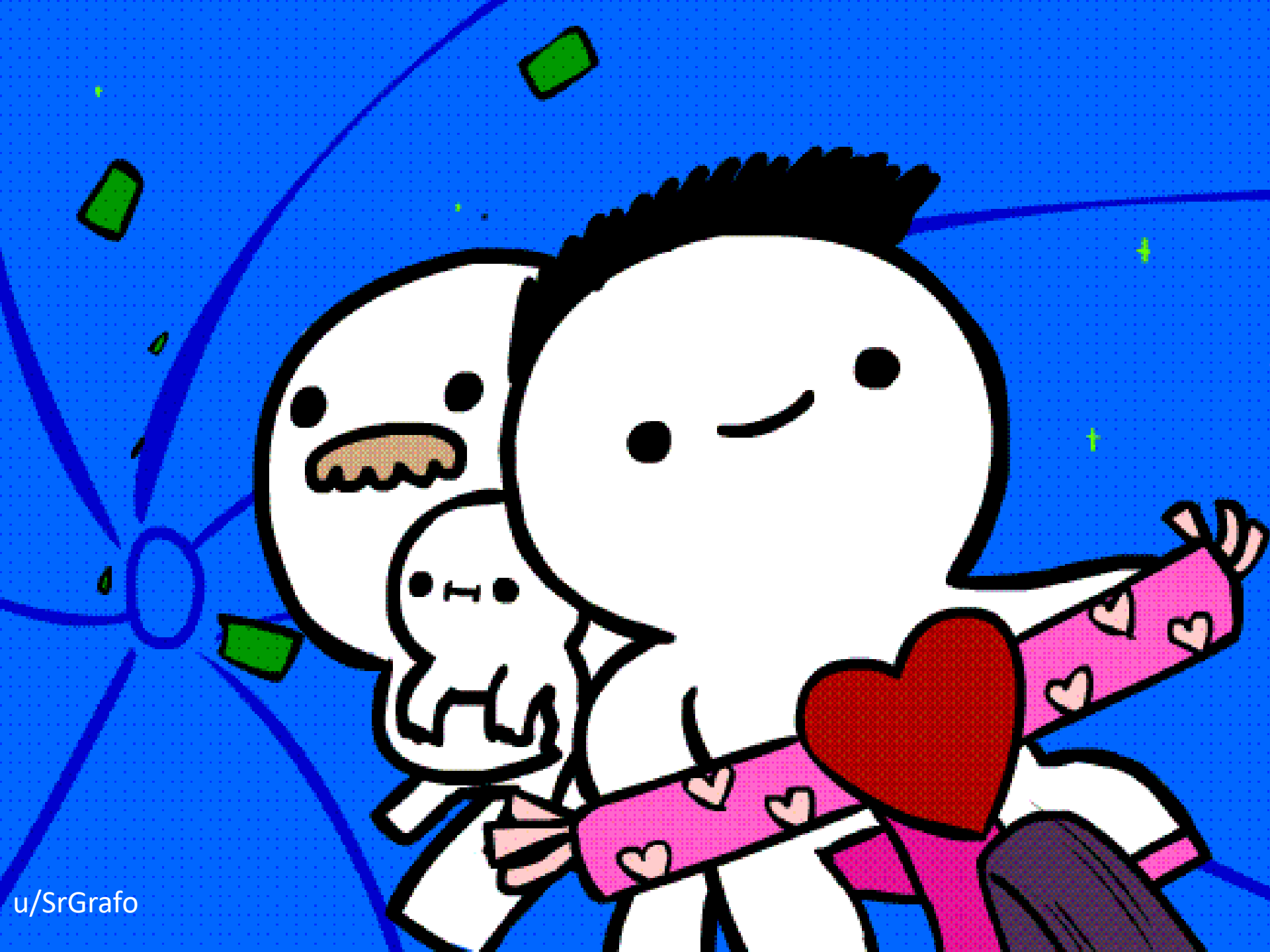
Item Type	*Quantity*
Features	3
Bugs	5
User Stories	6

Item Type	Orientation Hue Shape Texture Position
Quantity	Orientation Length Position Density Area Depth Saturation Luminance



Breakout Over!


THERE WILL
NOW BE A
BRIEF
INTERMISSION

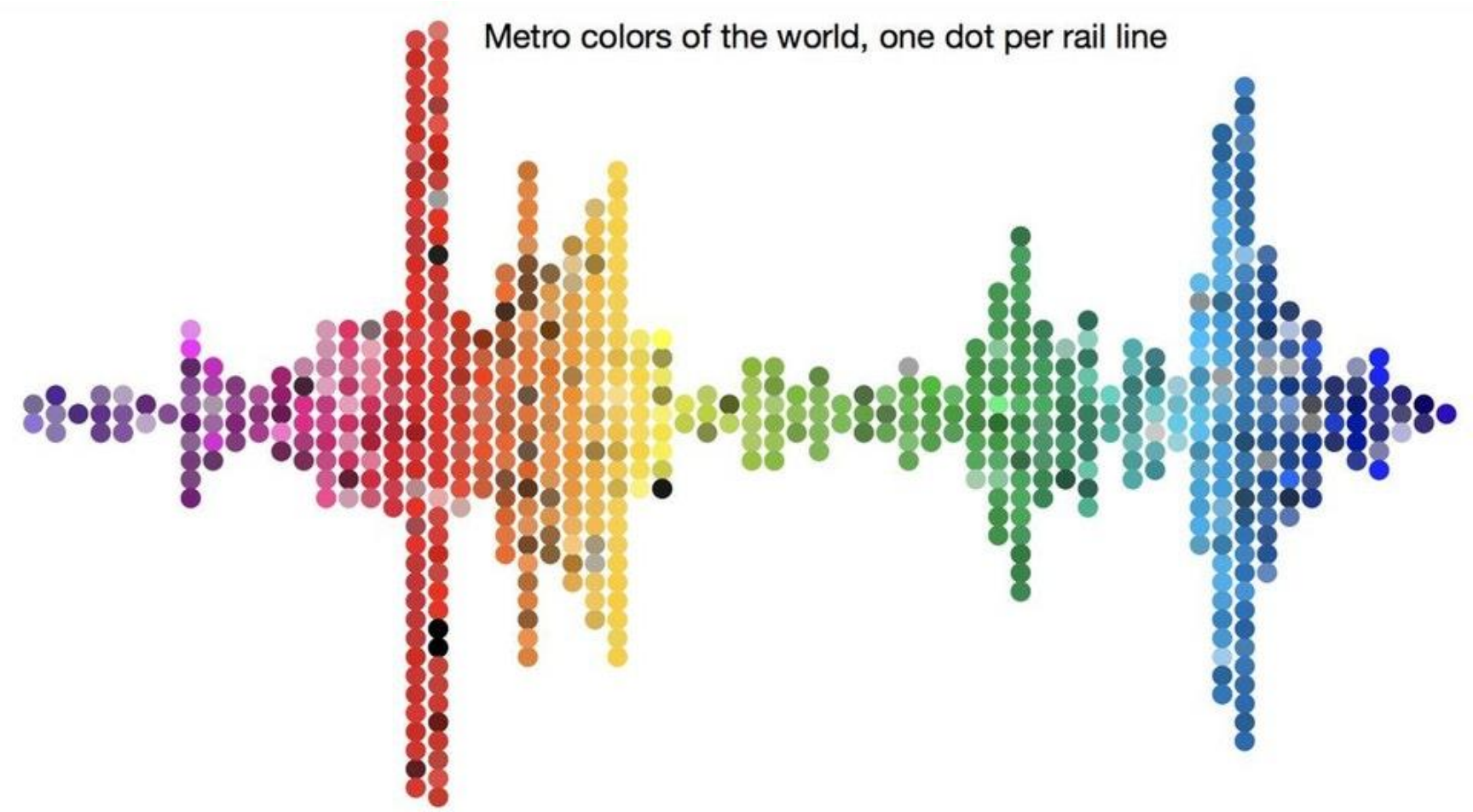

u/SrGrafo


THERE WILL
NOW BE A
BRIEF
INTERMISSION

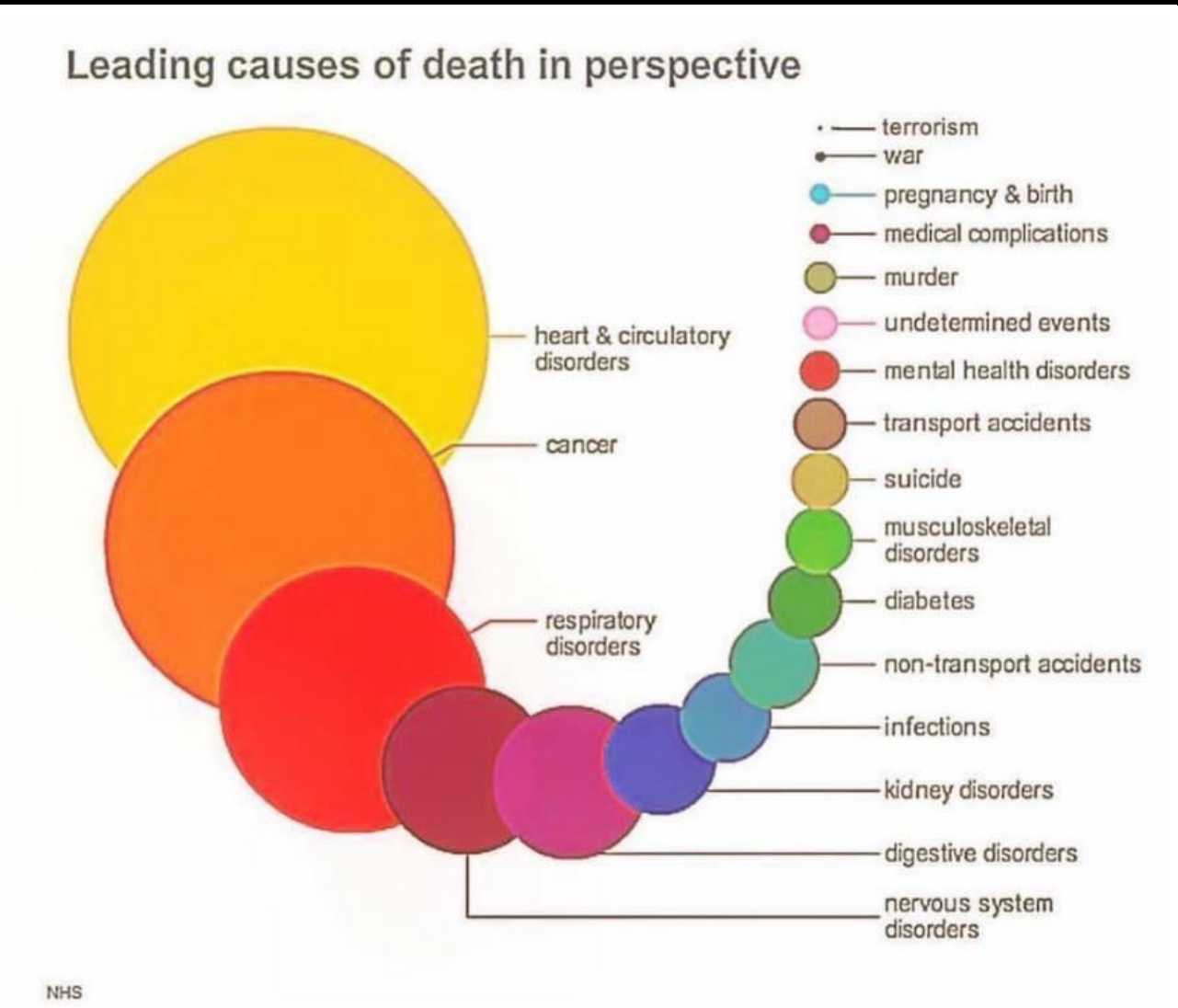

GOOD or EVIL?

Exibit A

https://www.c82.net/work/?id=355
https://www.reddit.com/r/dataisbeautiful/comments/7smt2w/all_the_worlds_metro_line_colors_by_hue_angle_oc



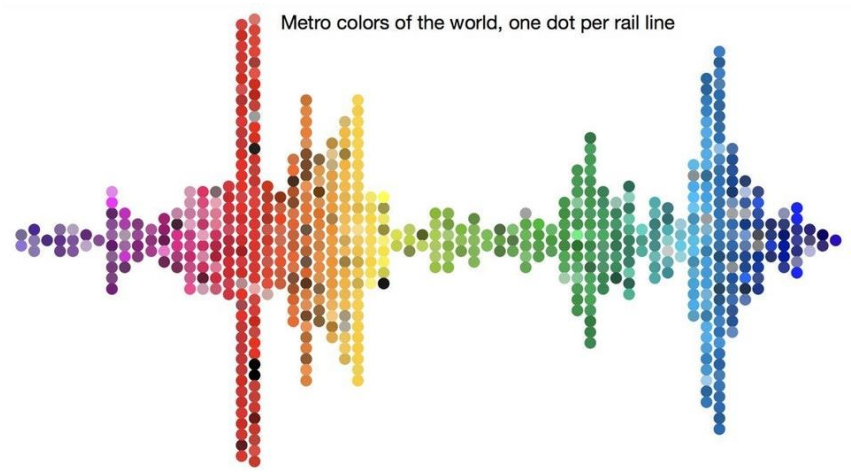
Exibit B



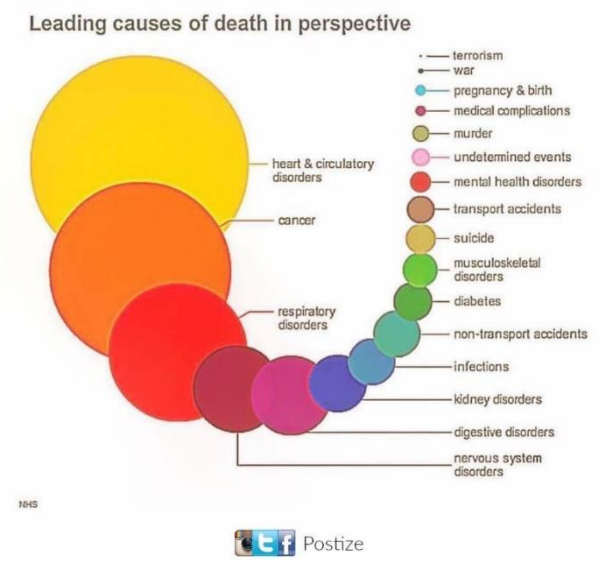
All Together Now!

http://www.prooffreader.com/2014/07/comparison-of-letter-positions-in-eight.html

A



B



Direct Poll

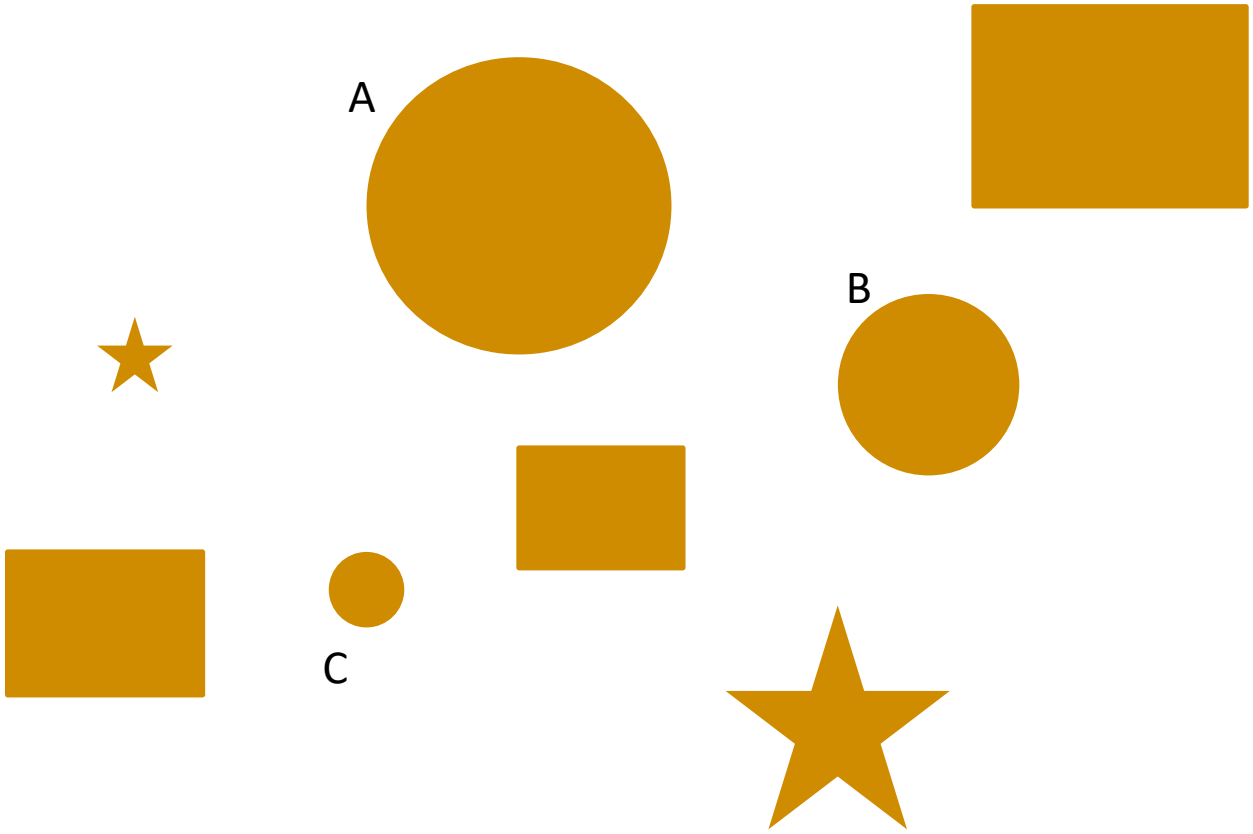
Not all can be combined

Size and Shape?

