Craft an Explanation

Goal

Begin writing a 30-45 minute lesson that teaches your topic to a beginner.

Warm Up

Get up and find a new seat next to the other people workshopping your topic.

Say hello and re-introduce yourself.

Pop Quiz

What is the goal of training?

Beginner

No mental model

Competent Practitioner

Useful mental model

Expert

Elaborate mental models

Beginner

No mental model

Competent Practitioner

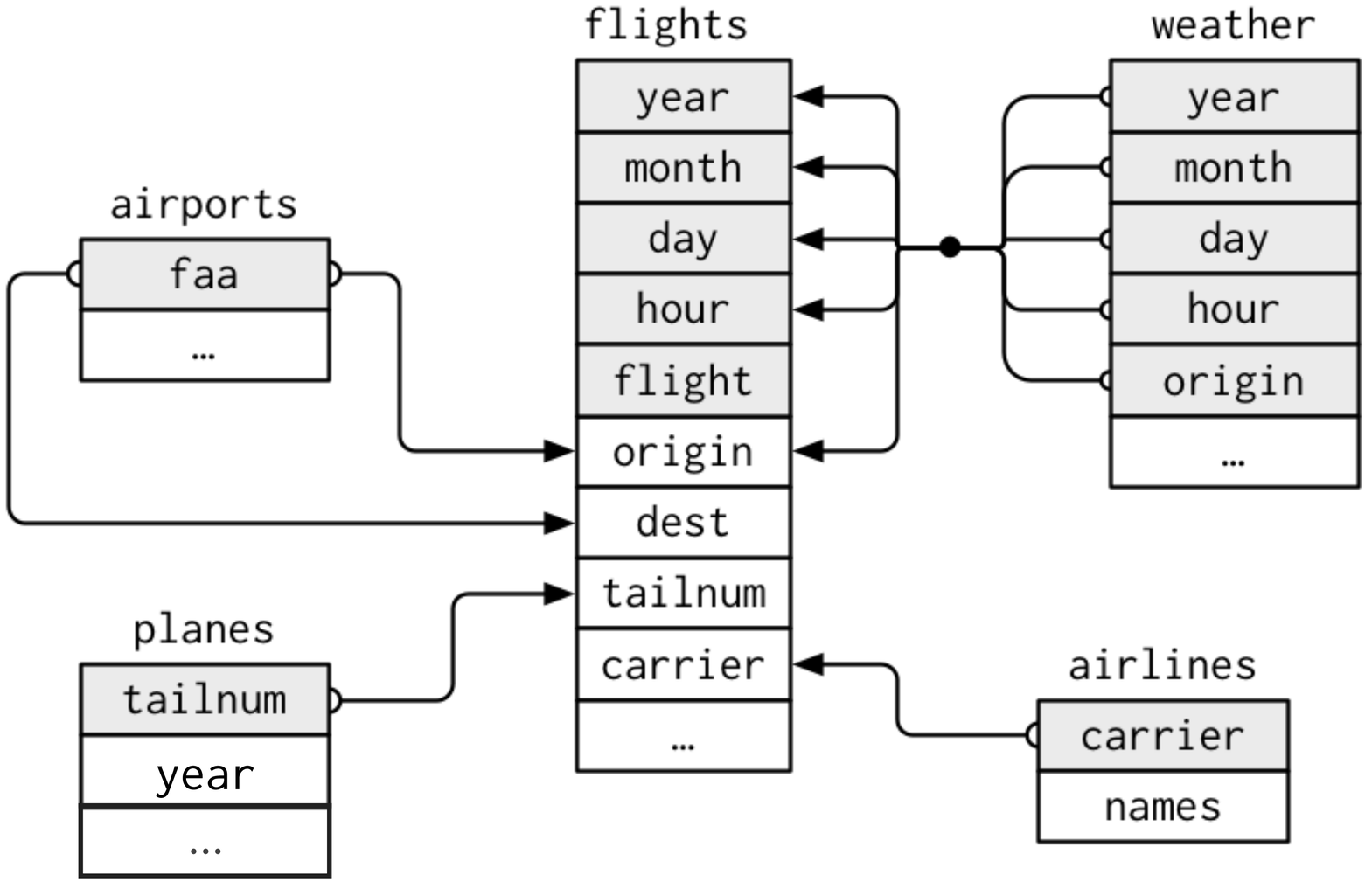
Useful mental model

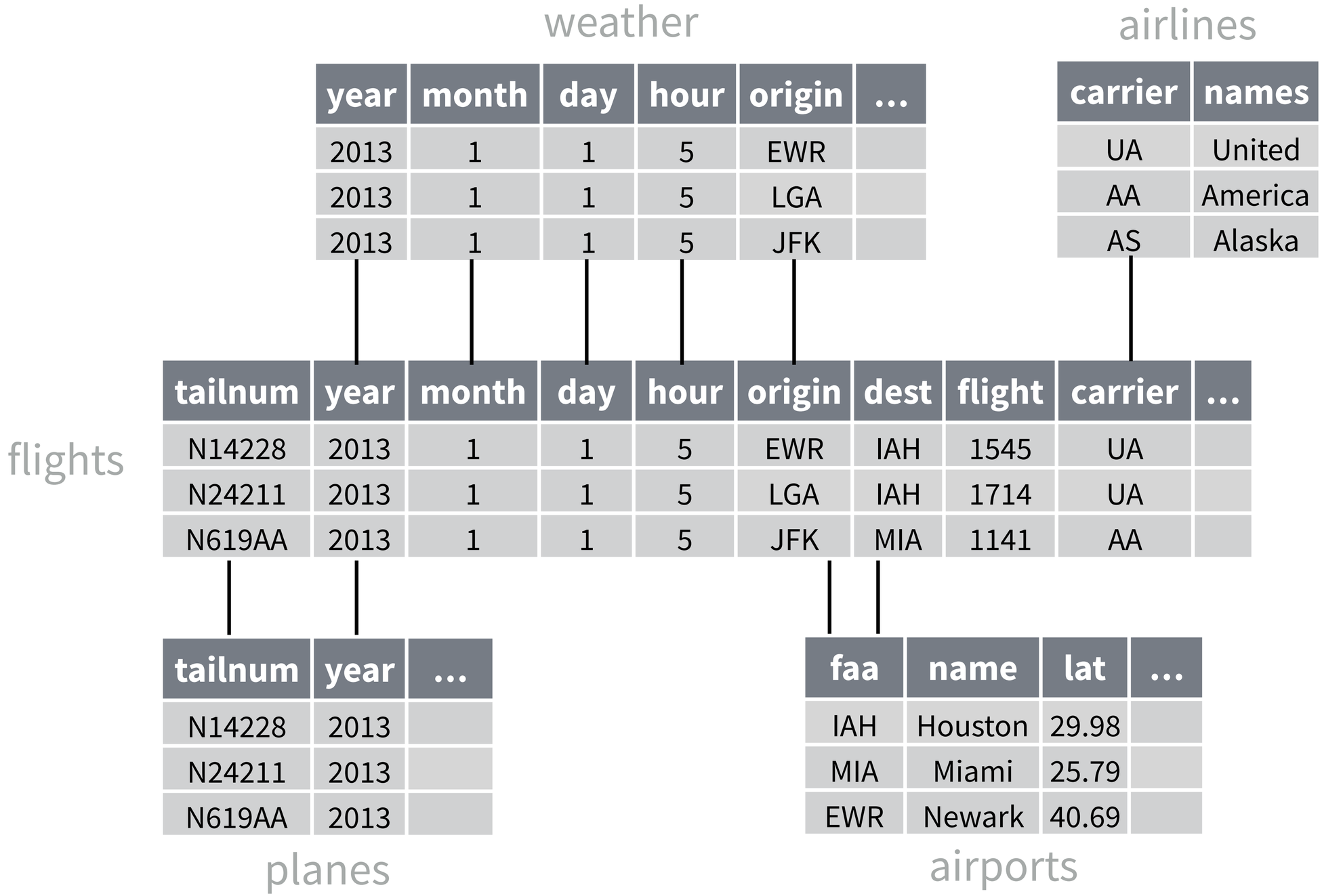
Expert

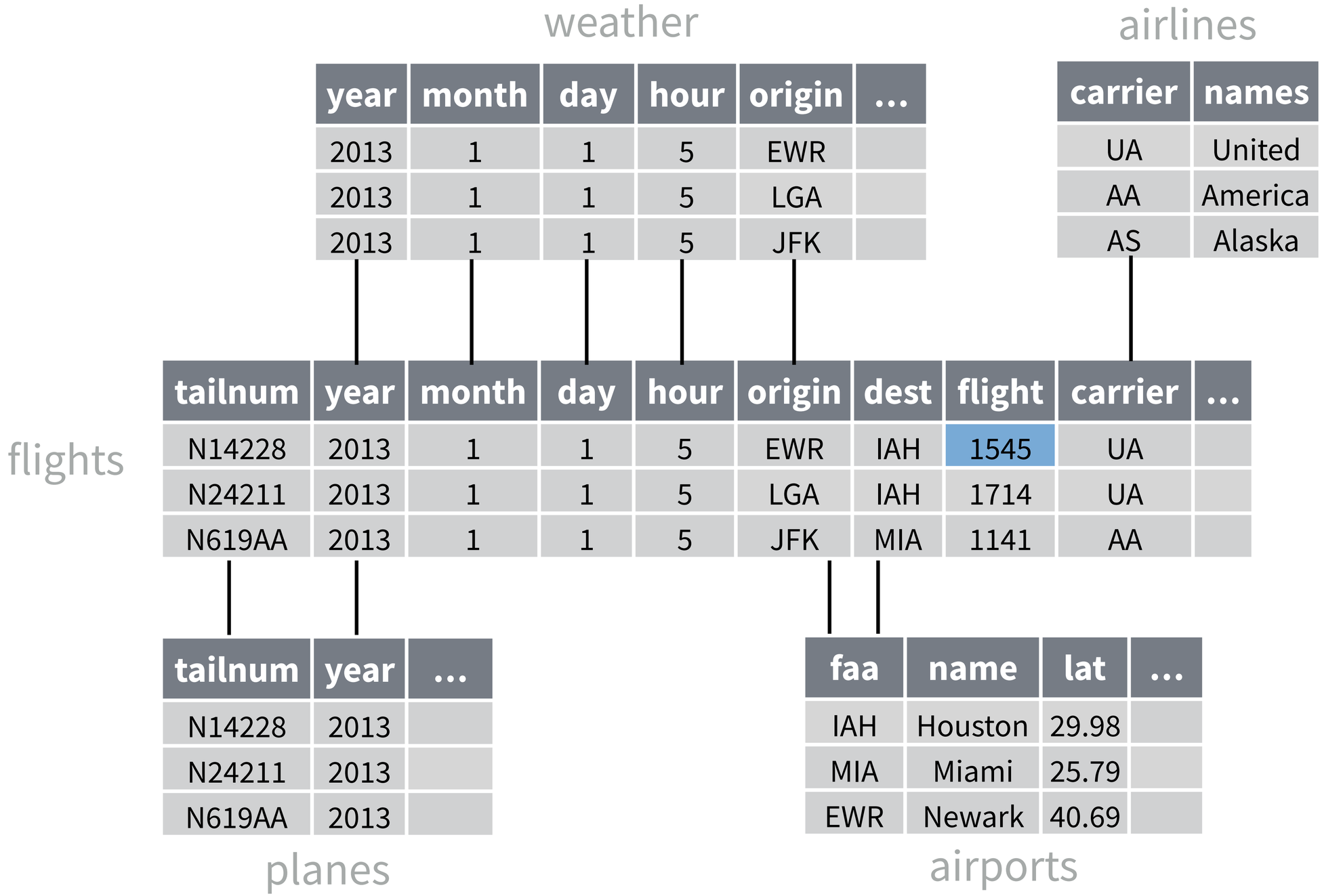
Elaborate mental models

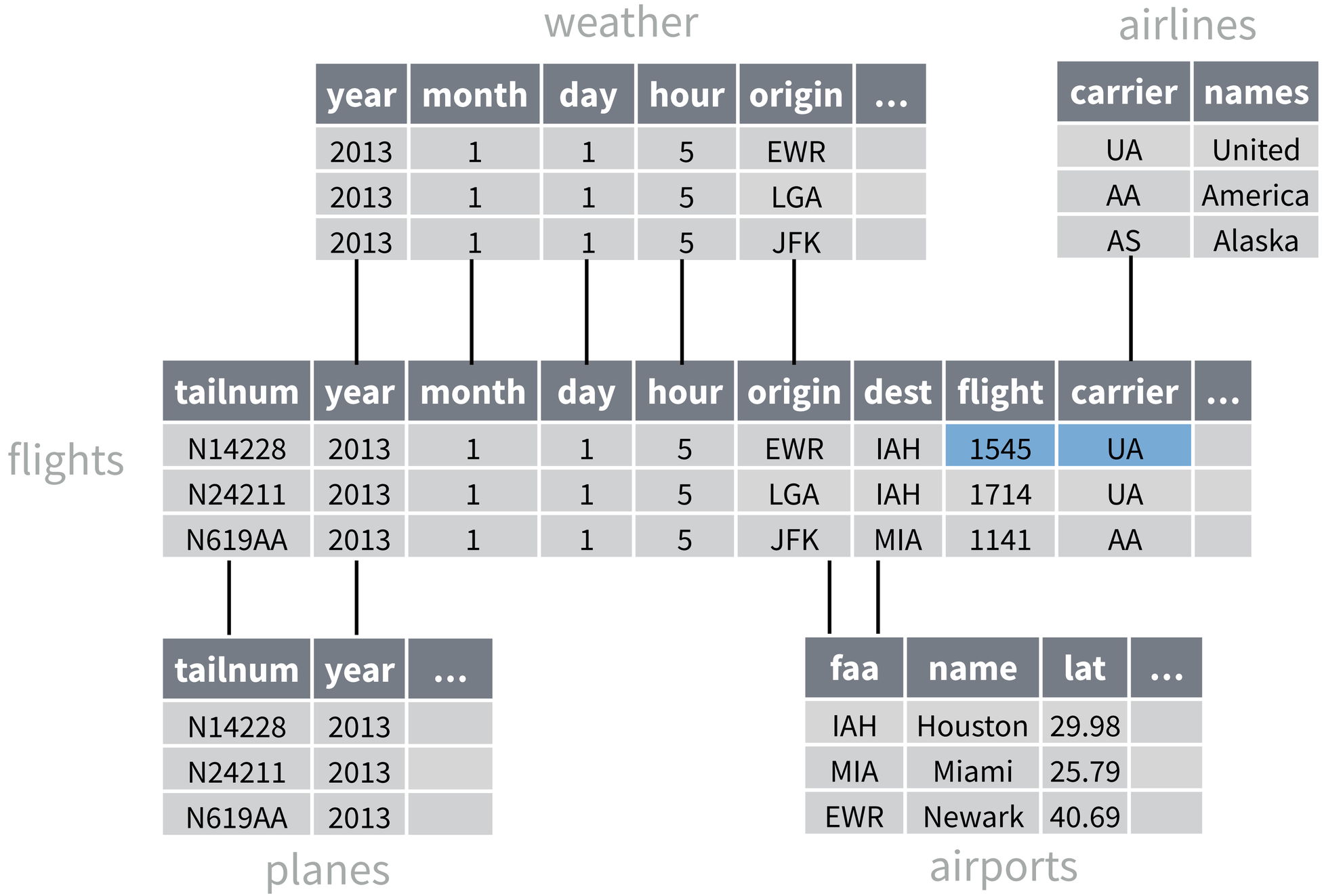
The mental model

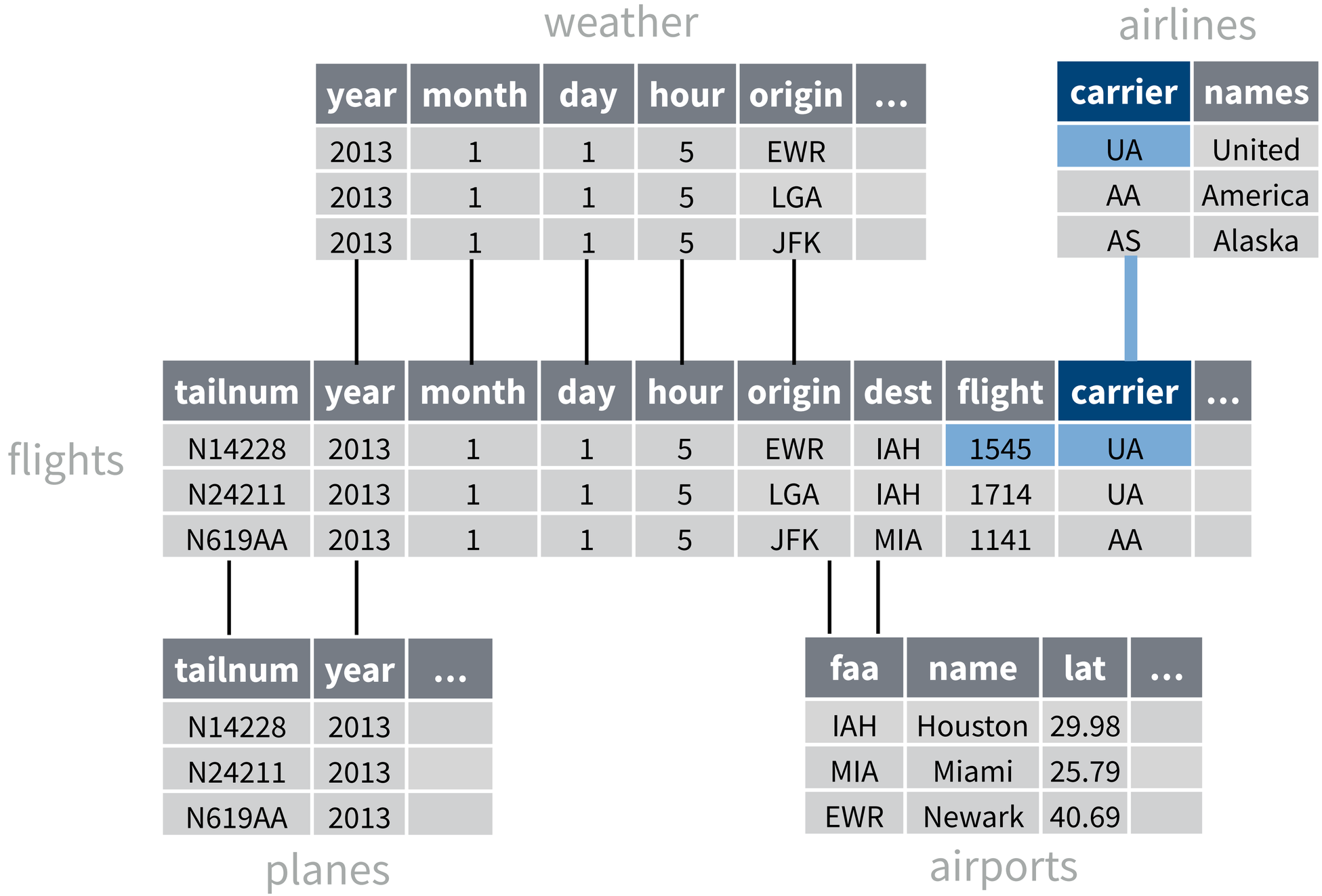
nycflights13

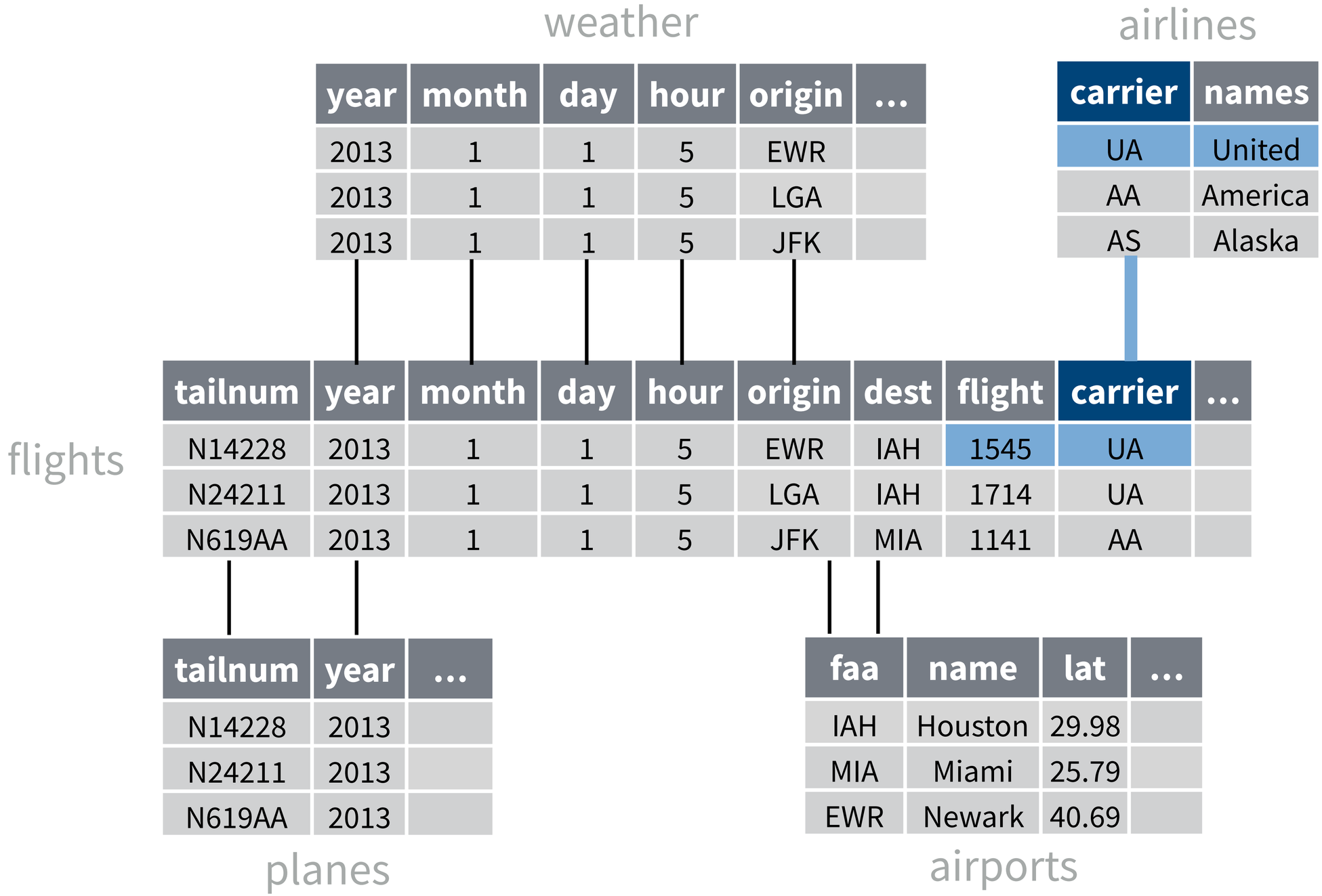


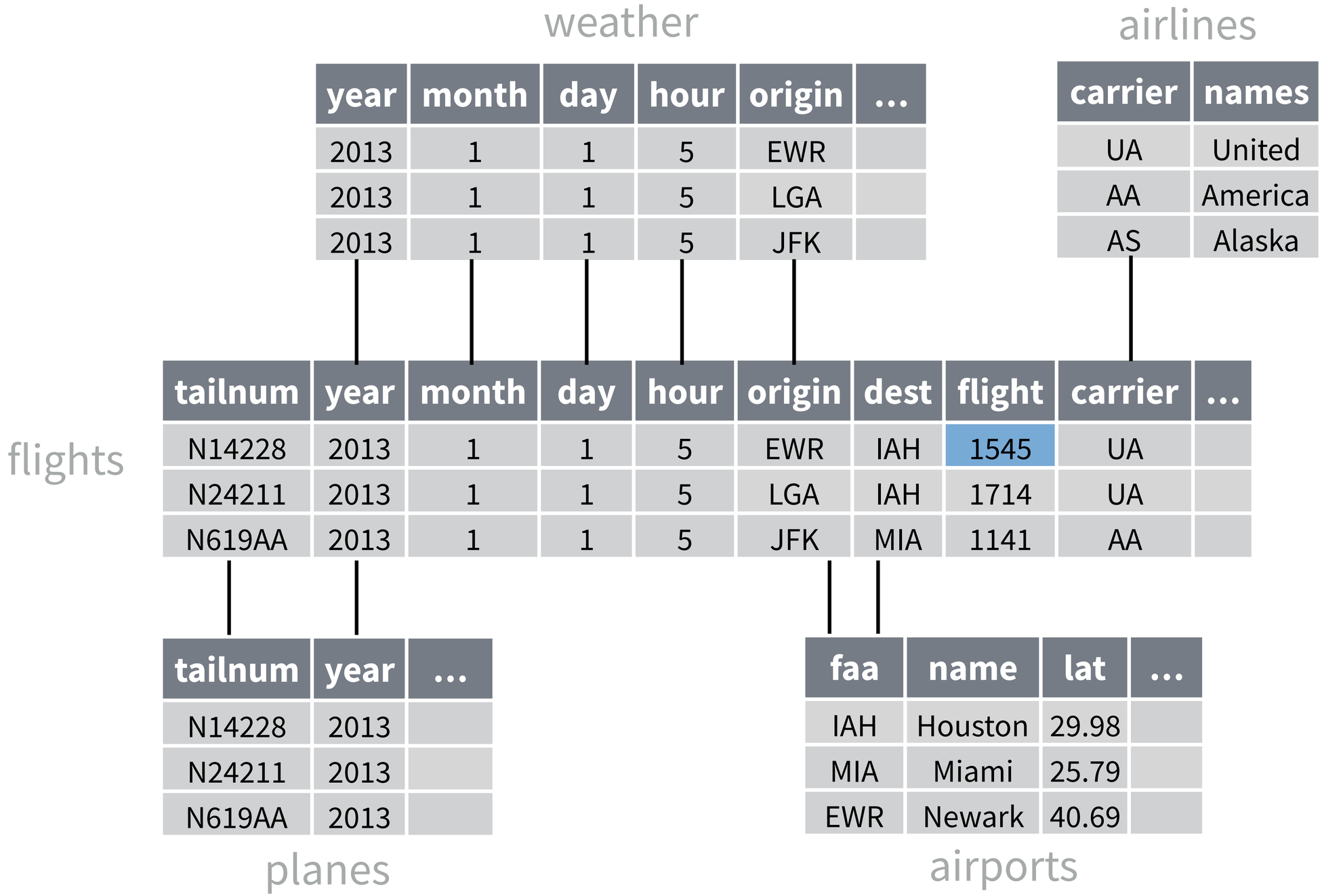


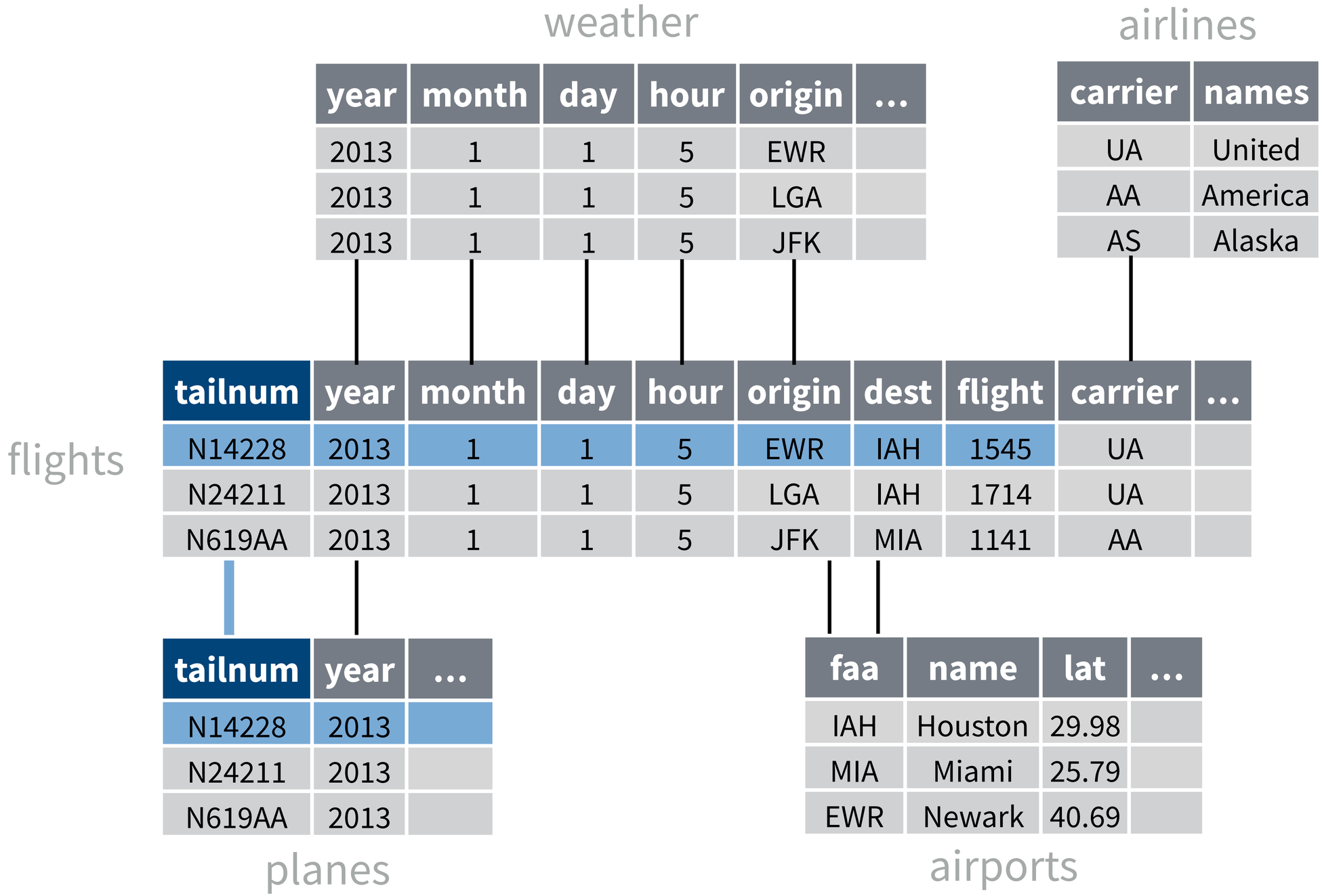












weather

year	mont	day	hour	origi	…
2013	1	1	5	EWR	
2013	1	1	5	LGA	
2013	1	1	5	JFK	

airlines

carrier	name
UA	United
AA	American
AS	Alaska

flights

tailnu	year	mont	day	hour	origi	des	flight	carrier	…
N14228	2013	1	1	5	EWR	IAH	1545	UA	
N24211	2013	1	1	5	LGA	IAH	1714	UA	
N619AA	2013	1	1	5	JFK	MIA	1141	AA	

tailnu	year	…
N14228	2013	
N24211	2013	
N619AA	2013	

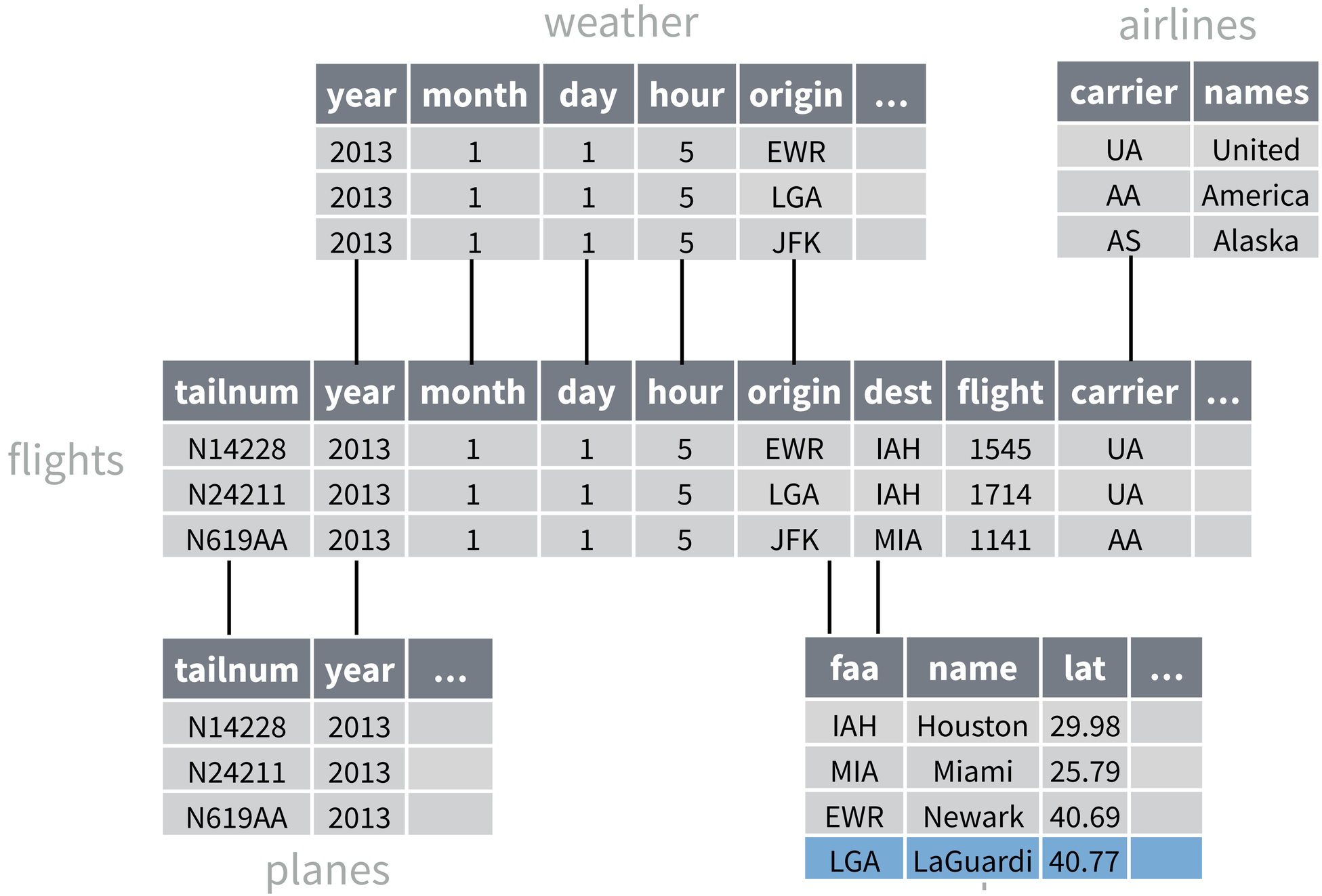
planes

faa	name	lat	…
IAH	Houston	29.98	
MIA	Miami	25.79	
EWR	Newark	40.69	

airports

Competent Practitioner

Useful mental model



Beginner

No mental model

- LGA is LaGuardia Airport
- It rained at JFK on 1/3/2013
- UA is United
- N619AA is a Cessna Plane
