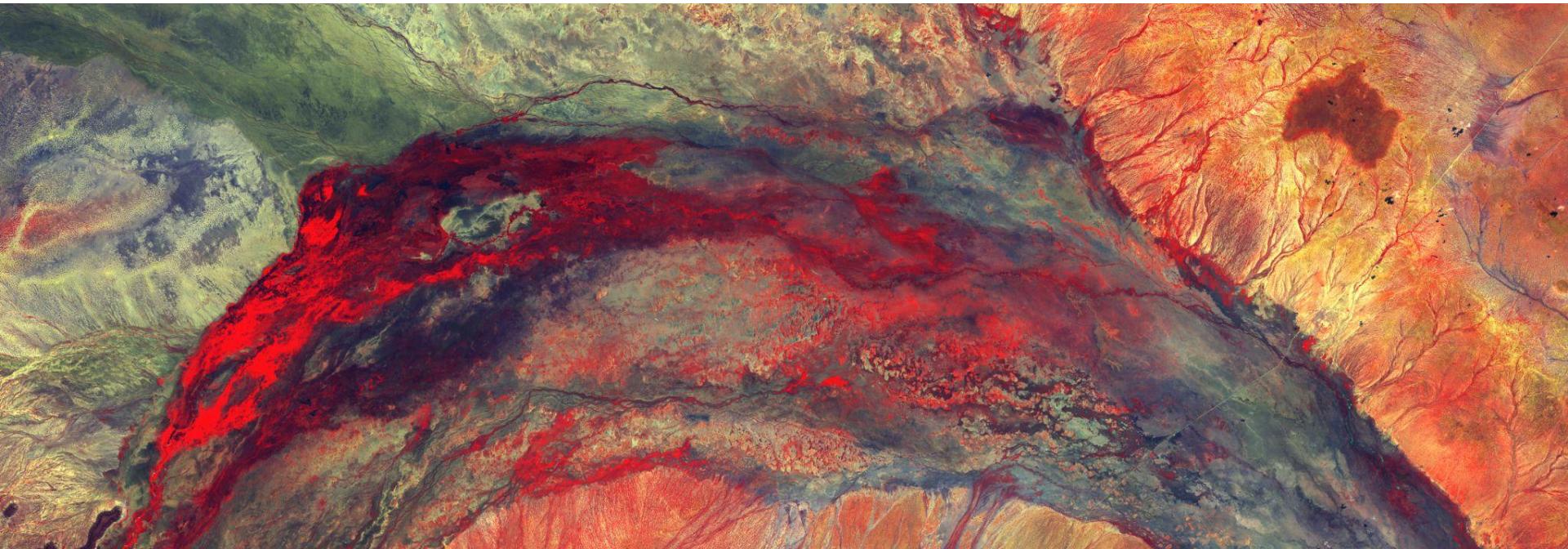


EDS 223: Geospatial Analysis & Remote Sensing

Week 3

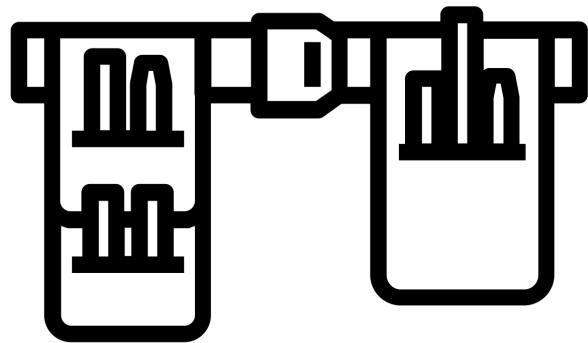


USGS via Unsplash

Welcome!

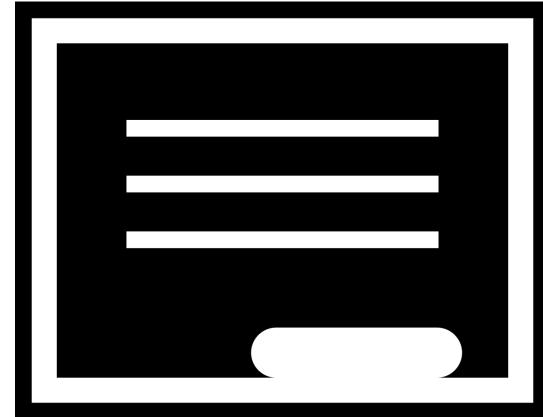
- Course logistics
- Building a spatial analysis workflow
 - Subsetting
 - Aggregating
 - Summarizing
 - Simplifying

Toolbelt for solving spatial problems



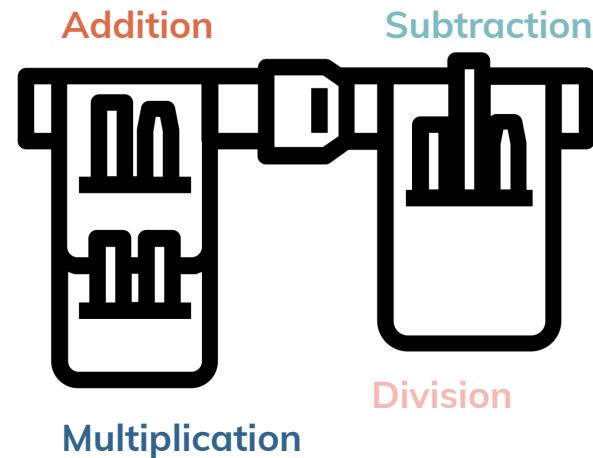
Toolbelt for solving spatial problems

There is a group of 10 people who are ordering pizza. If each person gets 2 slices and each pizza has 4 slices, how many pizzas should they order?



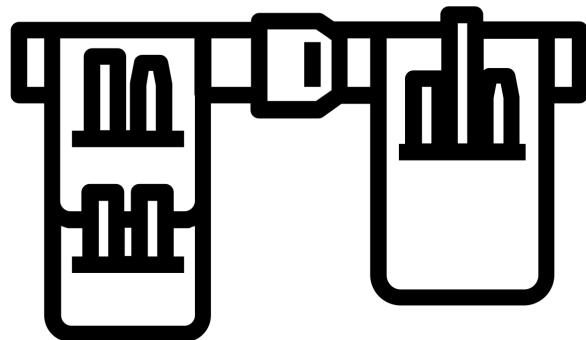
Toolbelt for solving spatial problems

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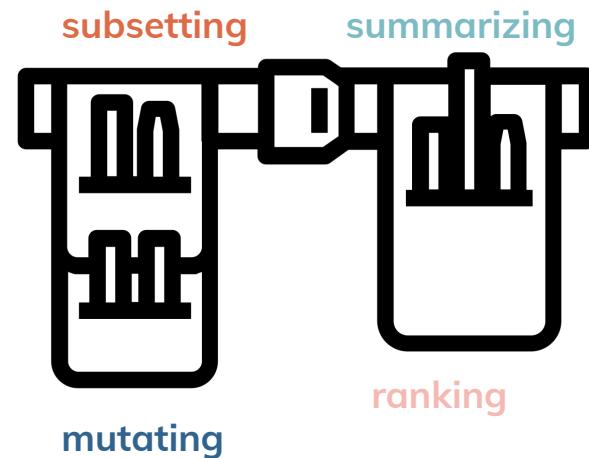
Toolbelt for solving spatial problems

What is the life expectancy of the country in Asia with the highest population density?



Toolbelt for solving spatial problems

What is the life expectancy of the country in Asia with the highest population density?



New tools for a new data type

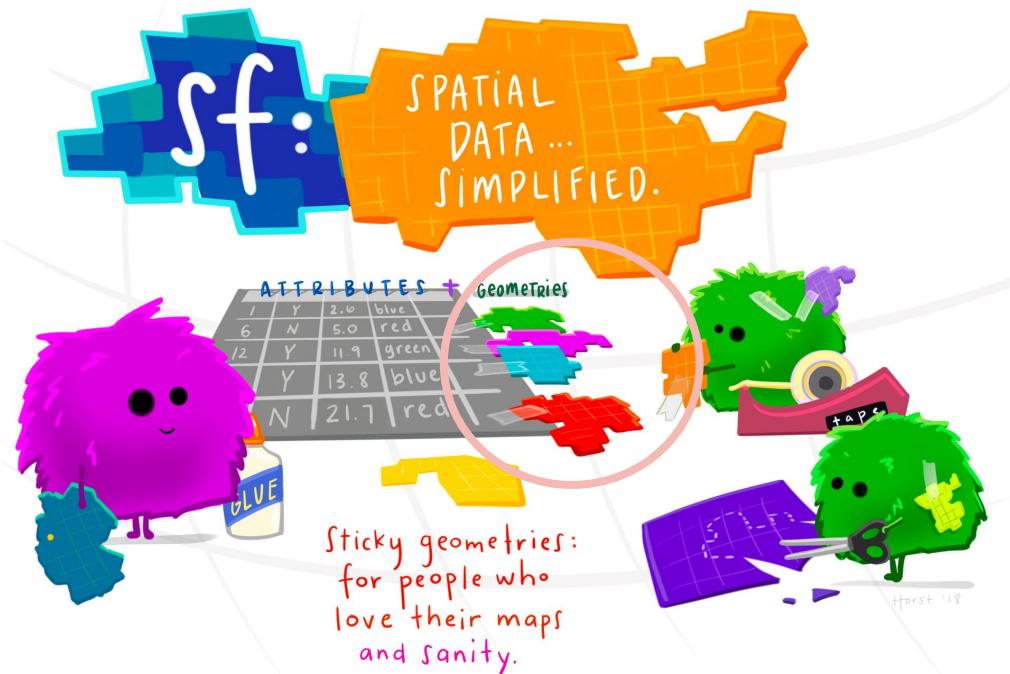
dplyr : go wrangling



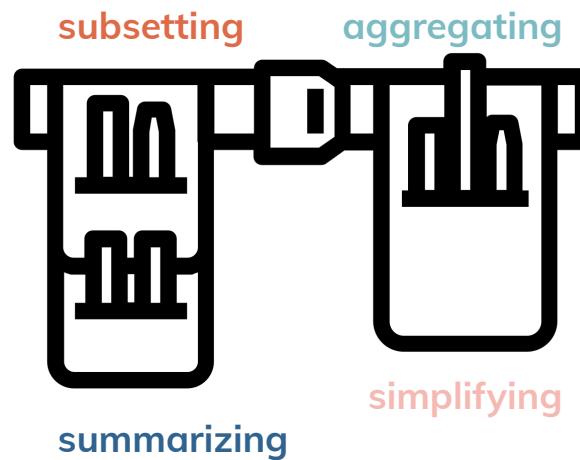
New tools for a new data type



New tools for a new data type

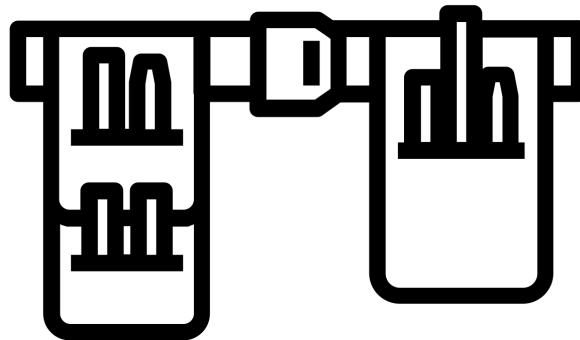


Toolbelt for solving spatial problems



Toolbelt for solving spatial problems

subsetting



New tools for a new data type

dplyr : go wrangling



dplyr::filter()

KEEP ROWS THAT
satisfy
your CONDITIONS

keep rows from... this data... ONLY IF... type is "otter" AND site is "bay"
filter(df, type == "otter" & site == "bay")



type	food	site
otter	urchin	bay
Shark	seal	channel
otter	abalone	bay
otter	crab	wharf

(random items)



New tools for a new data type

How many mountains over 14K feet are in the United States?

New tools for a new data type

How many mountains over 14K feet are in the United States?



Name	Country	Latitude, longitude
Machu Picchu	Peru	13.163°S, 72.545°W
...

New tools for a new data type

How many mountains over 14K feet are in the United States?



Name	Latitude, longitude
Machu Picchu	13.163°S, 72.545°W
...	...

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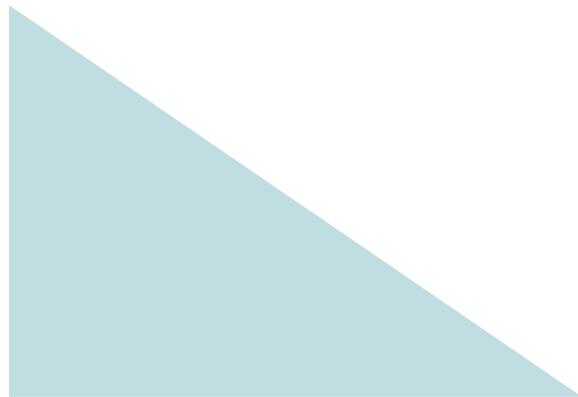
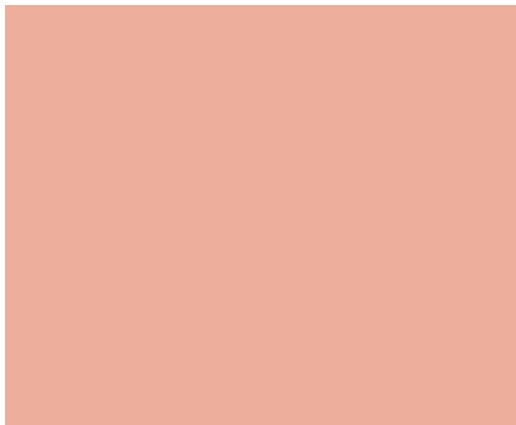


Name	Latitude, longitude
Machu Picchu	13.163°S, 72.545°W
...	...