Game #1.1!

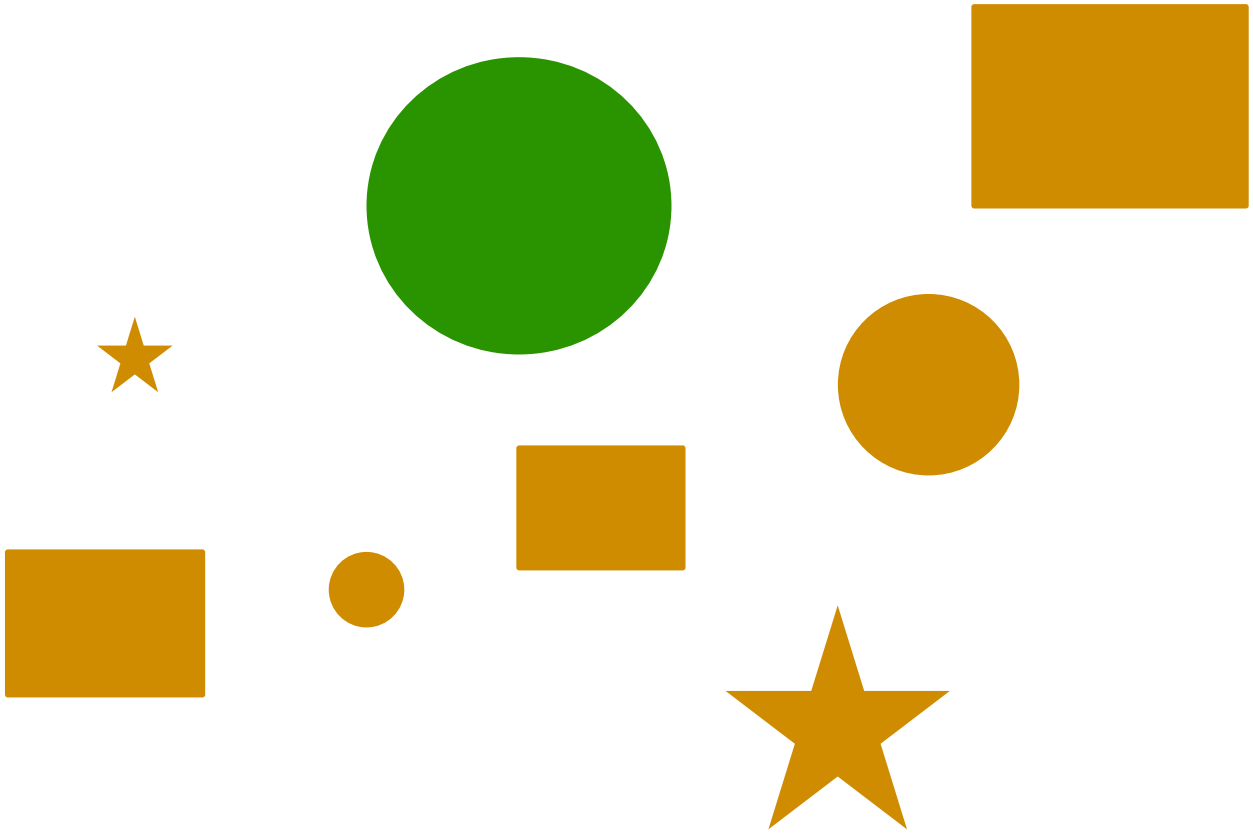
Direct Poll

Which is the larger circle?



Game #1.1!

Which is the larger circle?



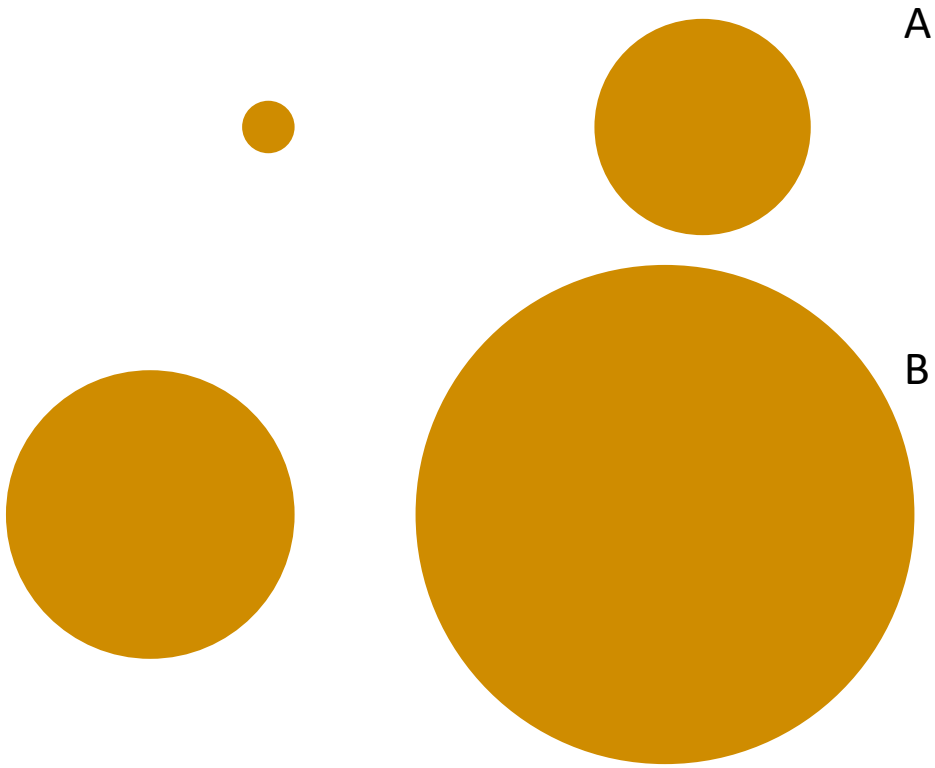
Not all can be combined

Size and Shape?

Game #1.2!

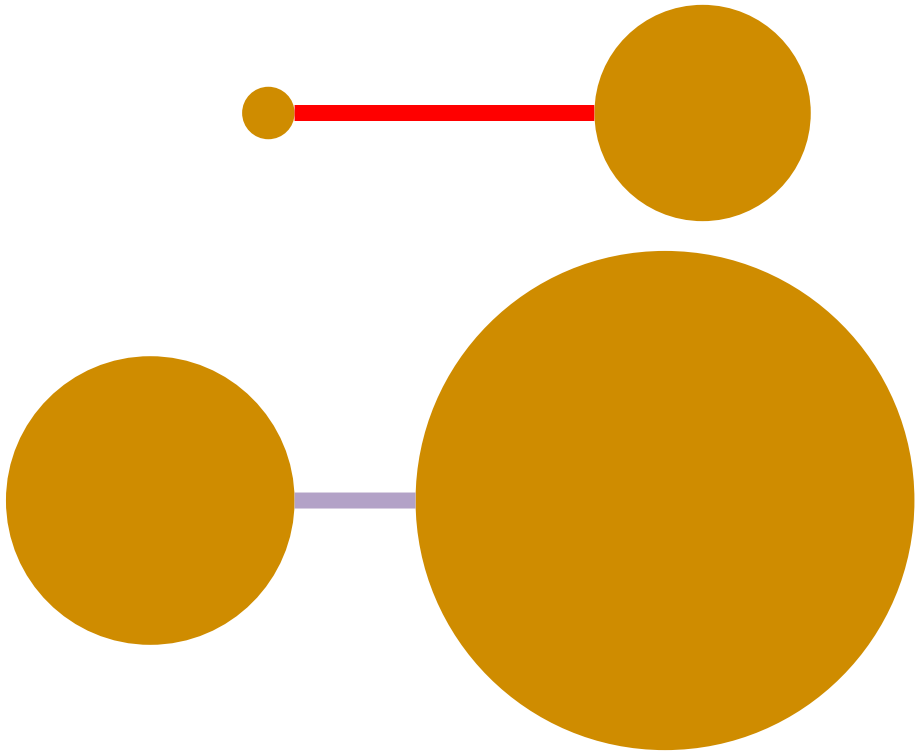
Direct Poll

Which pair is closest?



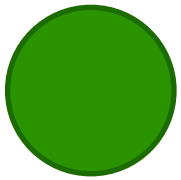
Game #1.2!

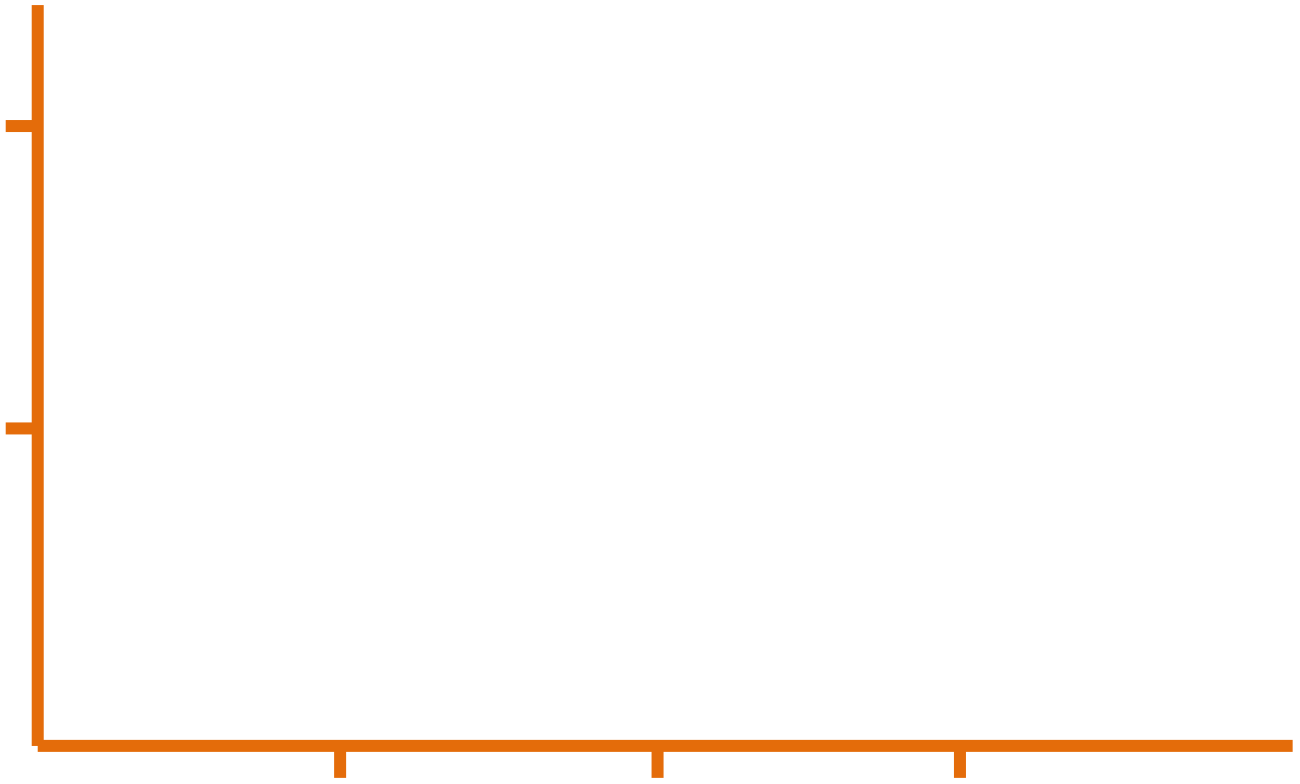
Which pair is closest?



But… is it really how you do things?

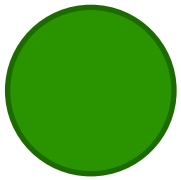
Place this bubble for (2,1)

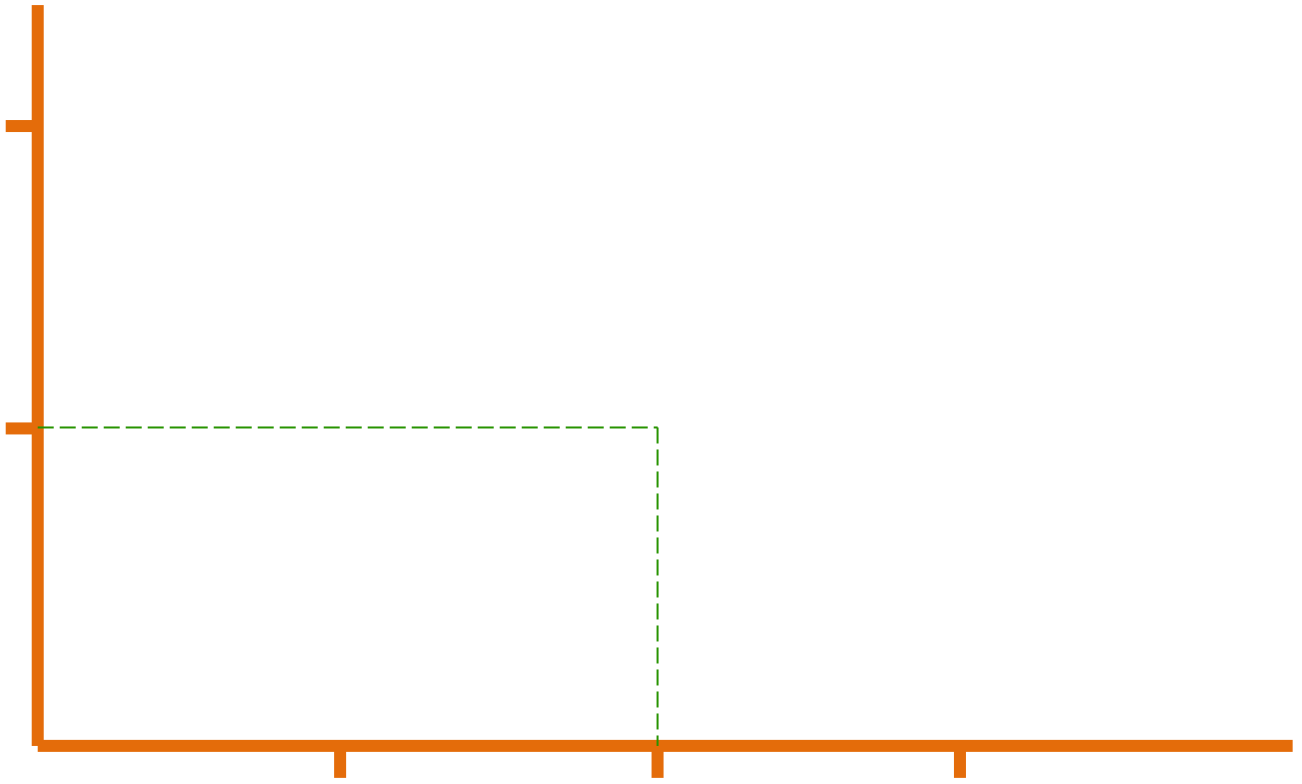




But… is it really how you do things?