- Flight 1532 was delayed on 12/31/13
- Flight 1714 flew from LGA to IAH
- Houston airport is at 29.98 latitude
- Miami is MIA

Beginner

No mental model

- LGA is LaGuardia Airport
- It rai[illegible]2013
- UA is United
- [illegible]
- Flight 1532 was delayed on 12/31/13
- [illegible]4 flew fror
- Houston airport is at 29.98 latitude
- Miami is MIA

Your Turn

Spend five minutes drawing out and elaborating a concept map of your mental model for your package topic.

Label the connections.

Pay particular attention to what is a pre-requisite for what.

Think 05:00

Pair 01:00

Your Turn

Compare your map to the people's next to you.

Are they surprisingly different? similar?

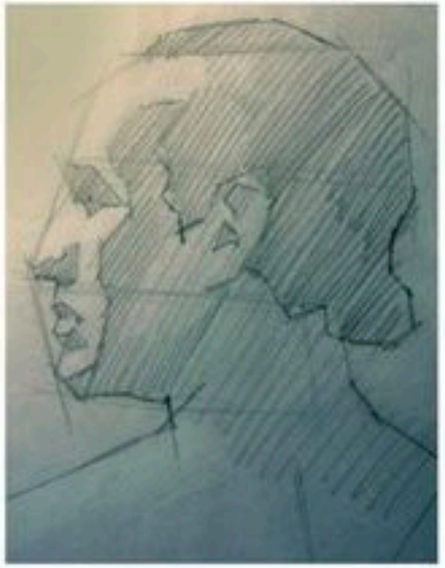
Think 05:00

Pair 01:00

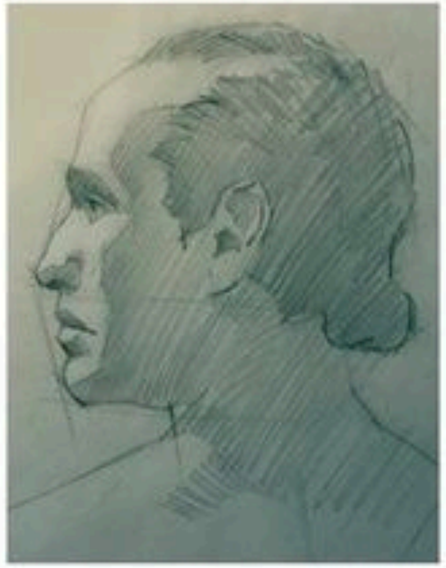
Now what?

1. Initial set-up

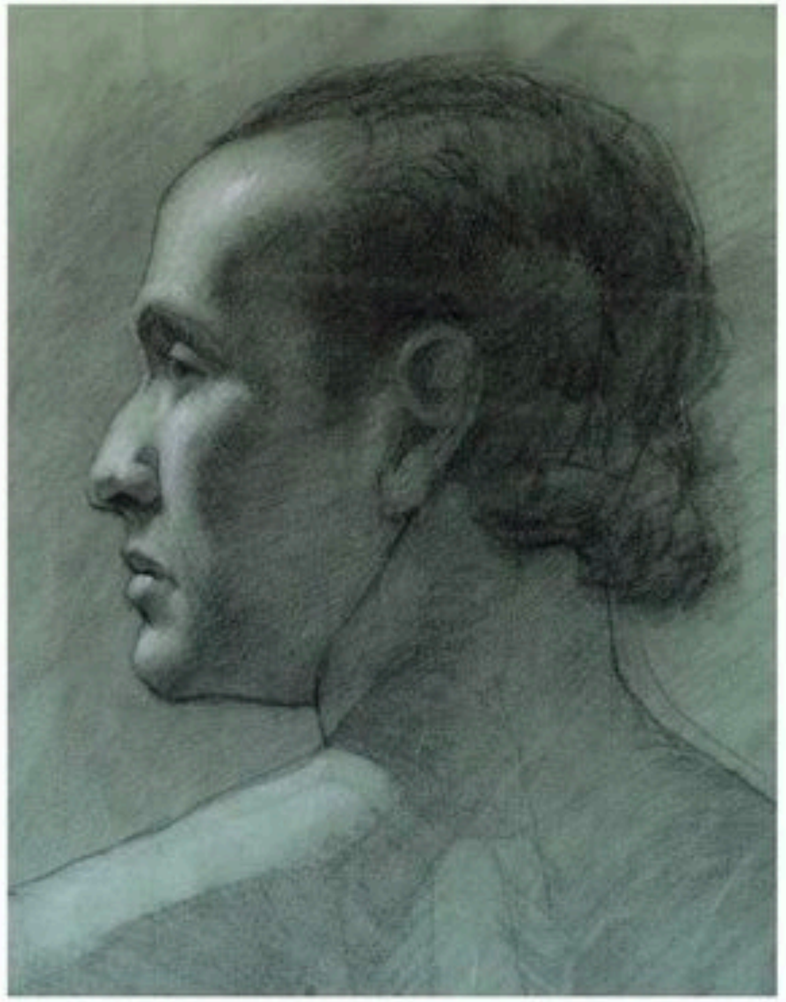
2. Find the major forms



3. Mass in the shadow shapes, they define the light shapes.



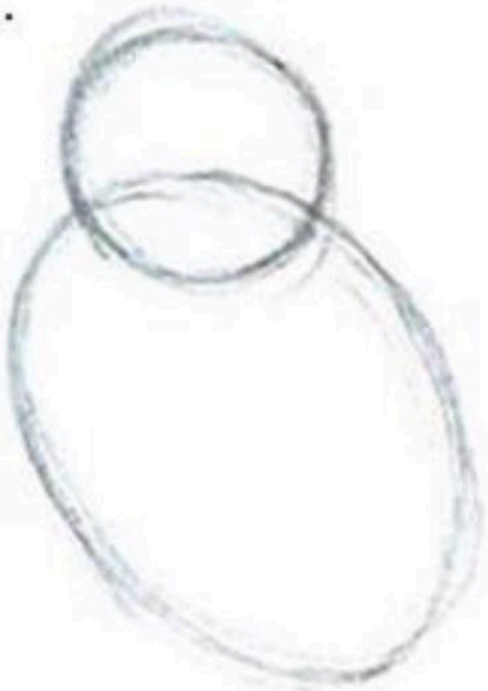
4. Further development of the shadow shapes.



Head study form life, charcoal and white chalk on green paper.

How to draw an owl

1.



2.

1. Draw some circles

2. Draw the rest of the fucking owl

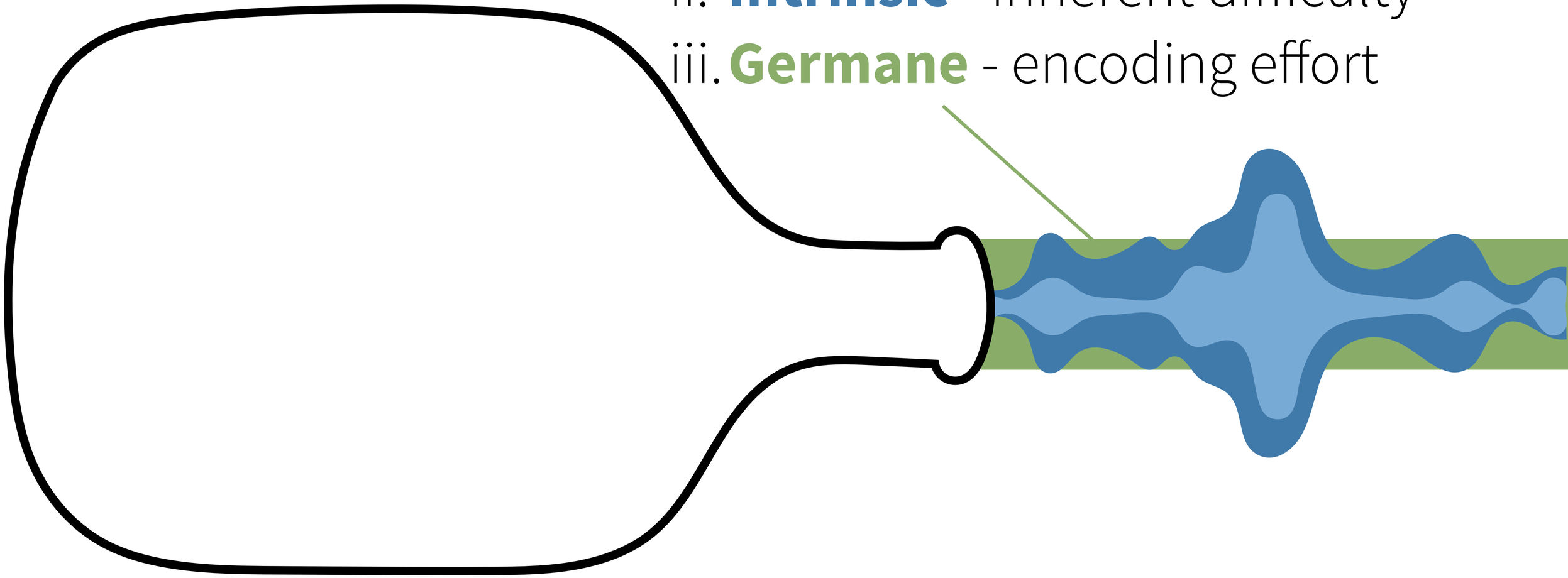
Poll

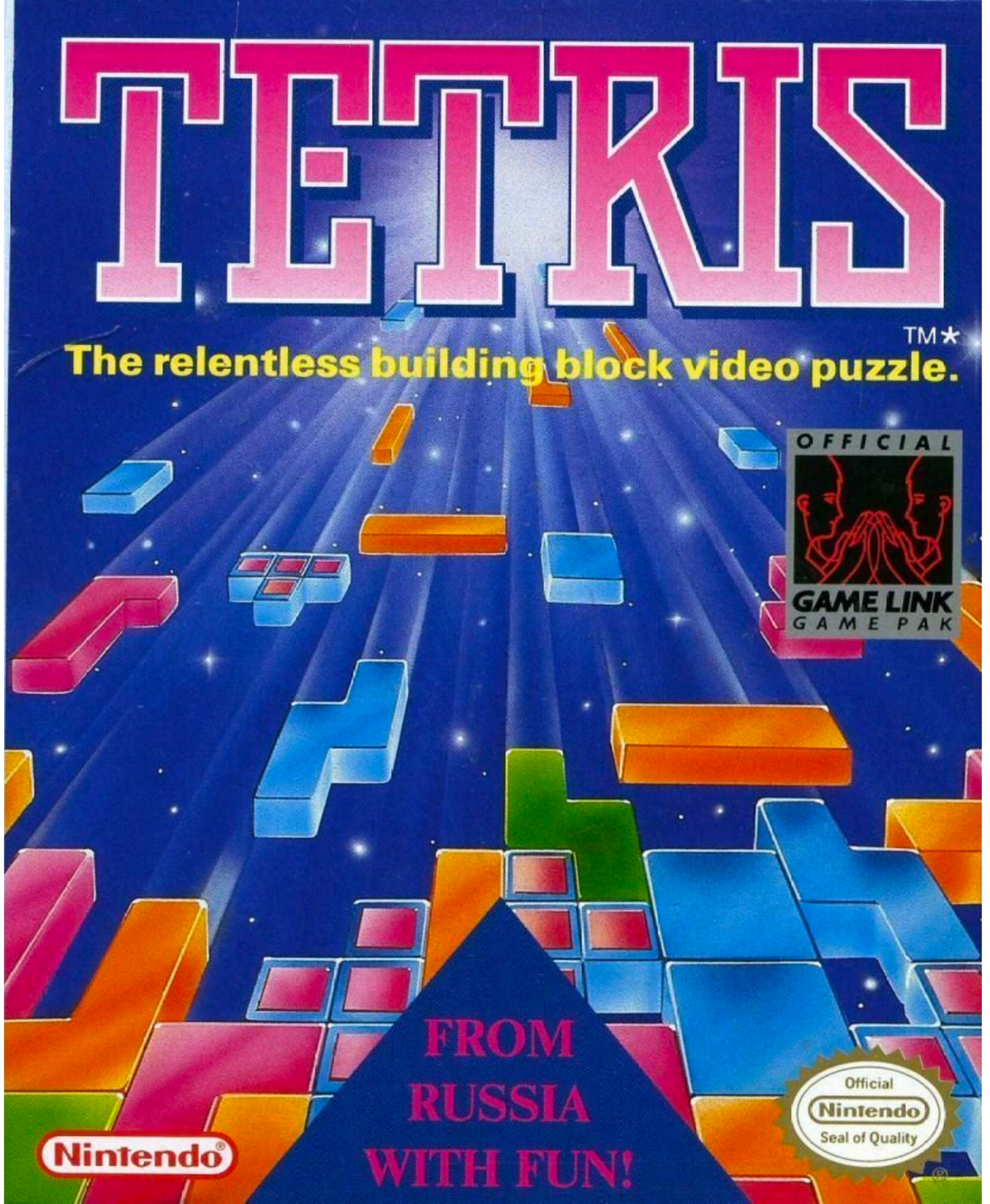
What's better at conveying a mental model:

Explanations or **Exercises?**

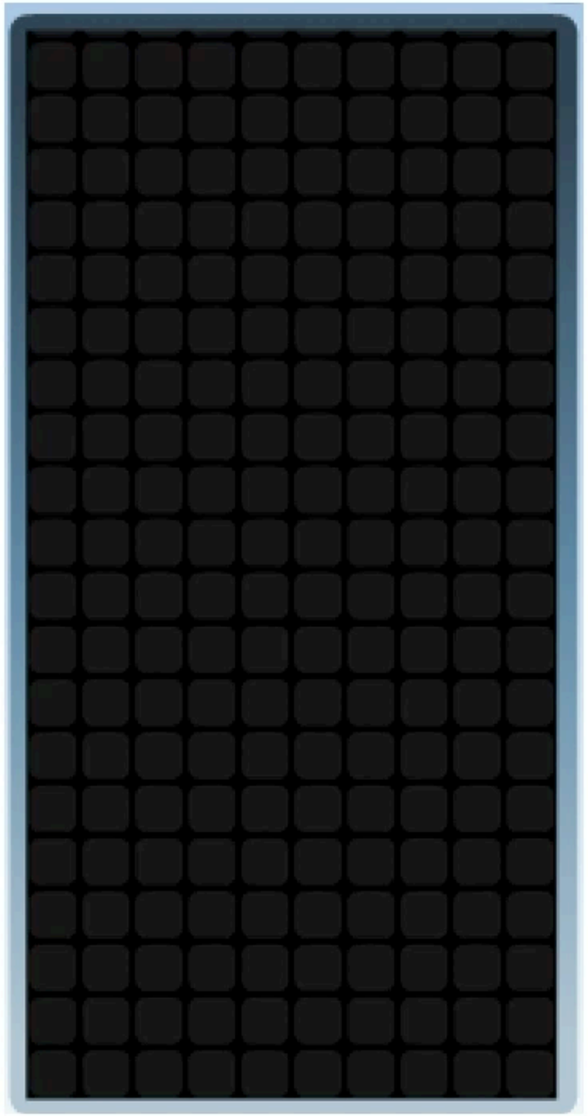
Cognitive Load Theory

i. **Extraneous** - lost to distractions
ii. **Intrinsic** - inherent difficulty
iii. **Germane** - encoding effort