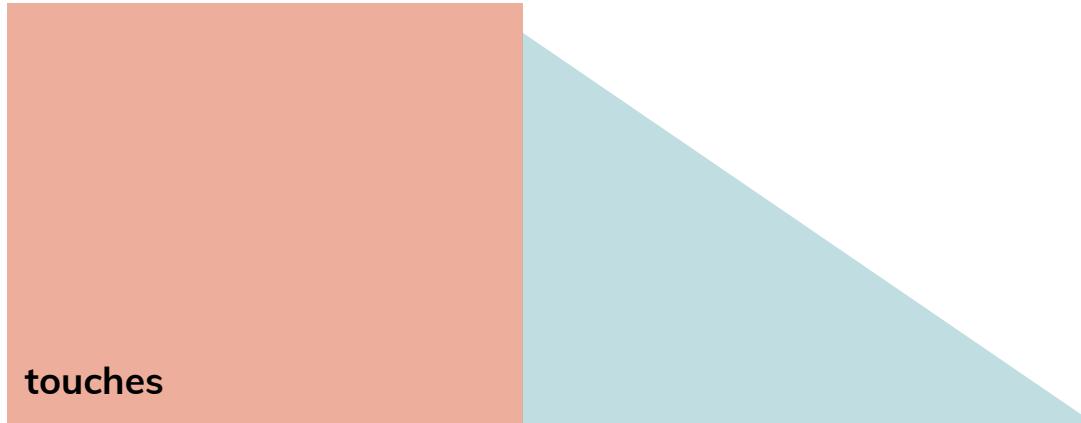


Geometry!