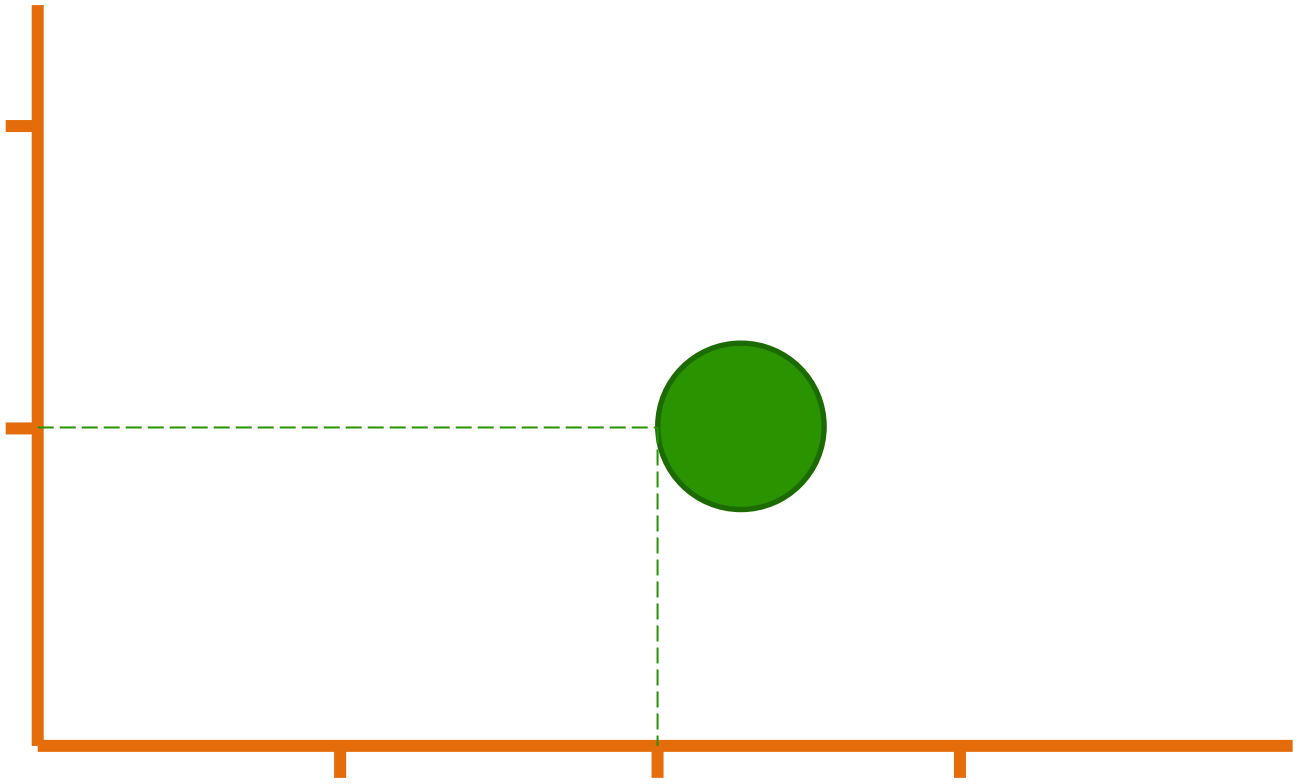
Place this bubble for (2,1)





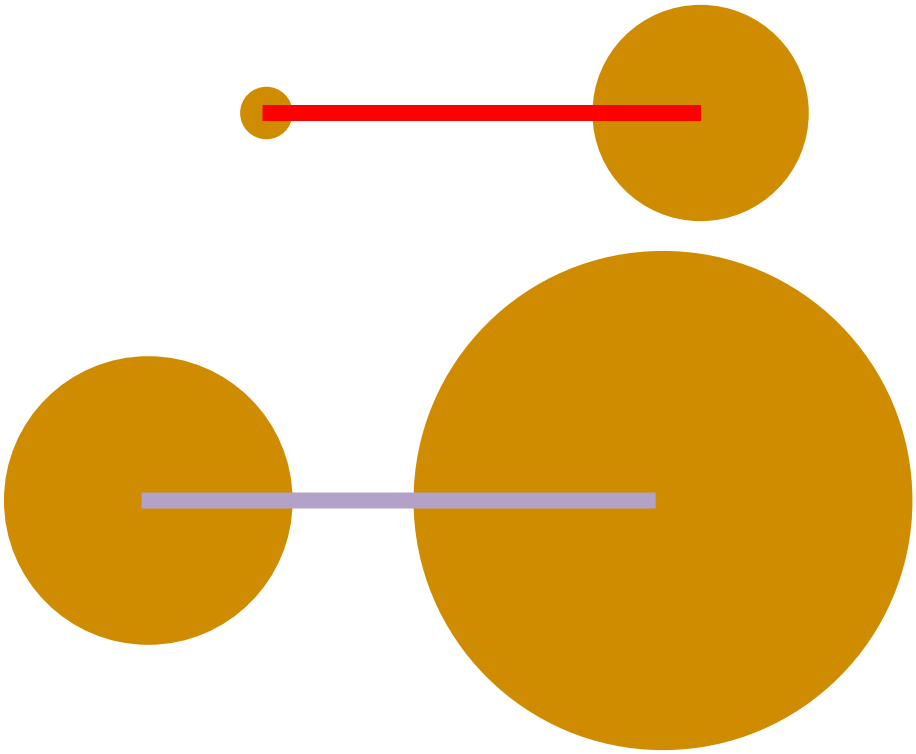
But… is it really how you do things?

Place this bubble for (2,1)



Game #1.2!

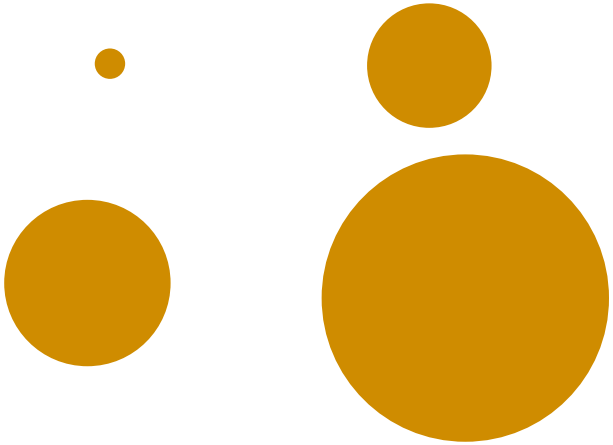
Which pair is closest?



Not all can be combined

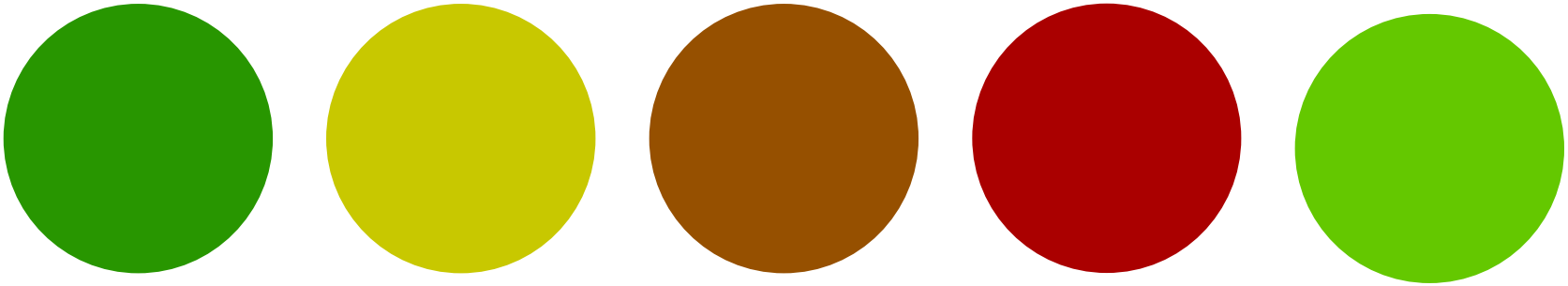
Size and Shape?

Size and proximity?



Game 2.1: Red – Green

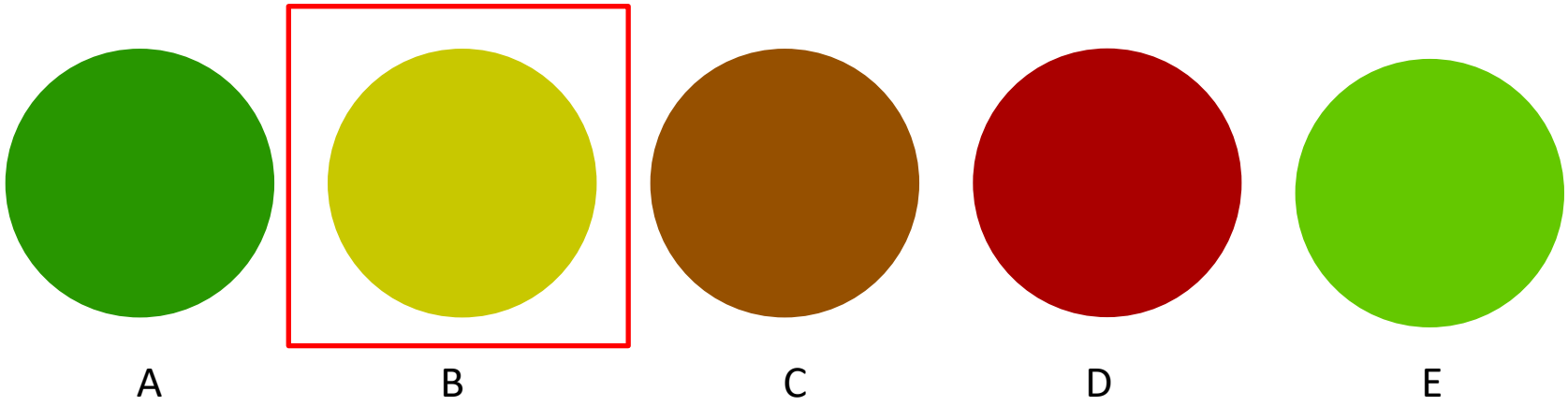
Which has more red?



A B C D E

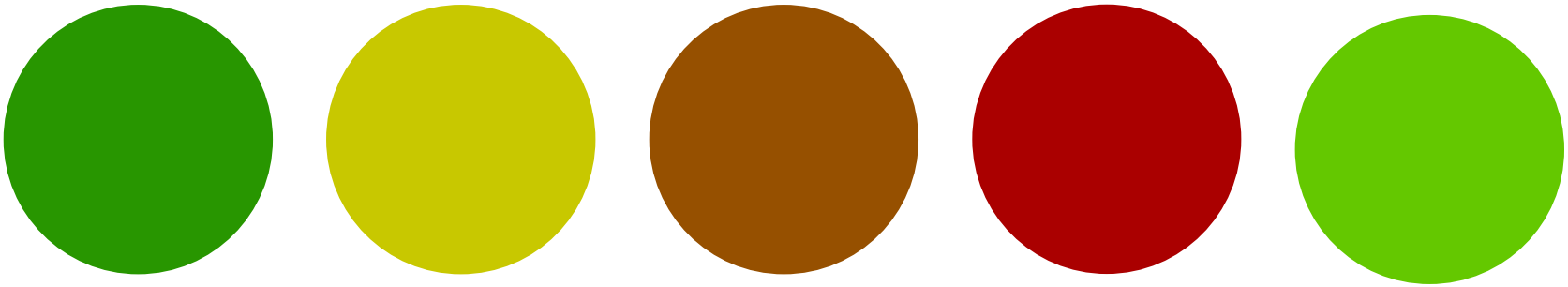
Game 2.1: Red – Green

Which has more red?



Game 2.1: Red – Green

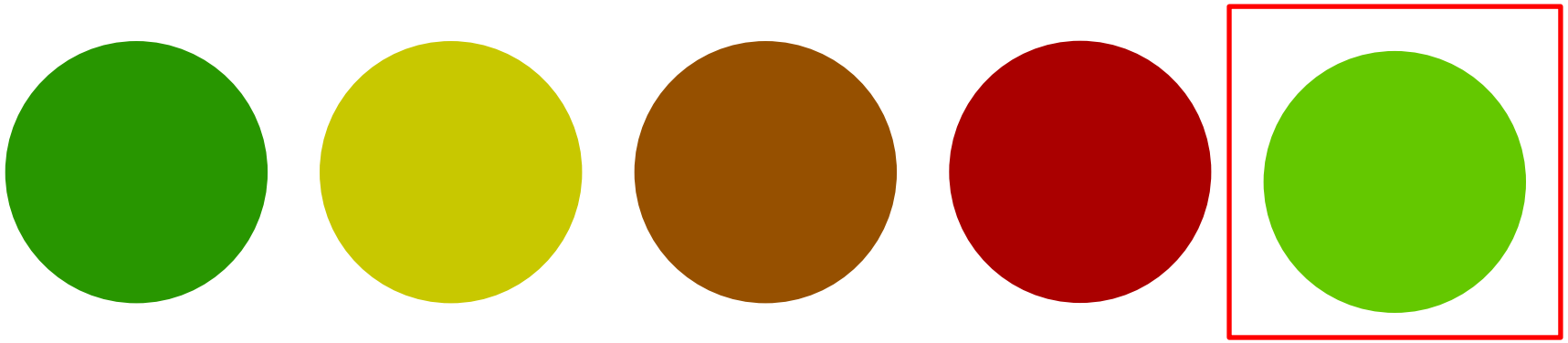
Which has more GREEN?



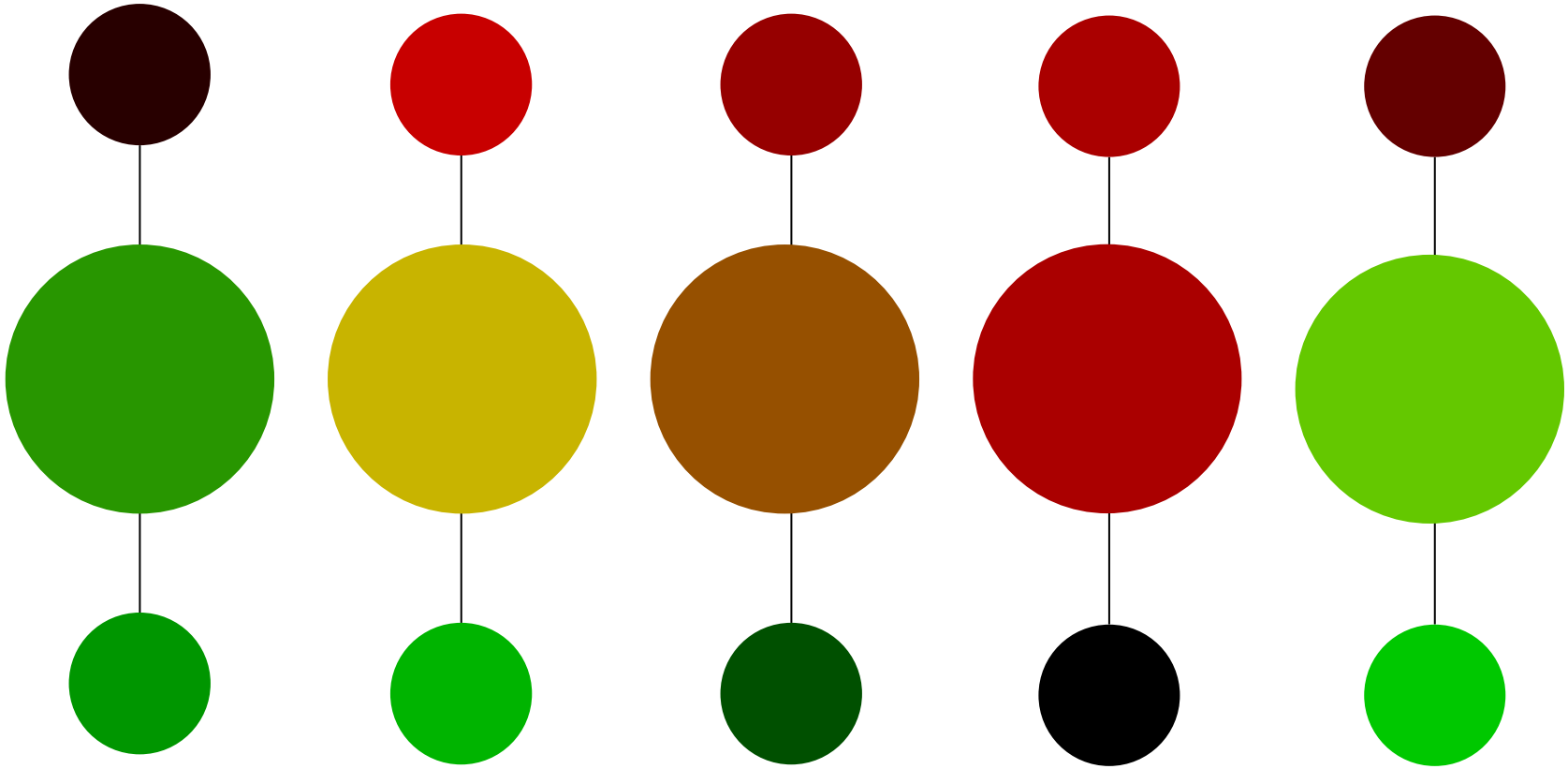
A B C D E

Game 2.1: Red – Green

Which has more GREEN?

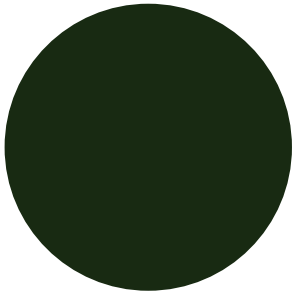


Game 2.1: Red – Green

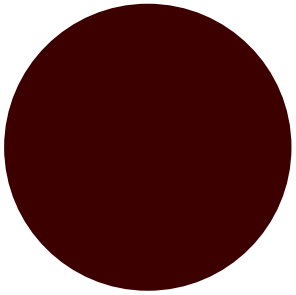


Game 2.2: Saturation and Luminance

Which is the stronger (more saturated)? RED or GREEN?