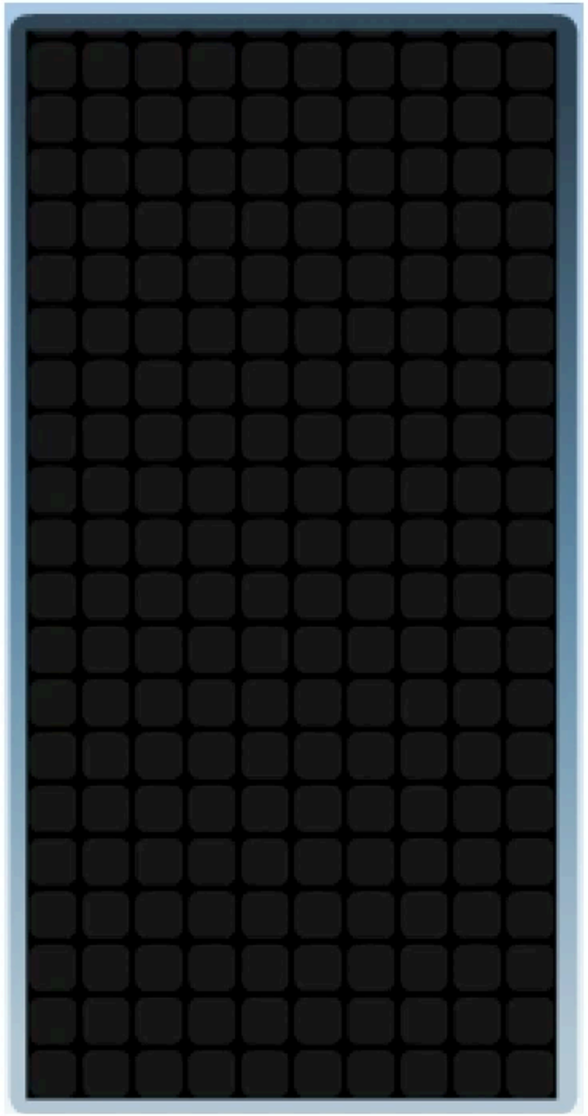


Germane Load



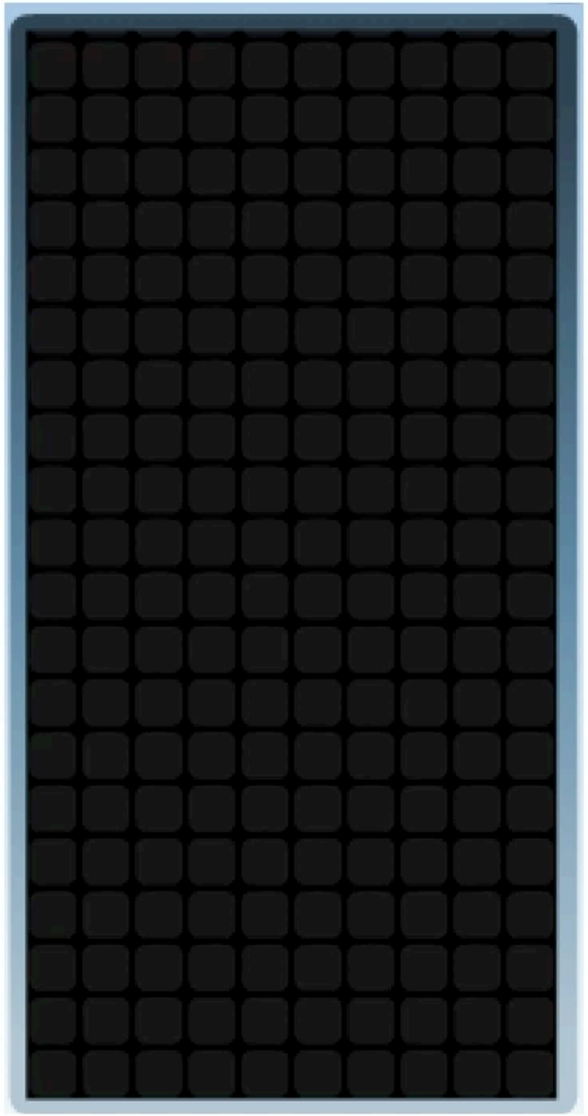
Exercises prevent this

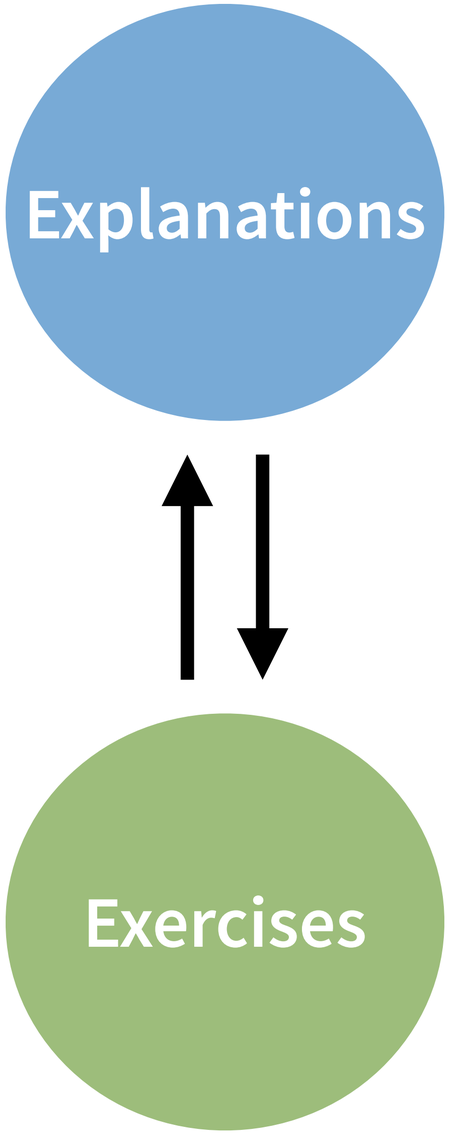
Intrinsic Load

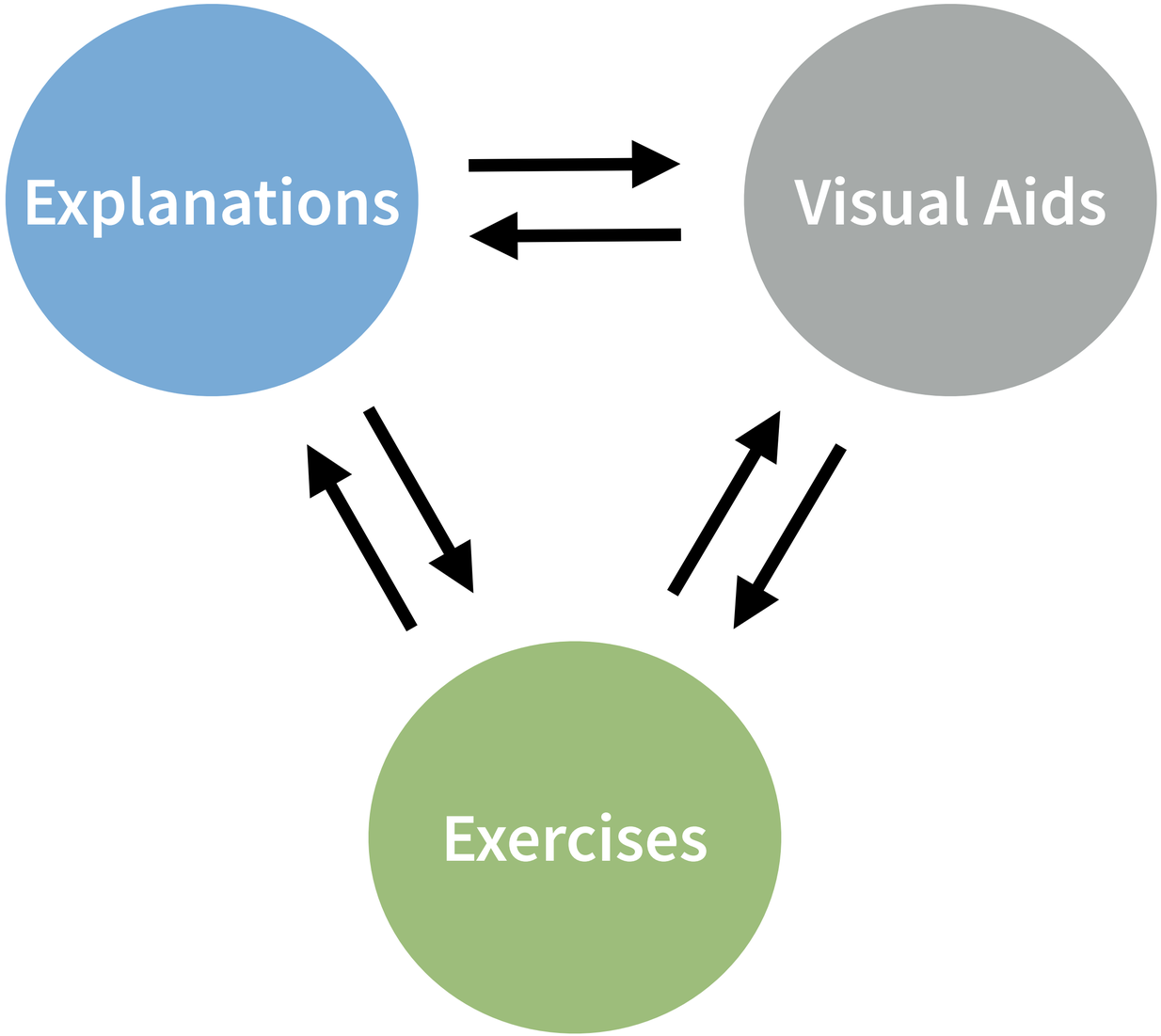


Explanations prevent this

Extrinsic Load







How to draw an owl

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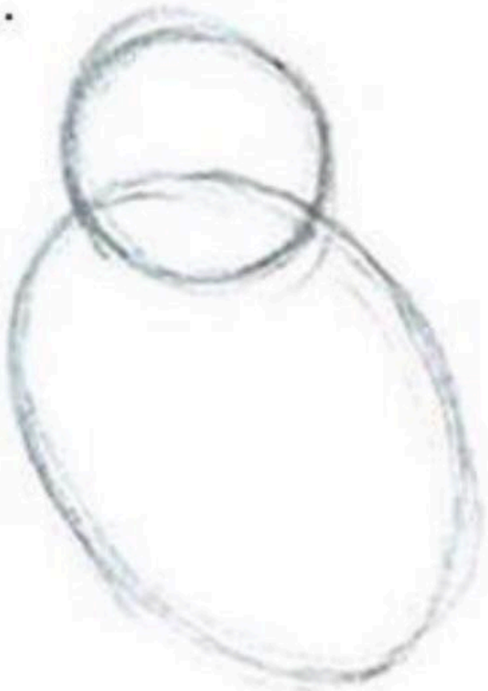


2.

1. Draw some circles

2. Draw the rest of the fucking owl

Your Turn

Look at your concept map, and decide which key parts you would like to teach in a short lesson (~30-45 minutes).

Write a learning objective that encapsulates those parts. You can be vague at this step.

How to Explain Anything Effectively

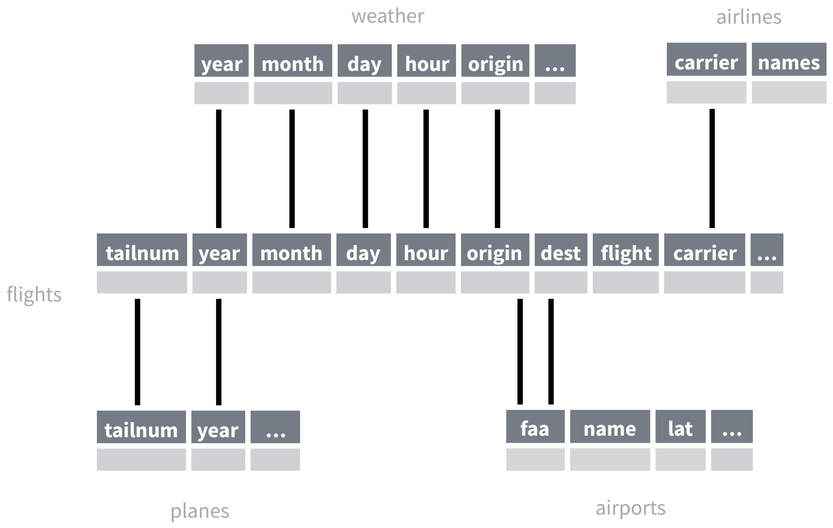
Goals

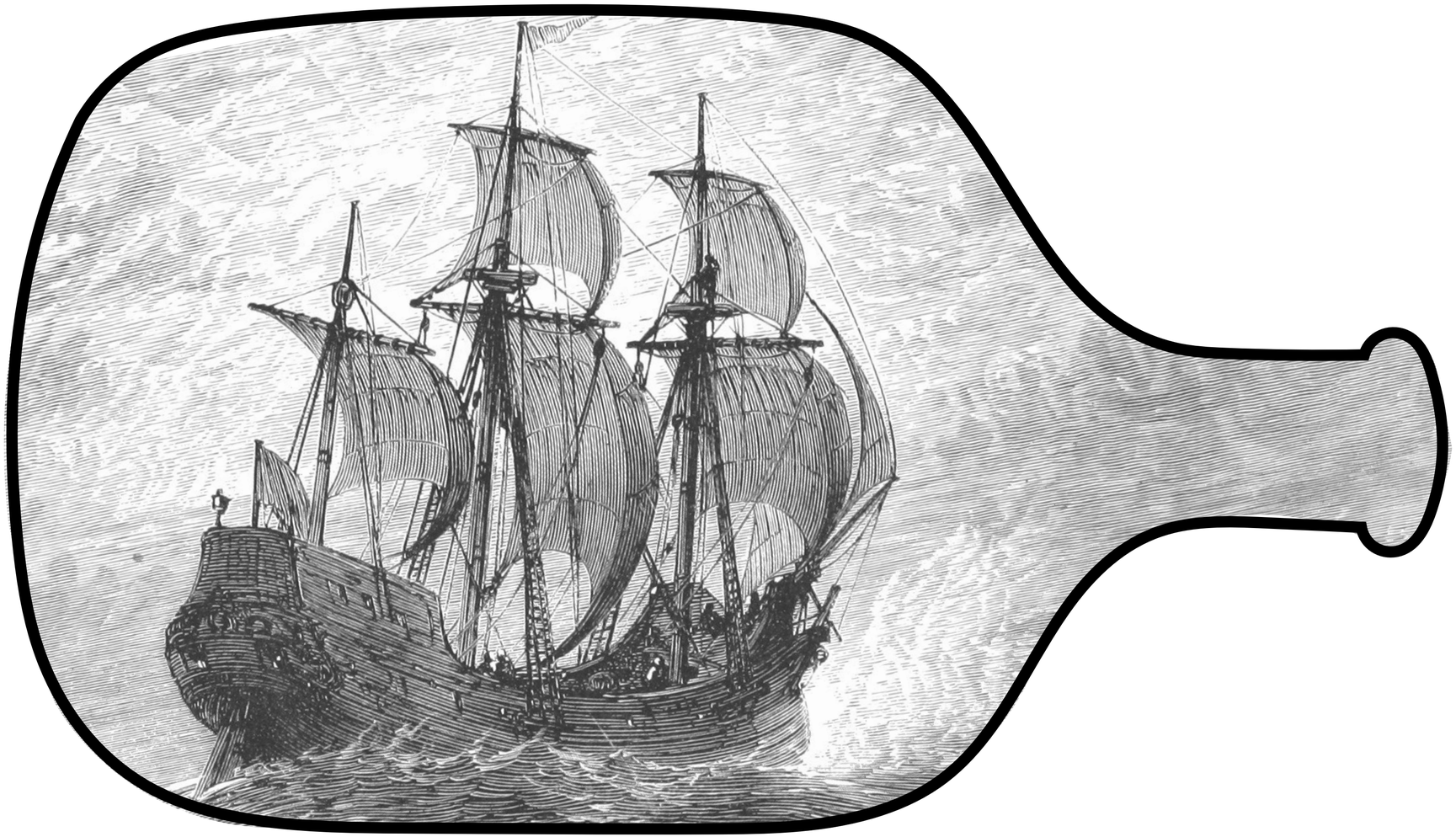
1. Reduce the intrinsic load

Intrinsic Load Analogy

Goals

1. Reduce the intrinsic load
2. Communicate the relationships



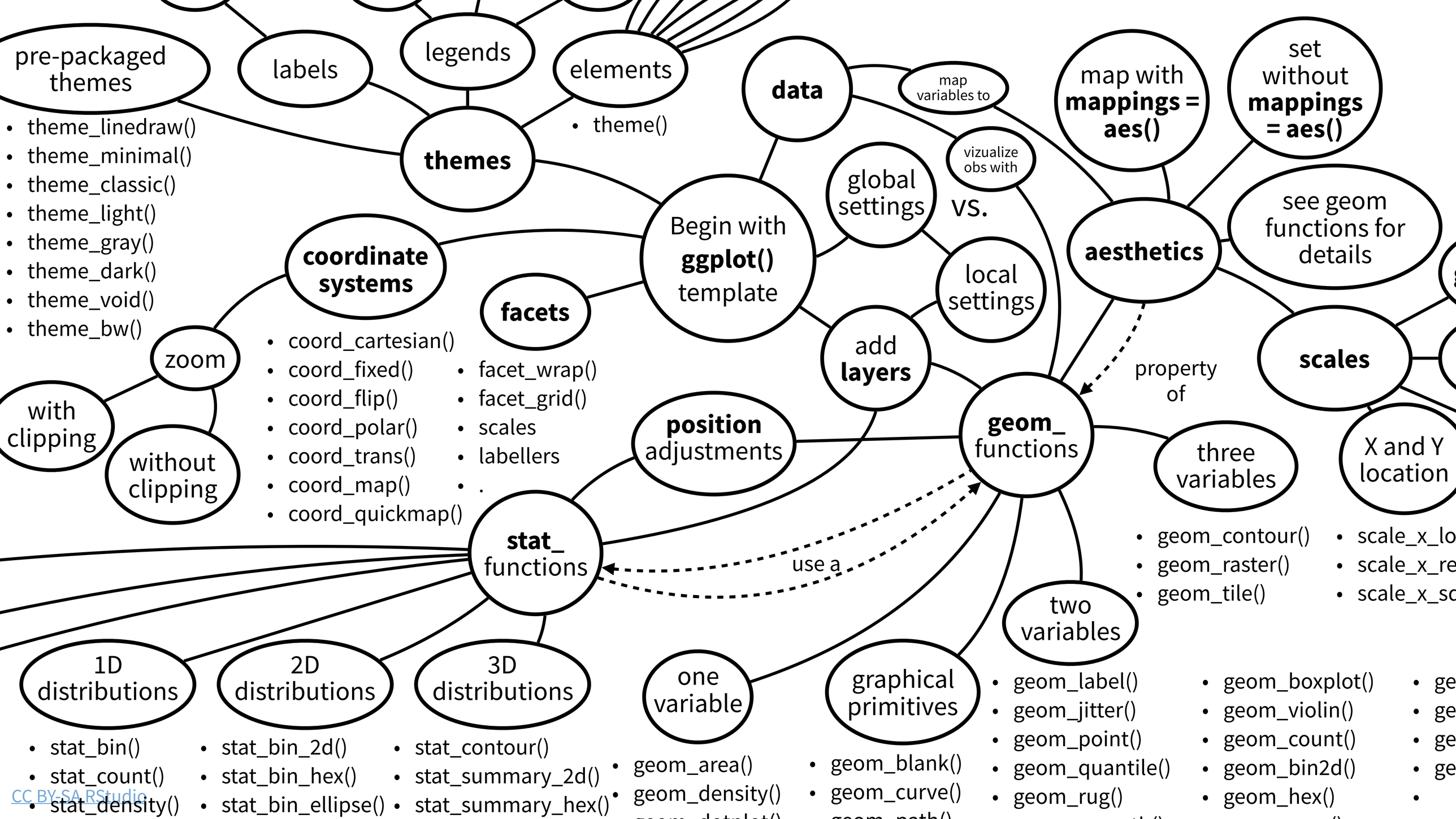


1. Lay the keel

2. Build topics in order

3. Connect to familiar things

Lay the keel

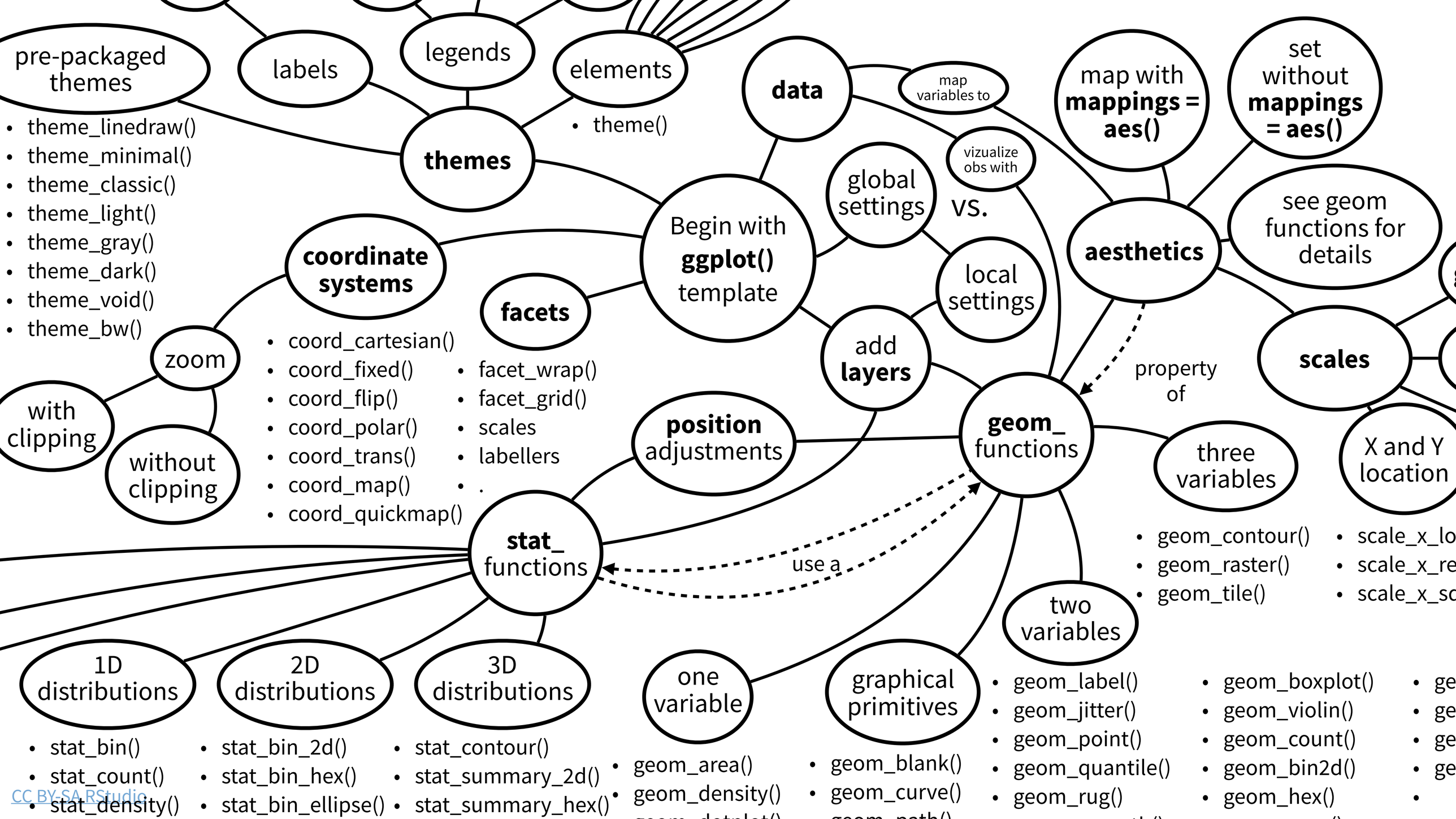


What is the keel of your mental model?

i.e., the core that everything else can hang on?

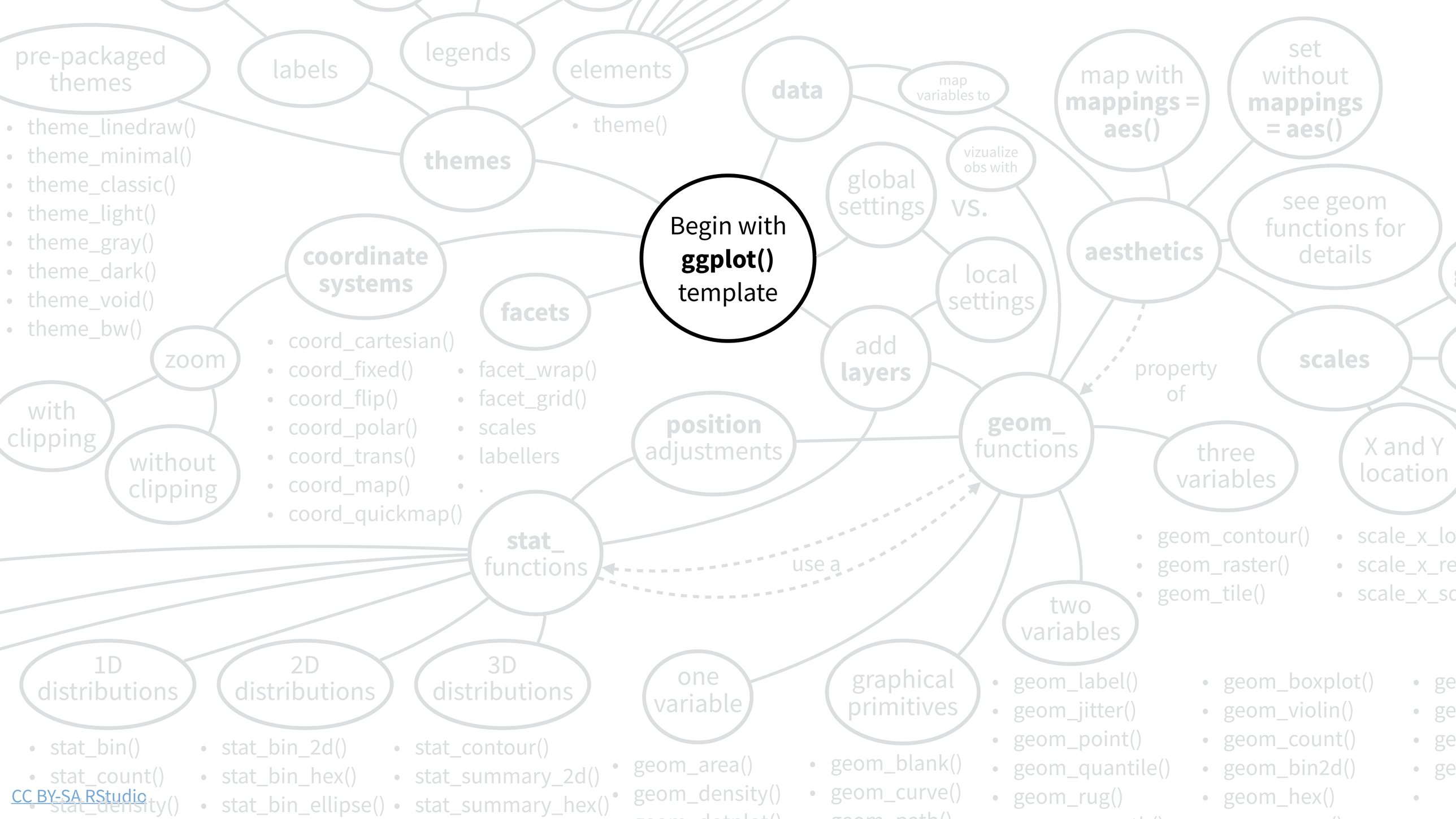
Your Turn

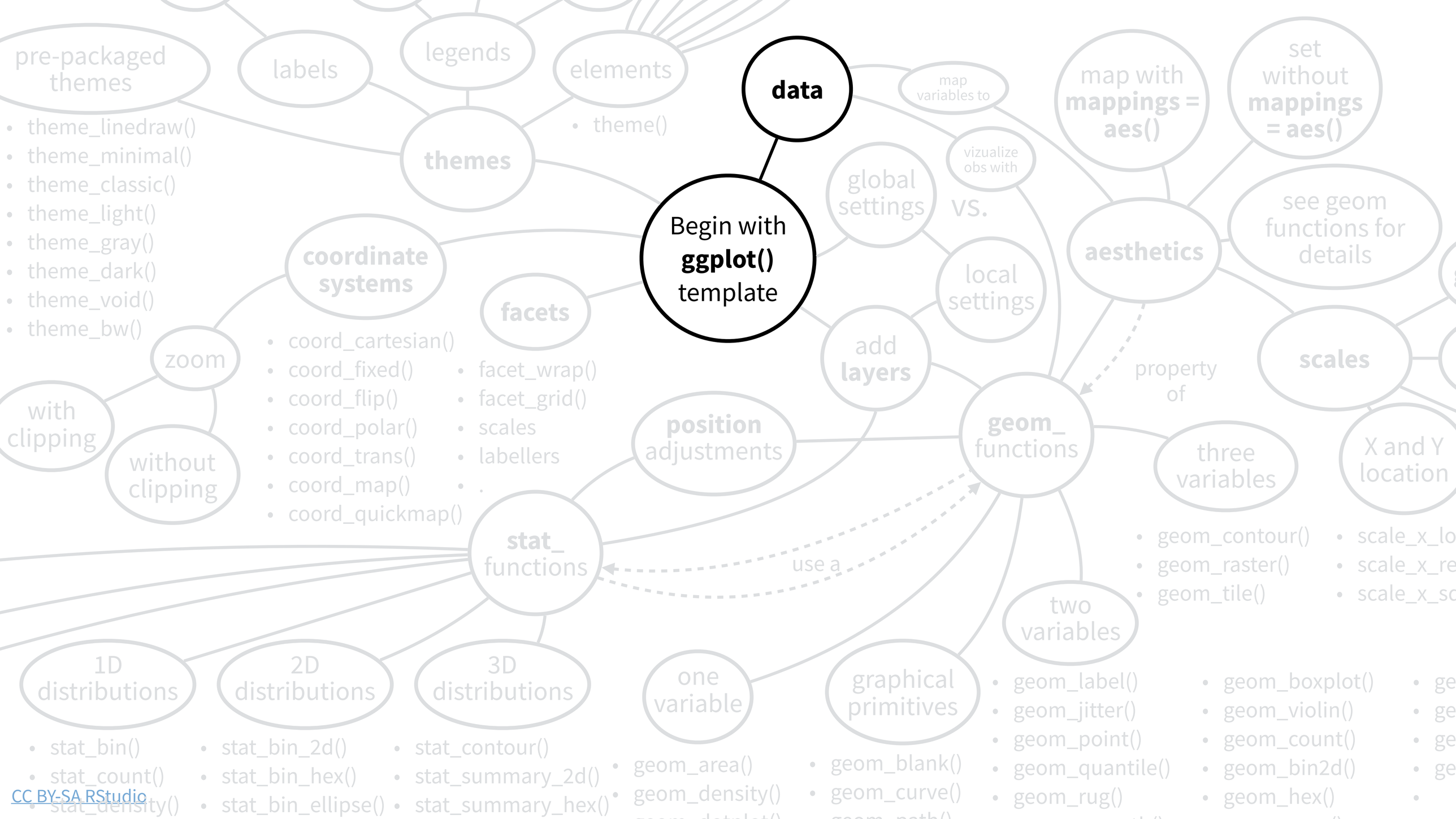
Examine the slides in 01-Data-Visualization. Spot the "initial" mental model of the section.