Topological relationships

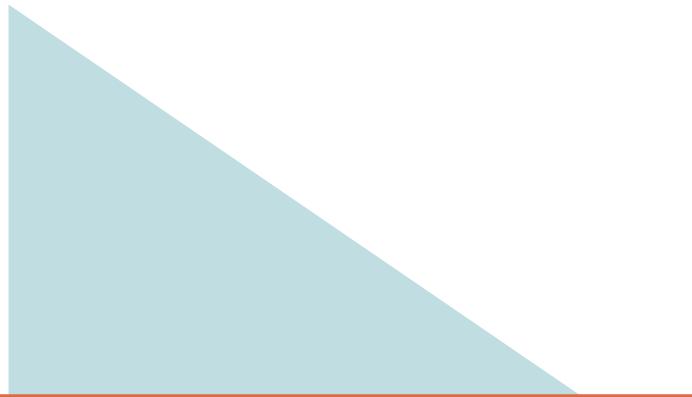


Topological relationships

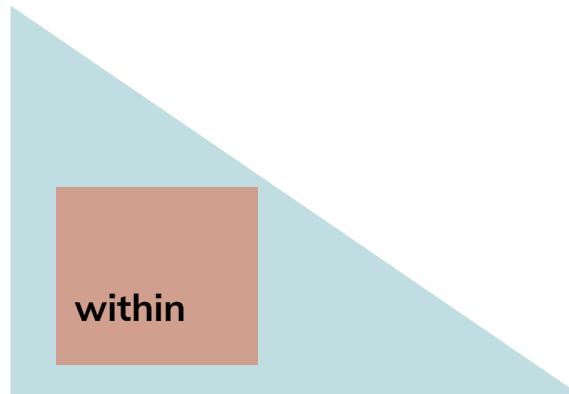


Topological relationships

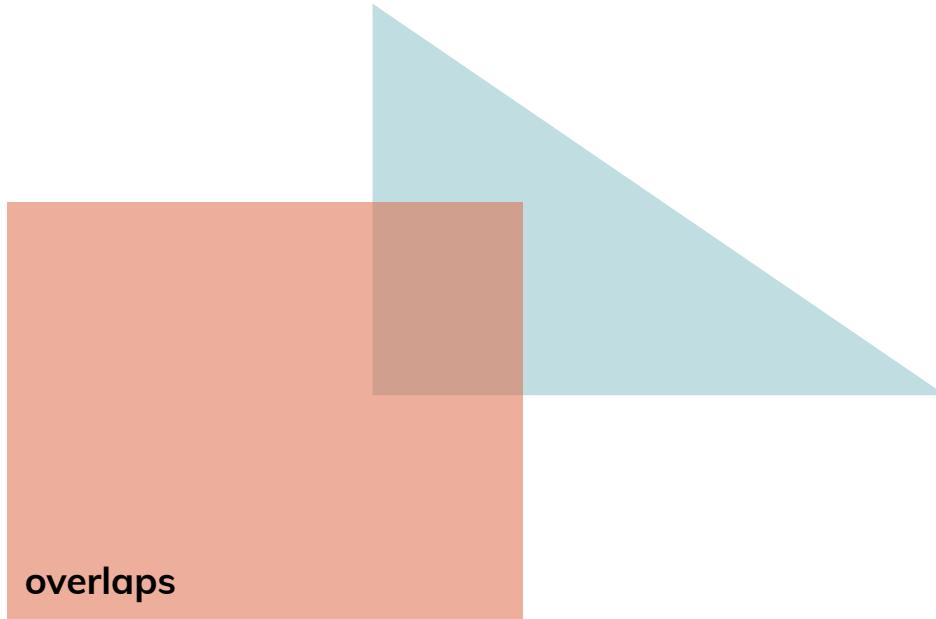
touches



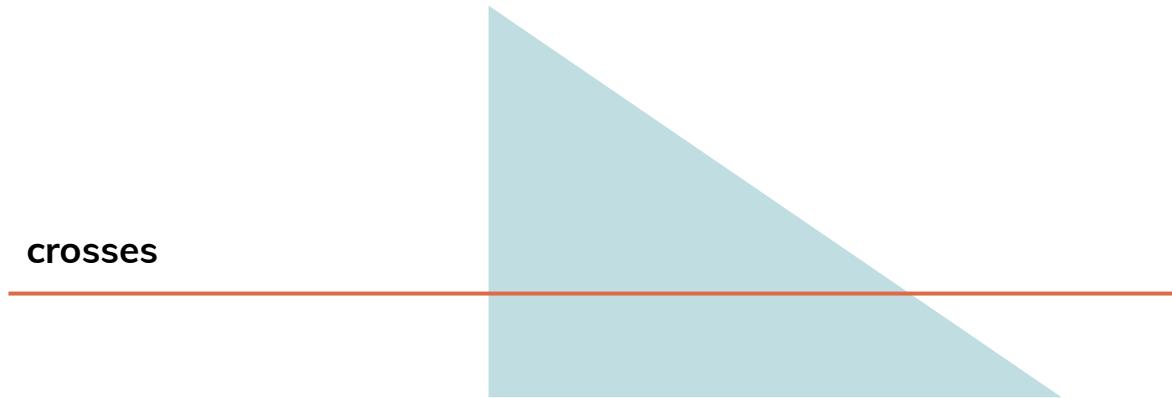
Topological relationships



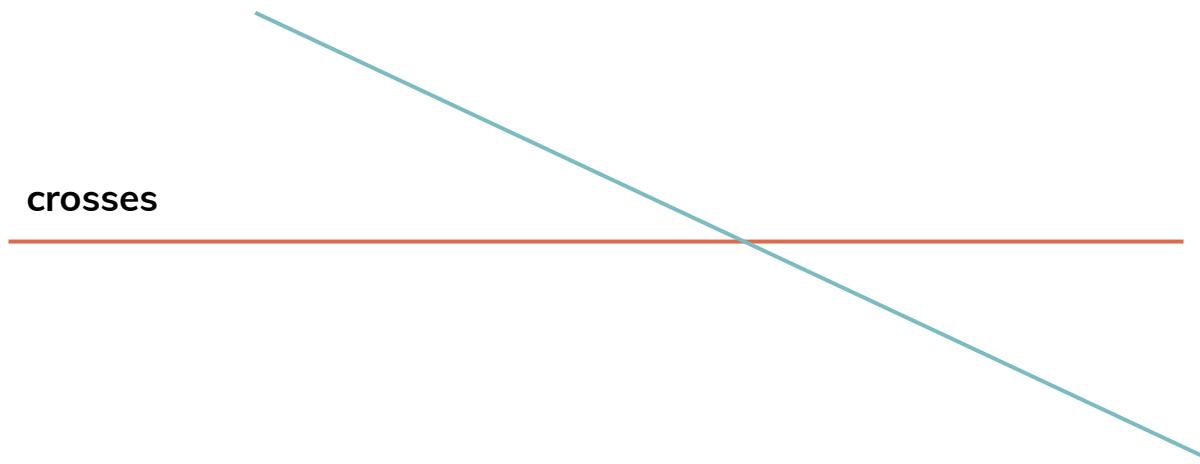
Topological relationships



Topological relationships

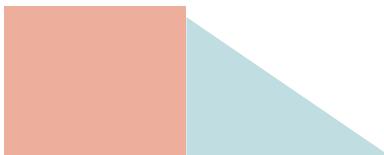


Topological relationships

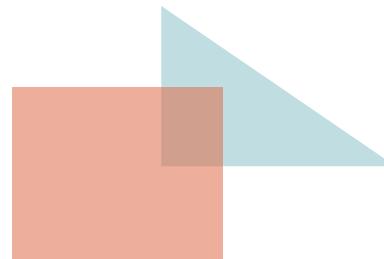


Topological relationships

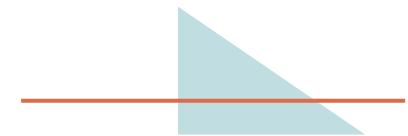
touches



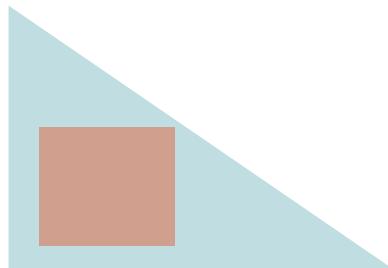
overlaps



crosses

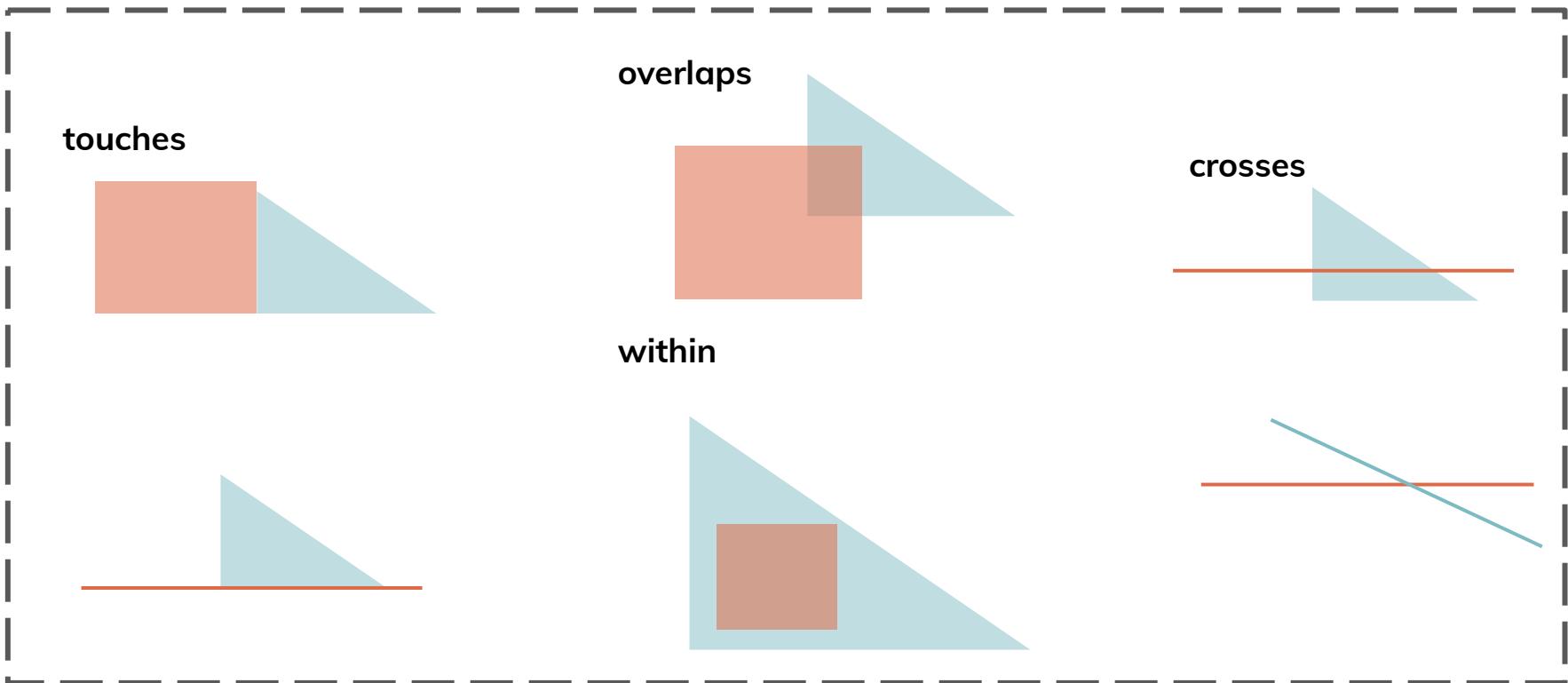


within



Topological relationships

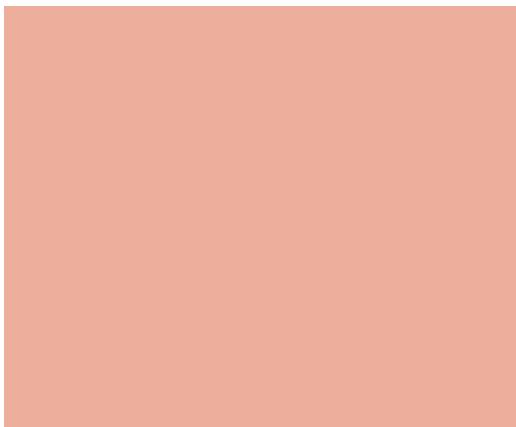
intersects



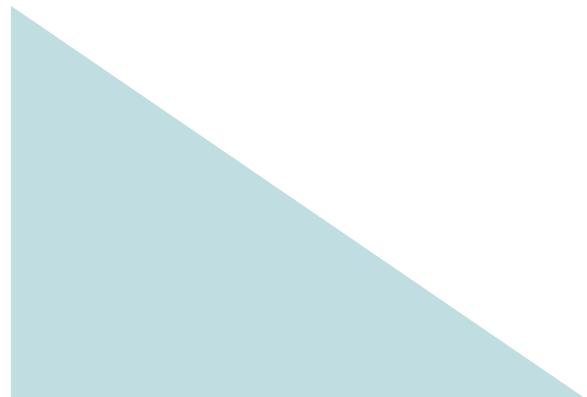
Yes or No

Topological relationships

disjoint

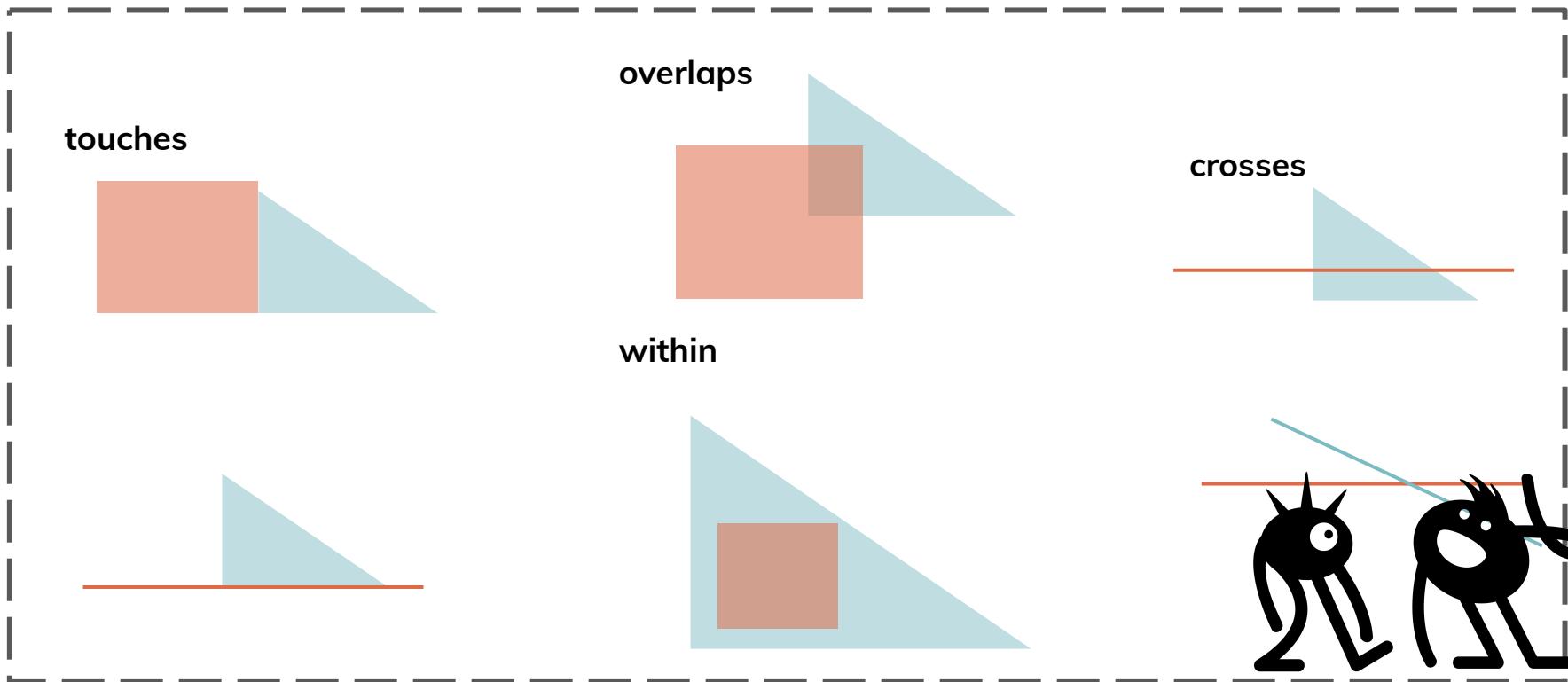


Yes or No



Topological relationships

intersects

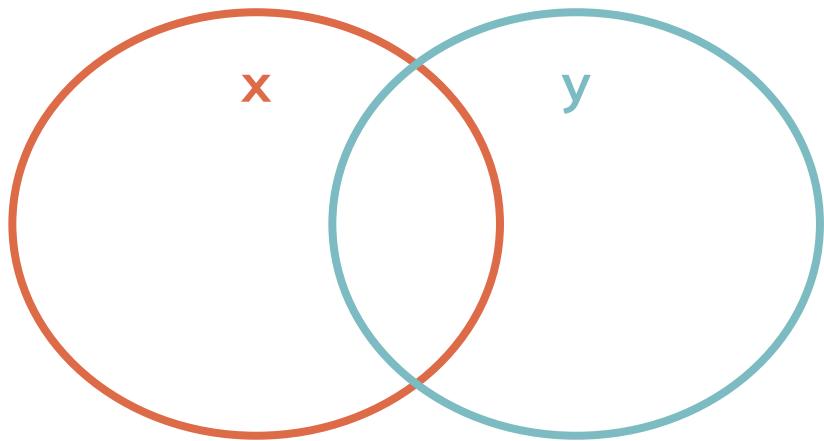


Yes or No

Topological relationships

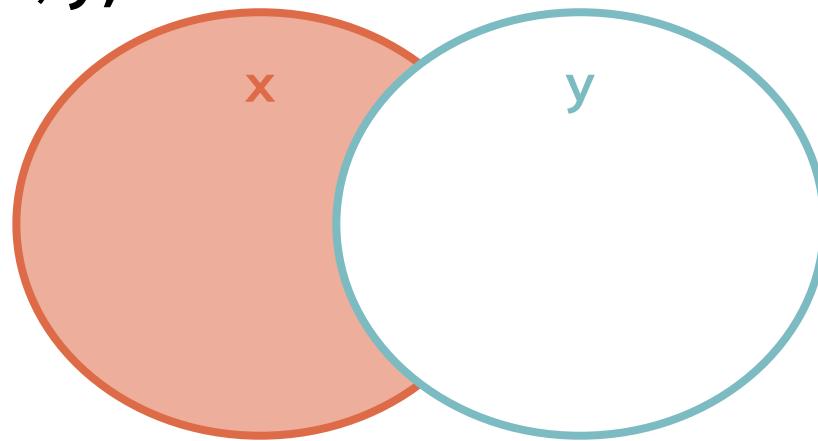


Topological relationships: clipping



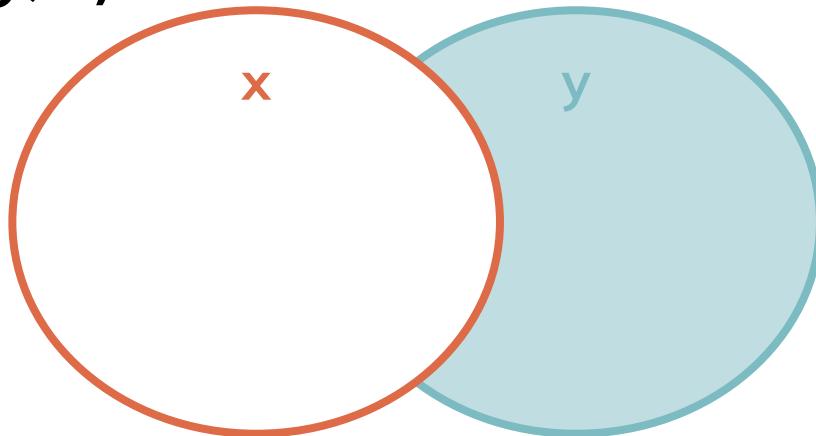
Topological relationships: clipping

difference (x, y)



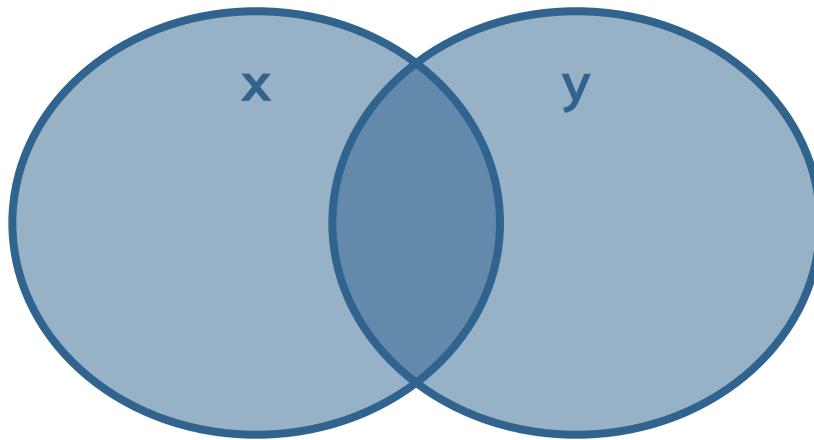
Topological relationships: clipping

difference (y, x)