A

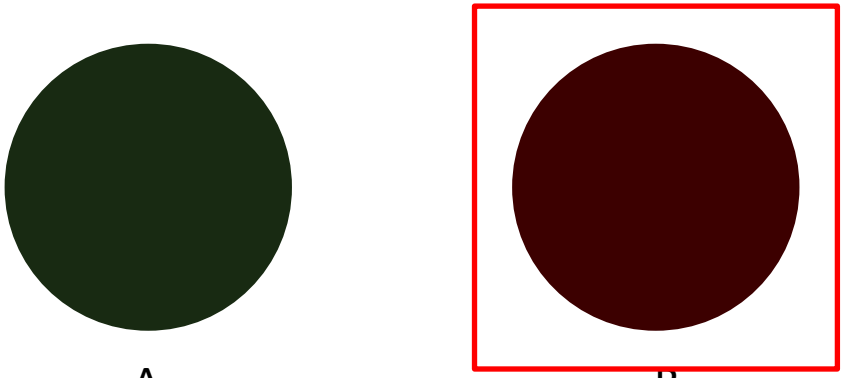


B

Direct Poll

Game 2.2: Saturation and Luminance

Which is the stronger (more saturated)? RED or GREEN?

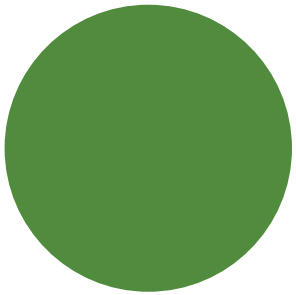


A
(99)

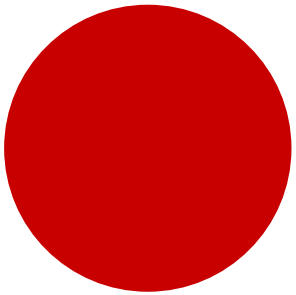
B
(255)

Game 2.2: Saturation and Luminance

Which is the stronger (more saturated)? RED or GREEN?



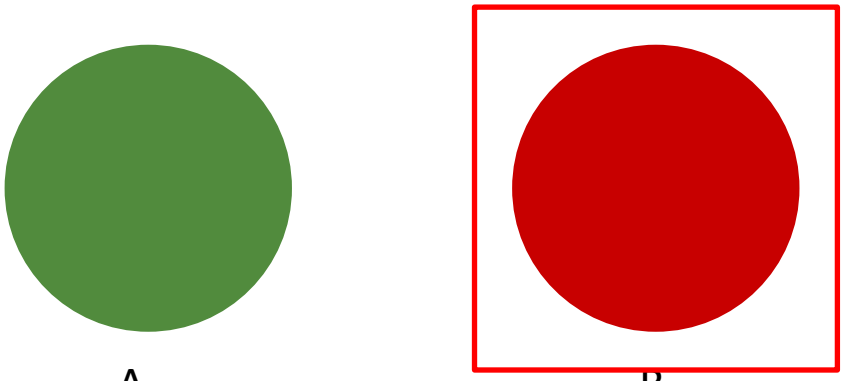
A



B

Game 2.2: Saturation and Luminance

Which is the stronger (more saturated)? RED or GREEN?

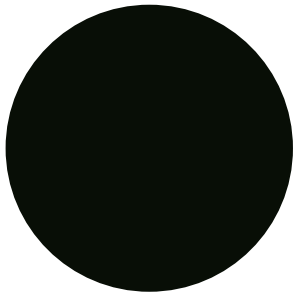


A
(99)

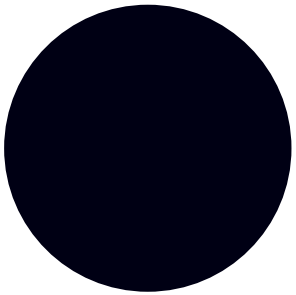
B
(255)

Game 2.2: Hue and Luminance

In fact… WHICH ONE IS THE RED ONE?



A

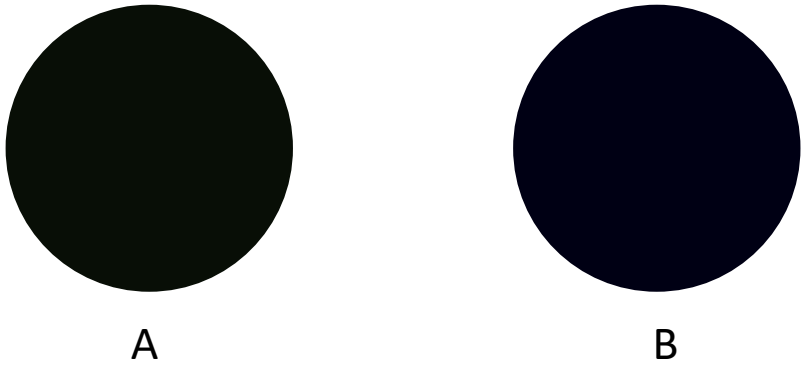


B

Direct Poll

Game 2.2: Hue and Luminance

In fact… WHICH ONE IS THE RED ONE?



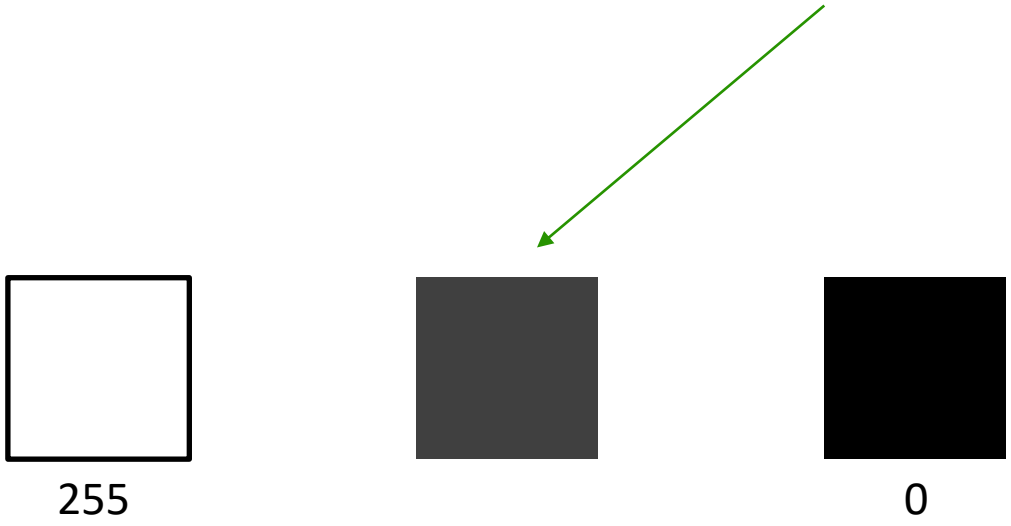
None is!

Accuracy

How close is our perceptual judgement of the actual stimulus?

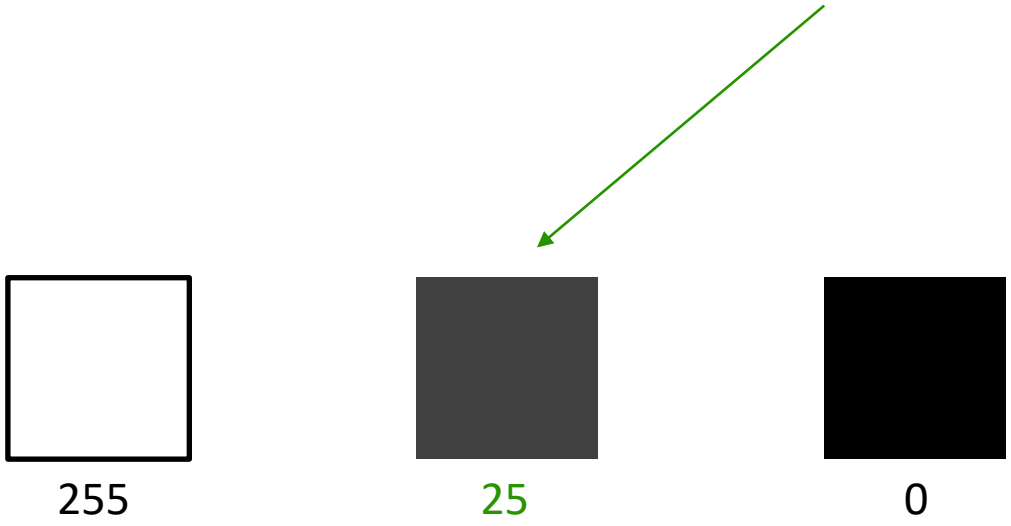
Accuracy

Example: what value is this square?



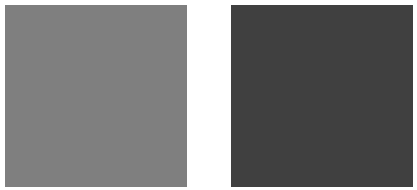
Accuracy

Example: what value is this square?



Accuracy

Example: which distance is greater?



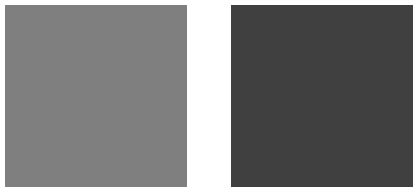
A

B

Direct Poll

Accuracy

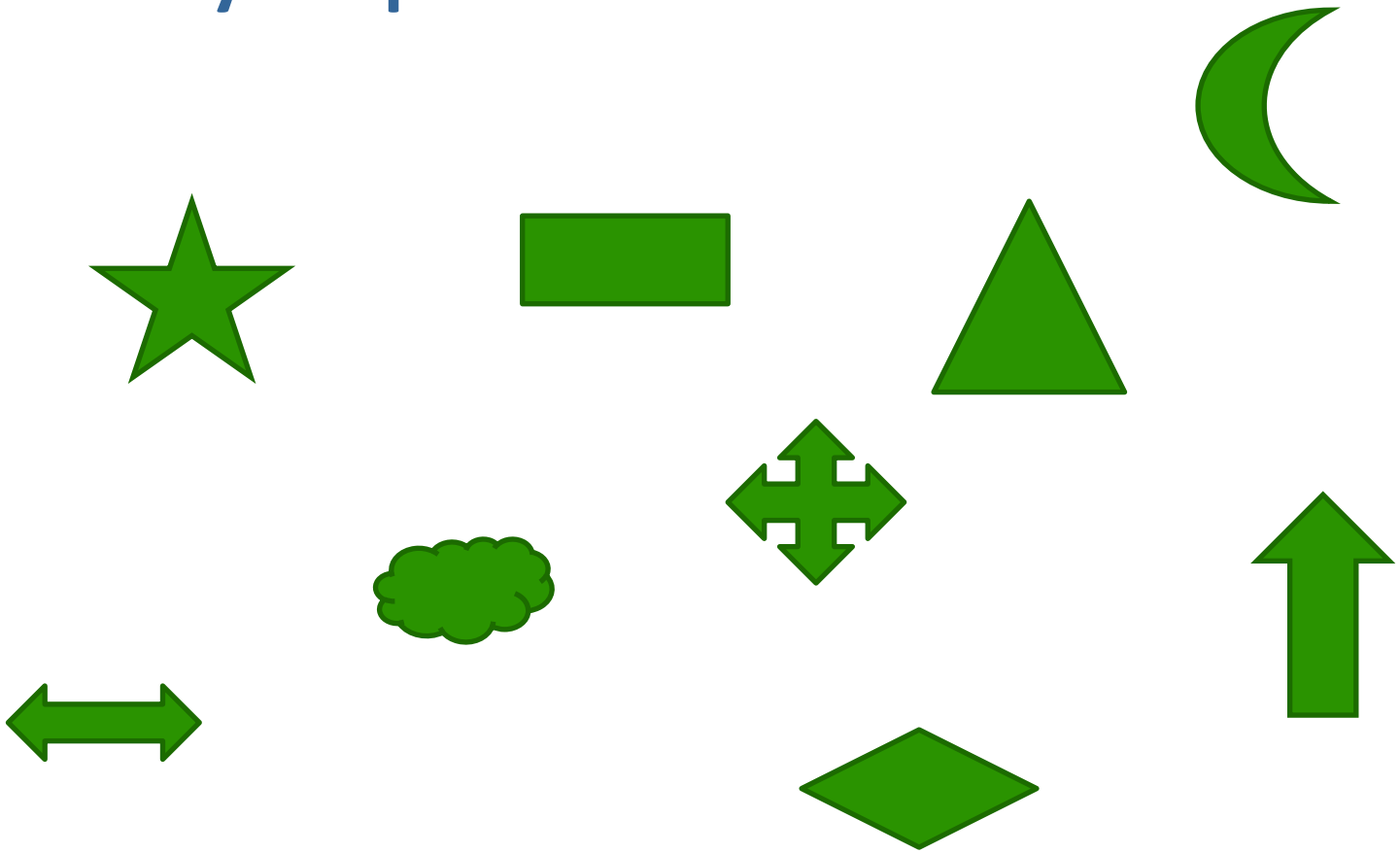
Example: which distance is greater?



Same!

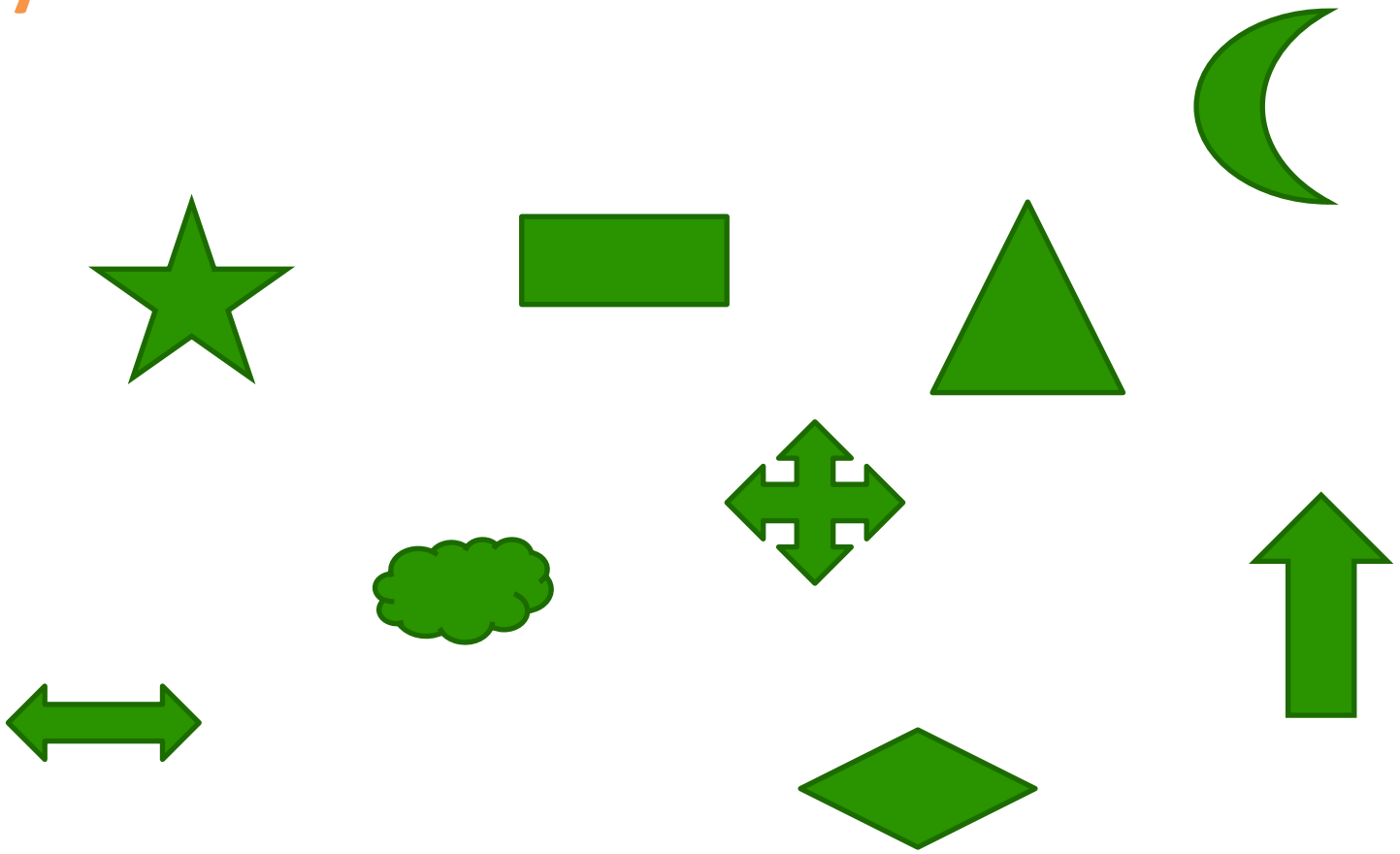
Game 3.2: Discriminability

How many shapes?