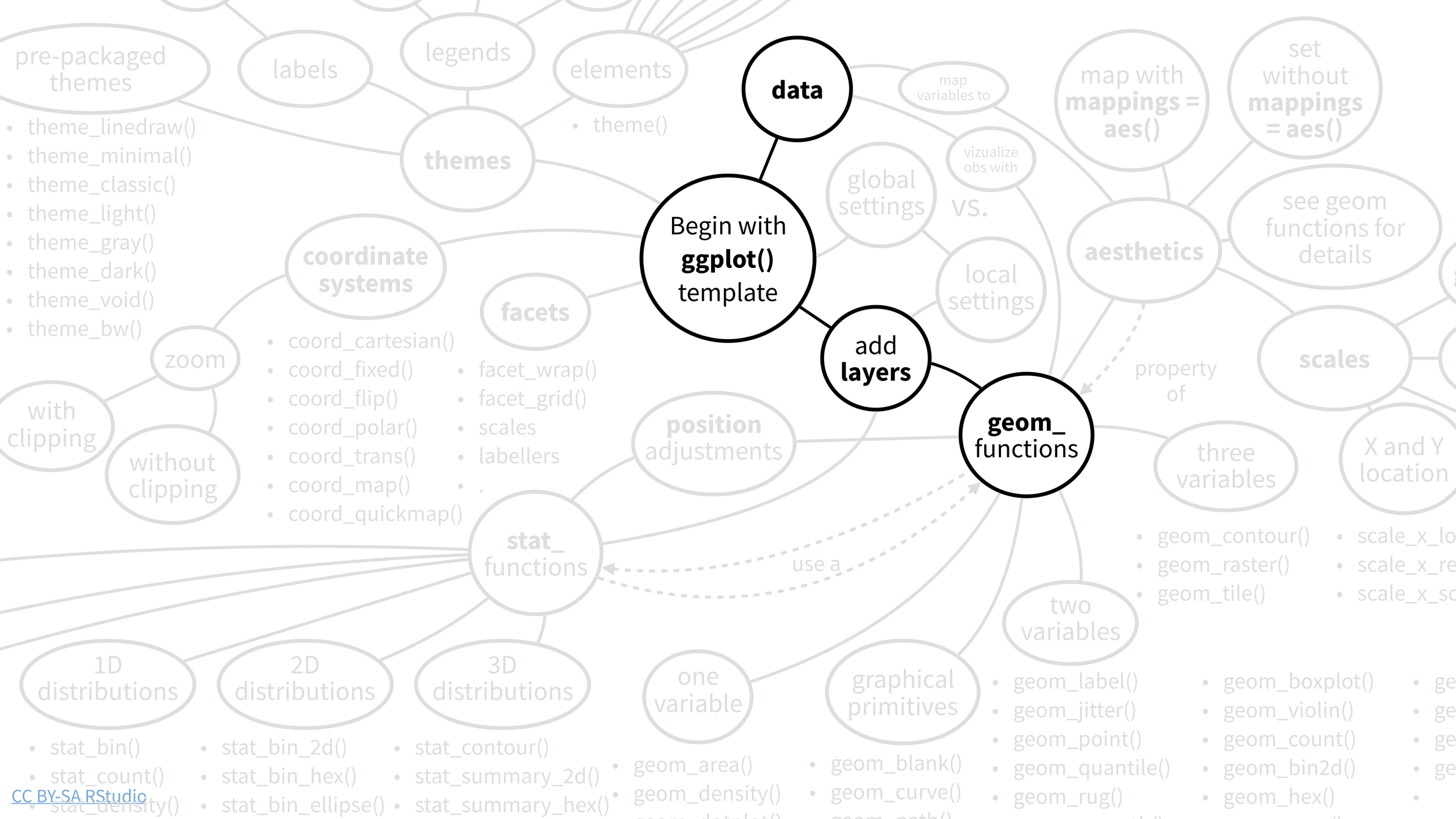


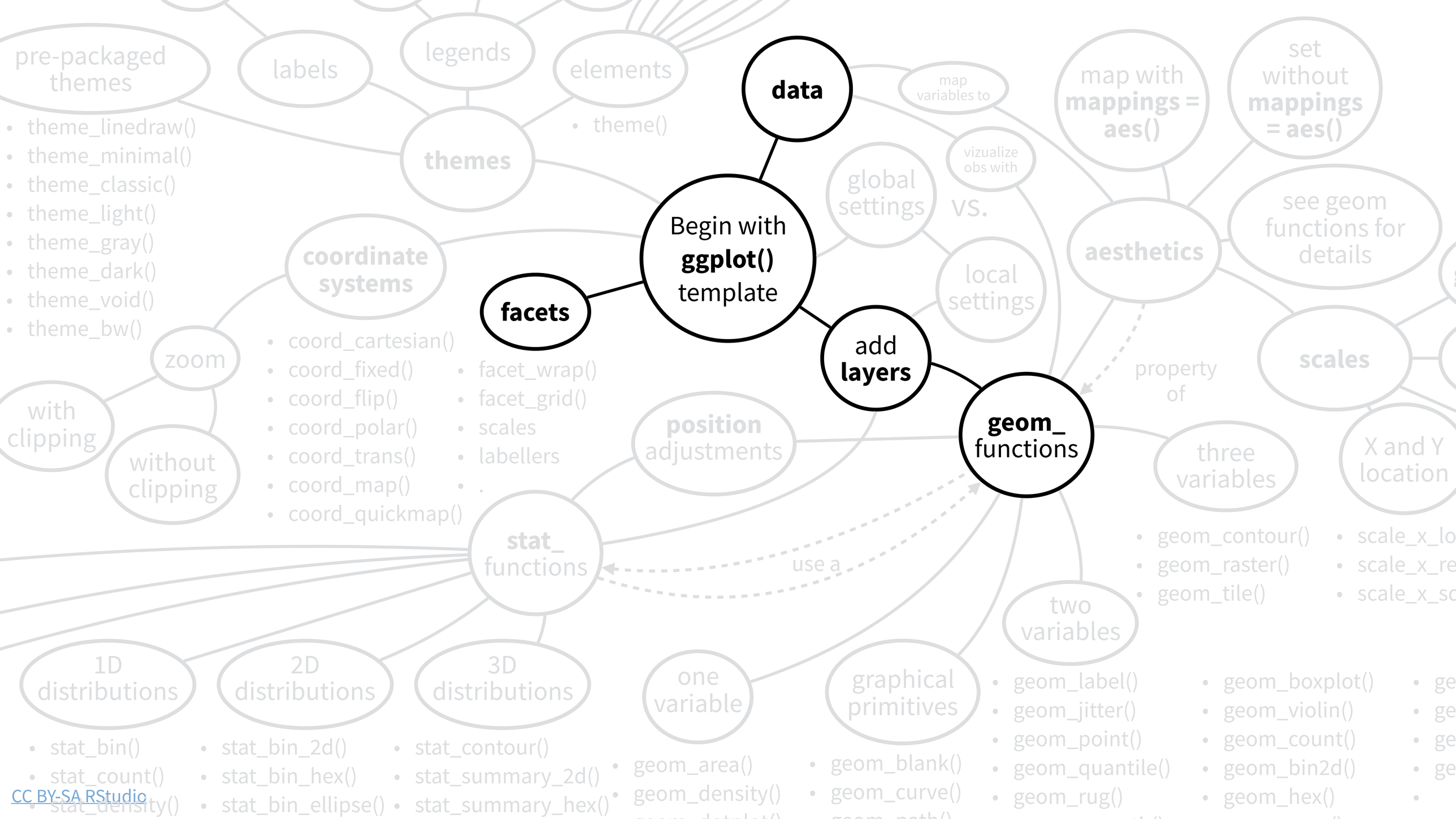
A template

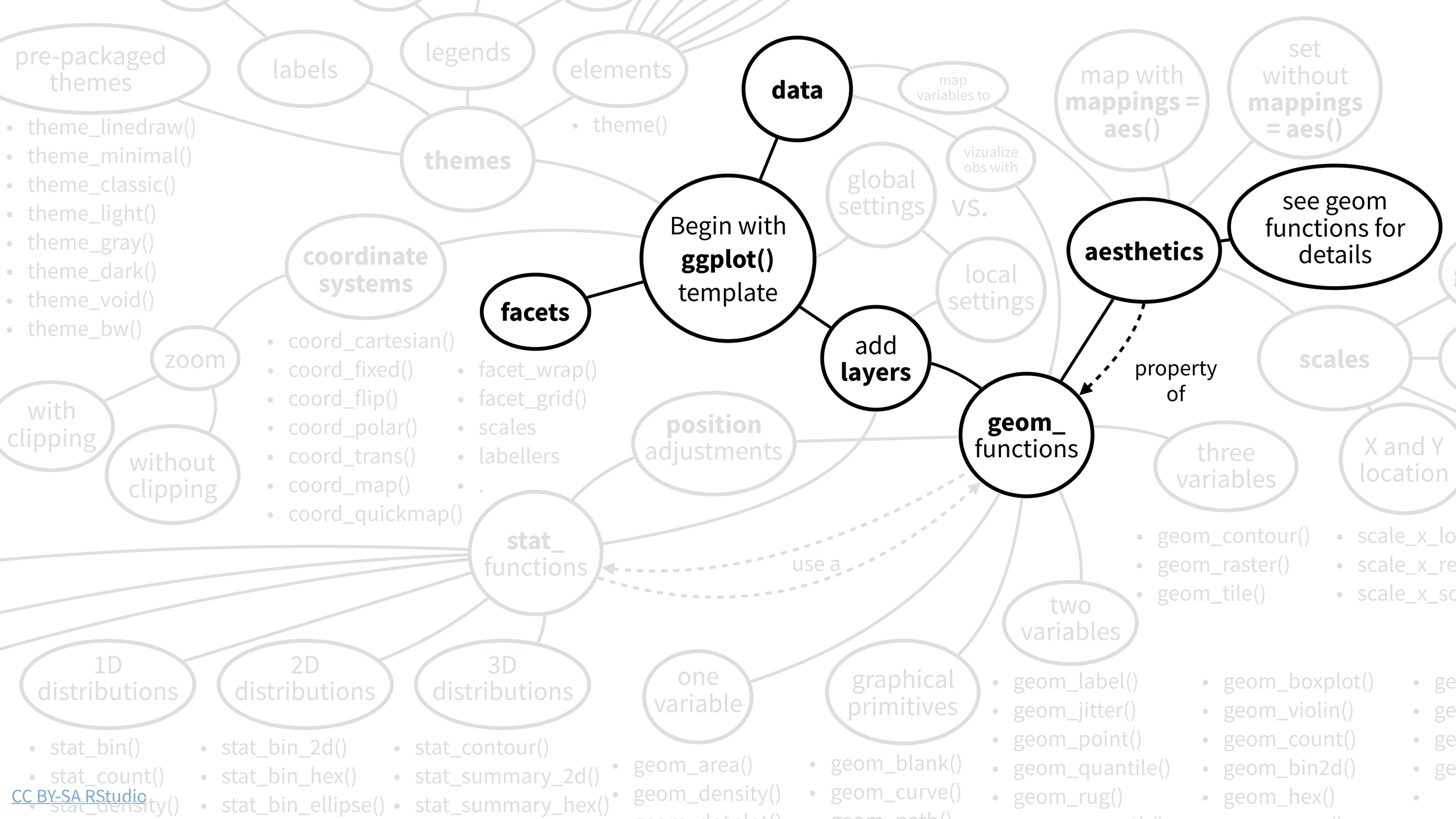
```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))
```











weather

year	mont	day	hour	origi	…
2013	1	1	5	EWR	
2013	1	1	5	LGA	
2013	1	1	5	JFK	

airlines

carrier	name
UA	United
AA	American
AS	Alaska

flights

tailnu	year	mont	day	hour	origi	des	flight	carrier	…
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N24211	2013	1	1	5	LGA	IAH	1714	UA	
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tailnu	year	…
N14228	2013	
N24211	2013	
N619AA	2013	

planes

faa	name	lat	…
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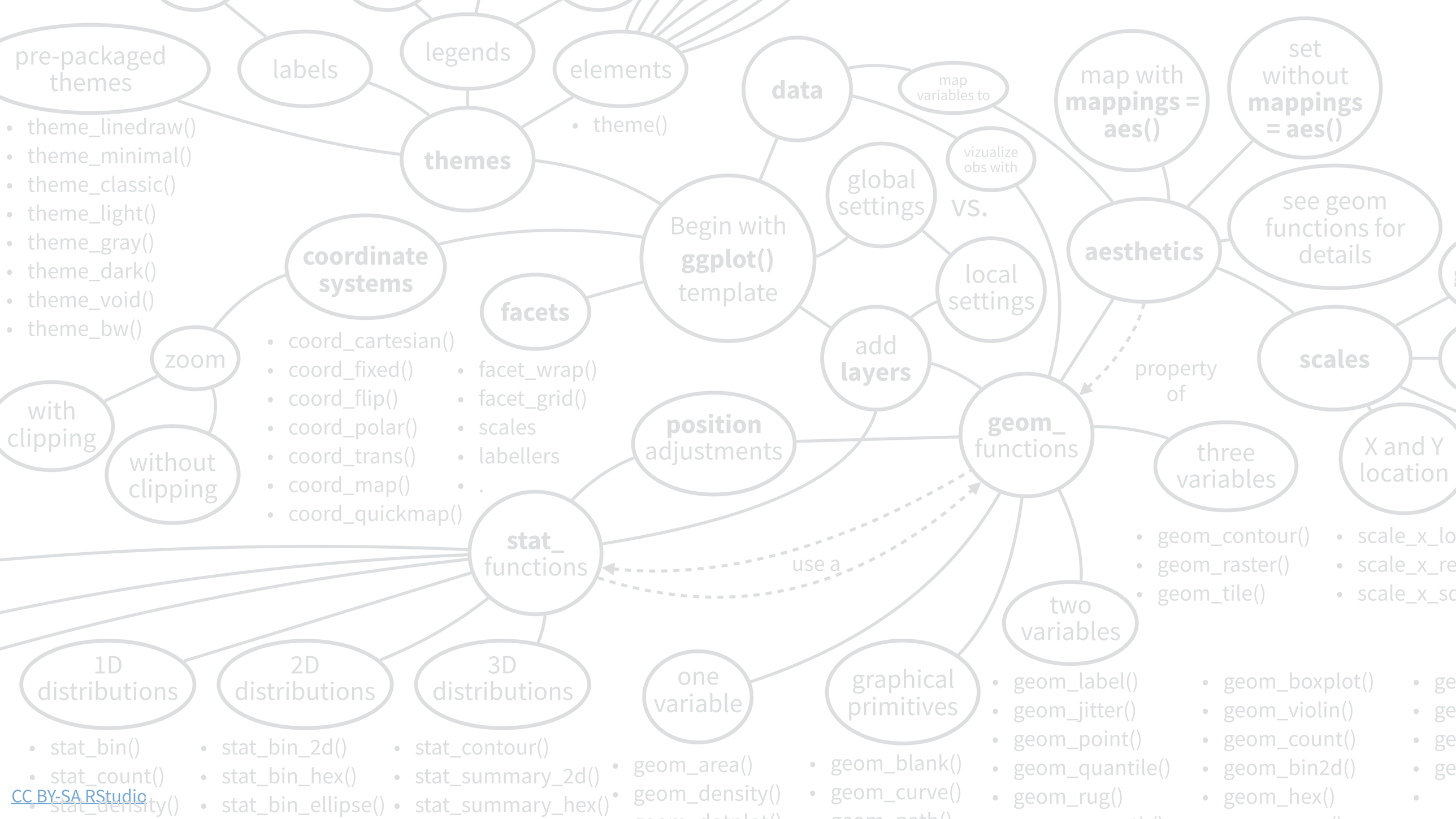
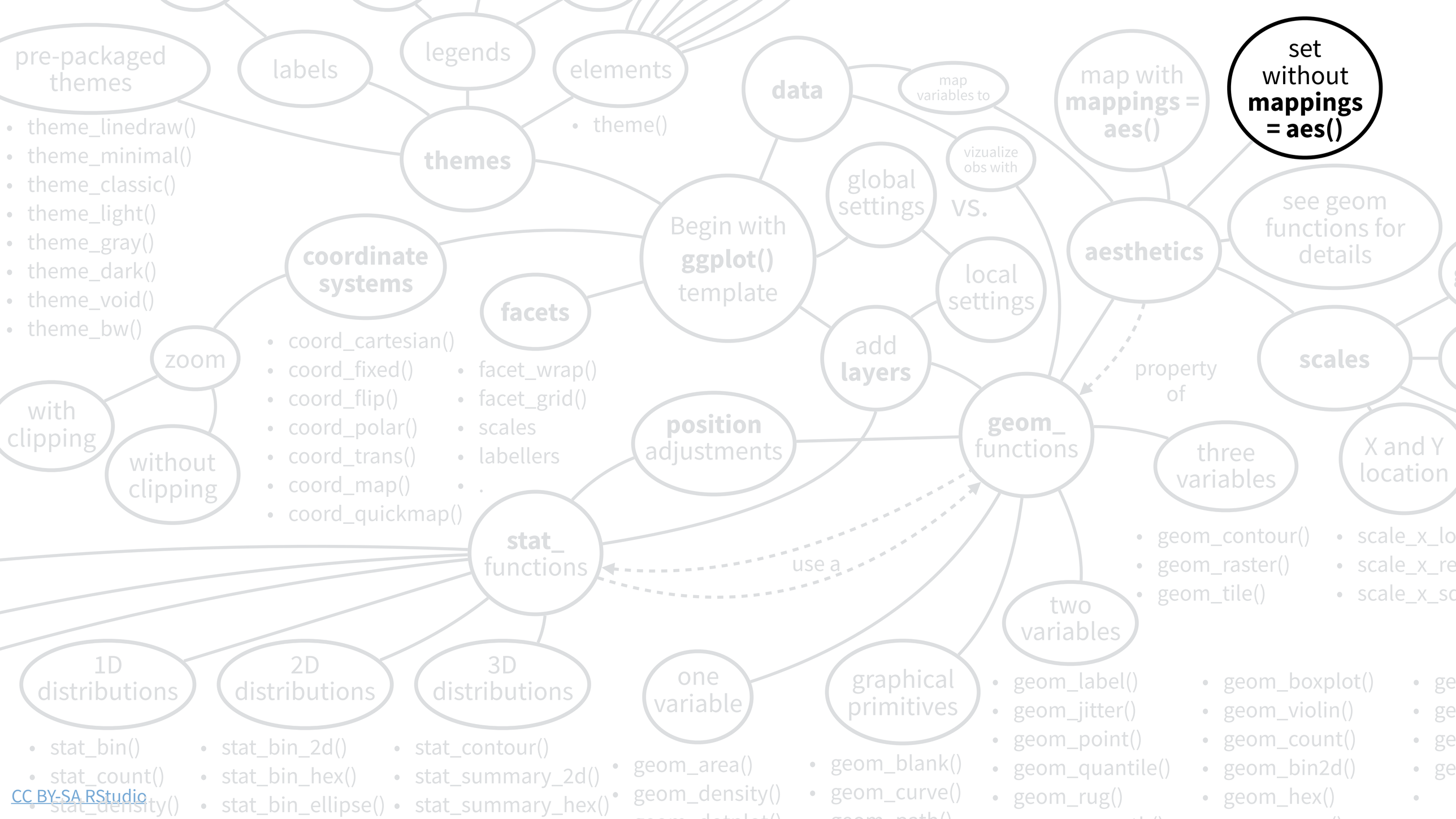
MIA	Miami	25.79	
EWR	Newark	40.69	