Topological relationships: clipping

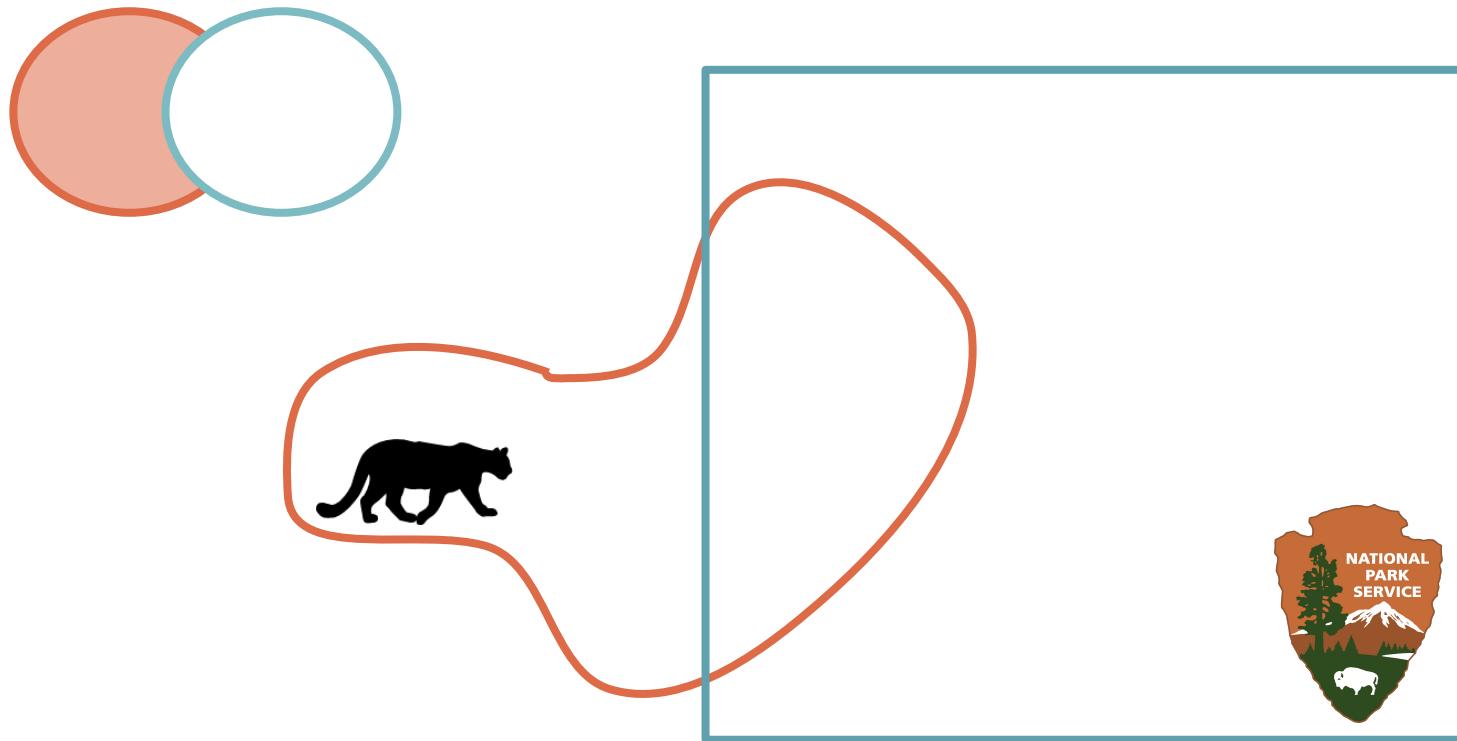
union



Topological relationships

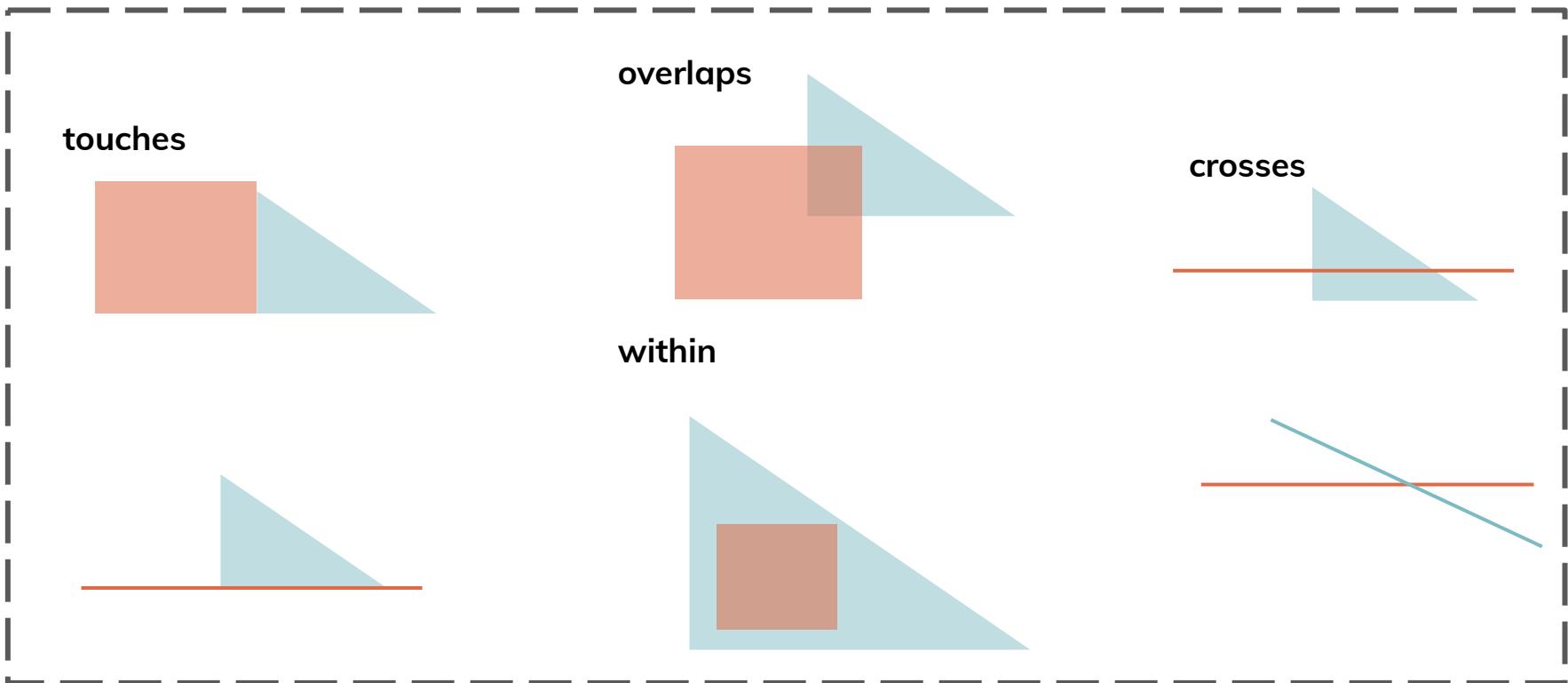
What proportion of a species' range is unprotected?

Topological relationships



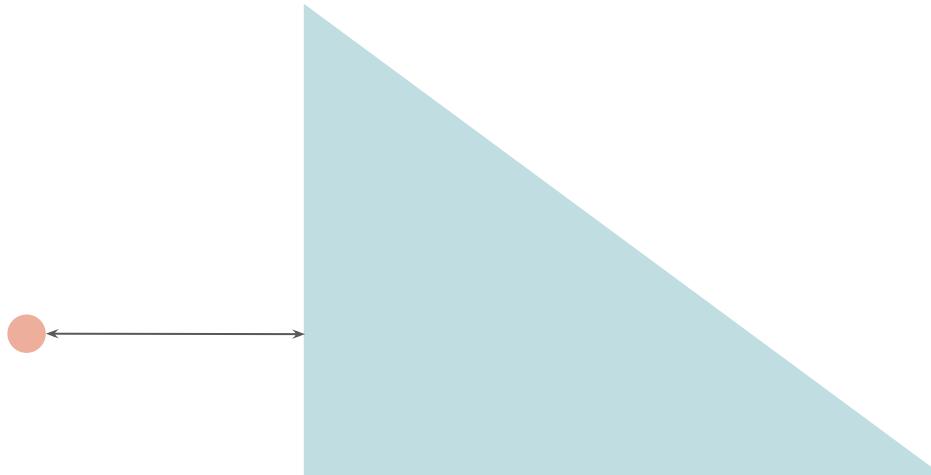
Topological relationships

intersects



Yes or No

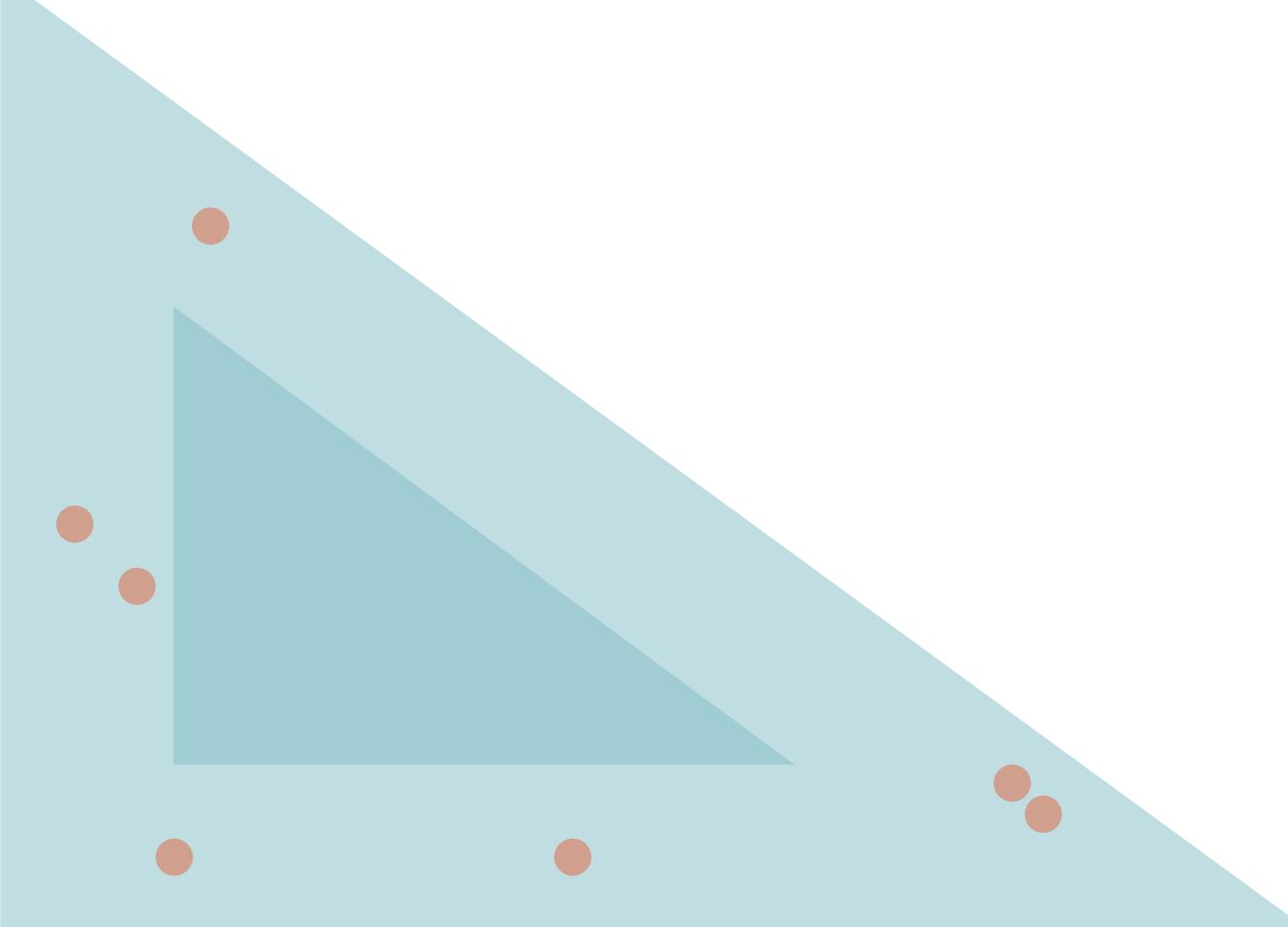
Topological relationships



Buffers



Buffers

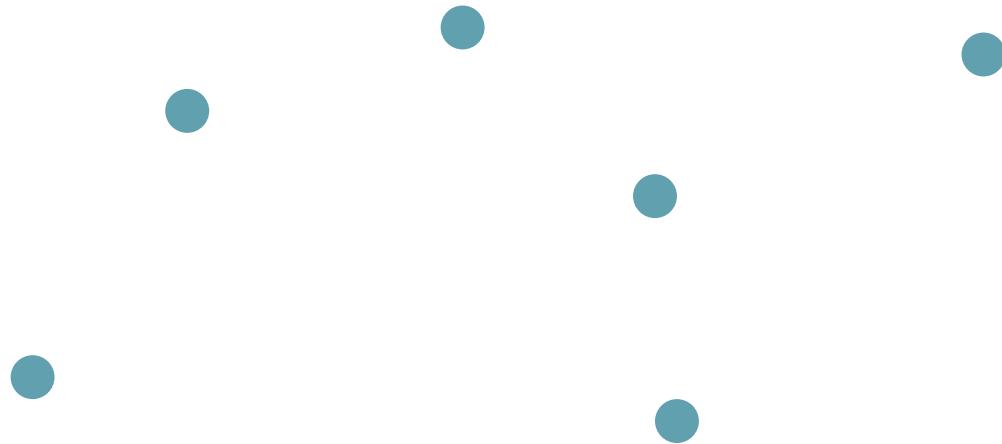


Buffers

How many people live within walking distance of a grocery store?

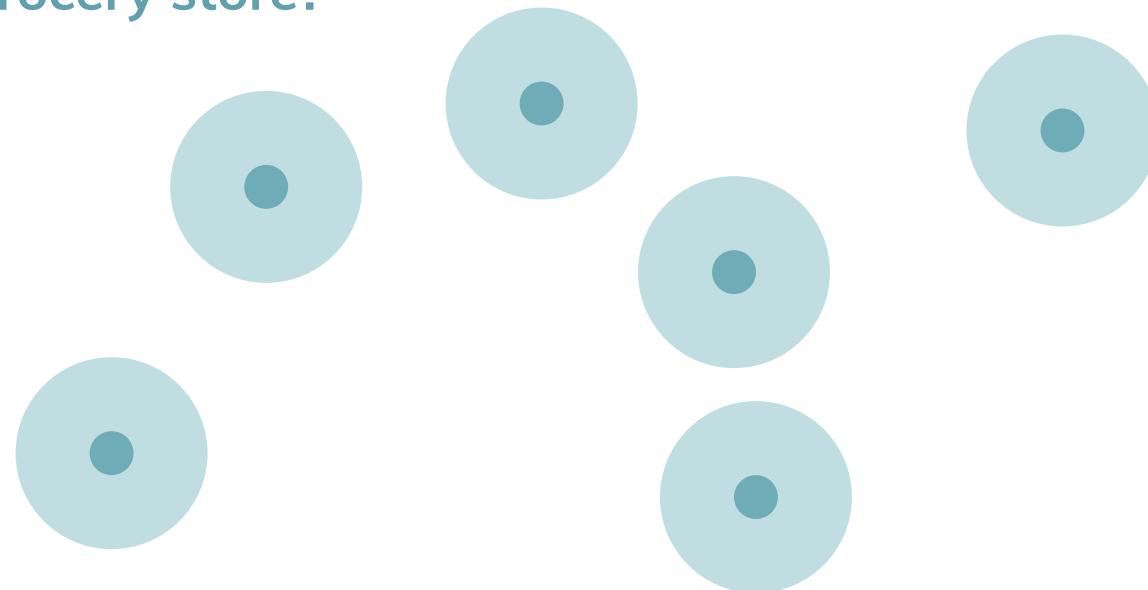
Buffers

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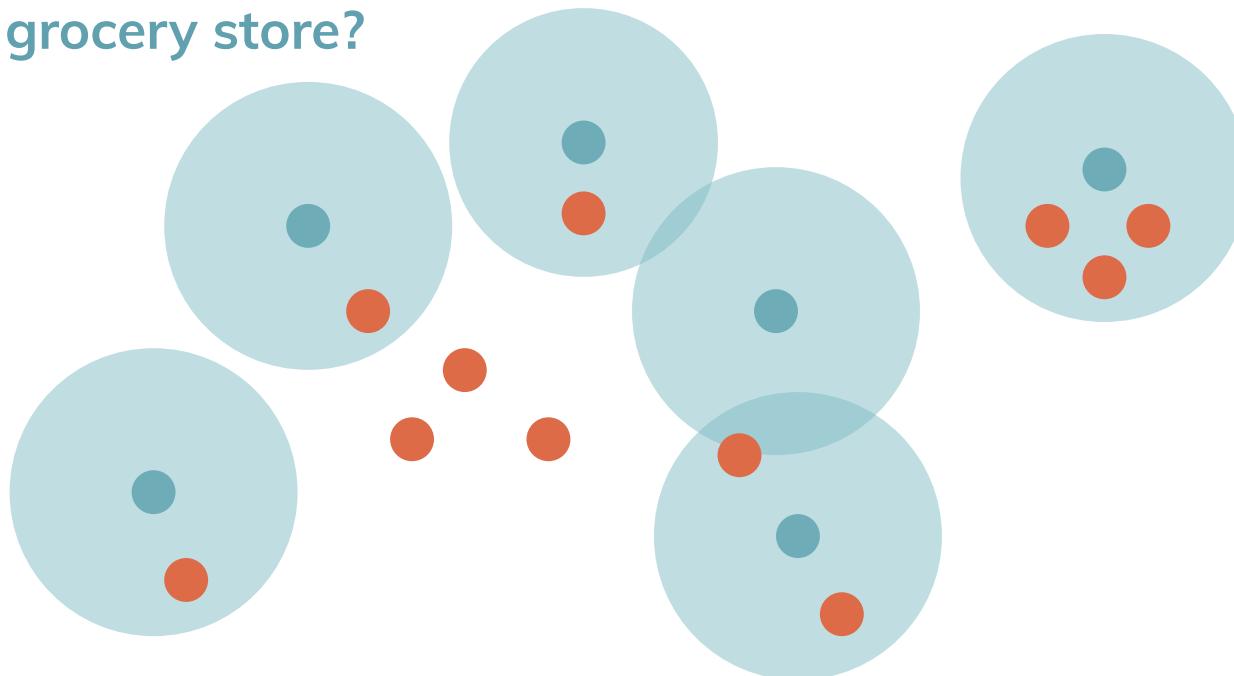
Buffers