Game 3.2: Discriminability

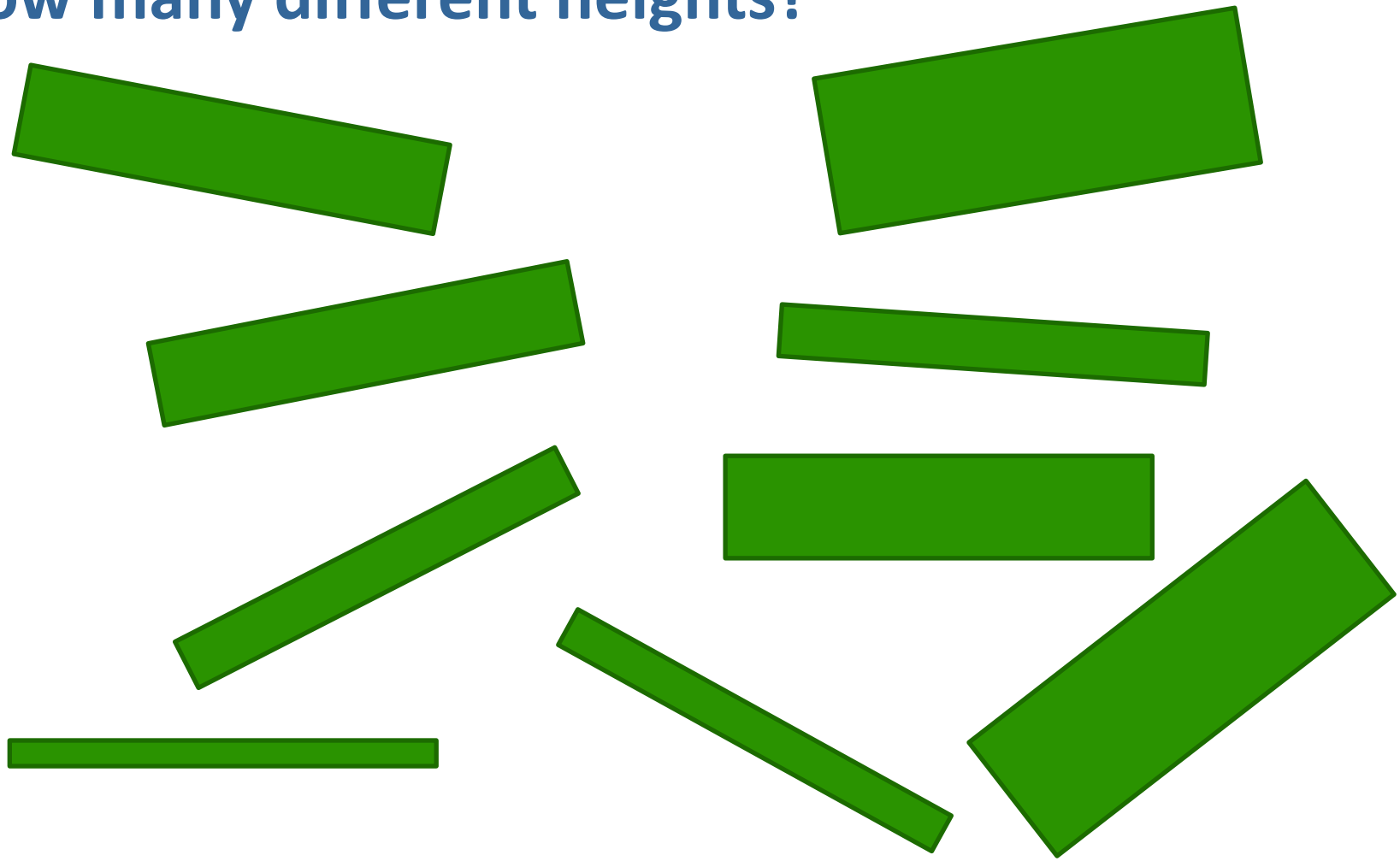
They are all different!



Game 3.2: Discriminability

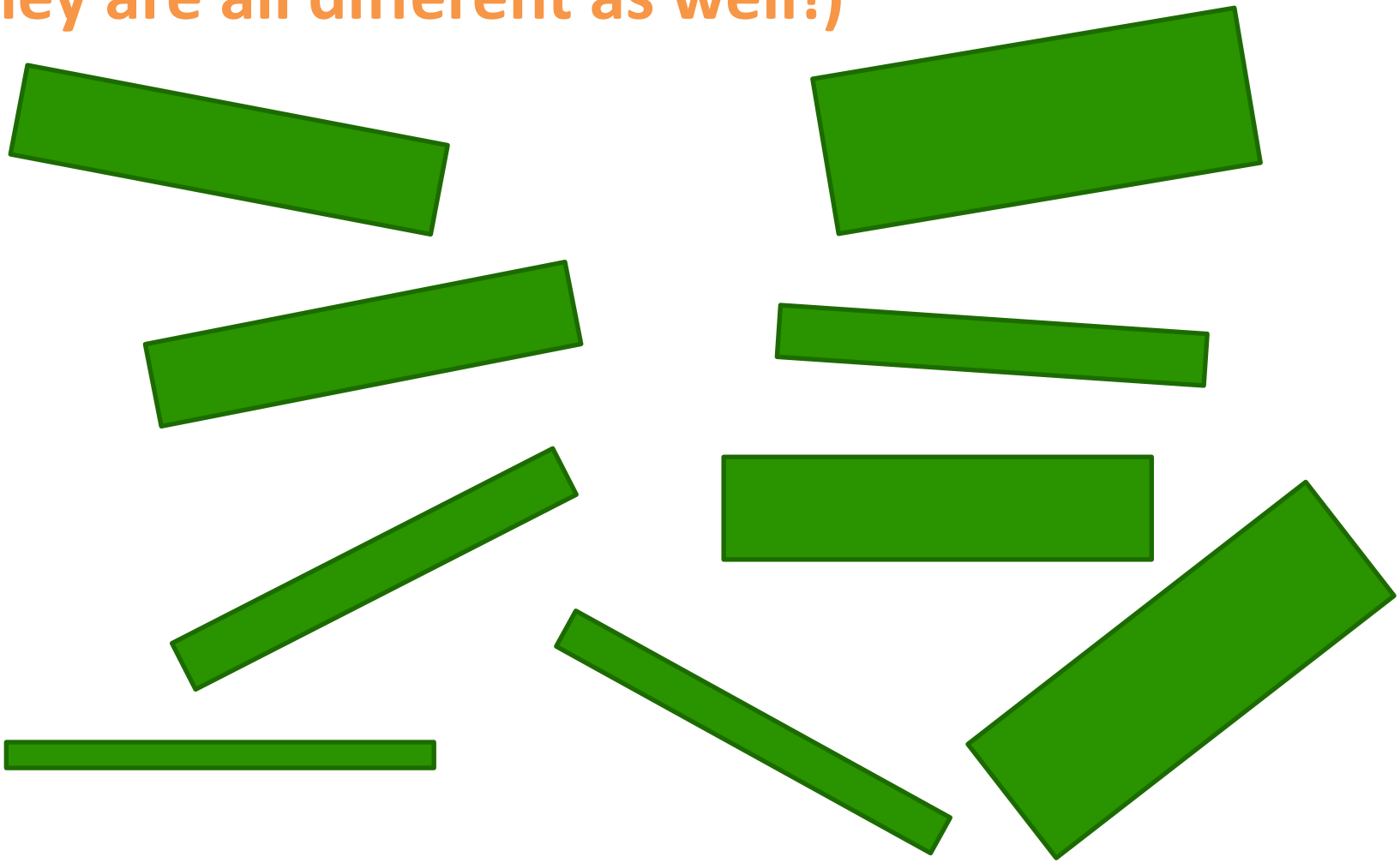
Direct Poll

How many different heights?



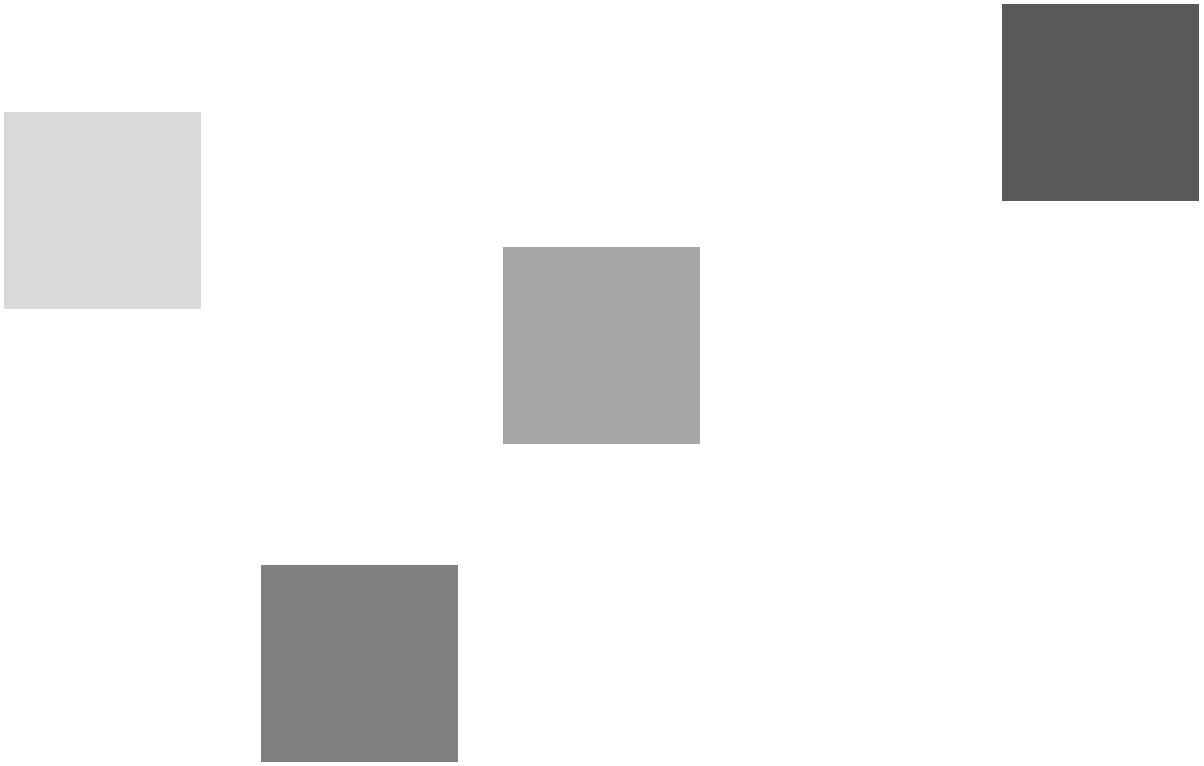
Game 3.2: Discriminability

(they are all different as well!)



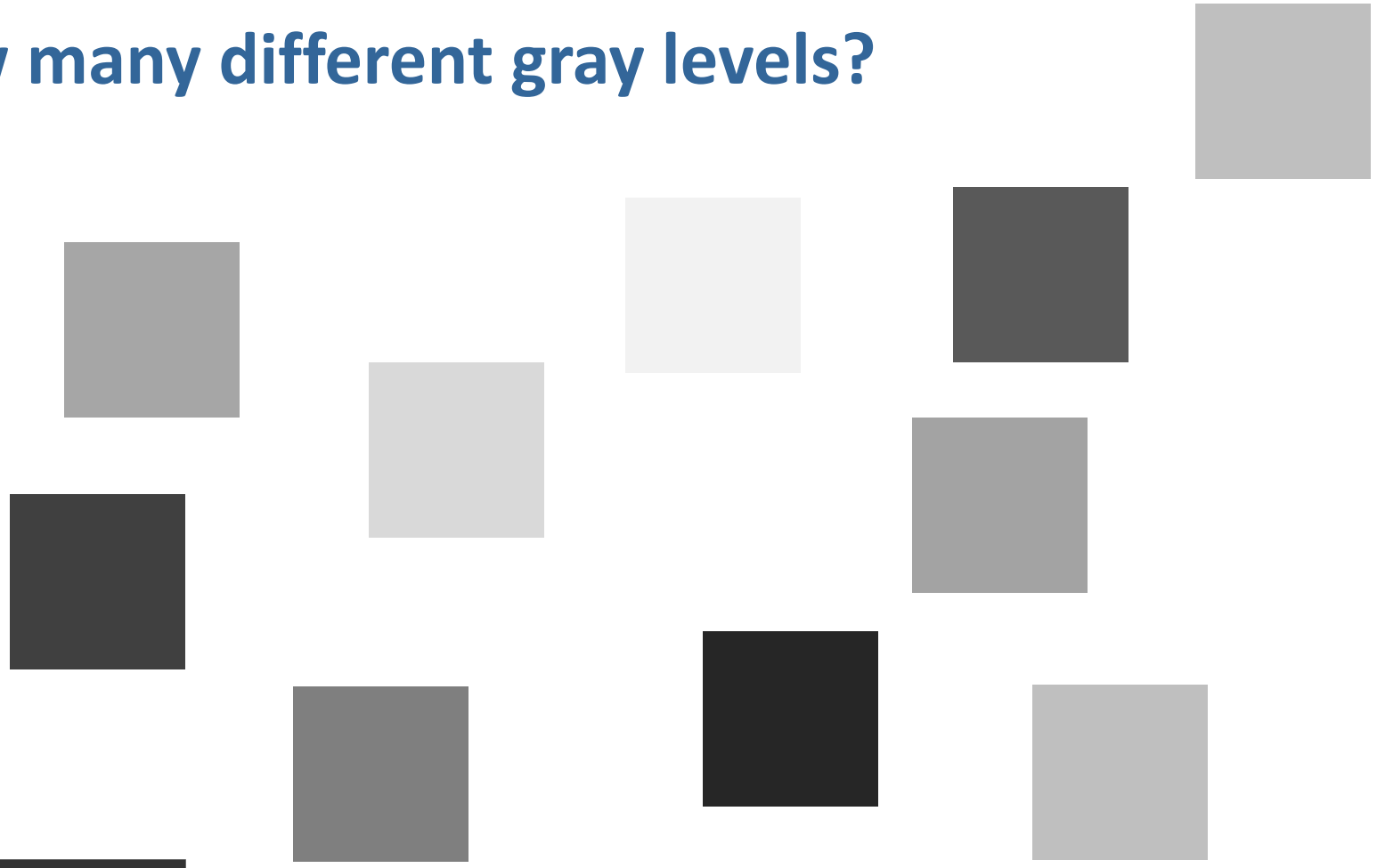
Game 3.2: Discriminability

How many different gray levels?



Game 3.2: Discriminability

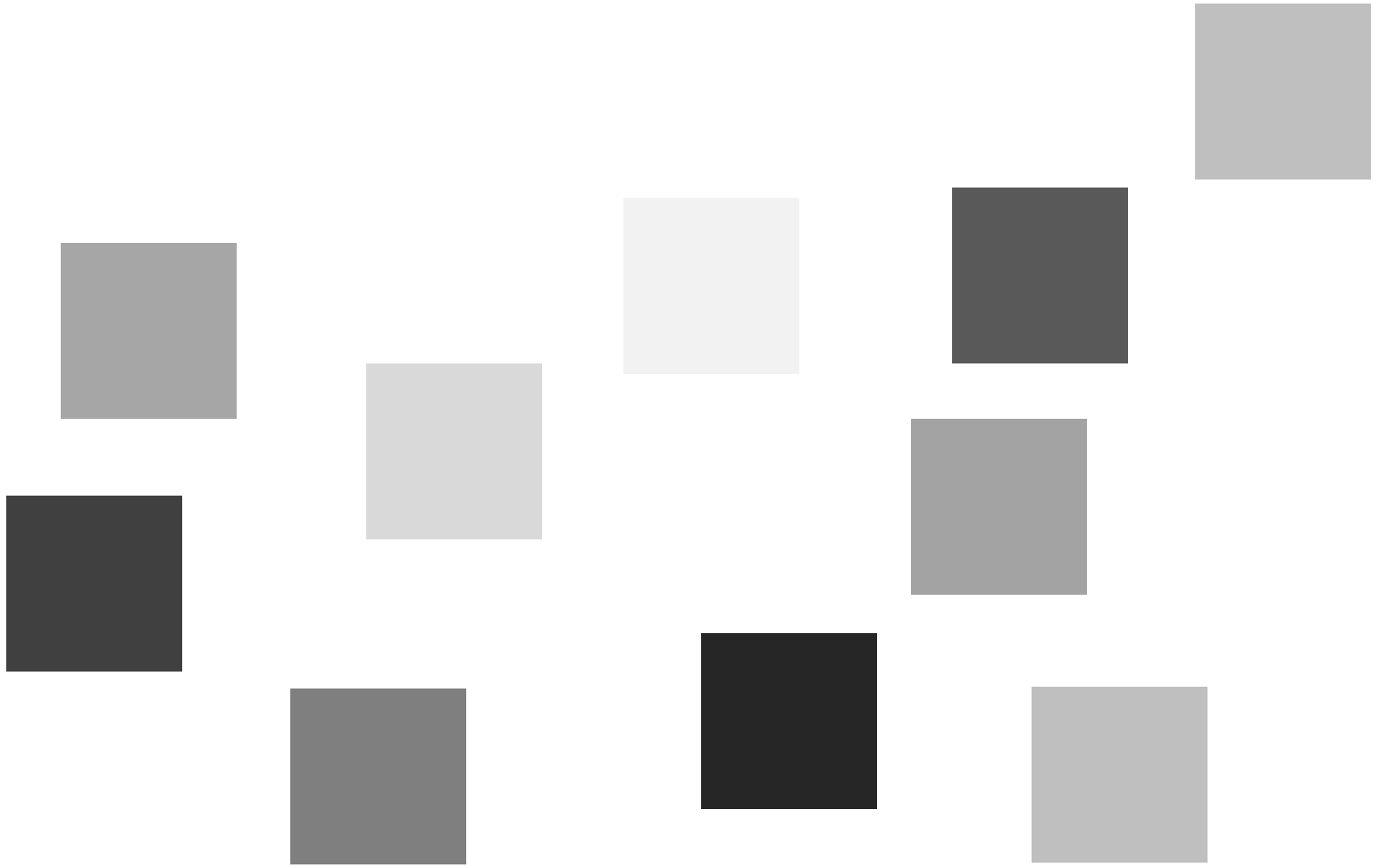
How many different gray levels?