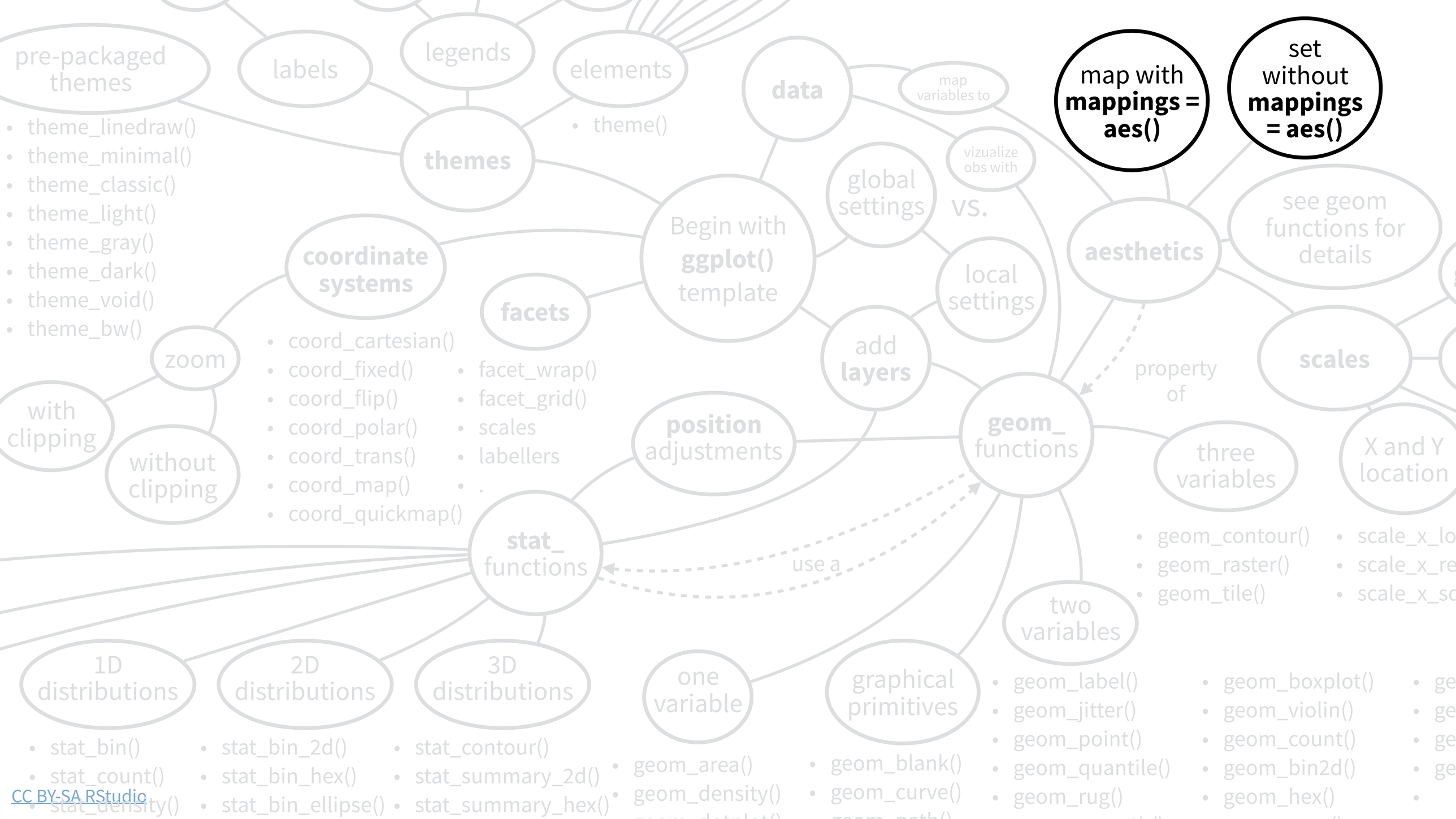
airports

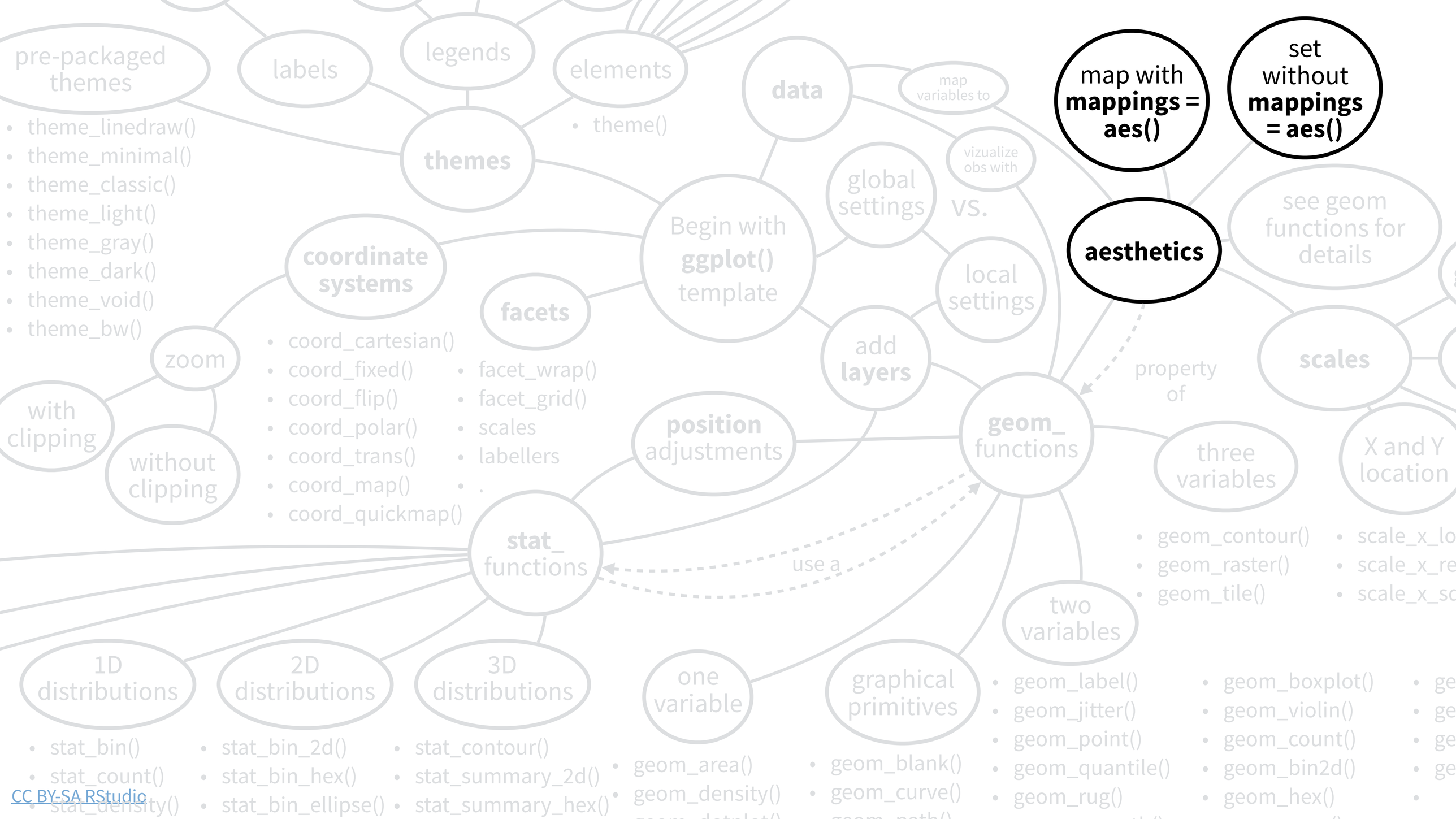
Competent Practitioner

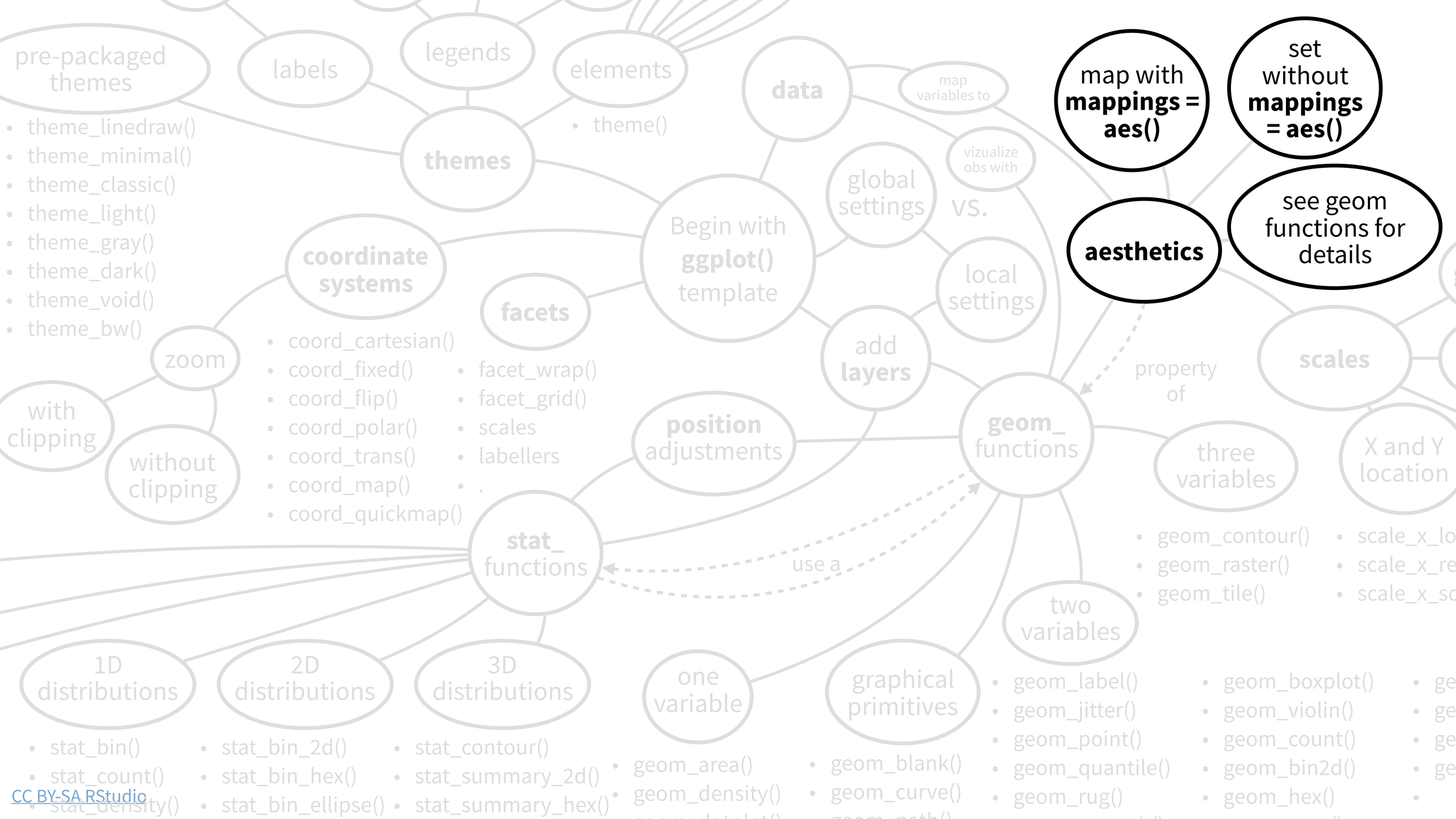
Useful mental model

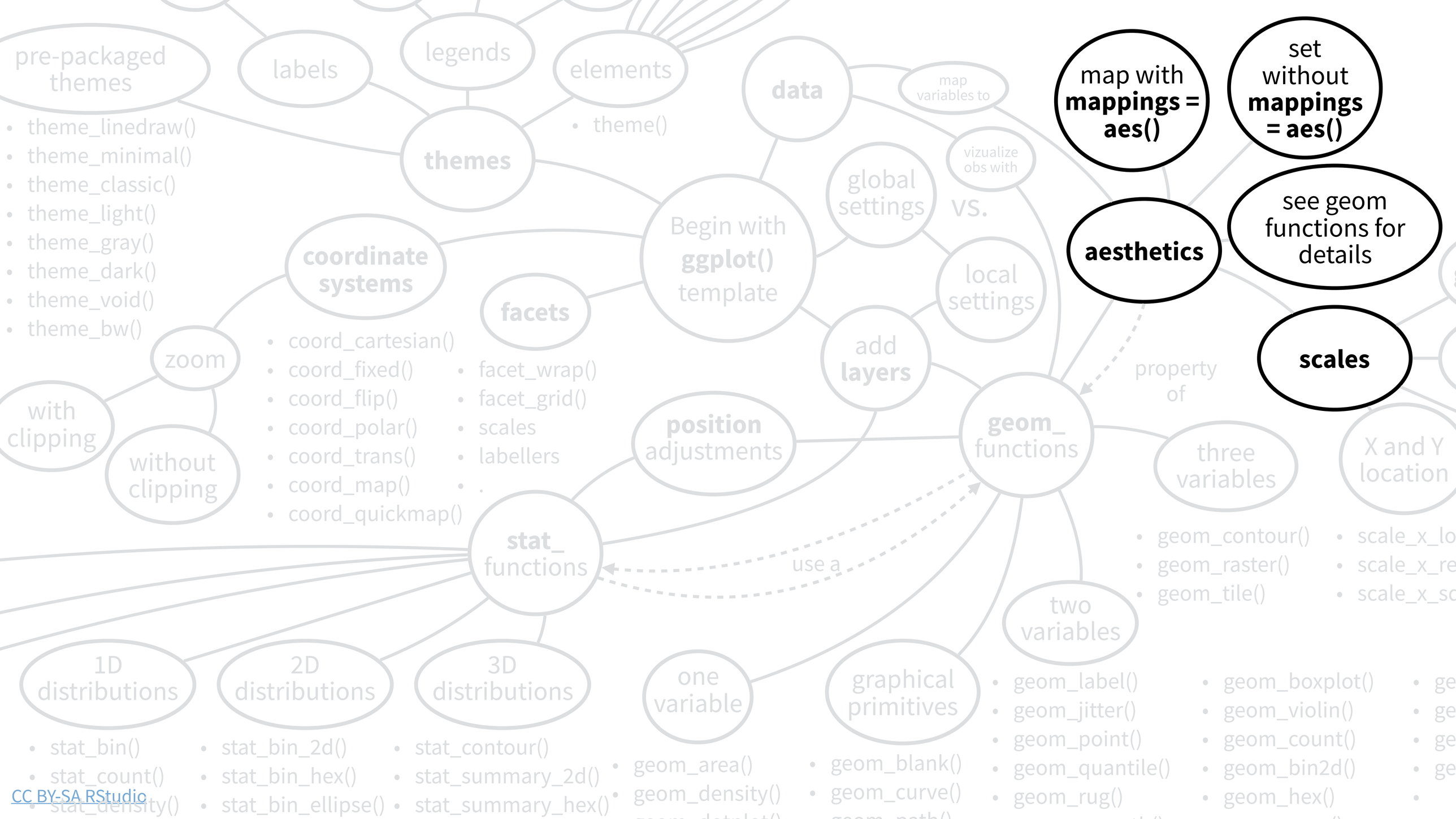


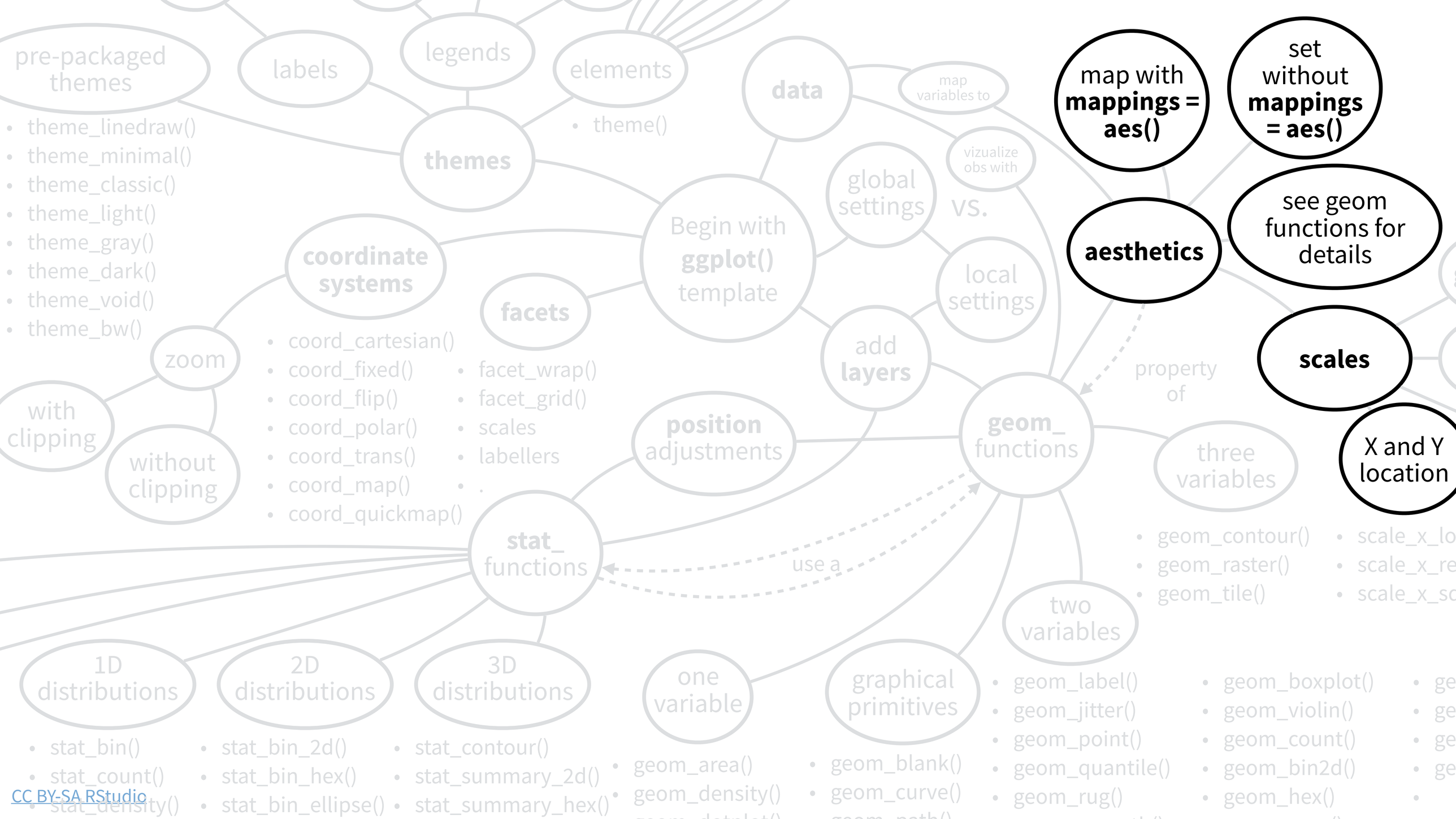


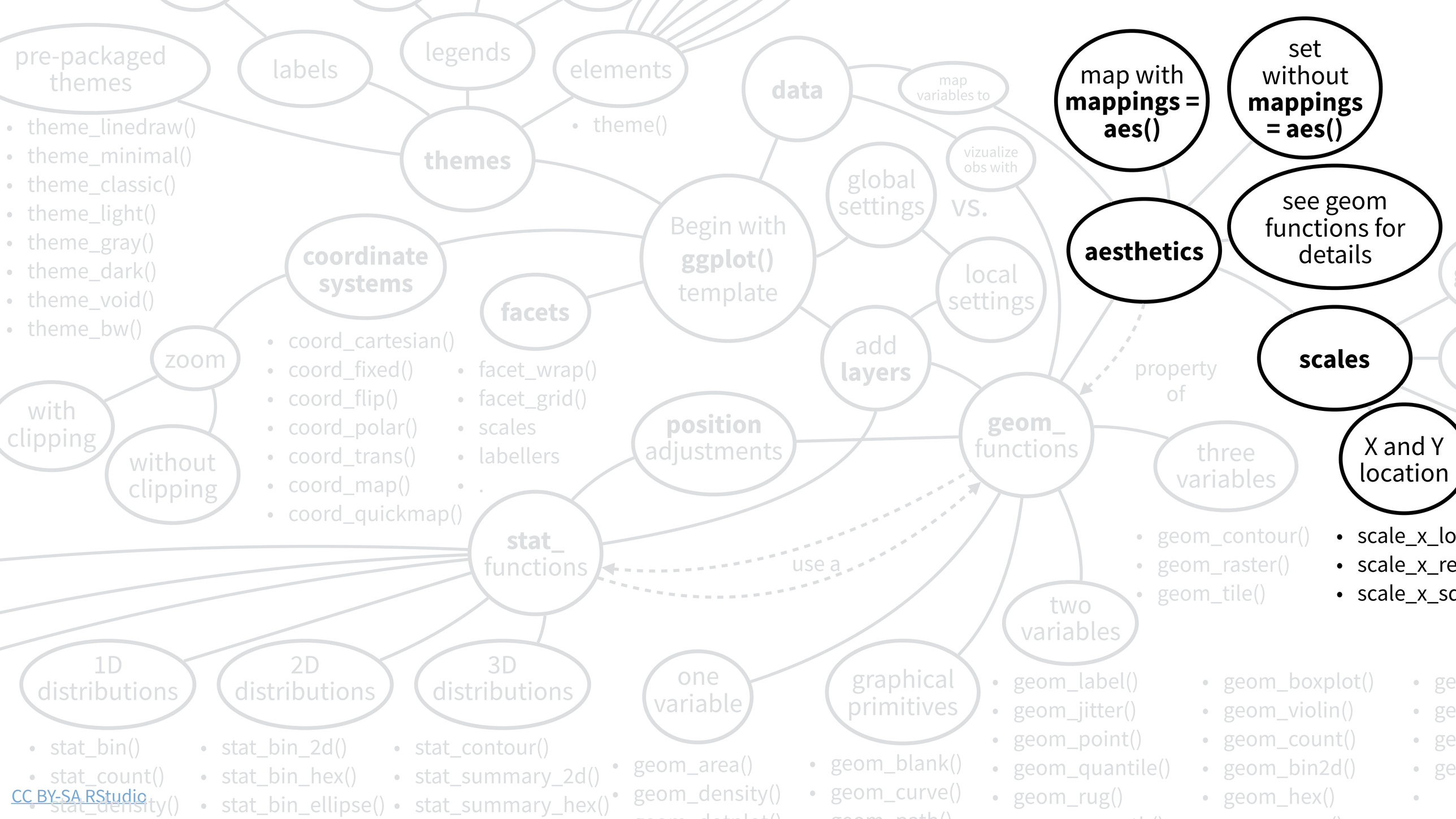




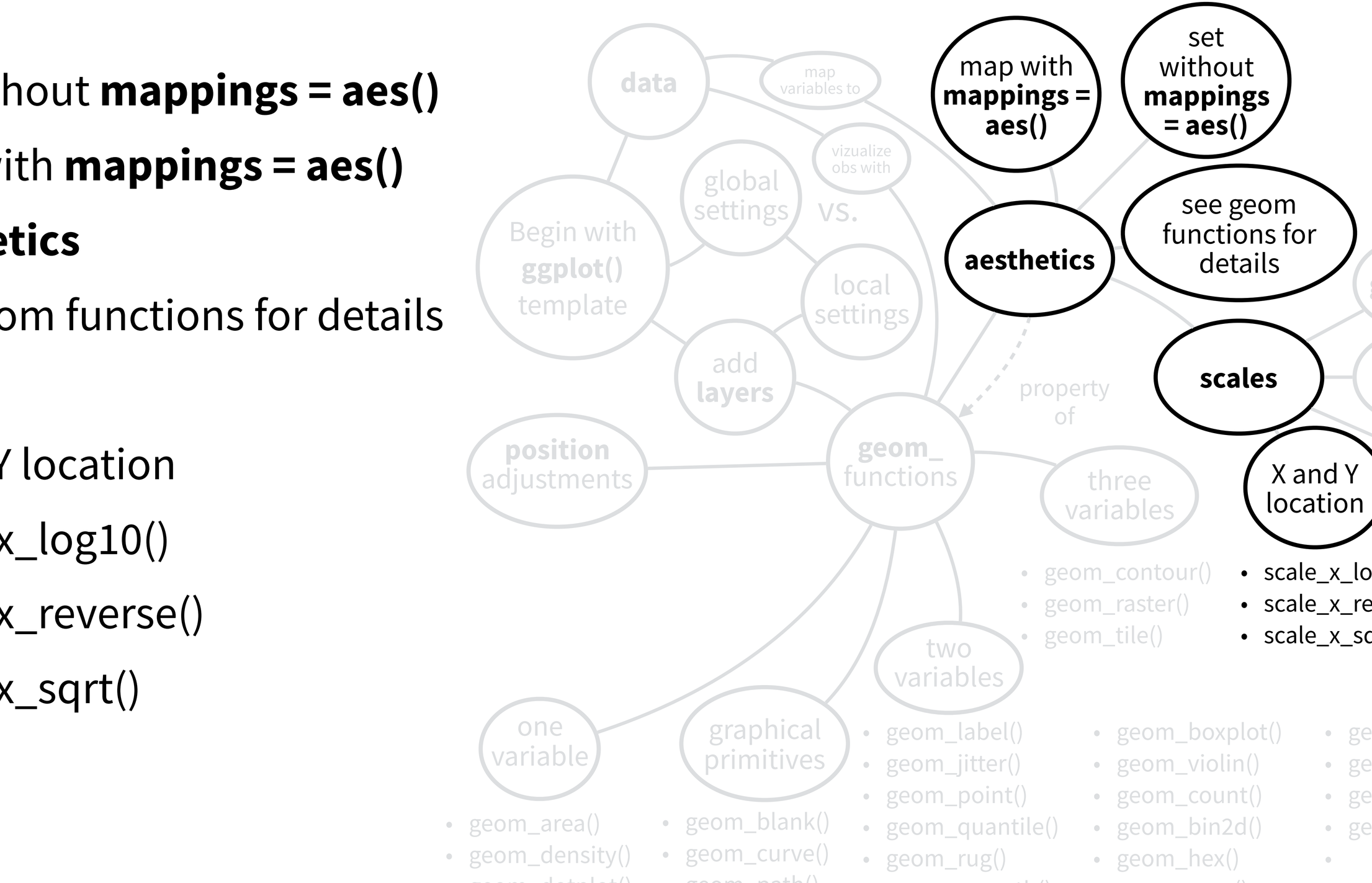








- set without **mappings = aes()**
- map with **mappings = aes()**
- **aesthetics**
- see geom functions for details
- **scales**
- X and Y location
- scale_x_log10()
- scale_x_reverse()
- scale_x_sqrt()



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- X and Y location
- scale_x_log10()
- scale_x_reverse()
- scale_x_sqrt()

A template

```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))
```

Your Turn

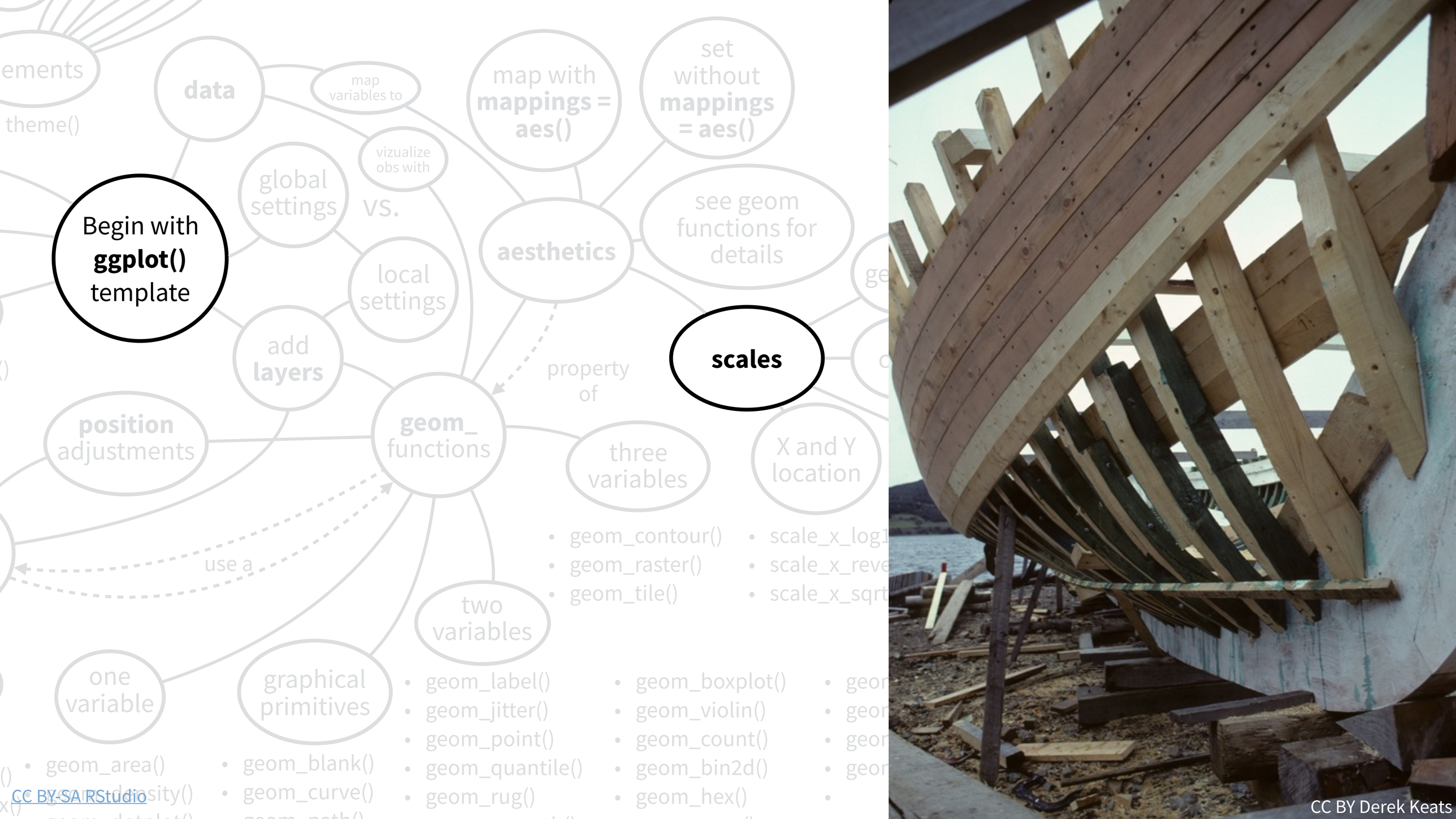
Choose a partner, work together to spot an initial "mental model" for your topic. (It might be the same for both topics).