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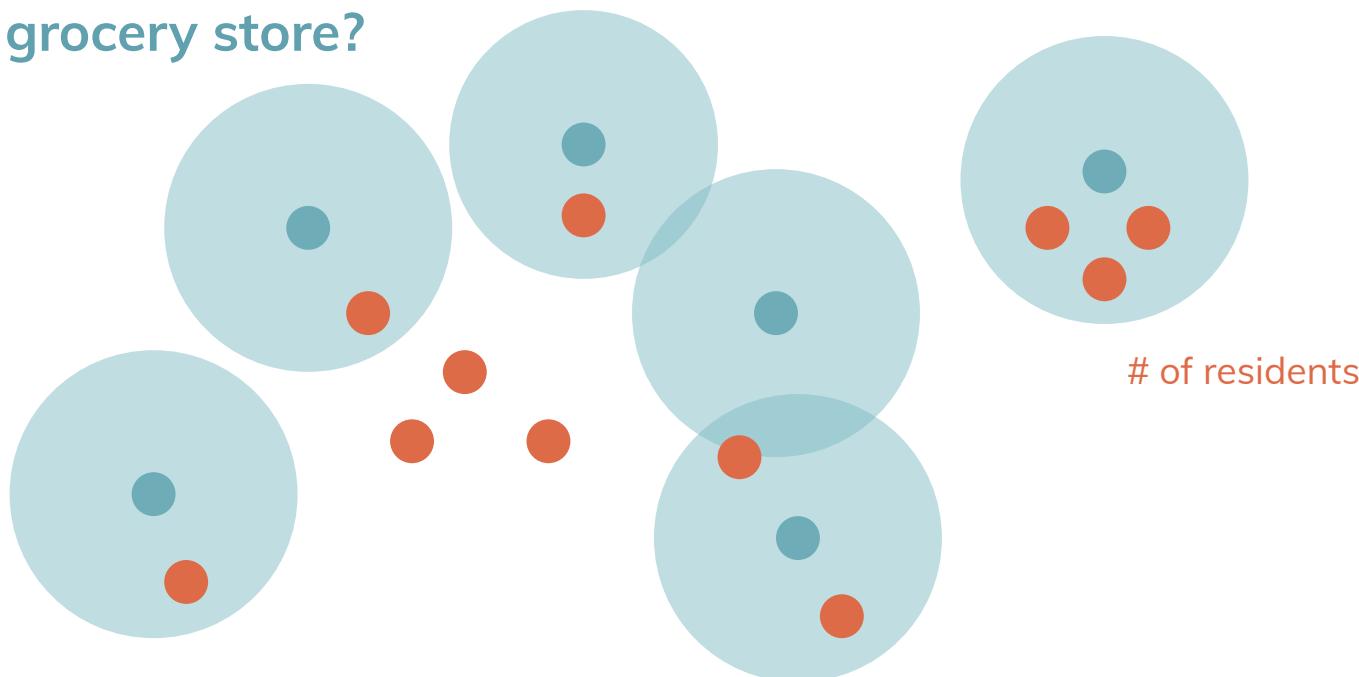
Buffers

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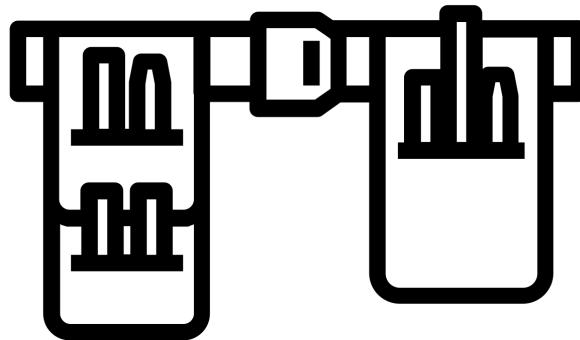
Buffers

How many people live within walking distance of a grocery store?

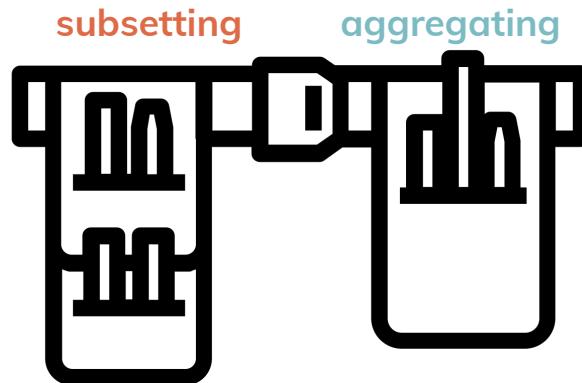


Toolbelt for solving spatial problems

subsetting



Toolbelt for solving spatial problems

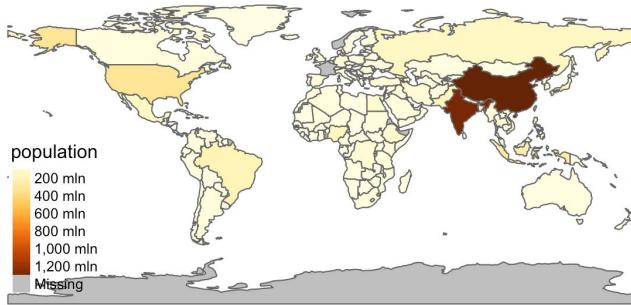


Aggregation

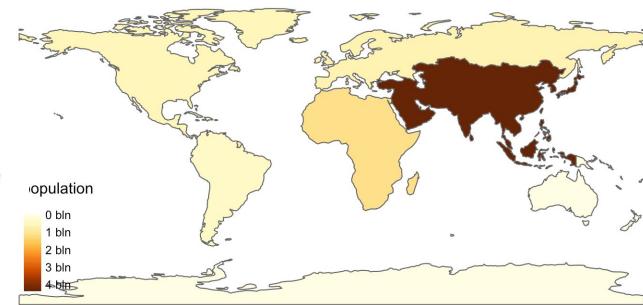
Which continent has the highest population?

Aggregation

Which continent has the highest population?



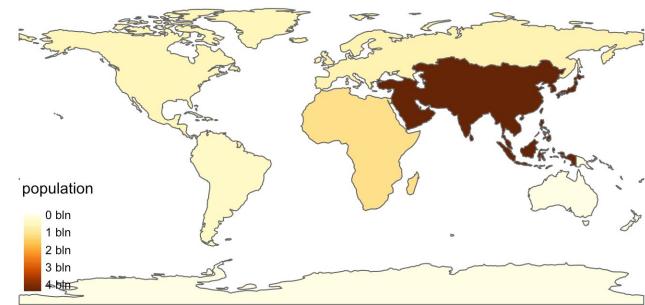
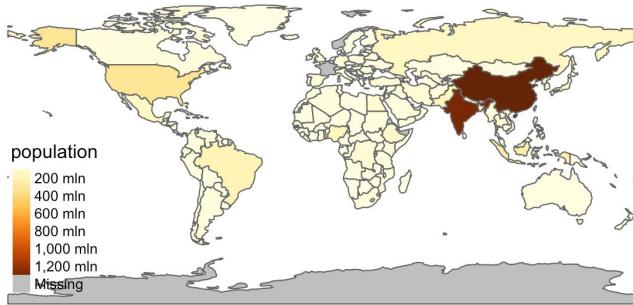
```
continents <- world %>%  
  group_by(continent) %>%  
  summarise(population = sum(pop, na.rm = TRUE))
```



Country	Continent
USA	North America
...	...

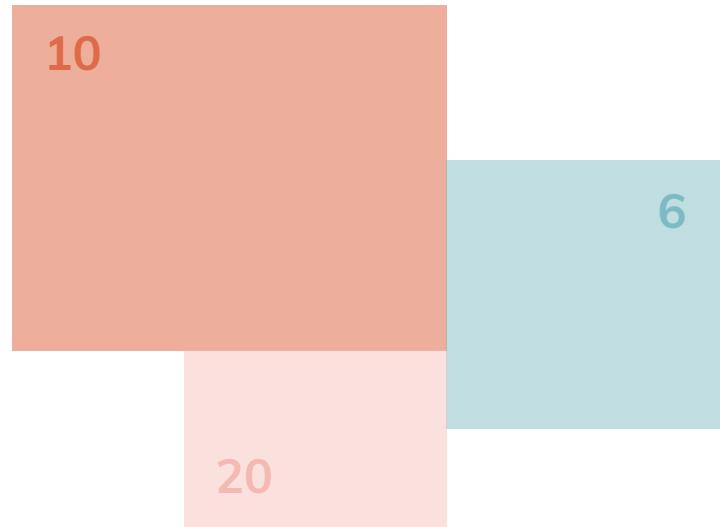
Aggregation

Which continent has the highest population?

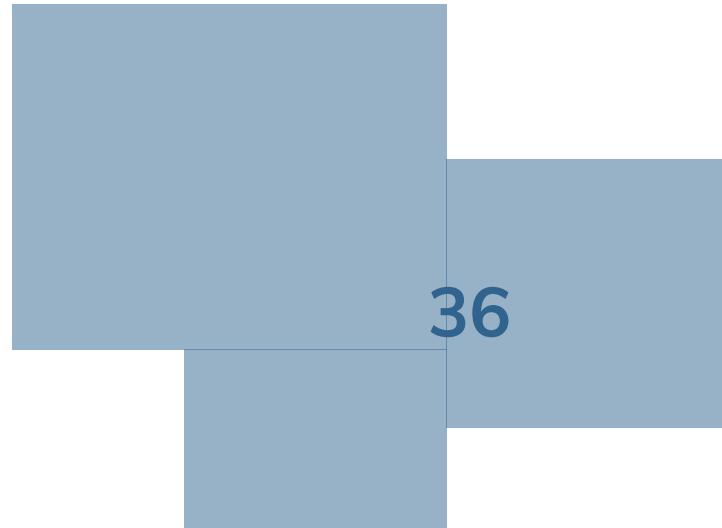


Country	Continent
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...	...