Direct Poll

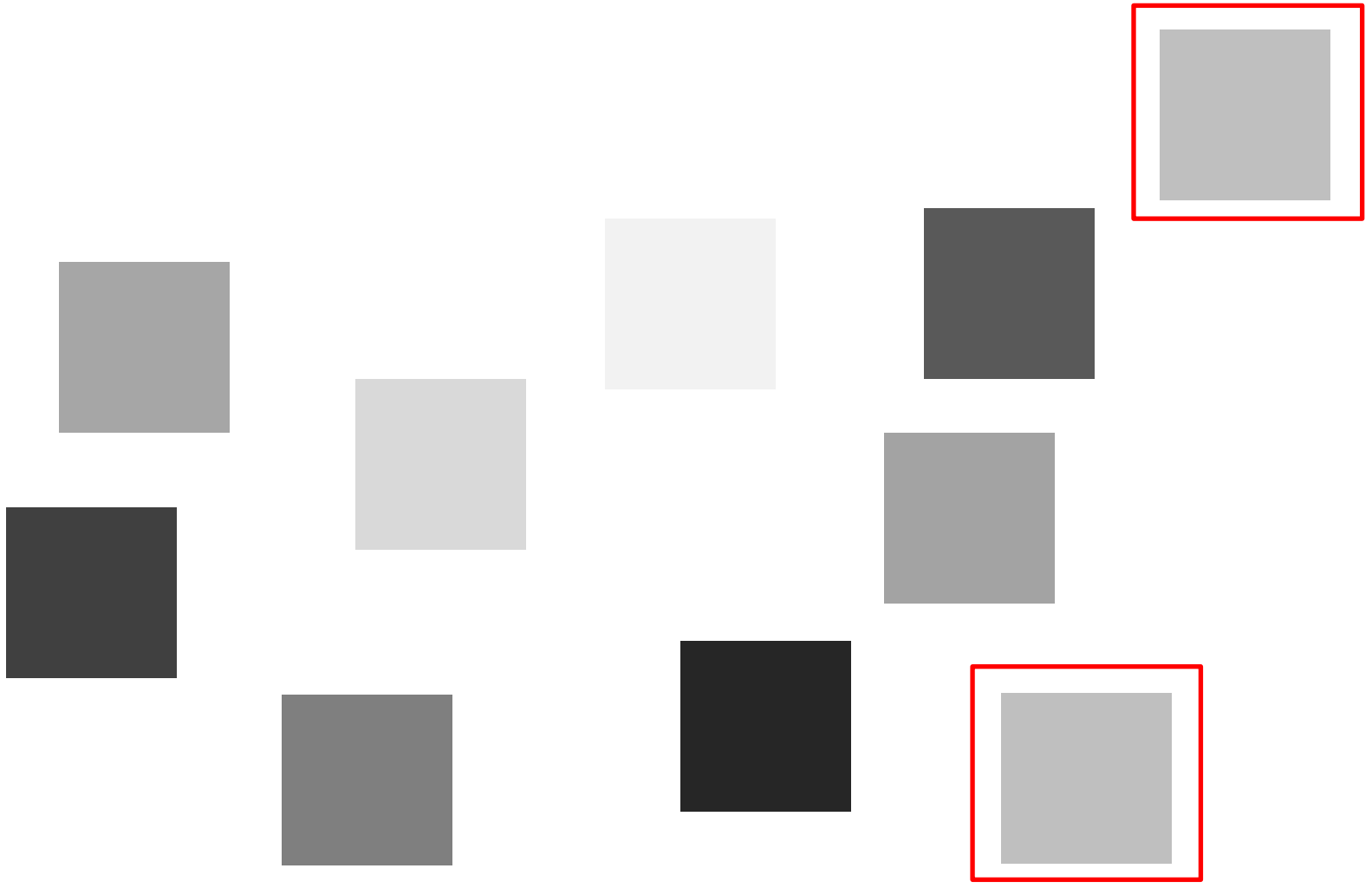
Game 3.2: Discriminability

9



Game 3.2: Discriminability

9



Channel resolution

	Bits	Levels
Position on a line	3.25	10-15
Line orientation	3.3	10
Hue	3.1	10
Line Length	3	8
Luminance	2.3	5
Sizes of squares	2.2	4-5
Curvature	1.6	3

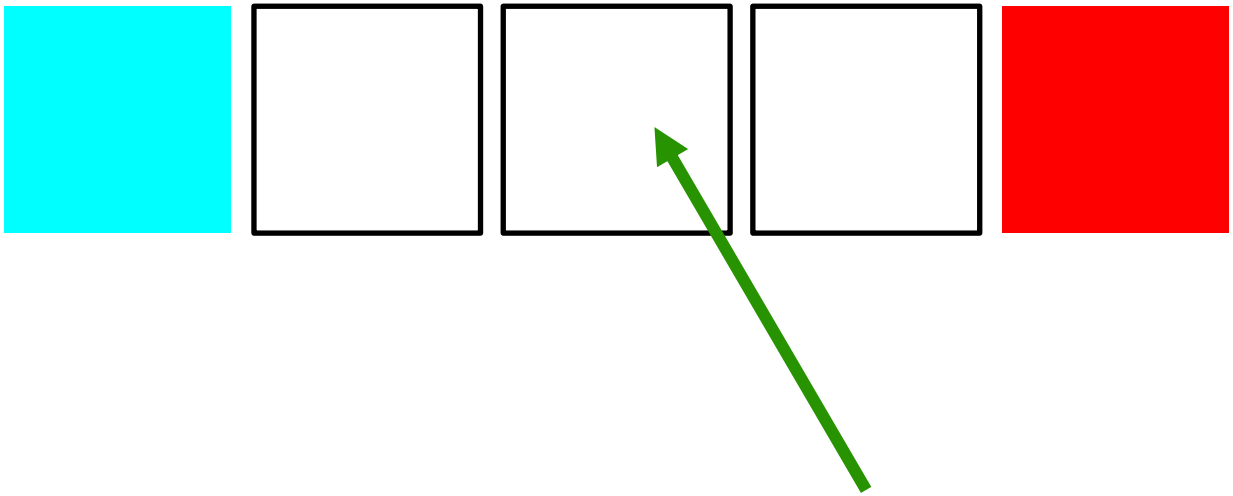
Discriminability

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 alpha or num	infinite	Good	Good	Good	Good
	length	yes	many	Good	Good		
	size, area	yes	many	Good	Good		
	angle	yes	medium	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		

04

COLOR

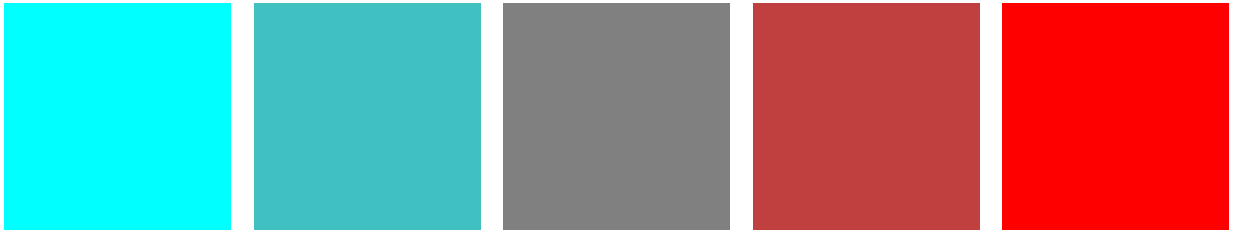
Game 1.1: What color goes here?



Direct Poll

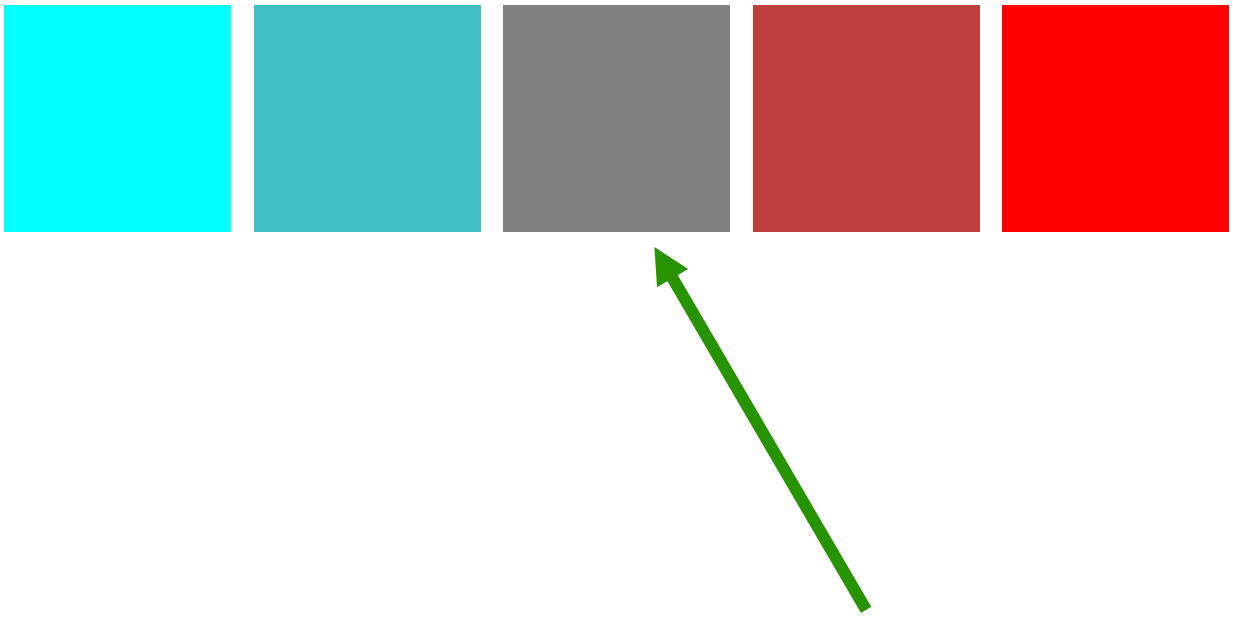
Game 1.1: What color goes here?

In RGB!



Game 1.1: What color goes here?

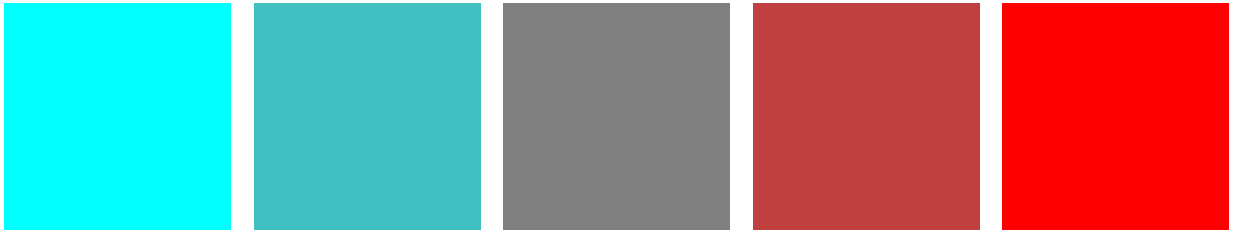
In RGB!



Gray????

Game 1.1: What color goes here?

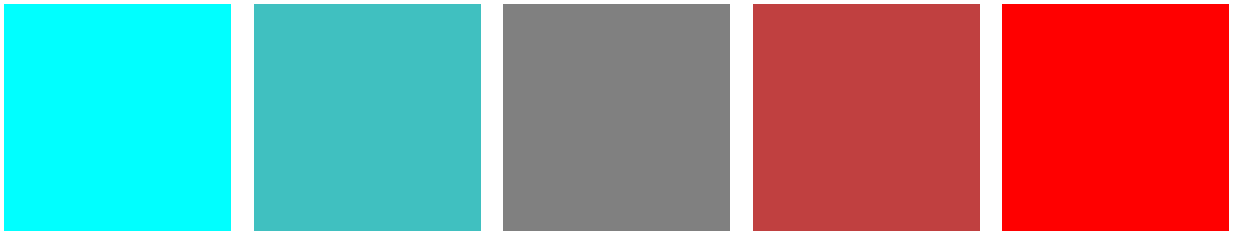
In RGB!



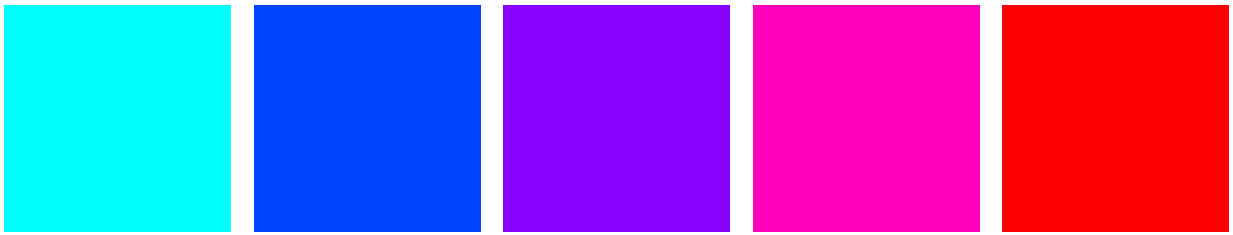
(0,255,255) (64,192,192)(128,128,128)(192,64,64) (255,0,0)

Game 1.1: What color goes here?

RGB



HSV



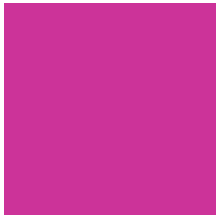
Hurray for HSV!

HSV

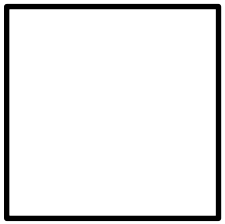
The Right Color

Direct Poll

Which of these is a “brighter” version?

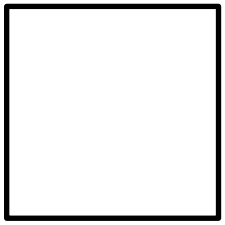


RGB = (204, 51, 153)



RGB = (233, 170, 174)

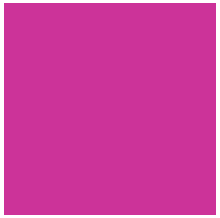
A



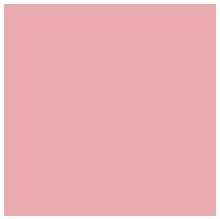
RGB = (233, 167, 211)

B

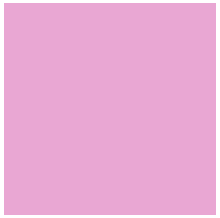
The Right Color



RGB = (204, 51, 153)



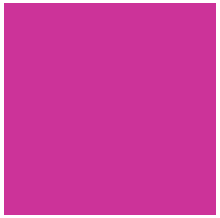
RGB = (233, 170, 174)



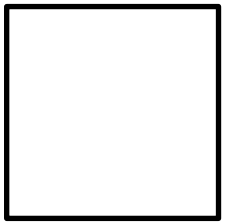
RGB = (233, 167, 211)

The Right Color

Which of these is a brighter version?

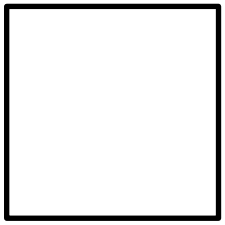


HSL = (227, 153, 228)



HSL = (227, 153, 200)

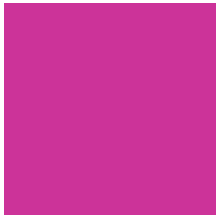
A



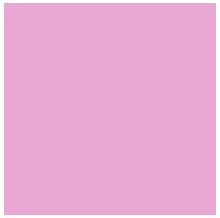
HSL = (227, 153, 240)

B

The Right Color



HSL = (227, 153, 228)

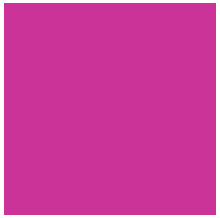


HSL = (227, 153, 200)

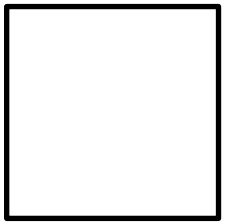
HSL = (227, 153, 240)

The Right Color

Which of these is a brighter version?