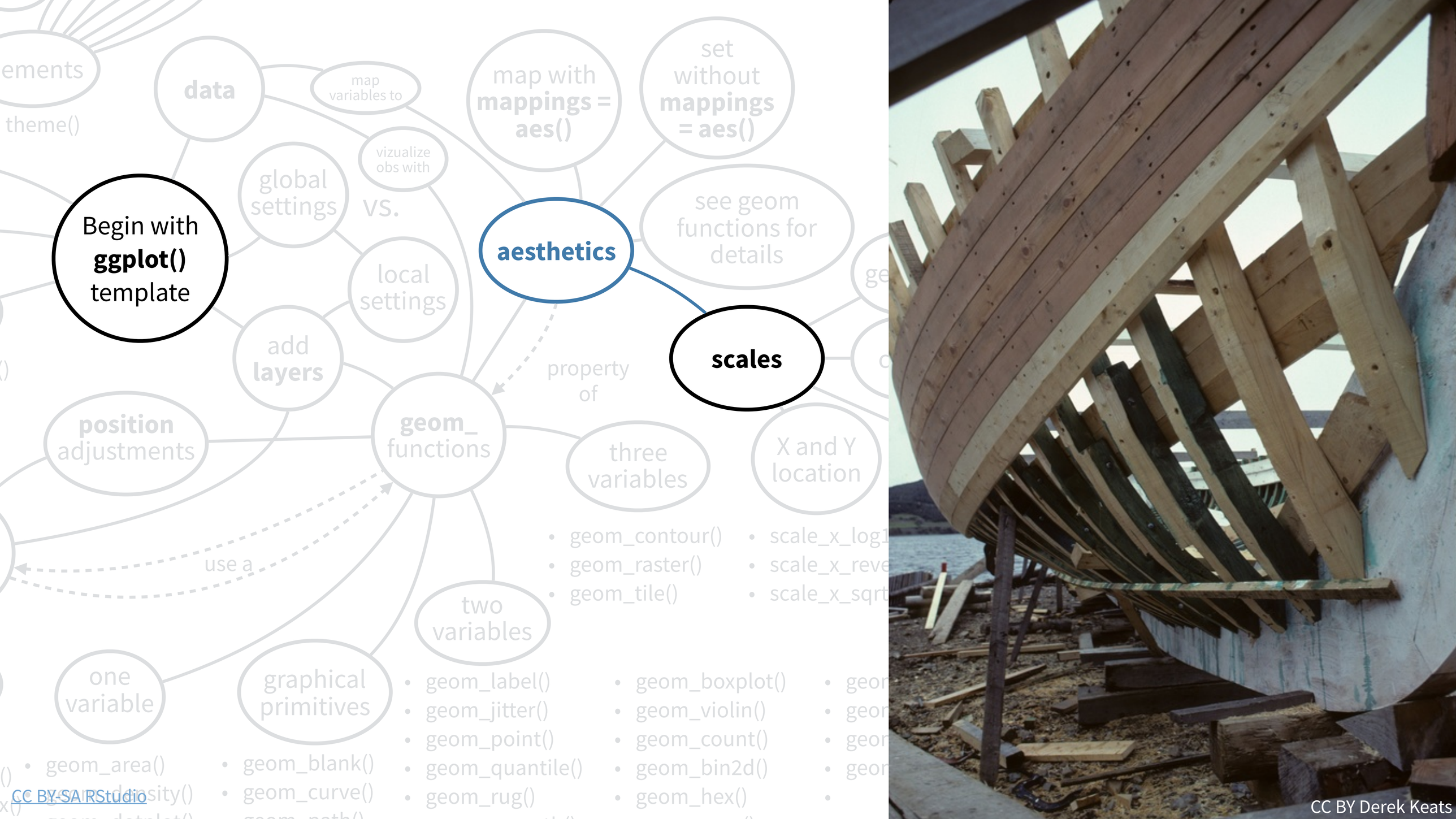
- An Analogy or Metaphor
- A Story
- A Diagram
- A Template, etc.

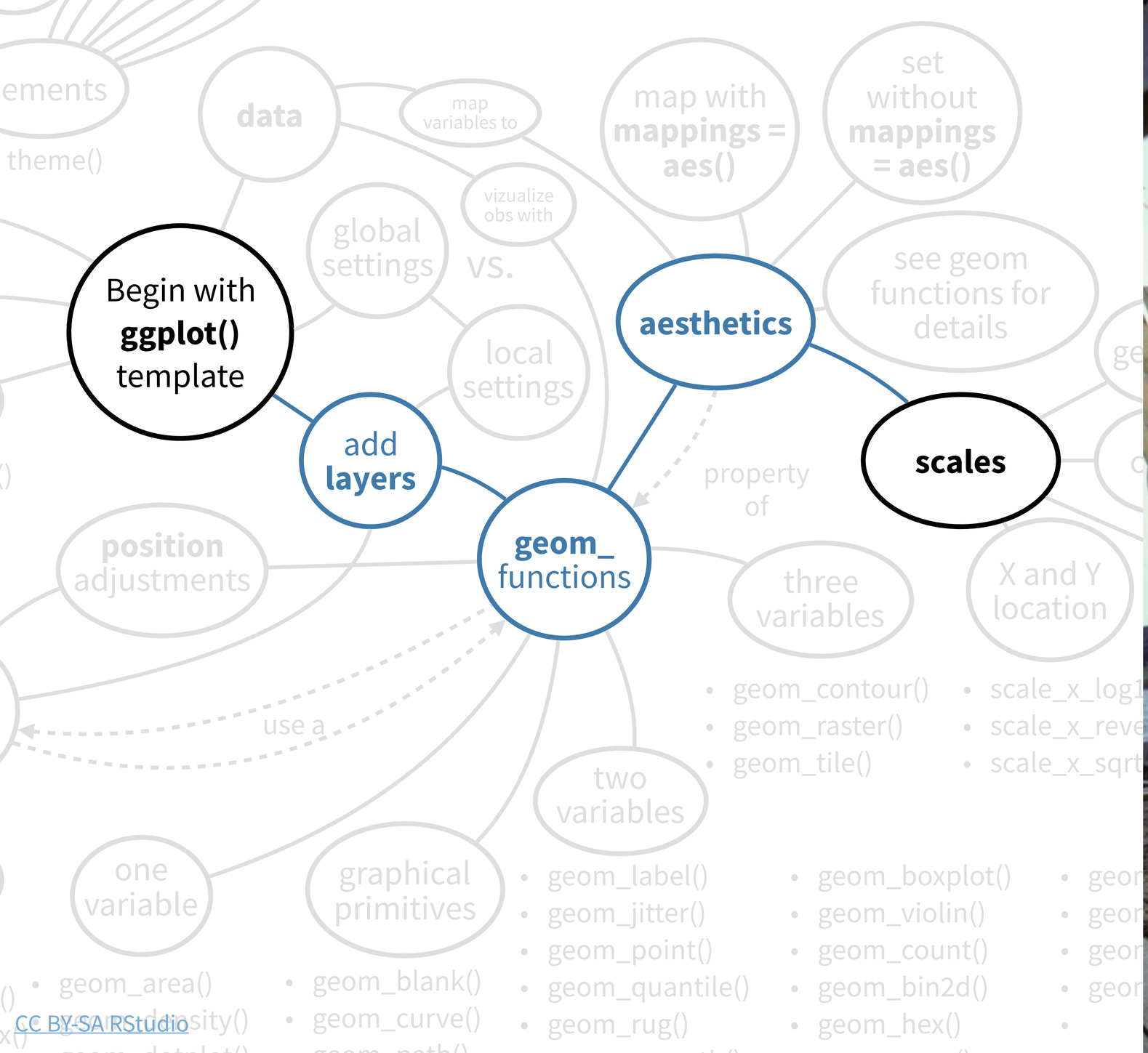
1. Lay the keel

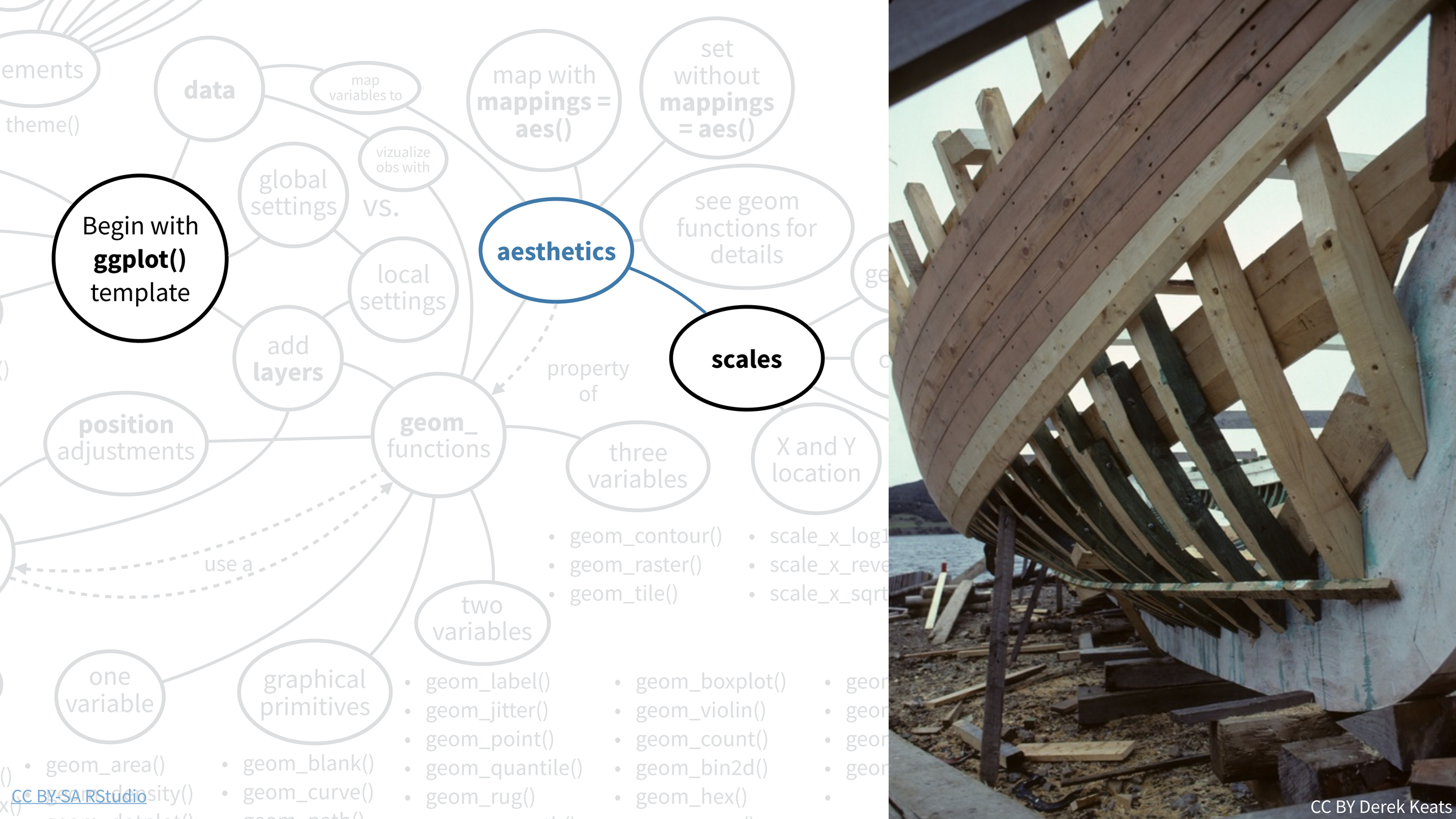
2. Build topics in order

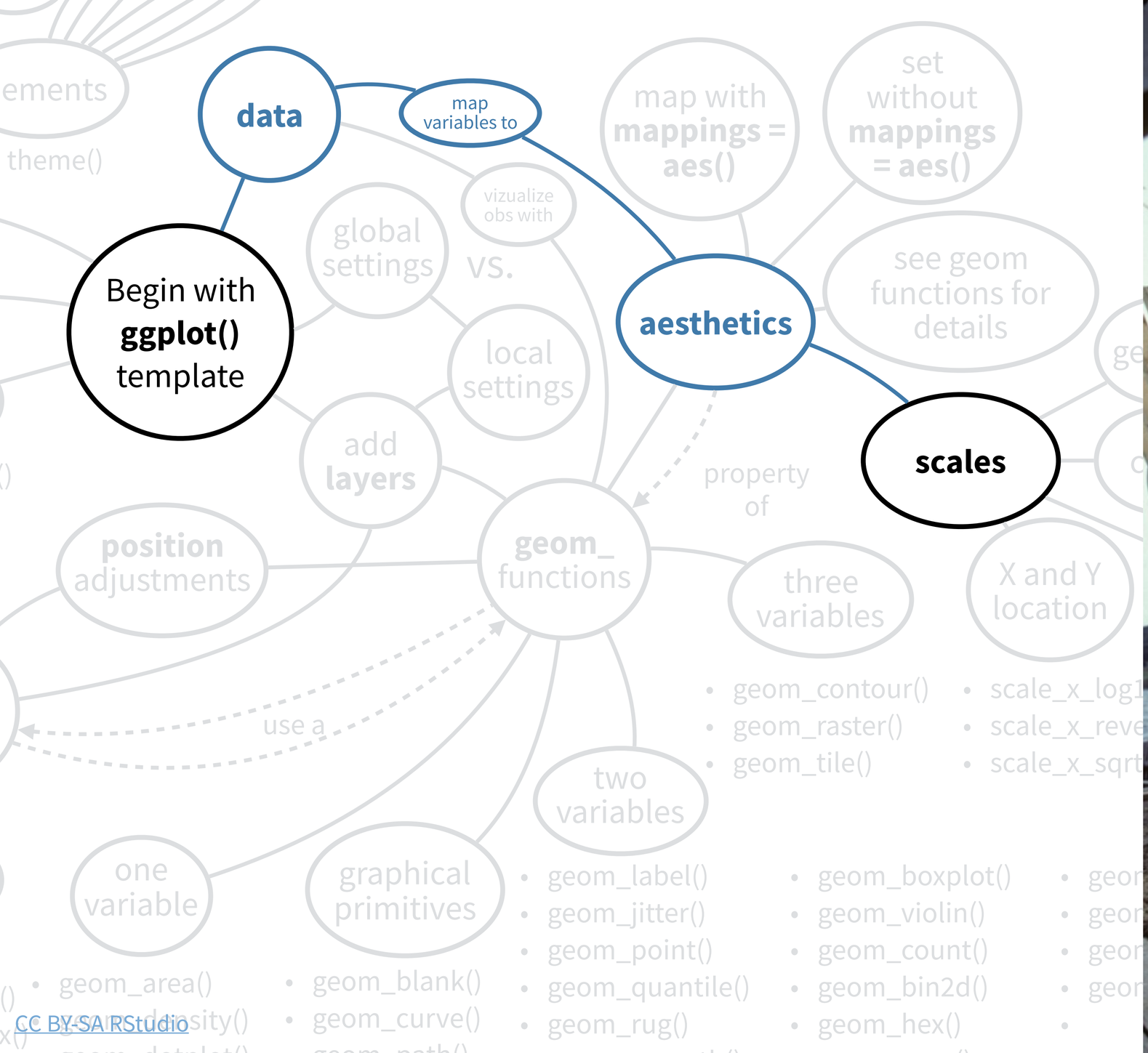
Build topics in order

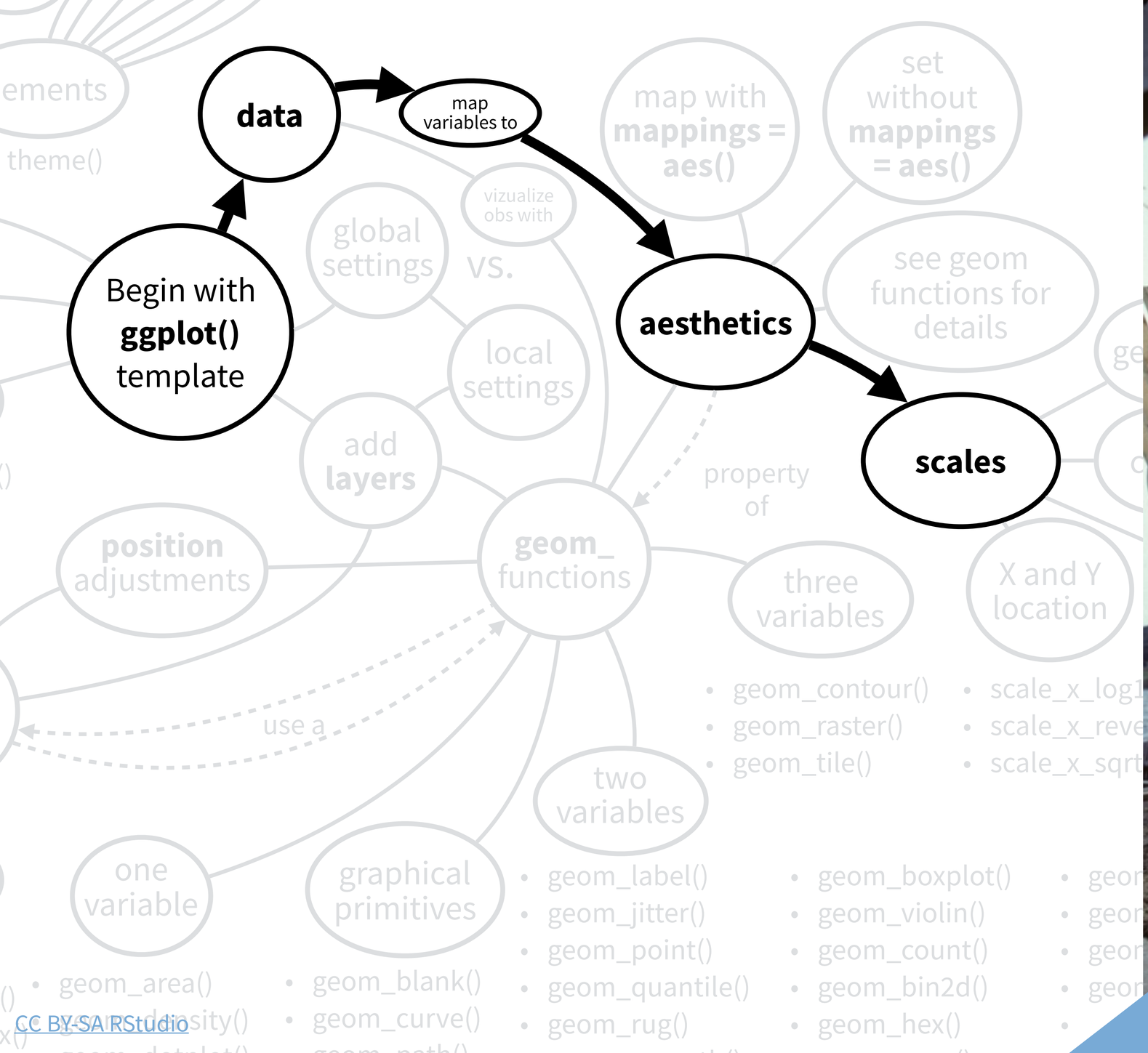












1. Lay the keel

2. Build topics in order

3. Connect to familiar things

Connect to familiar things

(or motivating ones)

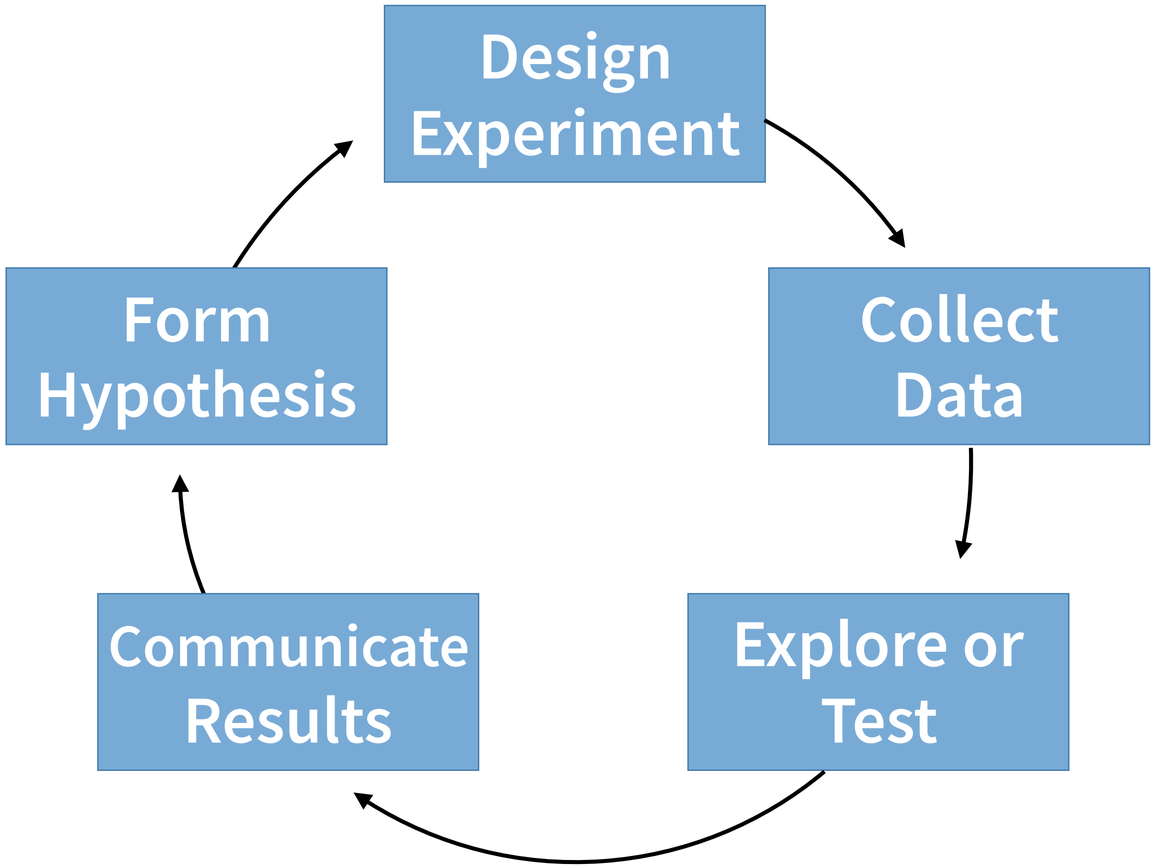
Think

Imagine that you will explain the **map()** function to three different students:

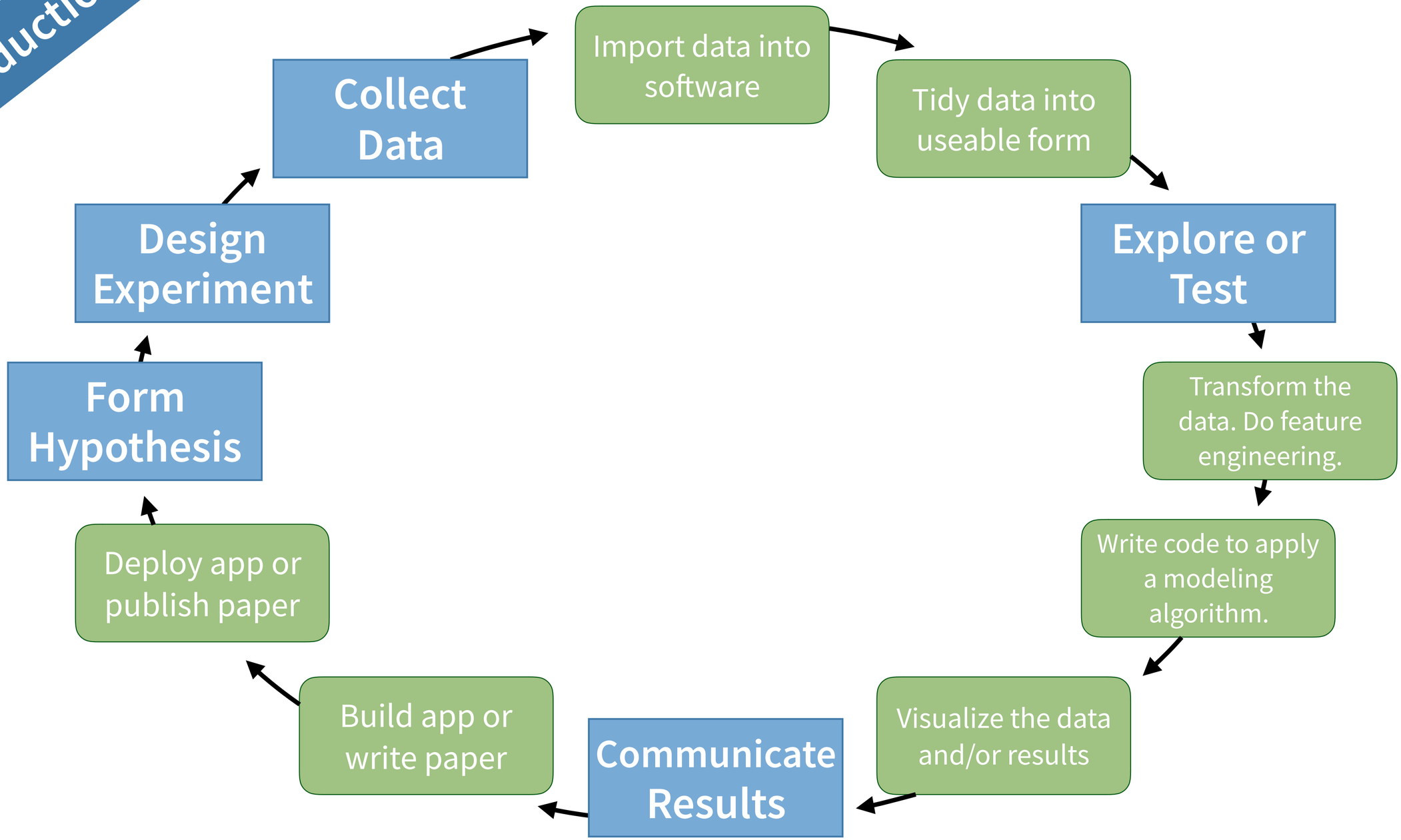
1. One who uses the **lapply()** family of functions
2. One who uses **for()** loops
3. One who has **never written** a **for()** loop

What questions will each ask?