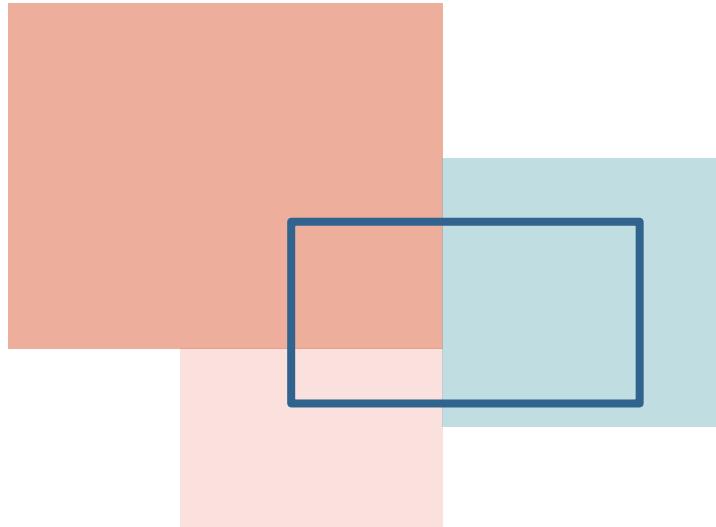
Geometry unions



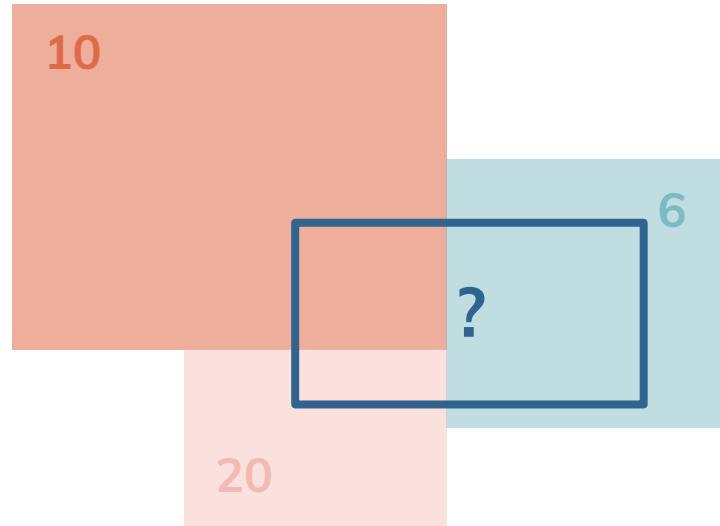
Geometry unions



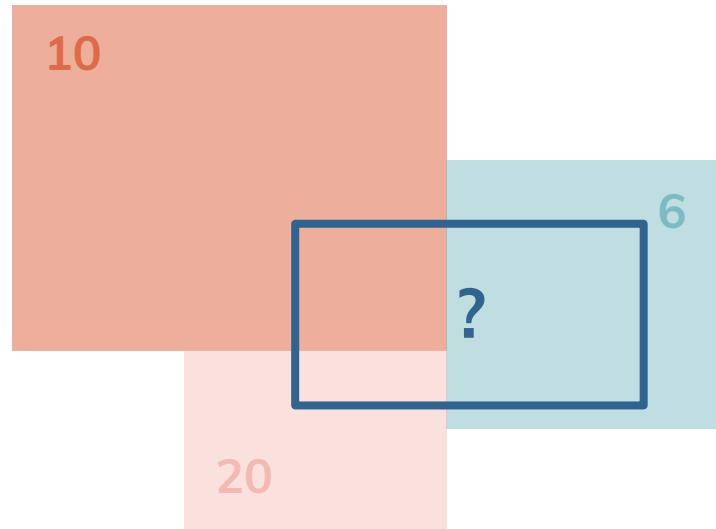
Geometry unions



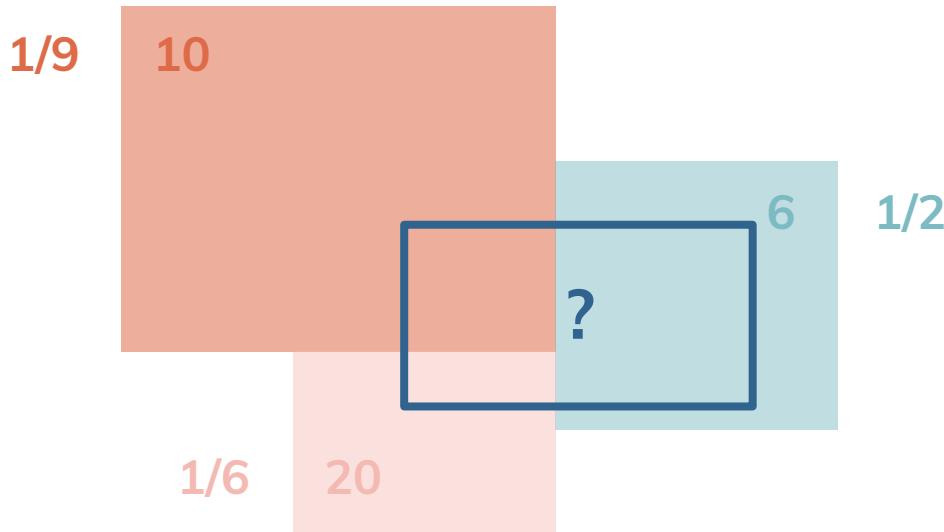
Geometry unions



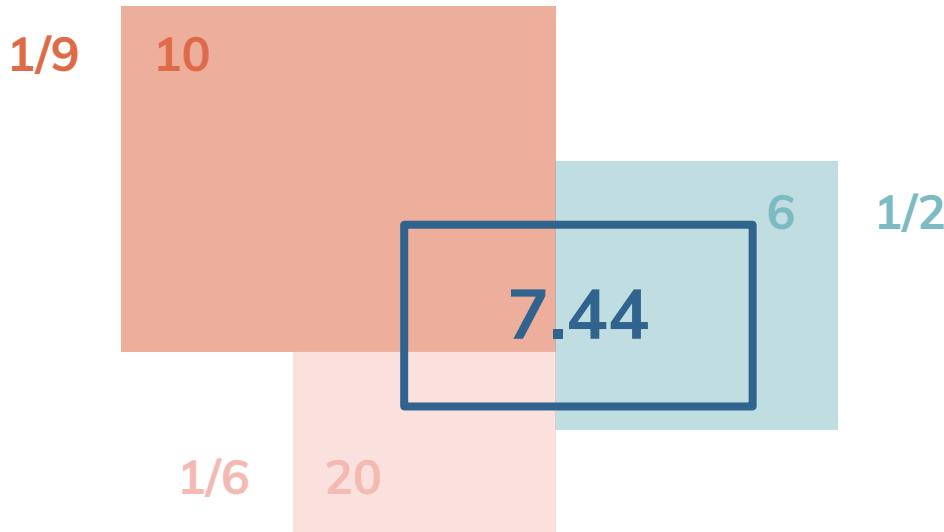
Geometry unions



Geometry unions: area-weighted interpolation

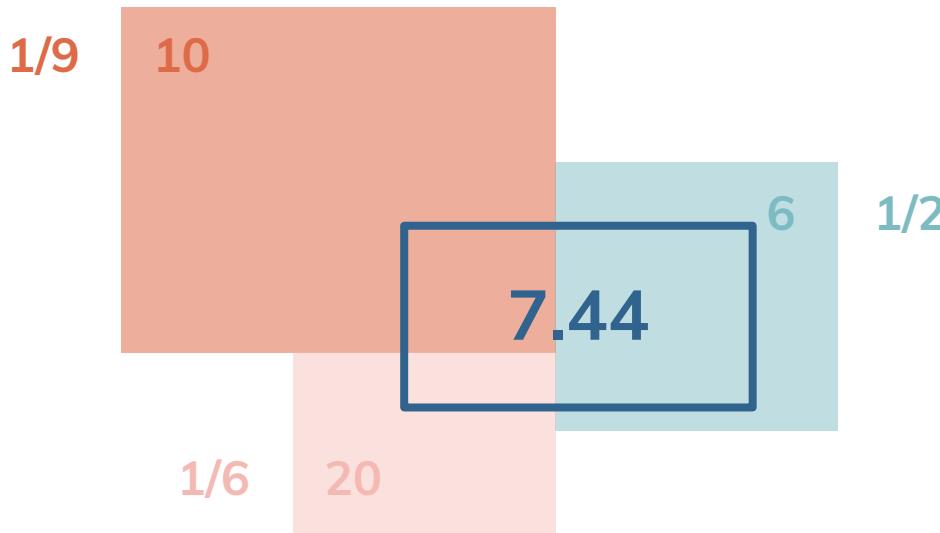


Geometry unions: area-weighted interpolation

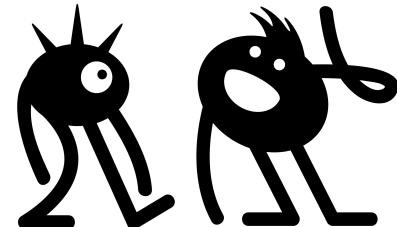


$$\frac{1}{9}(10) + \frac{1}{2}(6) + \frac{1}{6}(20) = 7.44$$

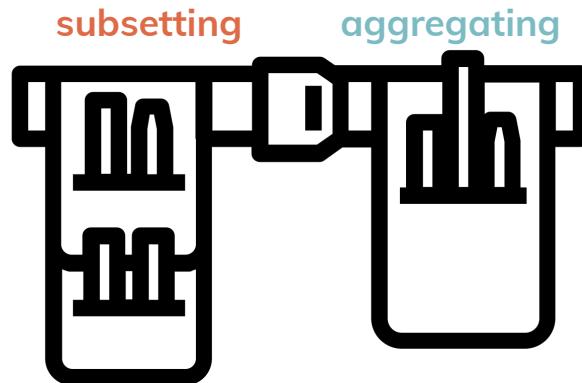
Geometry unions: area-weighted interpolation



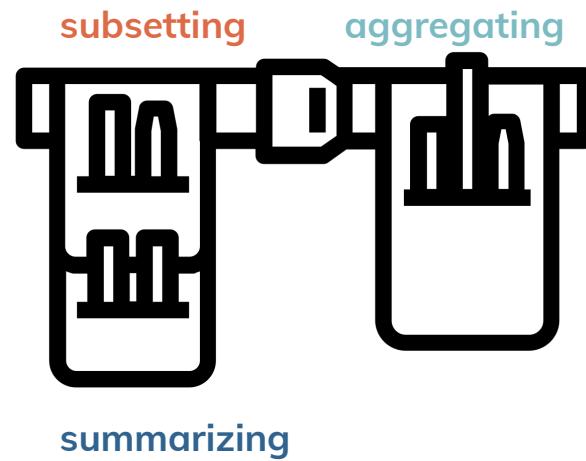
$$\frac{1}{9}(10) + \frac{1}{2}(6) + \frac{1}{6}(20) = 7.44$$