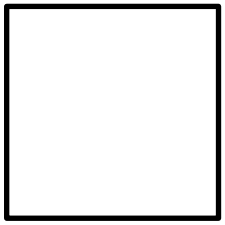


HSL = (227, 153, 228)



HSL = (227, 153, 200)

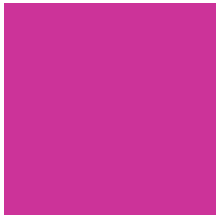
A



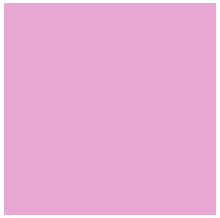
HSL = (247, 153, 228)

B

The Right Color



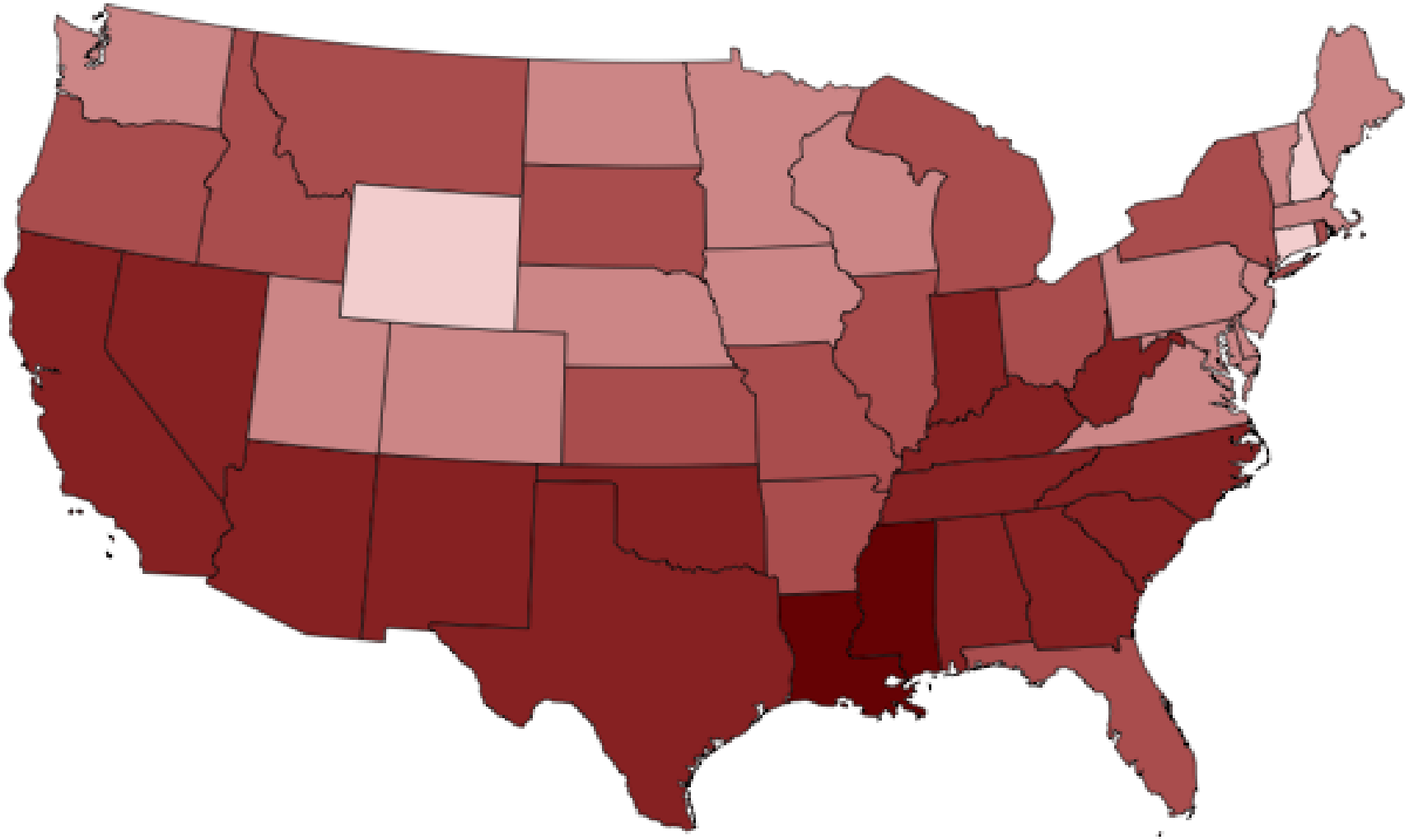
HSL = (227, 153, 228)



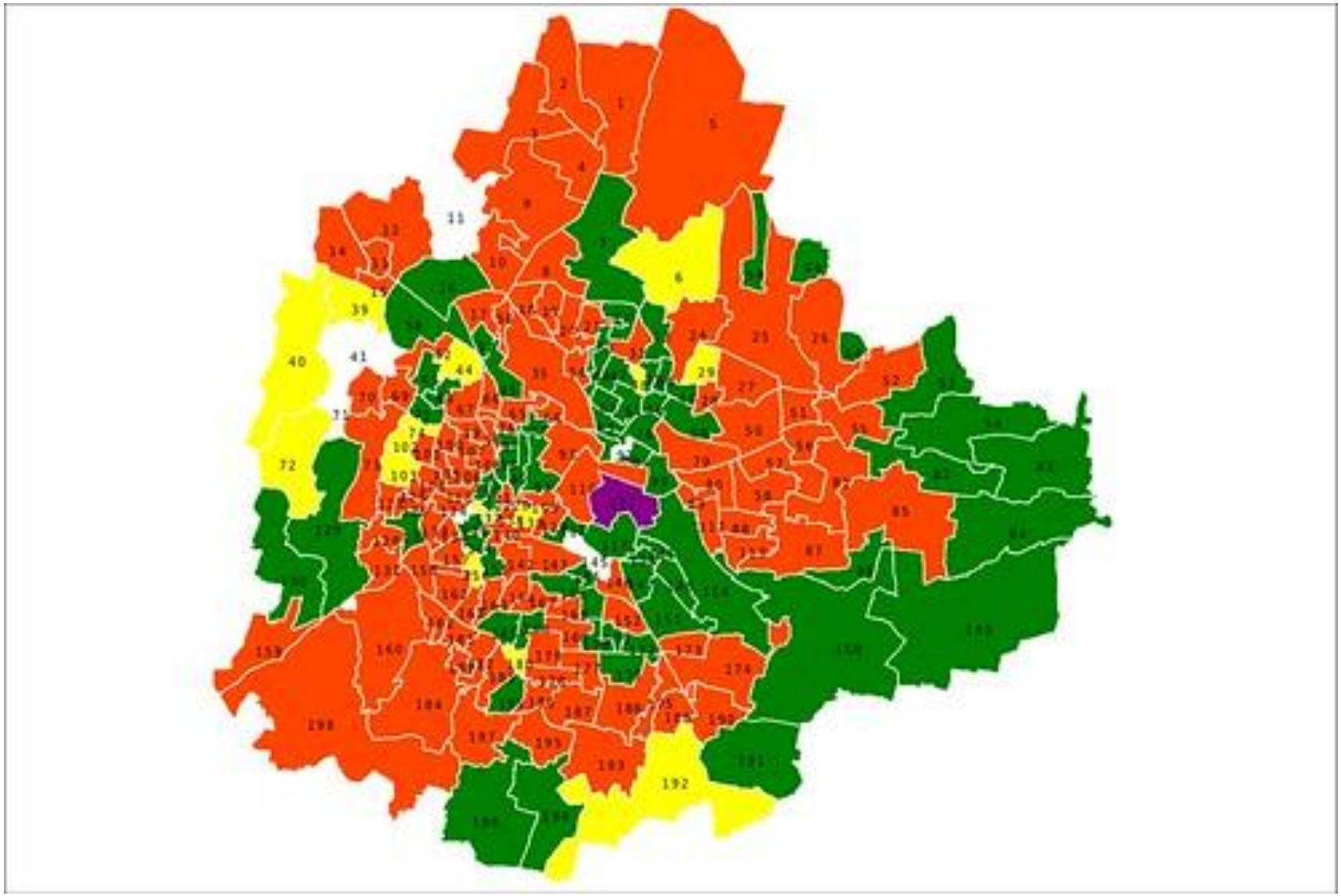
HSL = (227, 153, 200)

HSL = (247, 153, 228)

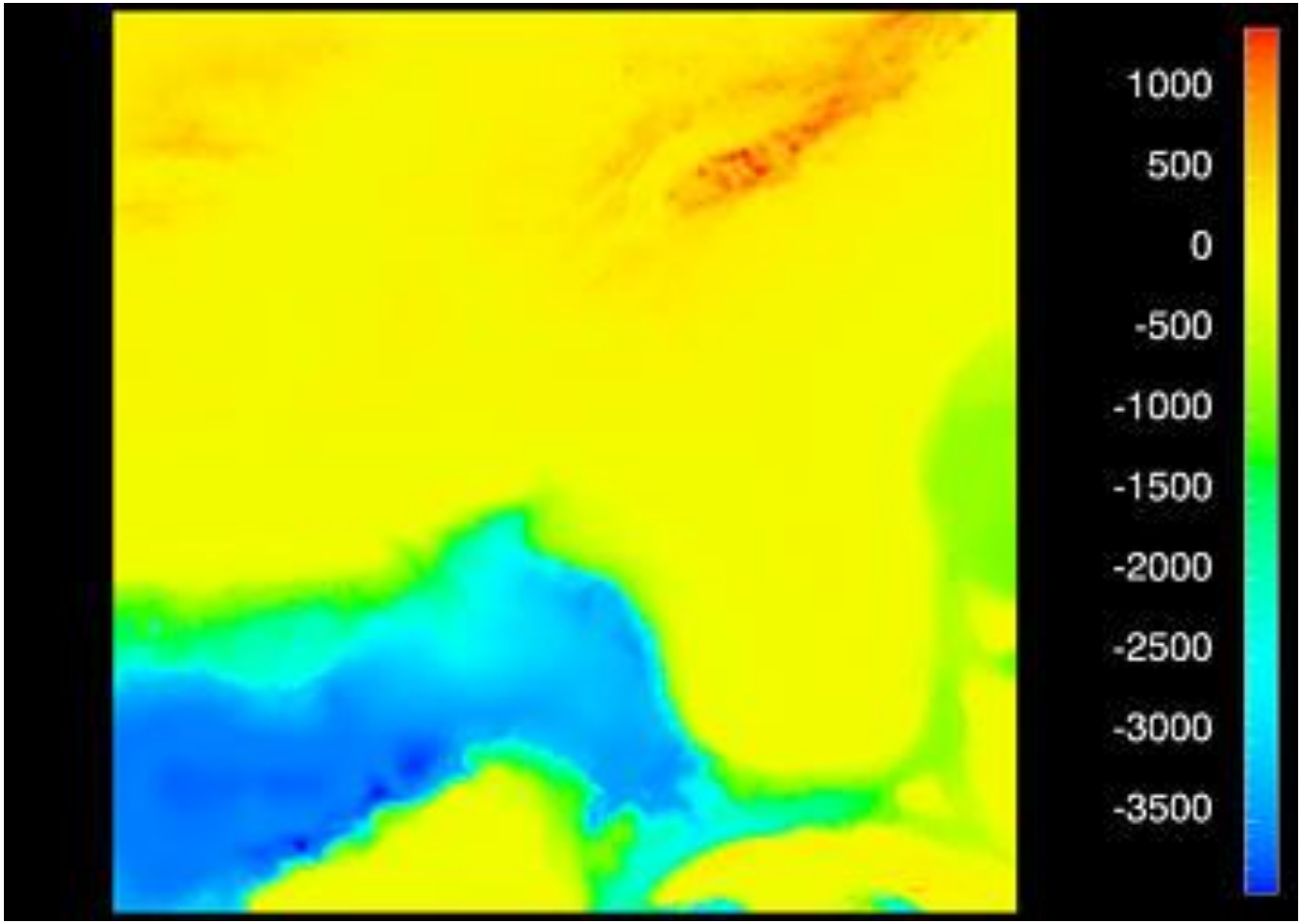
Game 2.1: What are we seeing here?



Game 2.1: What are we seeing here?

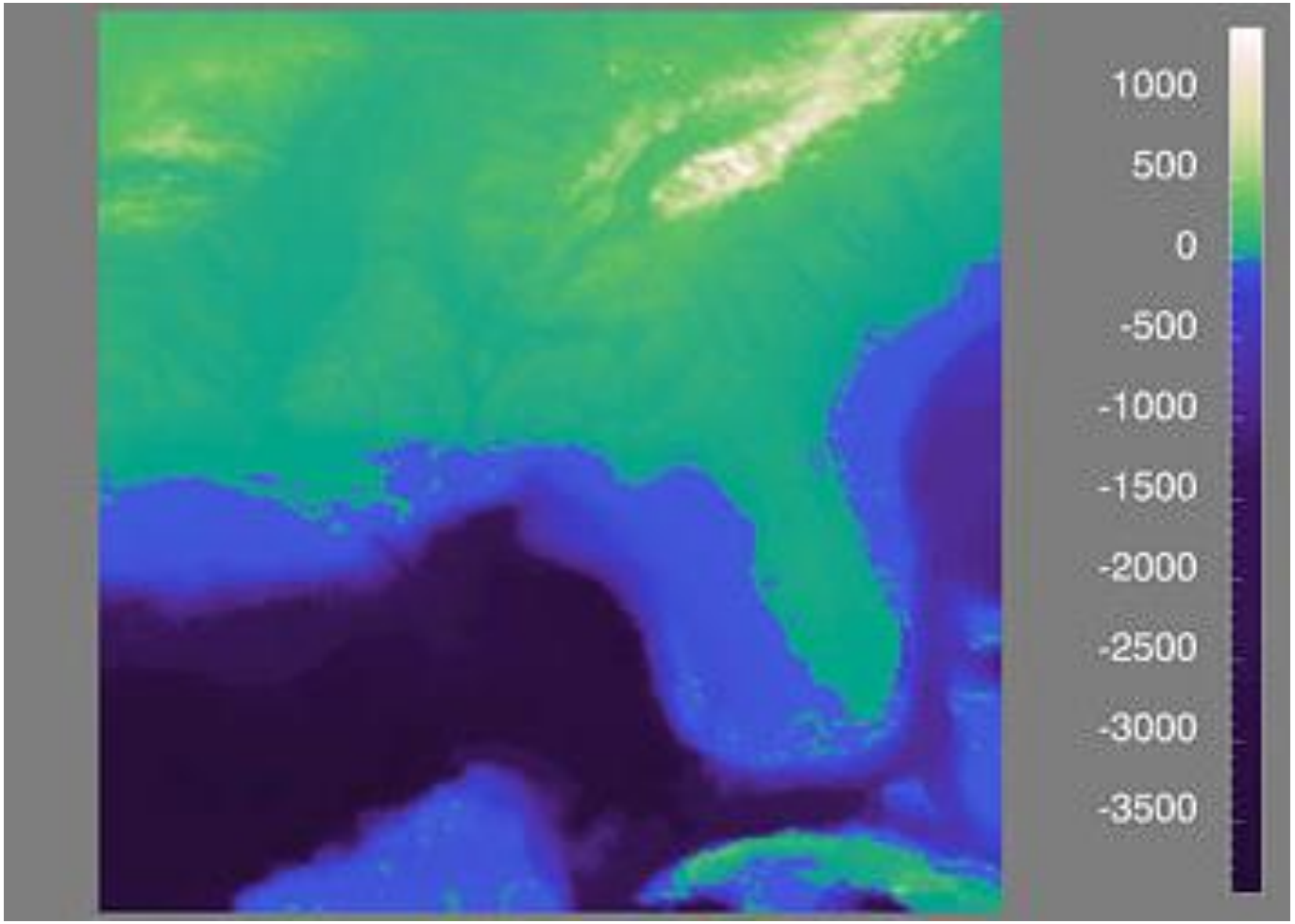


Game 3.1: What is there?

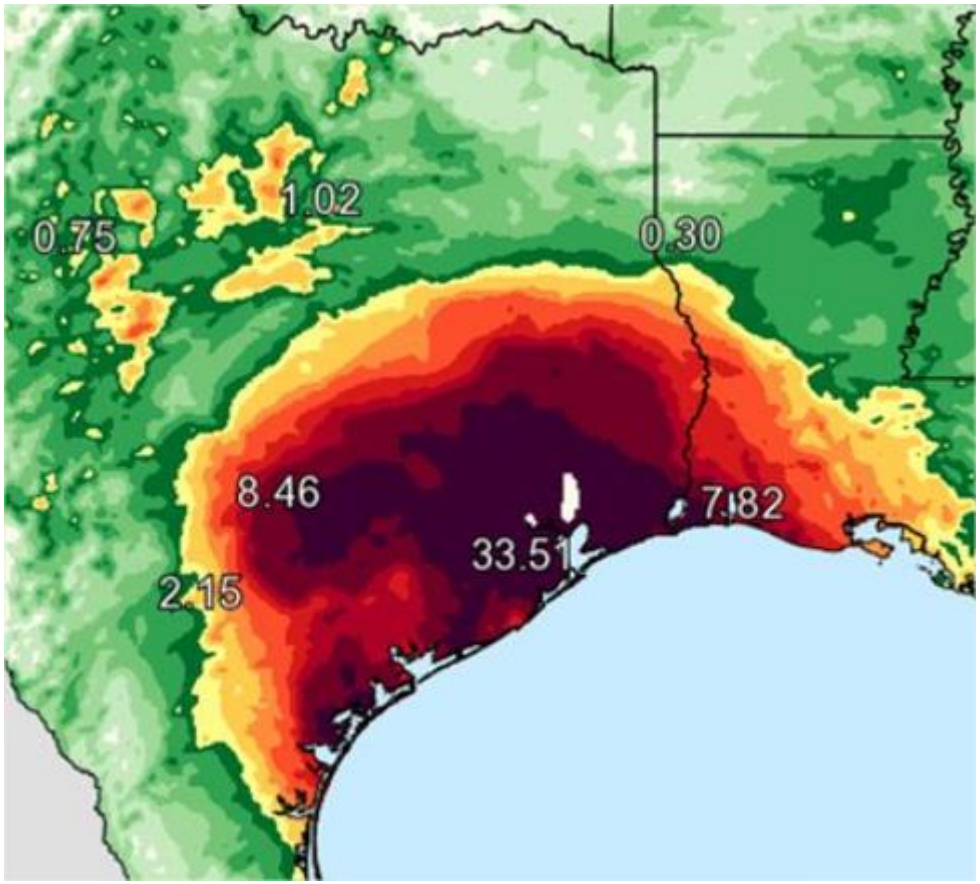


Game 3.1: What is there?