"Data Science"

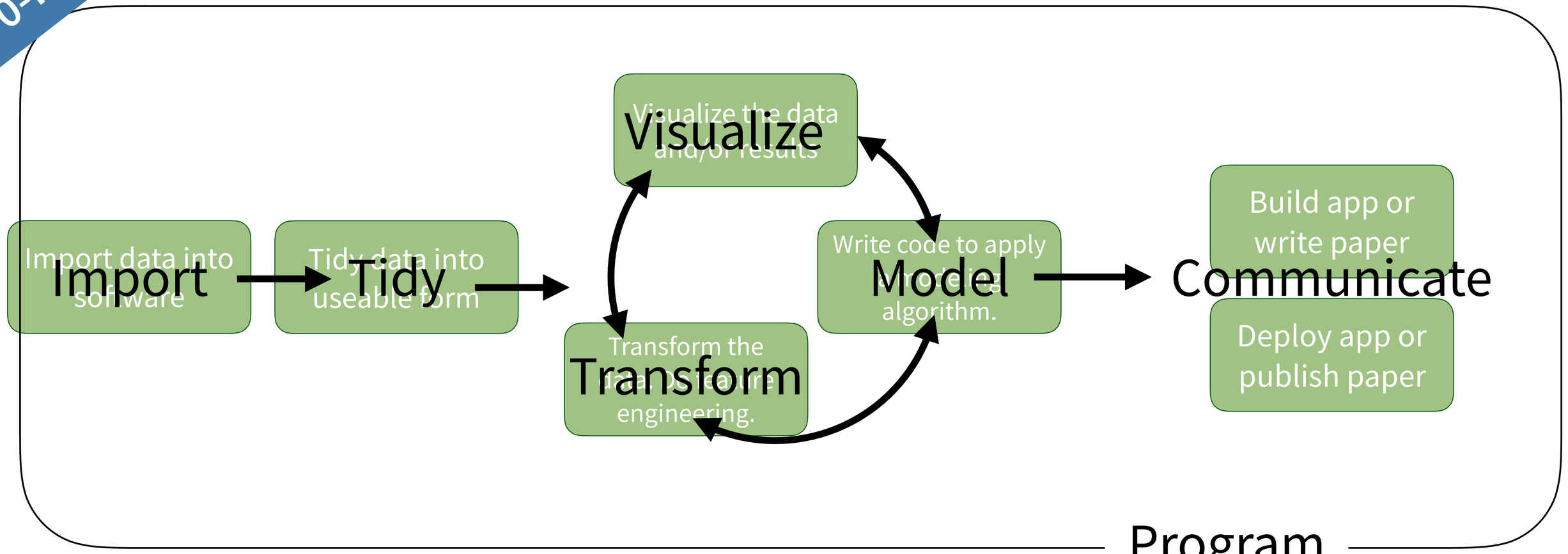


0-Introduction



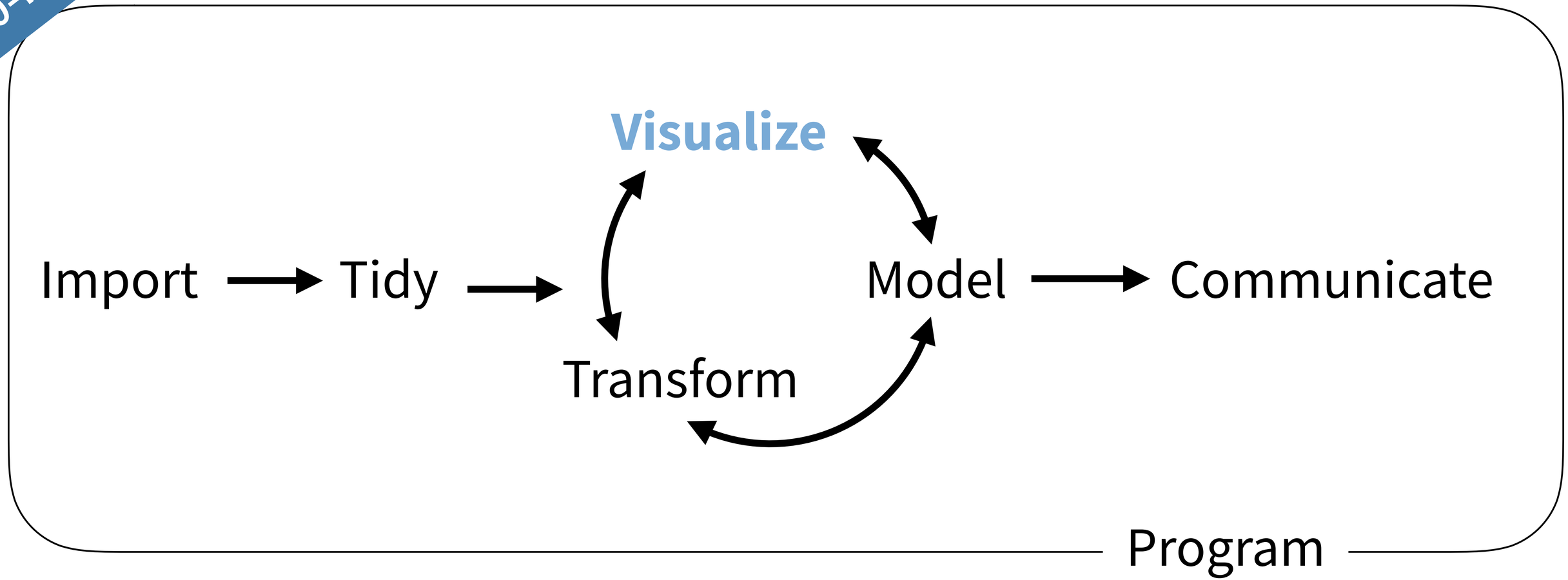
0-Introduction

(Applied) **Data Science**



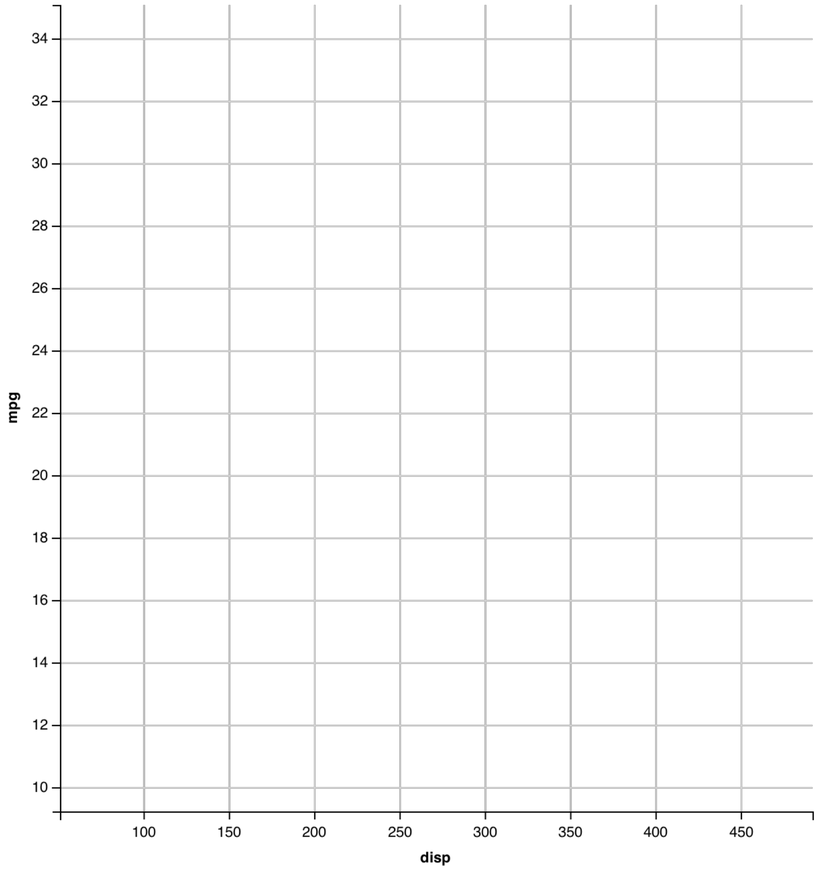
0-Introduction

(Applied) **Data Science**



1-Visualize-Data

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
18.1	6	225.0	2
14.3	8	360.0	5
24.4	4	146.7	1
22.8	4	140.8	1
19.2	6	167.6	2
17.8	6	167.6	2
16.4	8	275.8	3
17.3	8	275.8	3
15.2	8	275.8	3
10.4	8	472.0	4
10.4	8	460.0	4
14.7	8	440.0	4
32.4	4	78.7	1
30.4	4	75.7	1
33.9	4	71.1	1



data **geom**

1-Visualize-Data

mappings

fill

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
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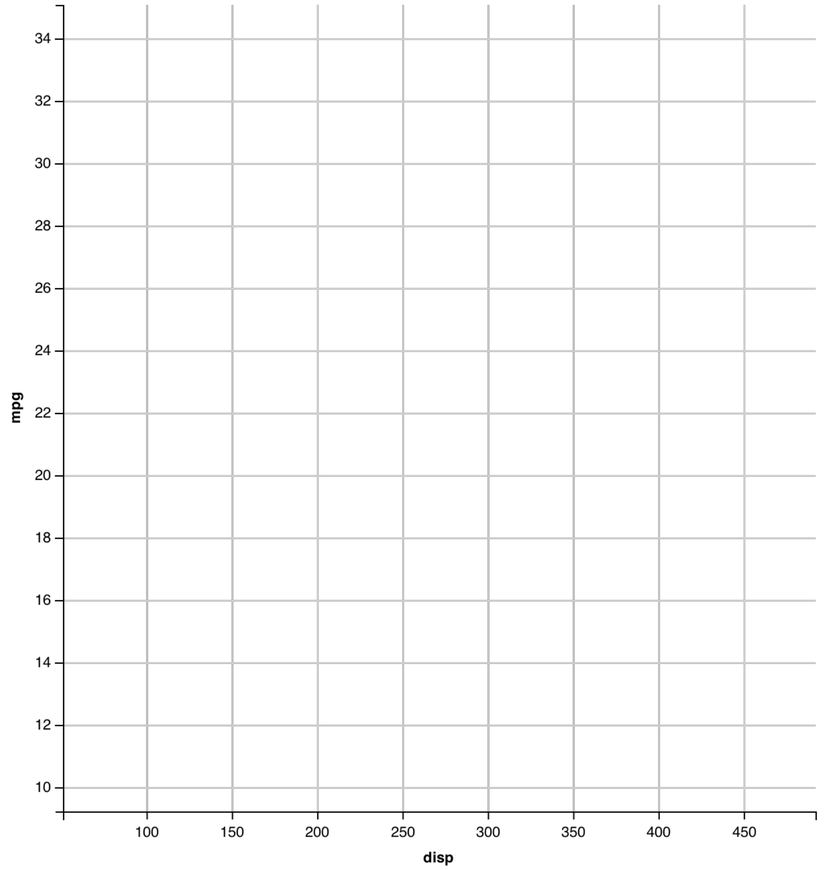

data geom

1-Visualize-Data

mappings

shape fill

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
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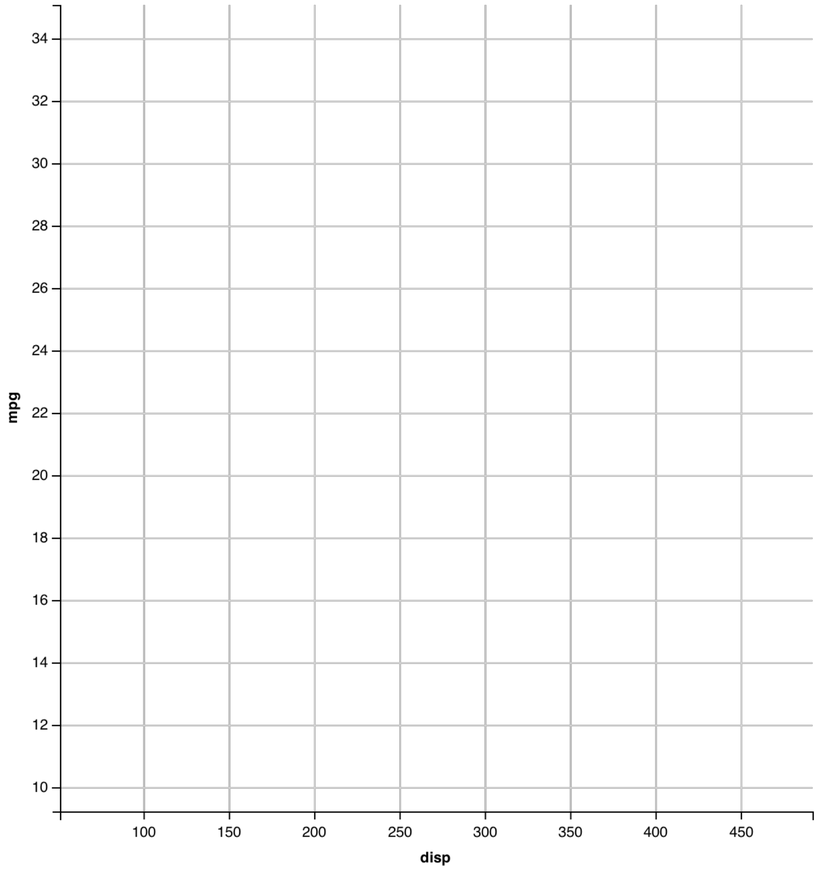
data



geom

ggplot2

1-Visualize-Data

mappings

shape x fill

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
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21.4	6	258.0	2
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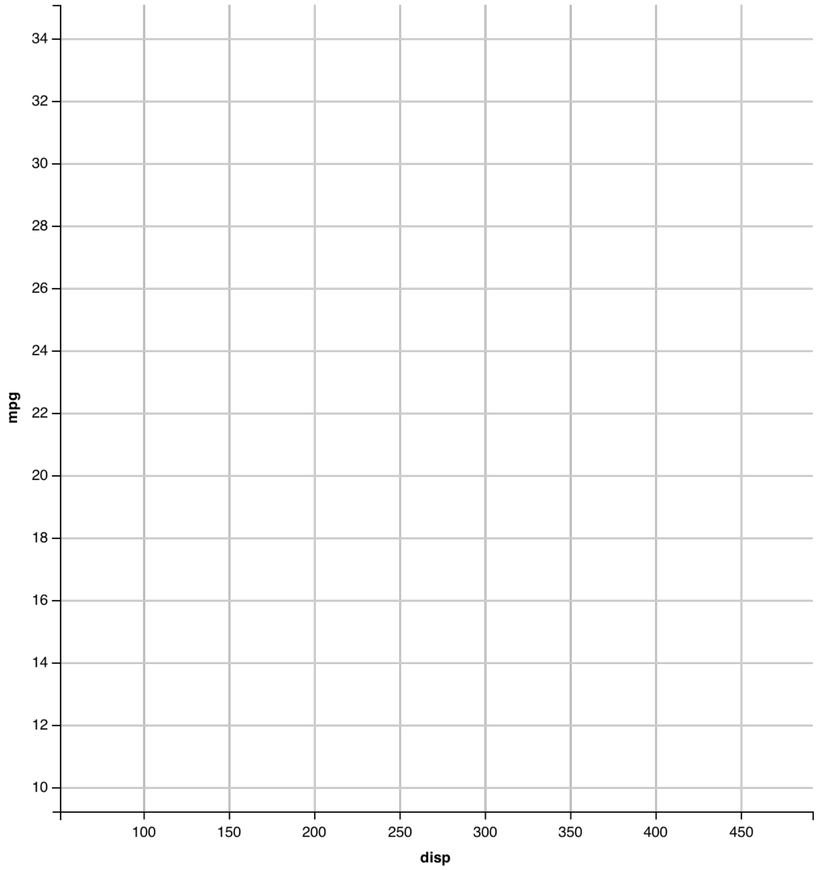

data geom

1-Visualize-Data

mappings

y	shape	x	fill

mpg	cyl	disp	hp
21.0	6	160.0	2
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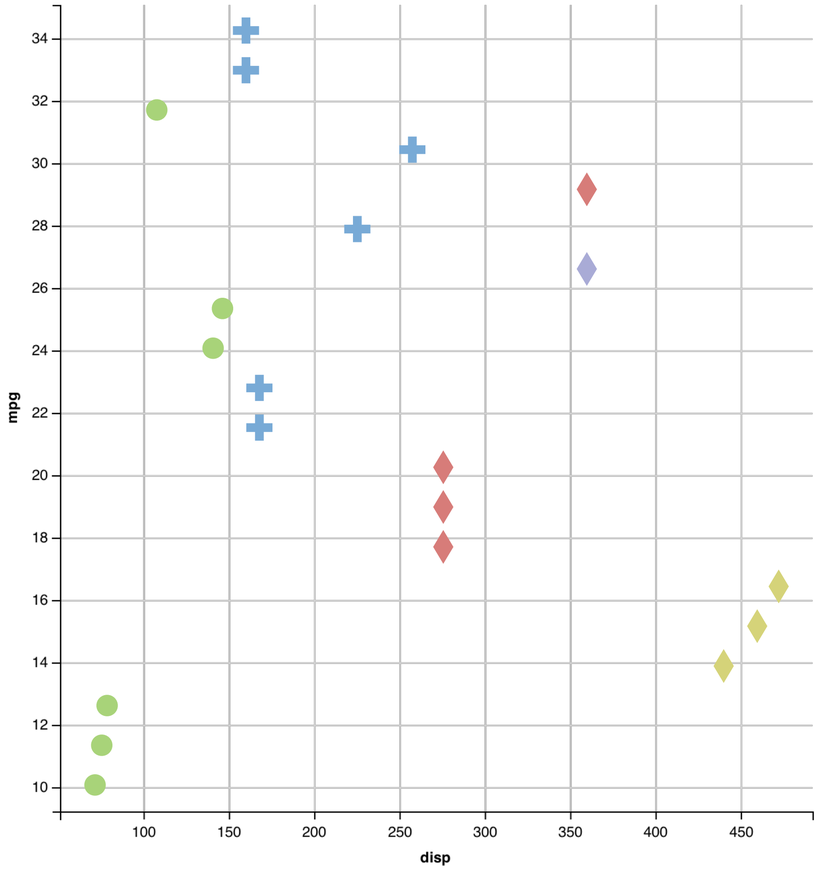

data **geom**

ggplot2

1-Visualize-Data

mappings

y shape x fill

mpg	cyl	disp	hp
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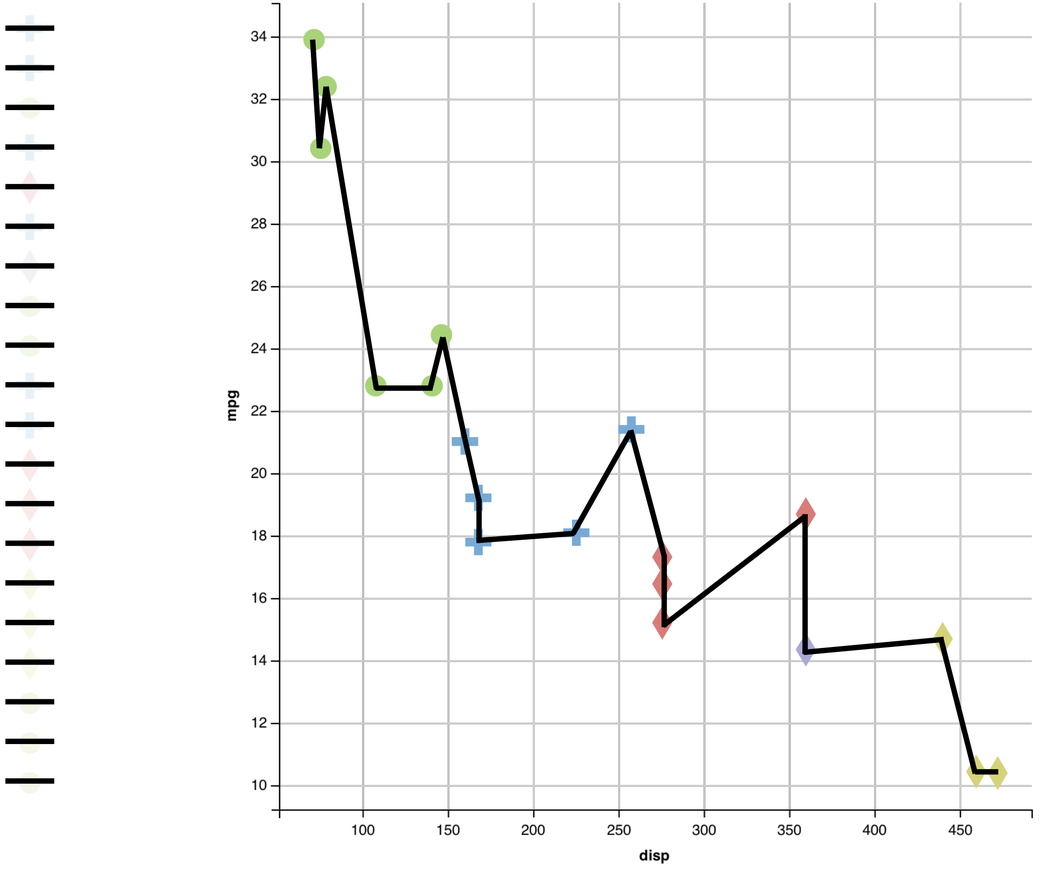

data **geom**

points

lines

ggplot2

1-Visualize-Data

mappings

y x

mpg	cyl	disp	hp
21.0	6	160.0	2
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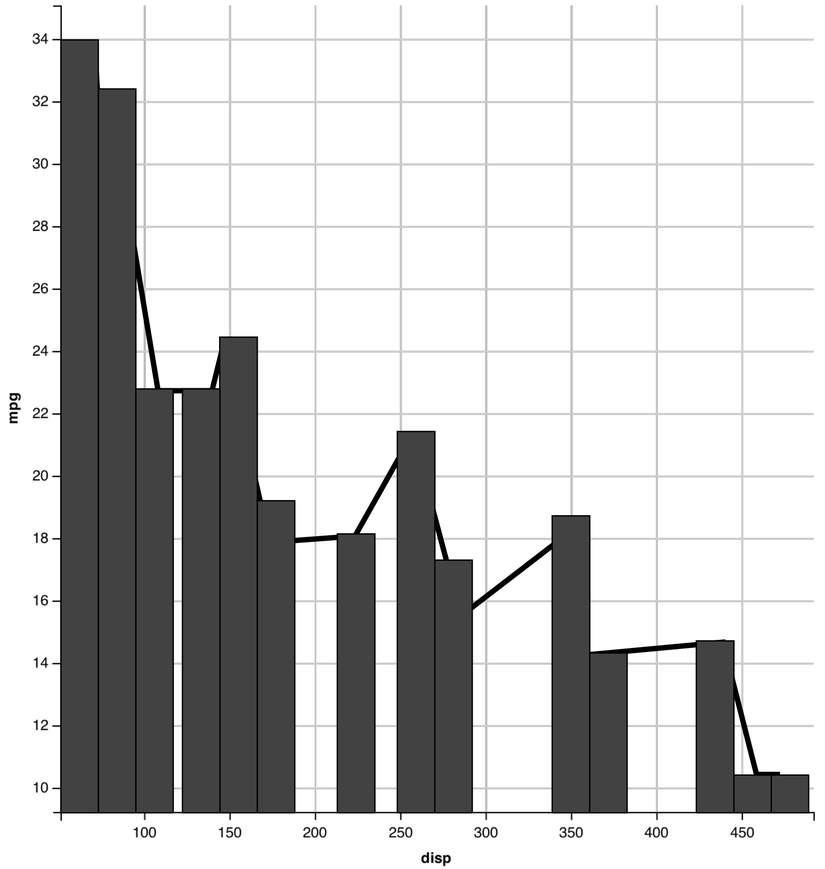

data **geom**

points

lines

bars

ggplot2

1-Visualize-Data

mappings

y fill

mpg	cyl	disp	hp
21.0	6	160.0	2
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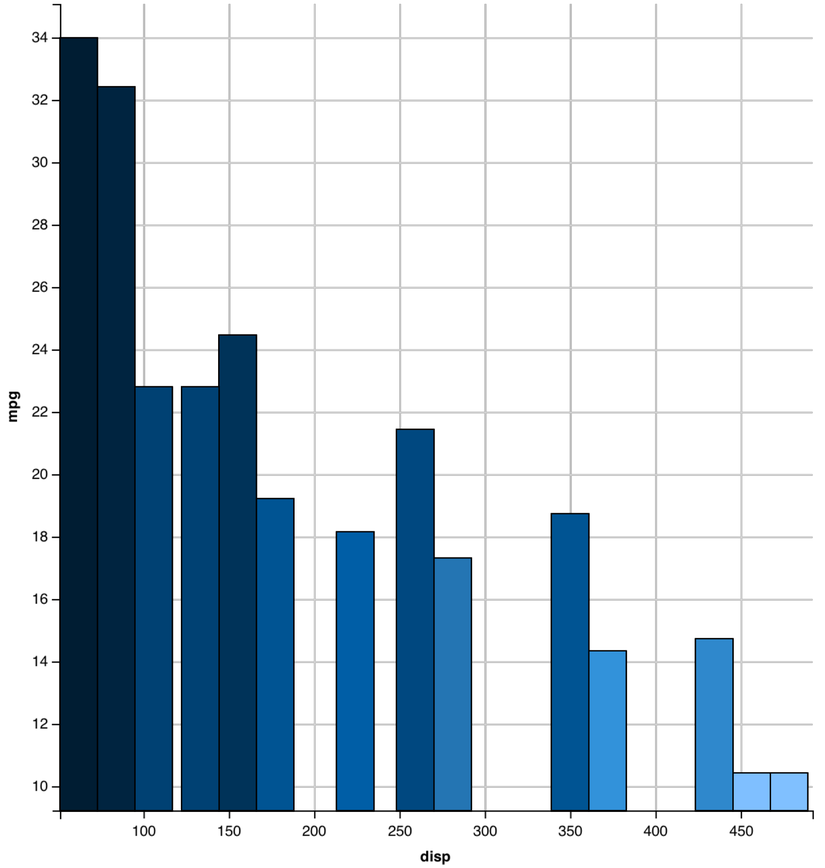

data

geom

points

lines

bars

ggplot2

1-Visualize-Data

To make a graph

[template]

```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))
```

1-Visualize-Data

To make a graph

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
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32.4	4	78.7	1
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33.9	4	71.1	1