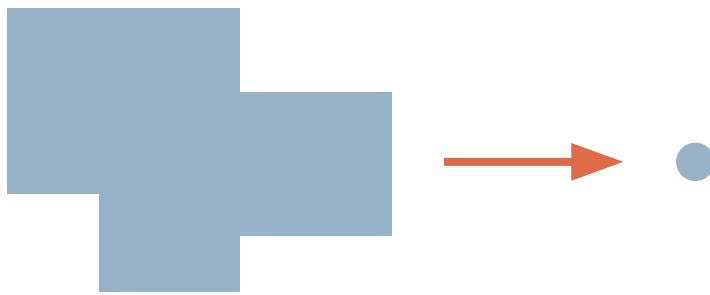
Toolbelt for solving spatial problems



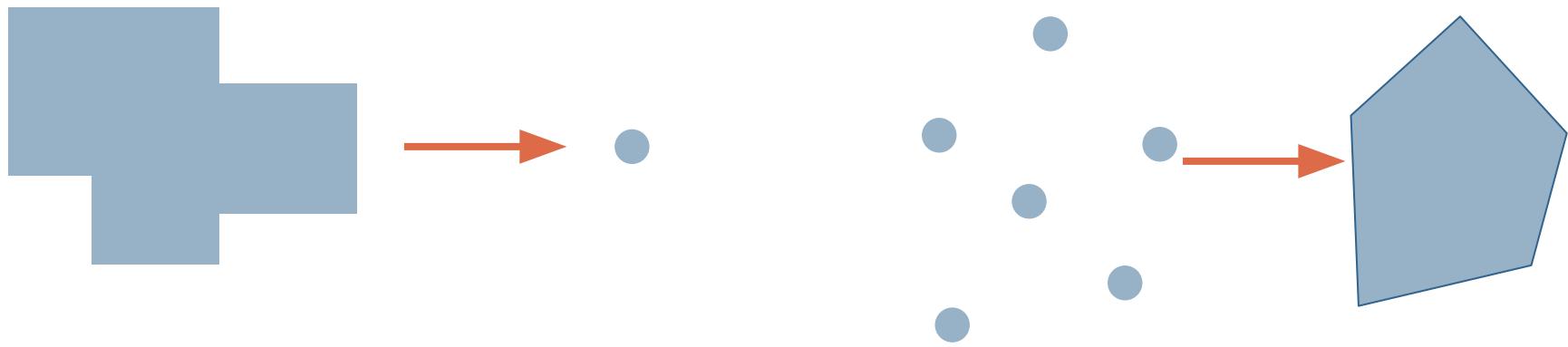
Toolbelt for solving spatial problems



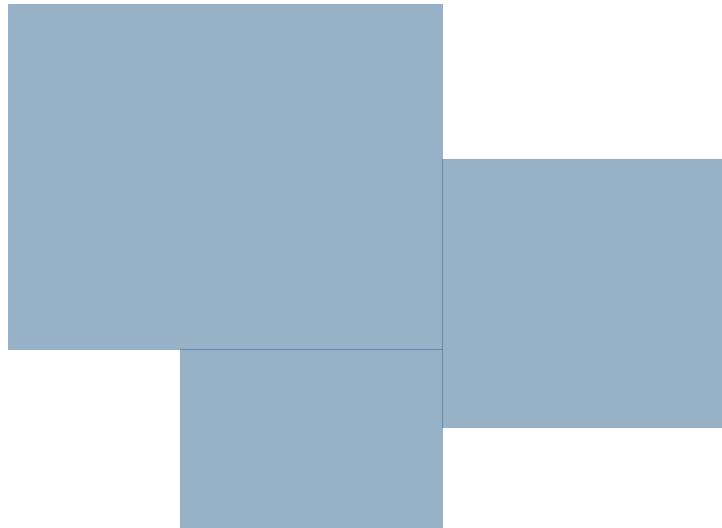
Summarizing



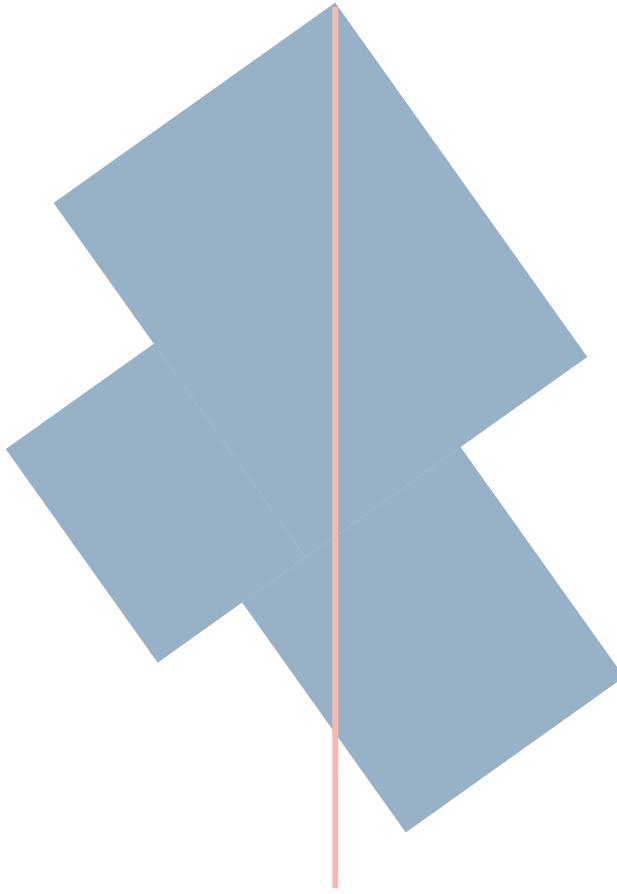
Summarizing



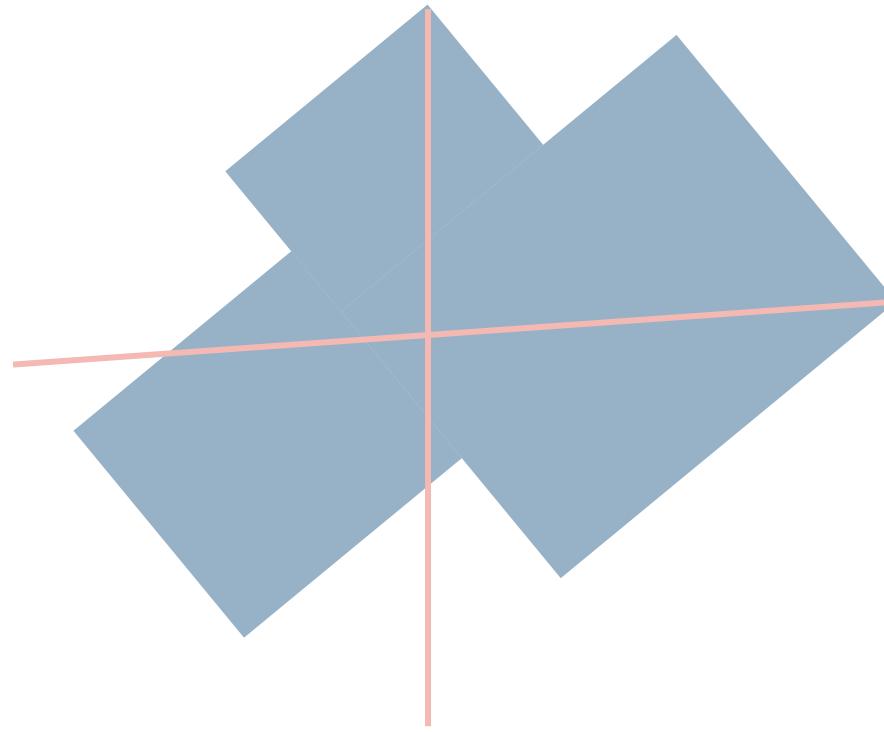
Centroids



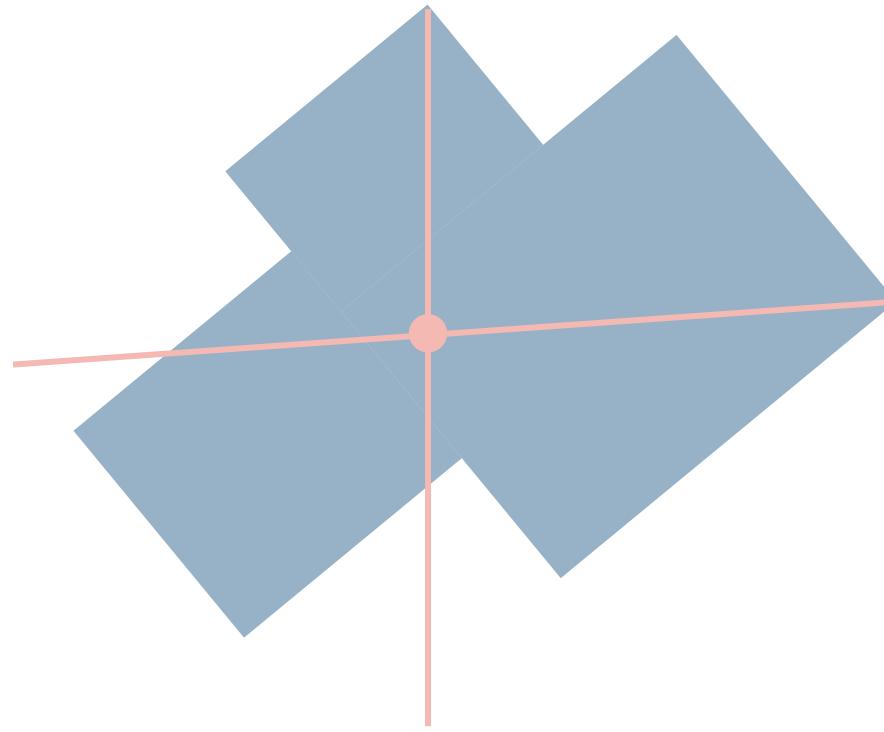
Centroids



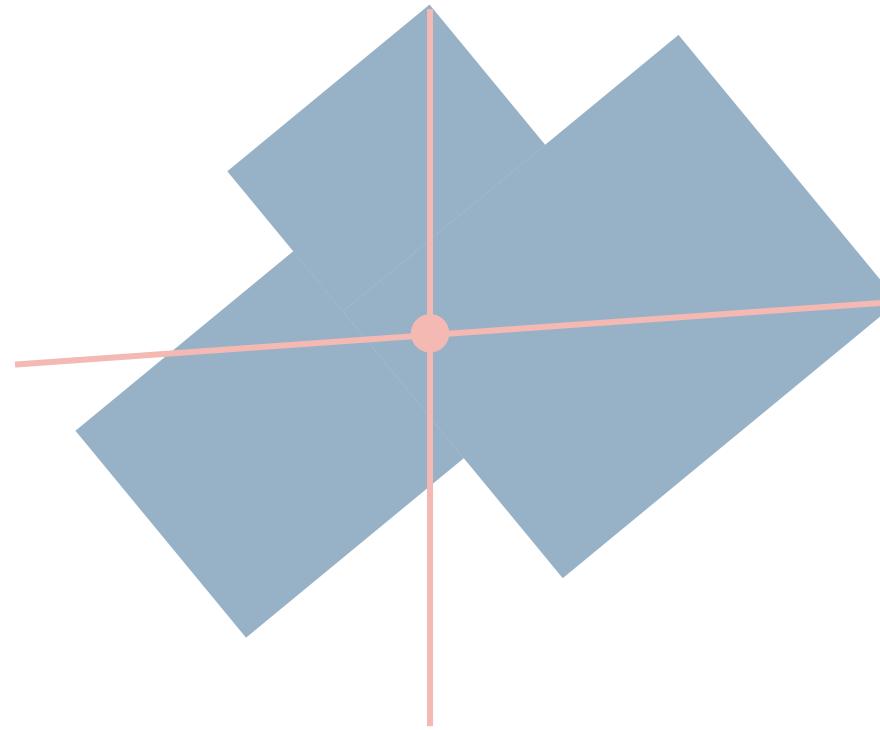
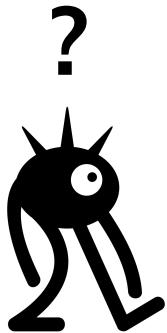
Centroids



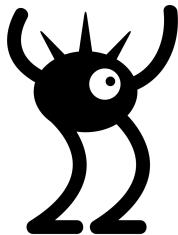
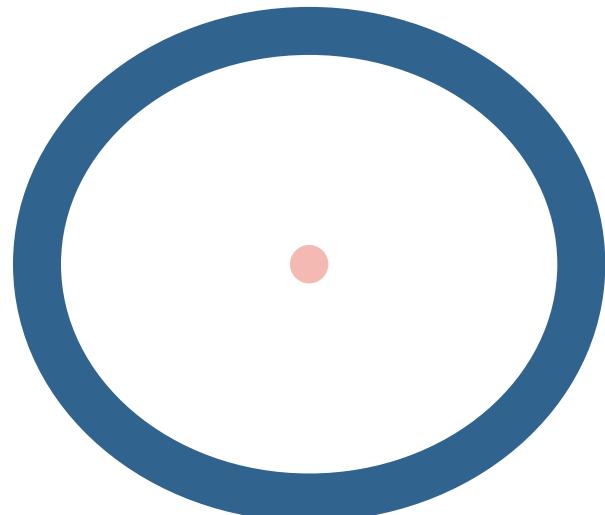
Centroids