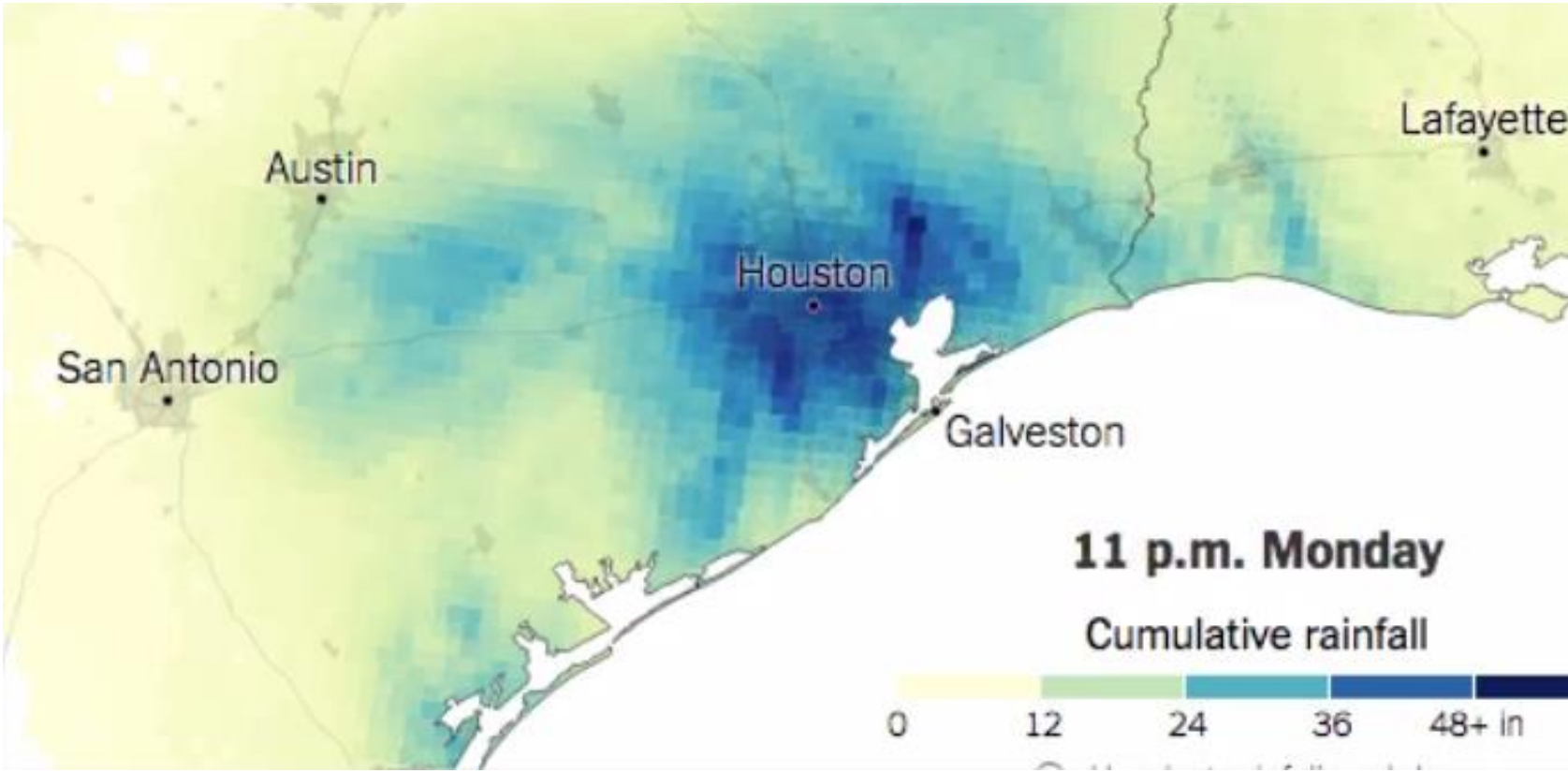
Florida!



Game 3.1: Where did it rain the most?



Game 3.1: Where did it rain the most?



Violating the Expressivness Principle

https://eagereyes.org/basics/rainbow-color-map

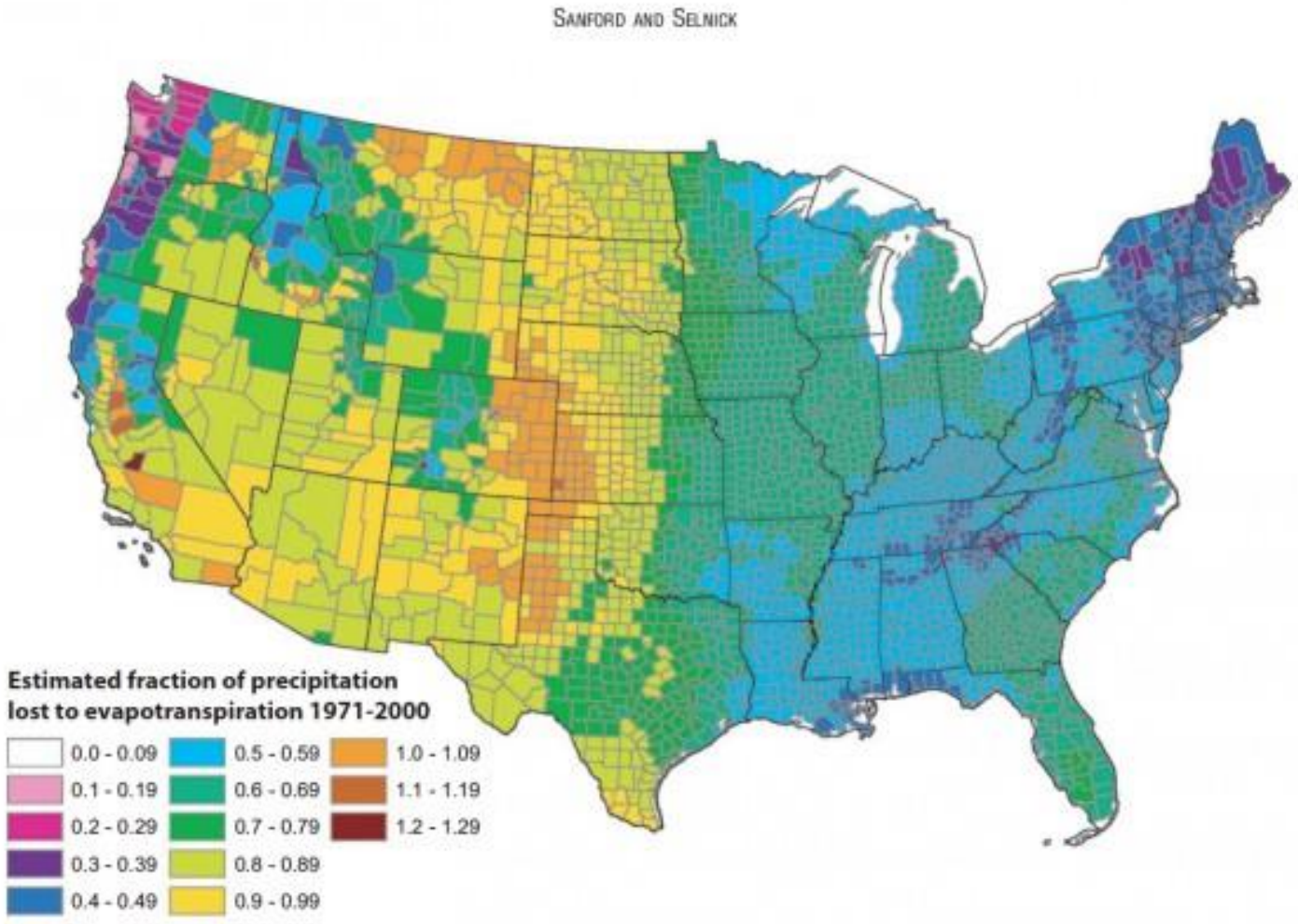


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

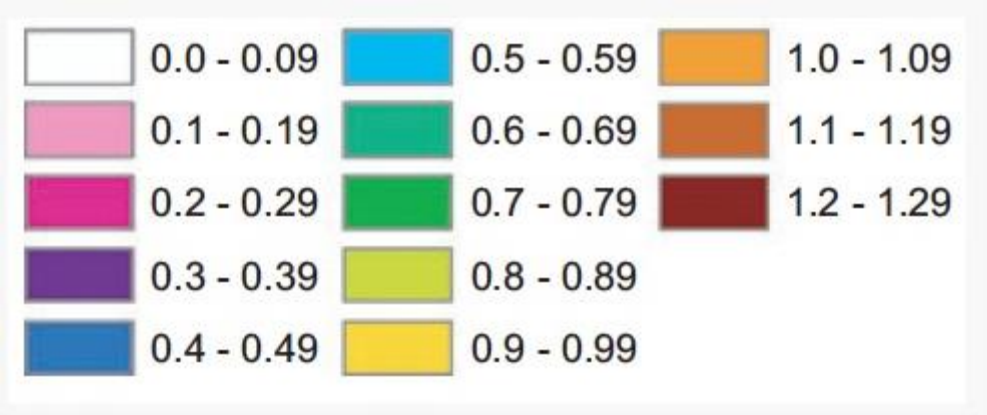
Expressiveness Principle

The visual encoding should express all of, and only, the information in the attributes

Violating the Expressivness Principle

https://eagereyes.org/basics/rainbow-color-map

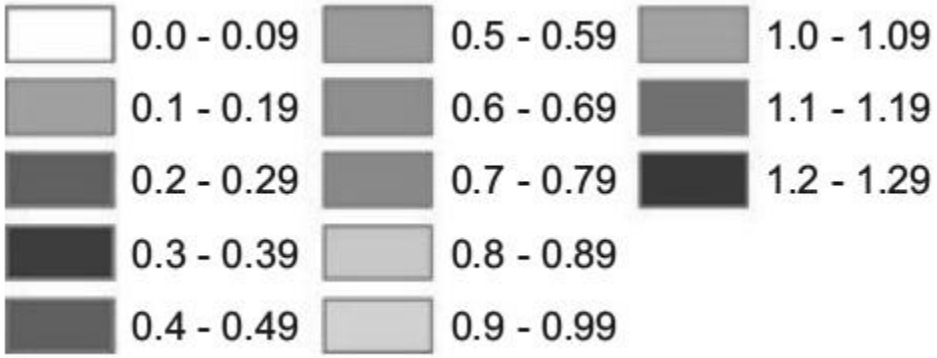
Seems ok, but…



Violating the Expressivness Principle

https://eagereyes.org/basics/rainbow-color-map

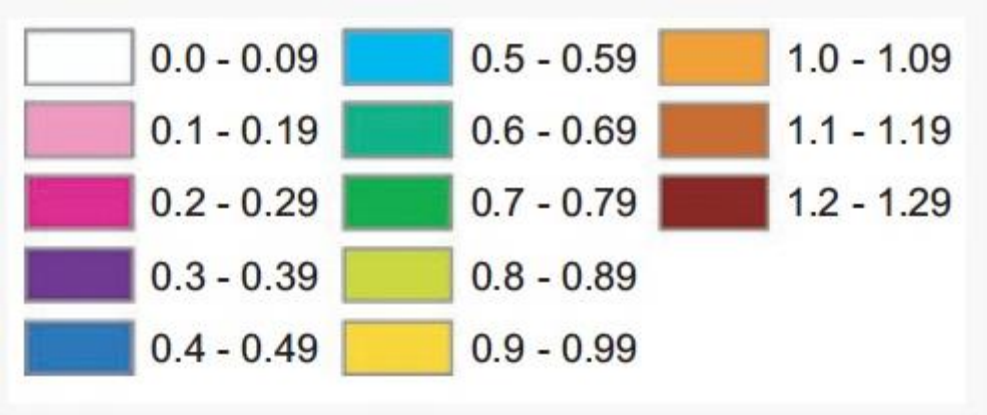
Luminance all over the place!



Violating the Expressivness Principle

https://eagereyes.org/basics/rainbow-color-map

Plus… different hues == different categories!



Thus the “Mid American Rift”

https://eagereyes.org/basics/rainbow-color-map

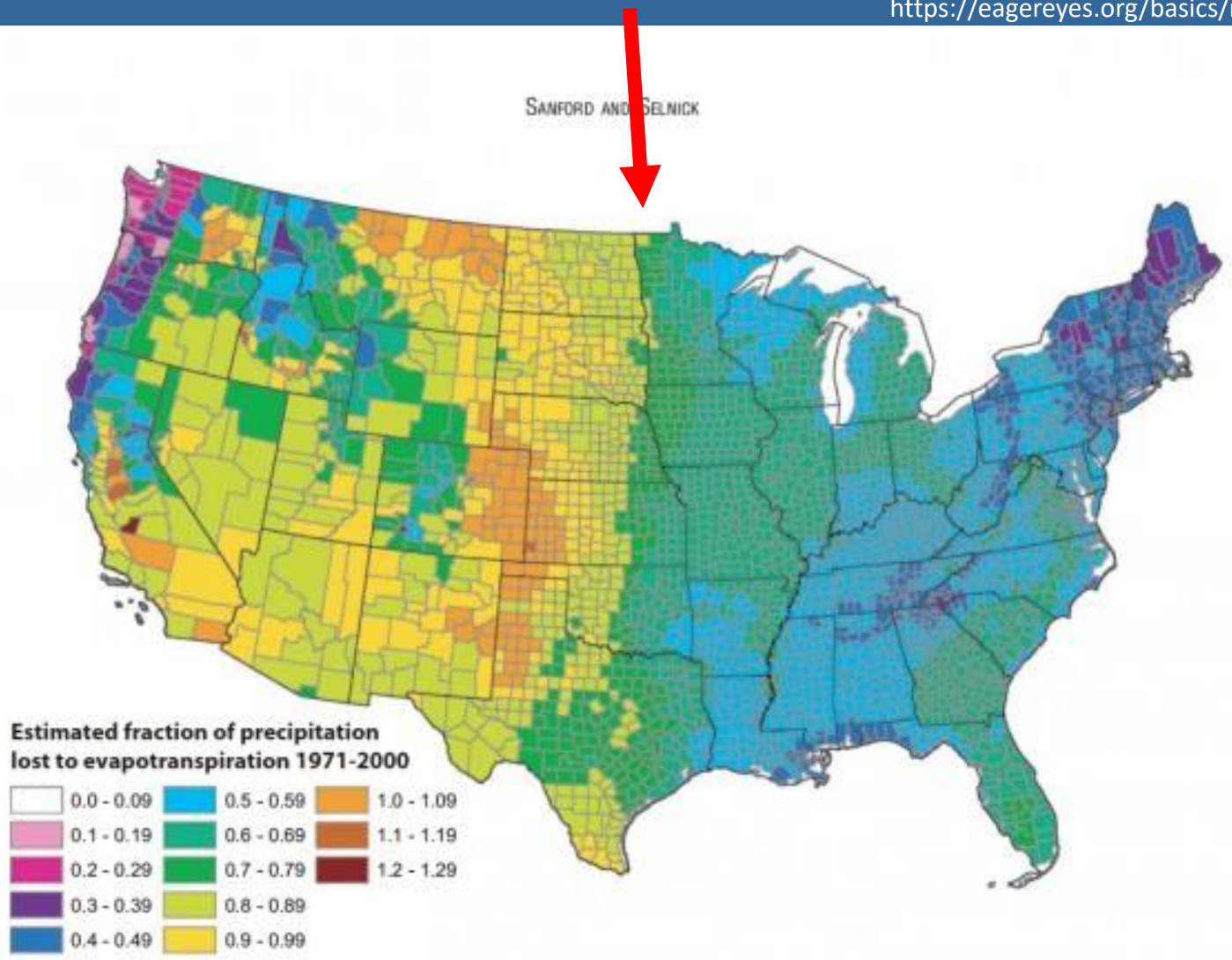


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

#endrainbow

QUESTIONS?