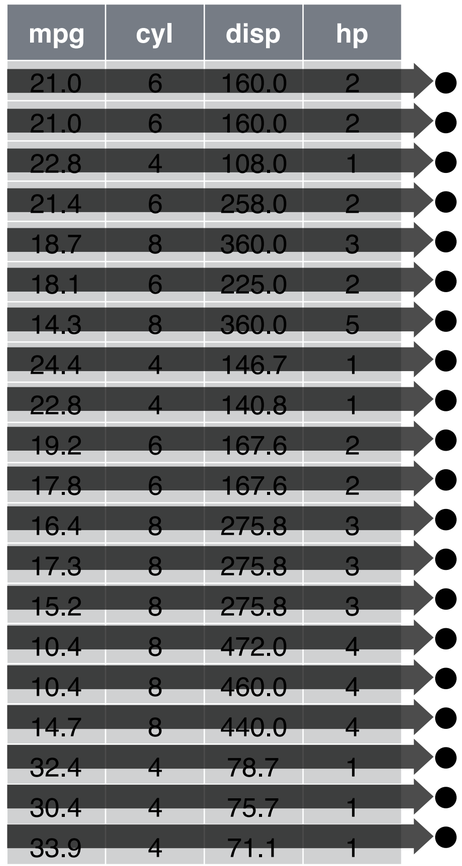
data

1. Pick a **data** set

```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))
```


1-Visualize-Data

To make a graph



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14.7	8	440.0	4
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30.4	4	75.7	1
33.9	4	71.1	1

data **geom**

1. Pick a **data** set

```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))
```

2. Choose a **geom** to display cases

1-Visualize-Data

To make a graph

mappings

fill

mpg	cyl	disp	hp
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21.4	6	258.0	2
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32.4	4	78.7	1
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33.9	4	71.1	1

data geom

1. Pick a **data** set

```
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))
```

2. Choose a **geom** to display cases

3. **Map** aesthetic properties to variables

Your Turn

Add into your concept maps:

1. Your initial mental model
2. Prior knowledge to connect to

Then use the map to outline a simple explanation of your topic.

What if it doesn't work? - ADEPT

ADEPT Method for Learning	
Analogy	Tell me what it's like.
Diagram	Help me visualize it.
Example	Allow me to experience it.
Plain English	Describe it with everyday words.
Technical Definition	Discuss the formal details.

- https://betterexplained.com/articles/adept-method/

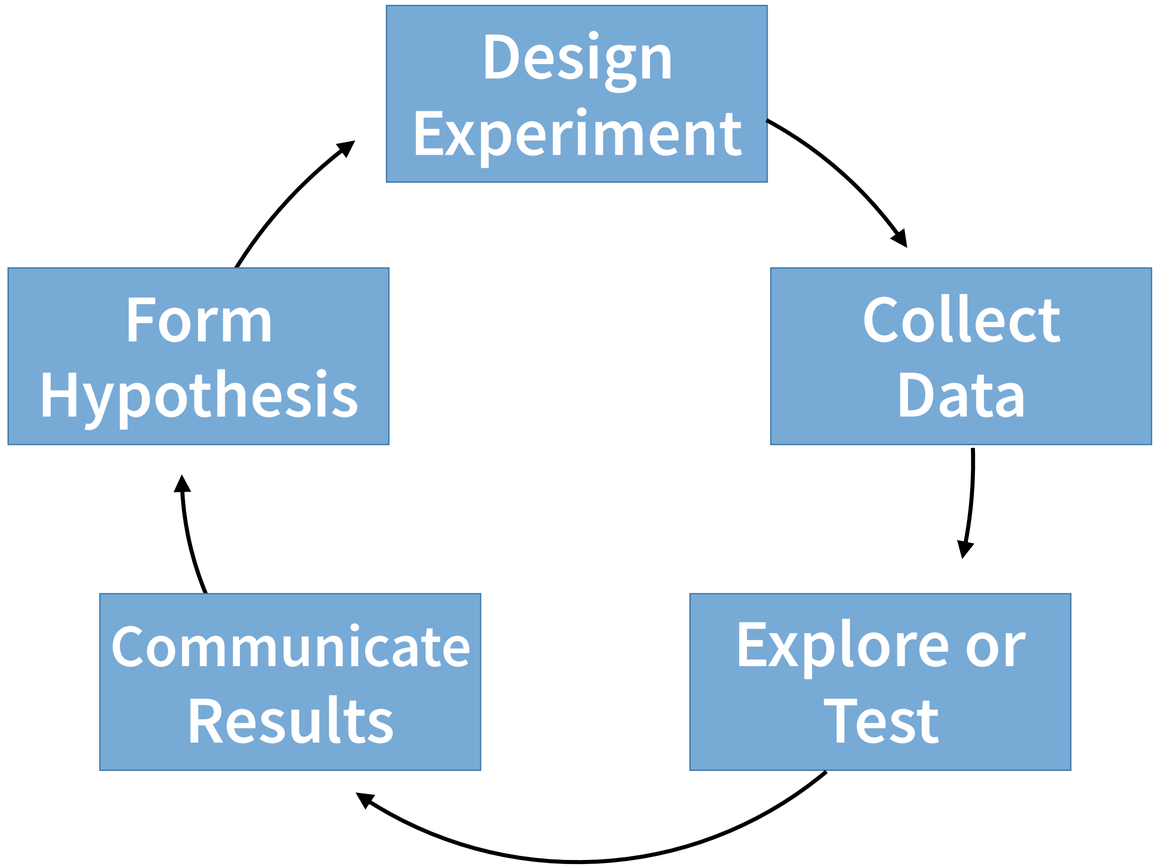
Your Turn

Within your group, use several methods from ADEPT to create a brief explanation of what the tidyverse is.

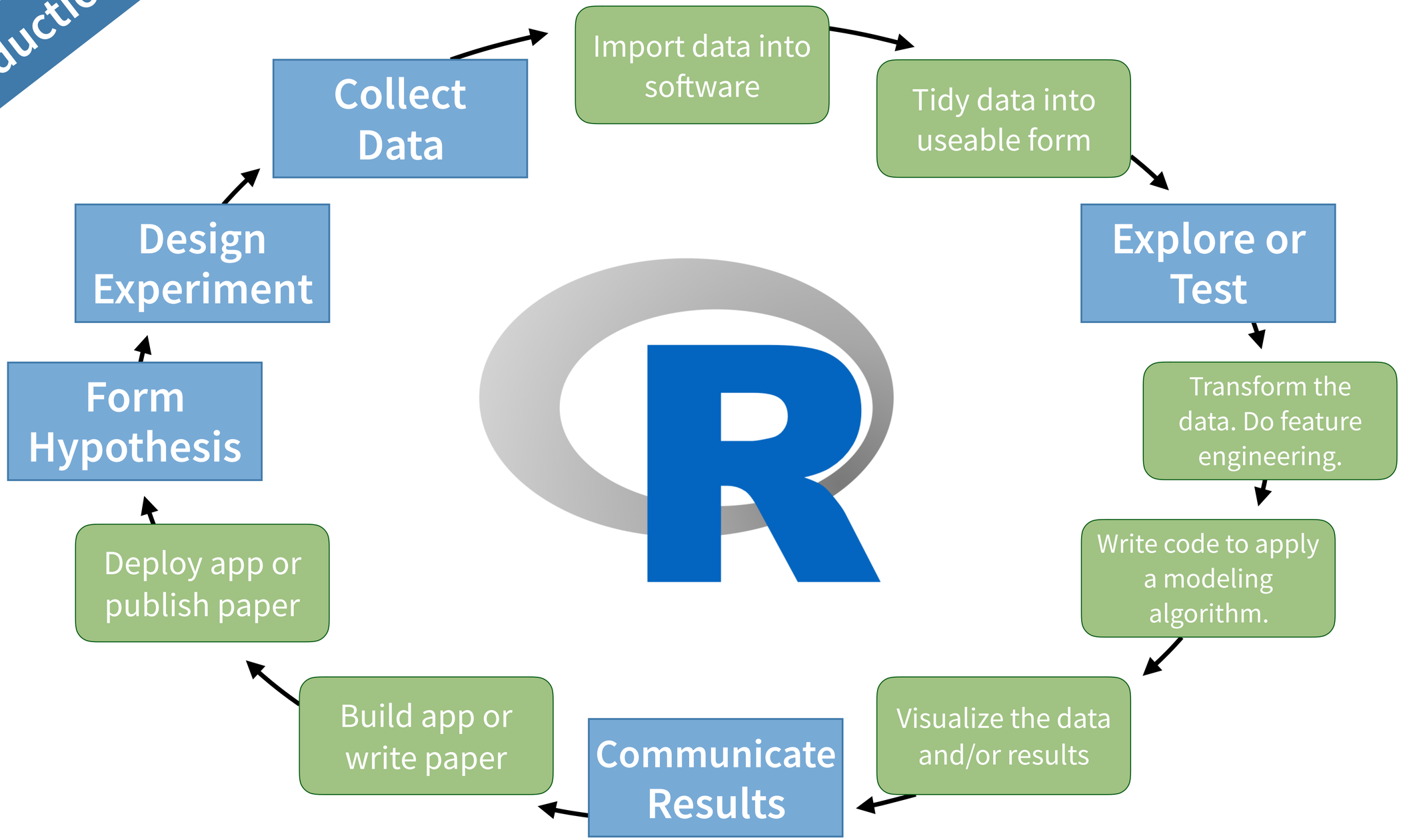
Consider adding motivation to your explanation.

ADEPT Method for Learning	
Analogy	Tell me what it's like.
Diagram	Help me visualize it.
Example	Allow me to experience it.
Plain English	Describe it with everyday words.
Technical Definition	Discuss the formal details.

"Data Science"

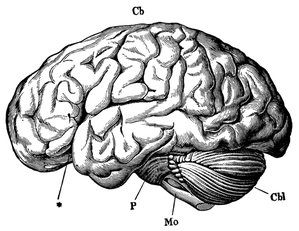


0-Introduction



0-Introduction

R - A computer language for scientists



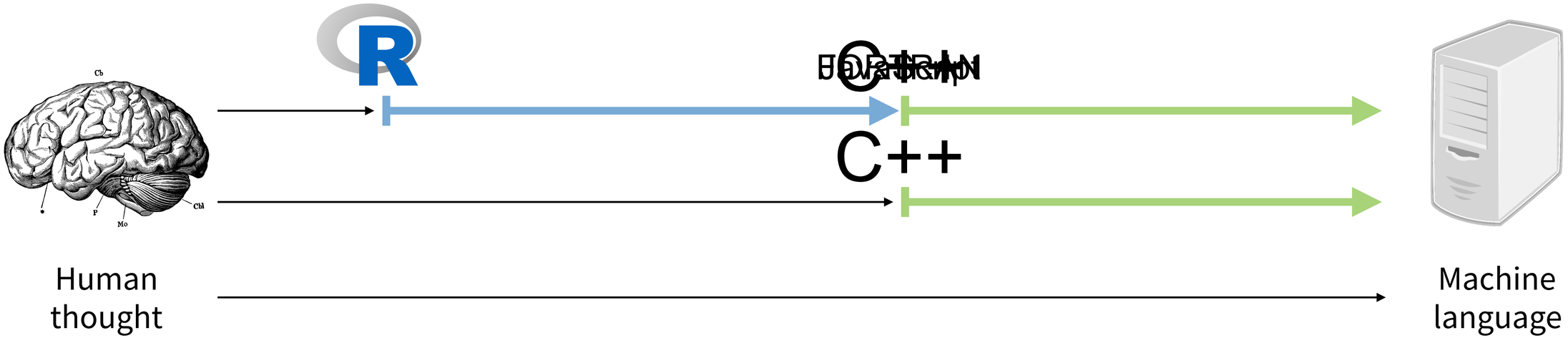
Human thought

C++

Machine language

0-Introduction

R - A computer language for scientists



0-Introduction

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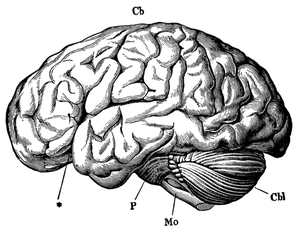


Human thought

`map()`

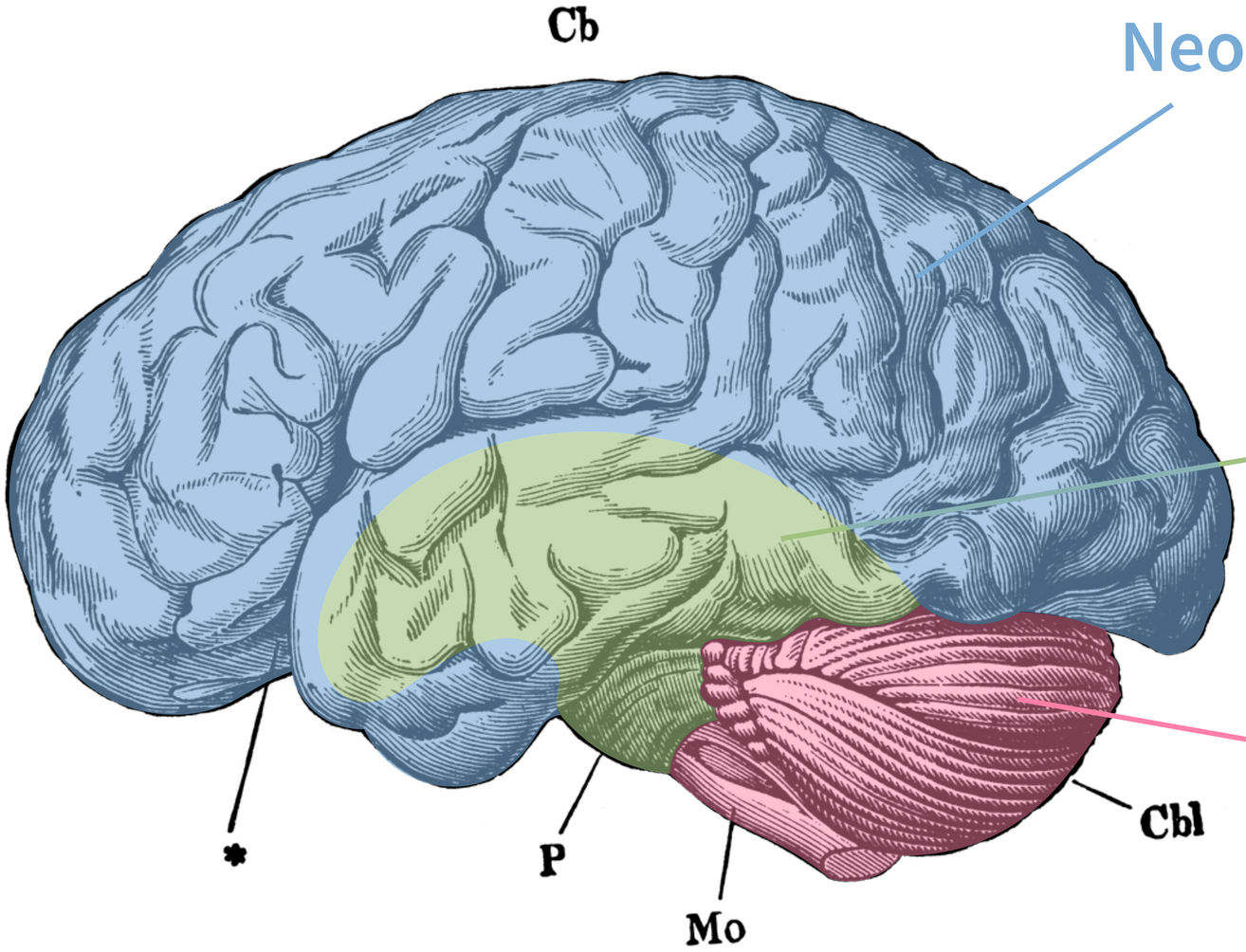
`sapply()`

`for()`

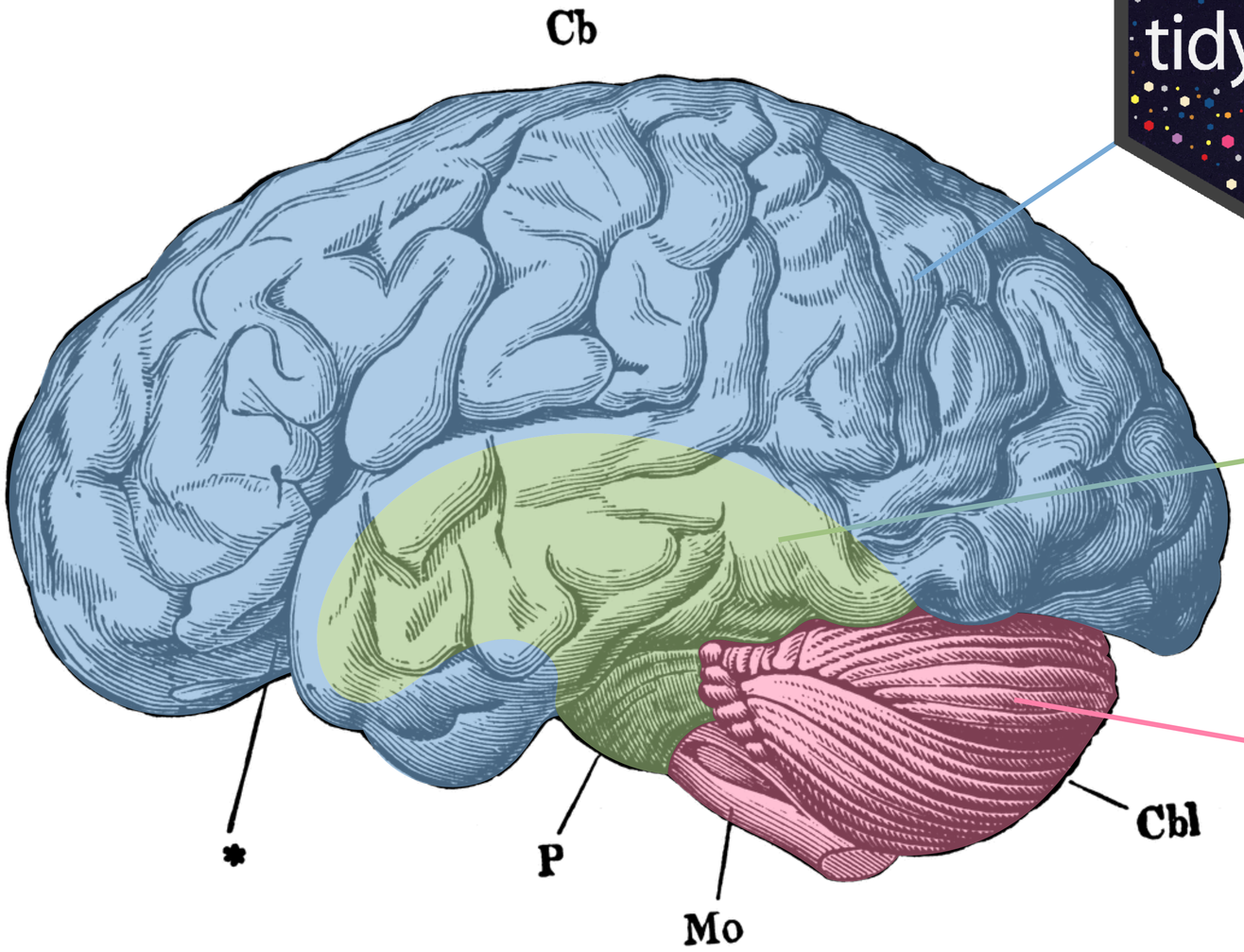
C++

Machine language

0-Introduction



0-Introduction



tidyverse

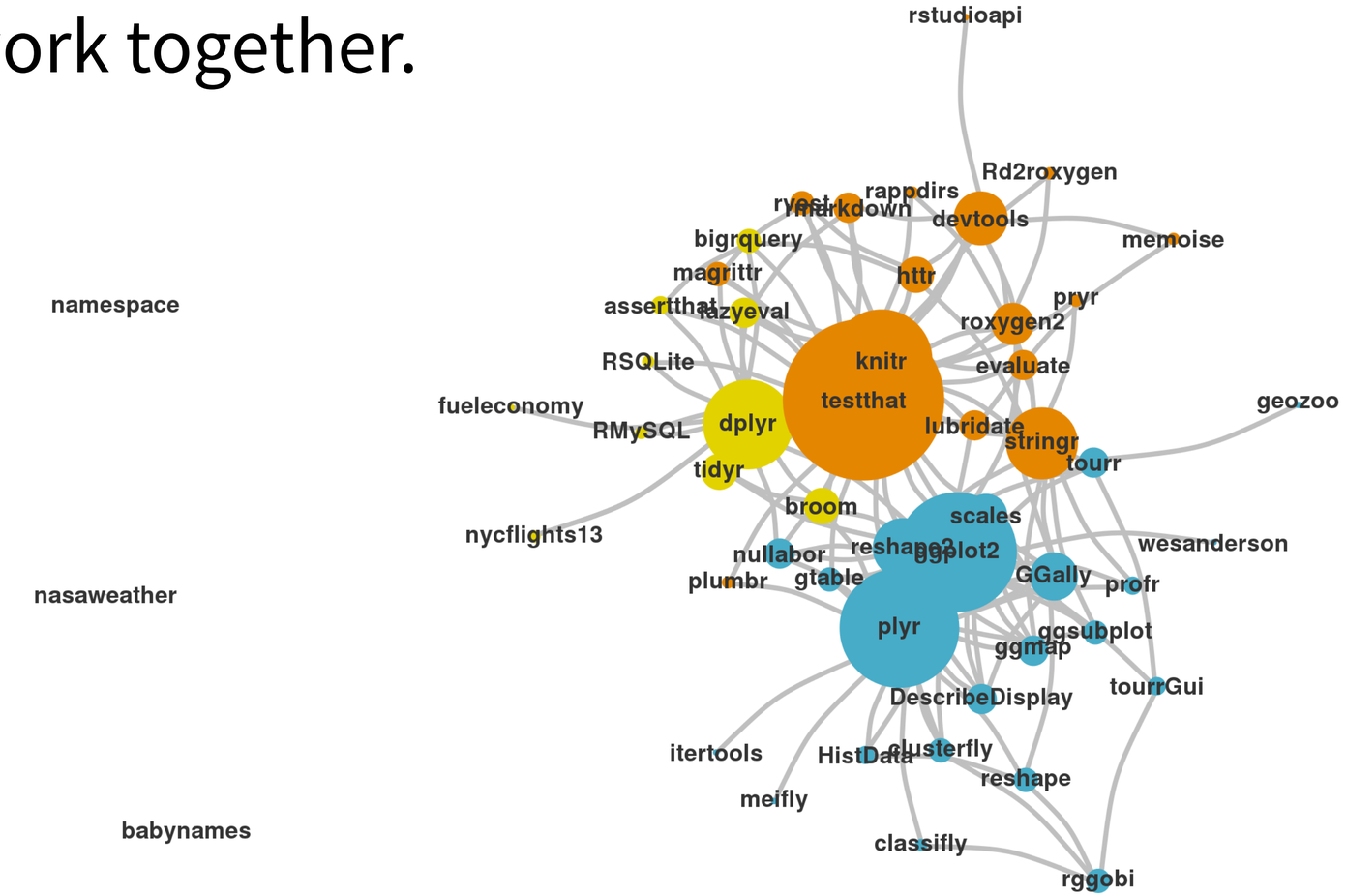
Limbic System

Reptilian Brain

0-Introduction

The Tidyverse

A collection of modern R packages that share common philosophies, embed best practices, and are designed to work together.



Display by Adolfo Álvarez