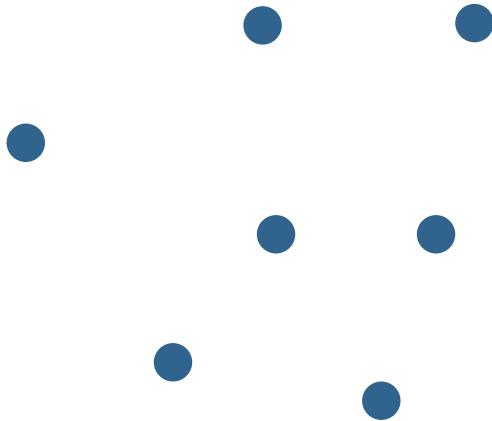
Centroids



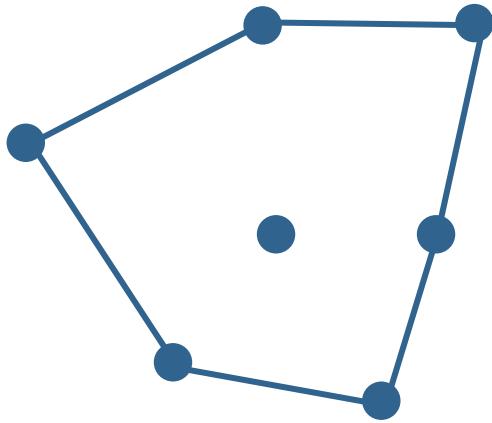
Centroids



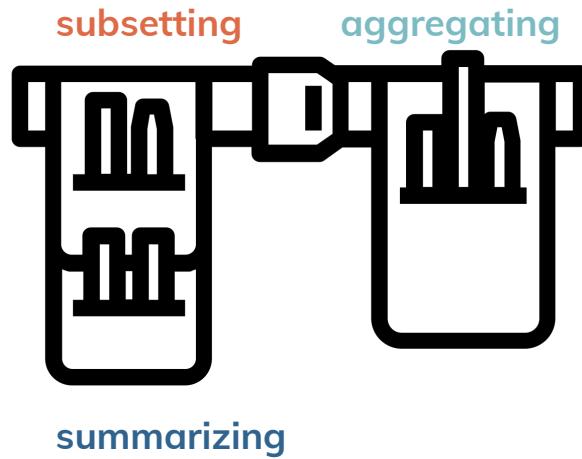
Convex hulls



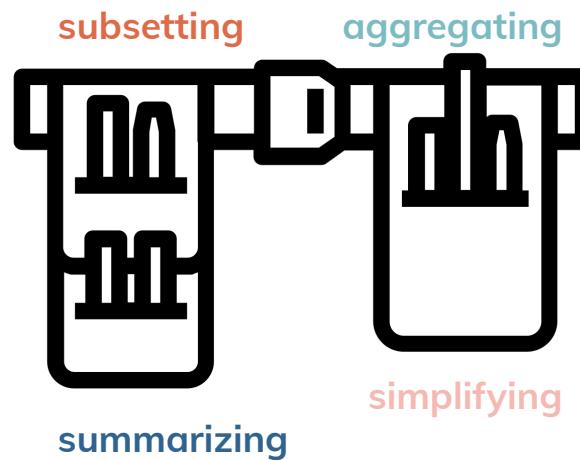
Convex hulls



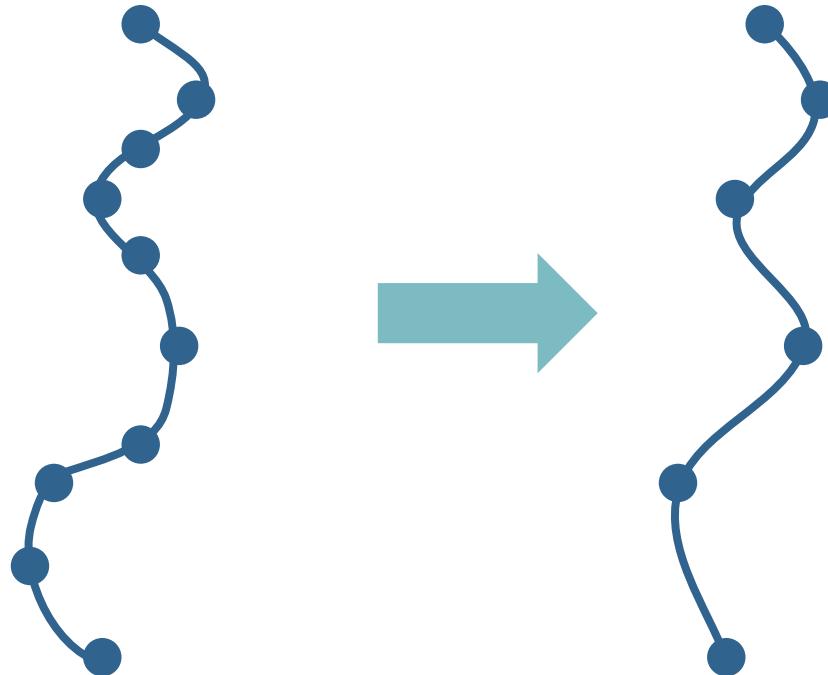
Toolbelt for solving spatial problems



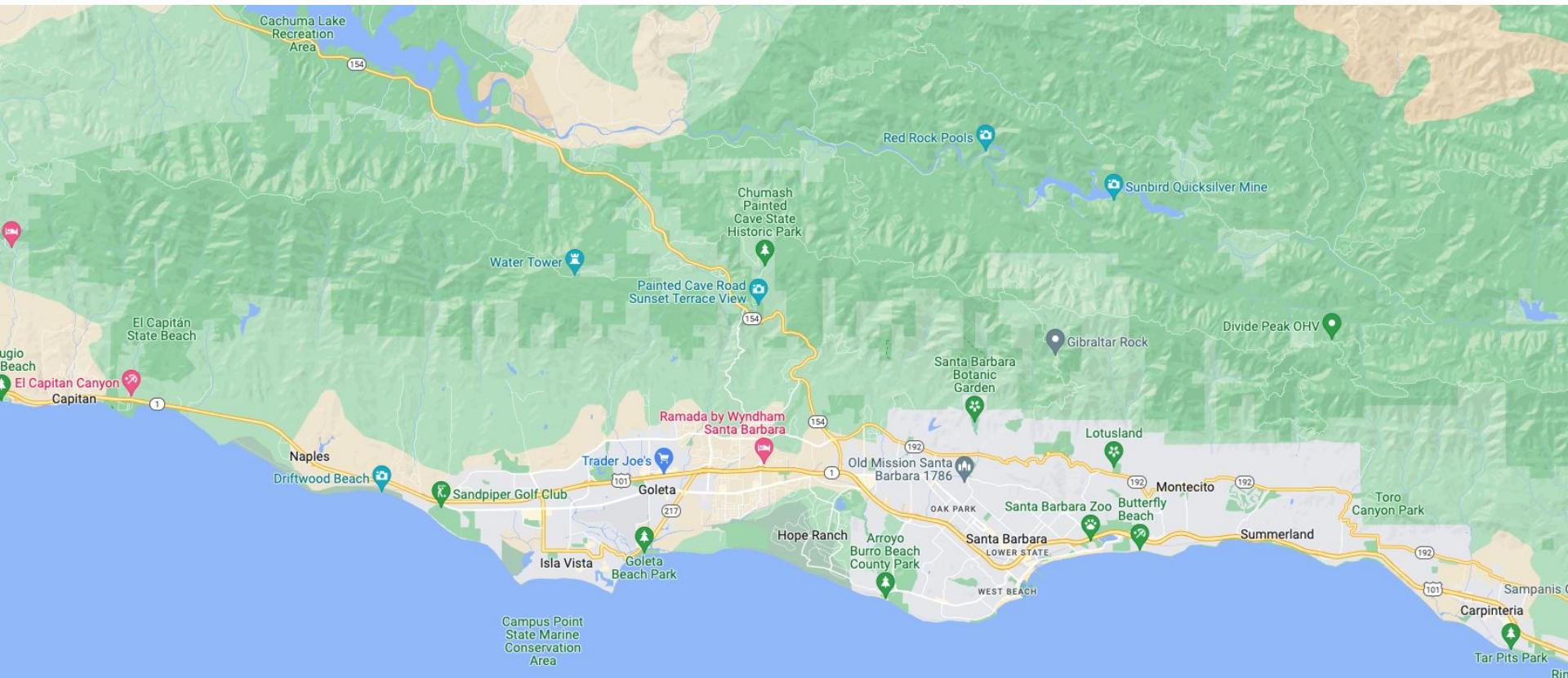
Toolbelt for solving spatial problems



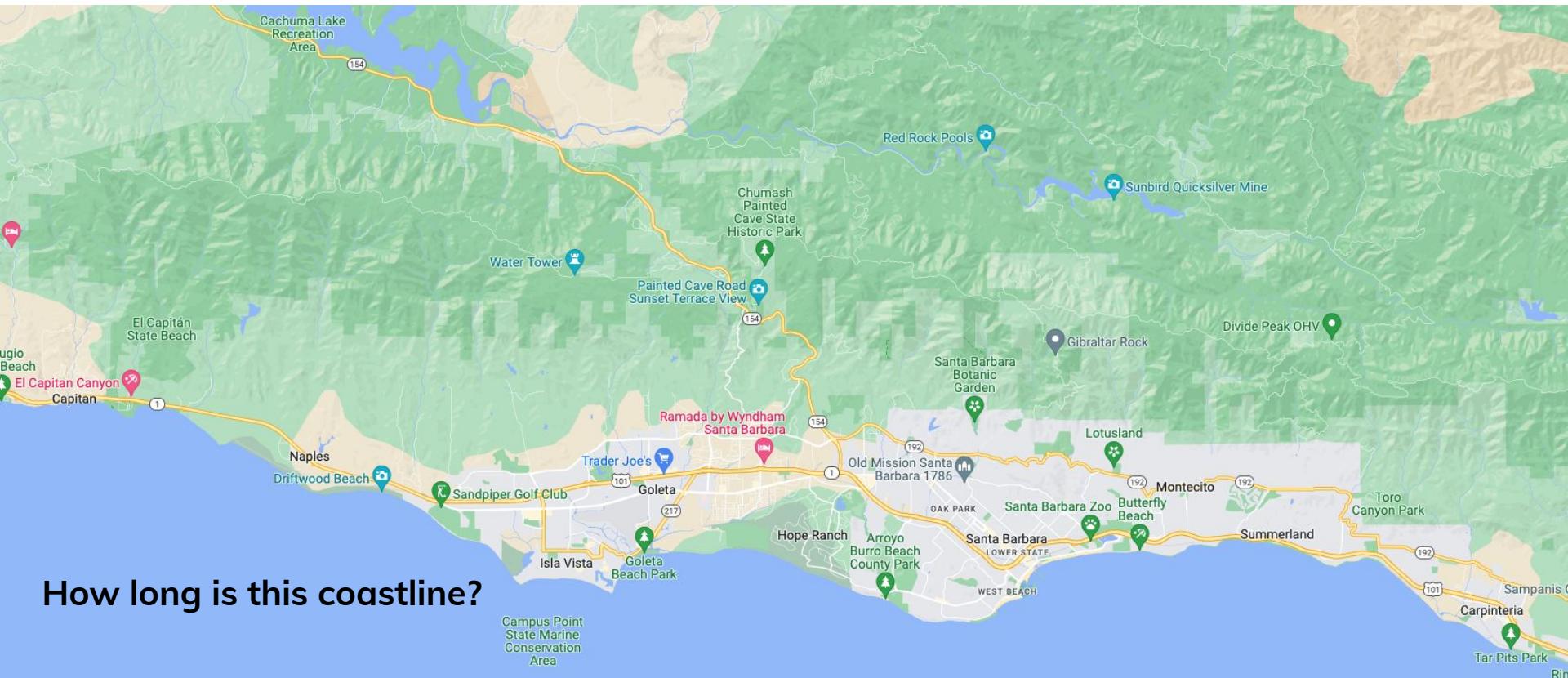
Simplifications



Coastline paradox

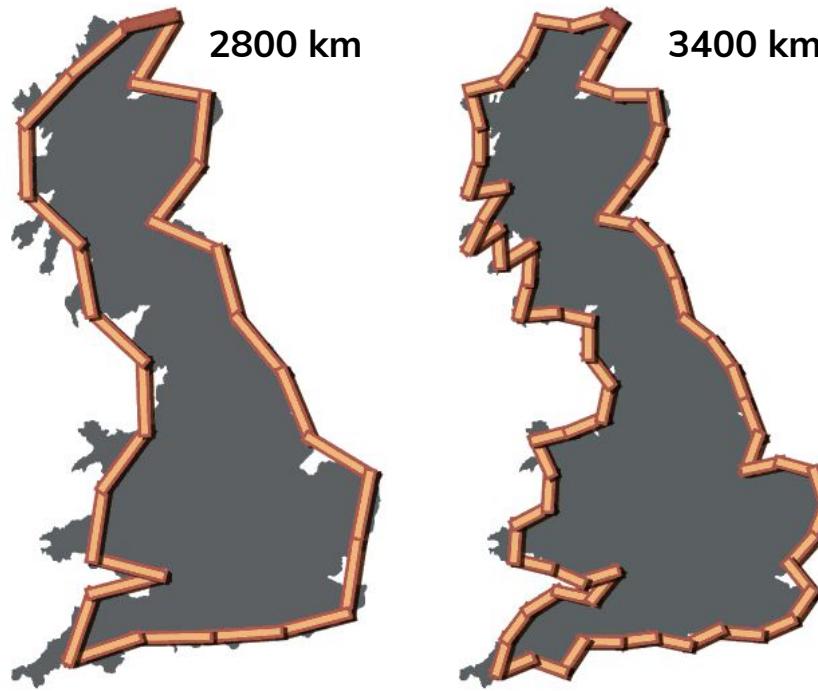


Coastline paradox

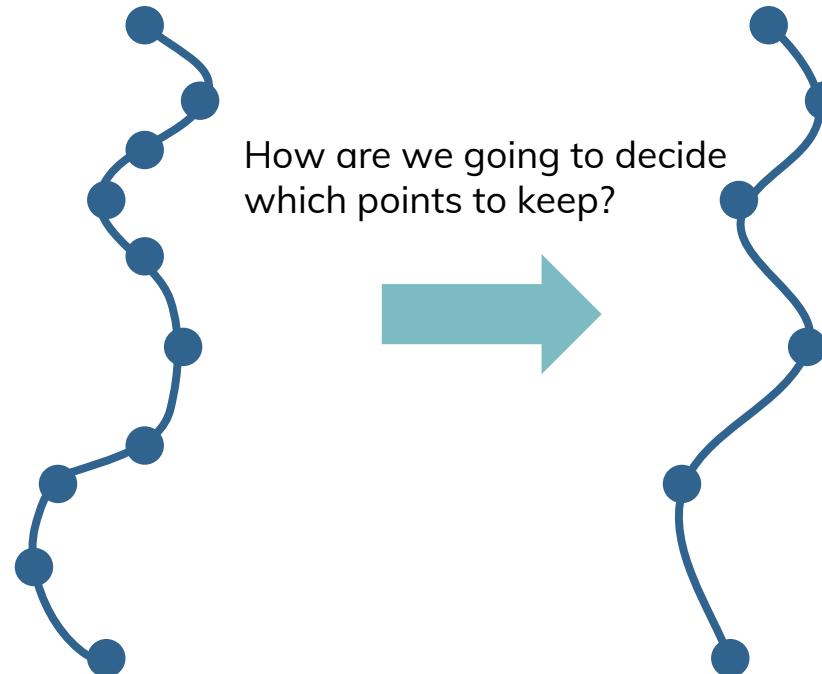


How long is this coastline?

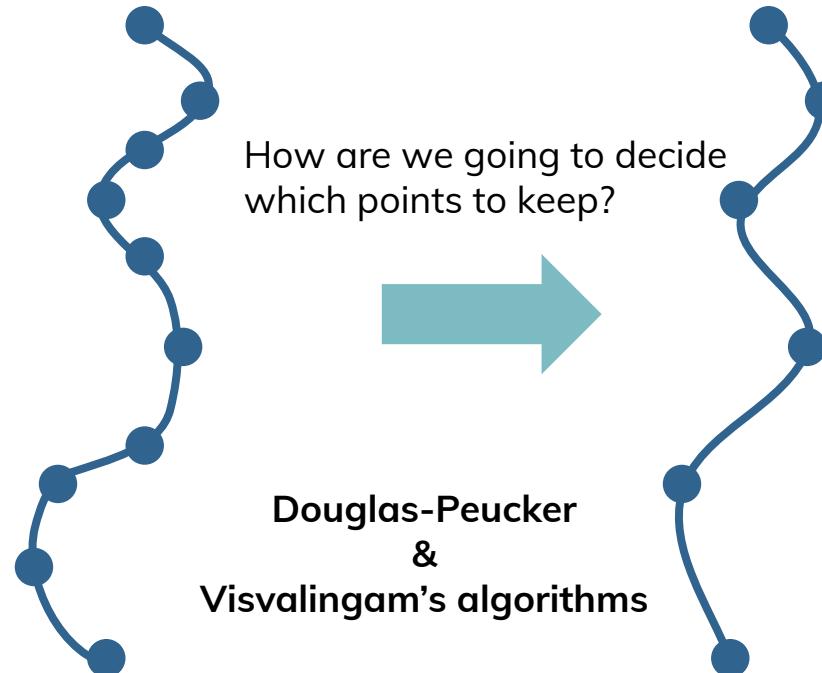
Coastline paradox



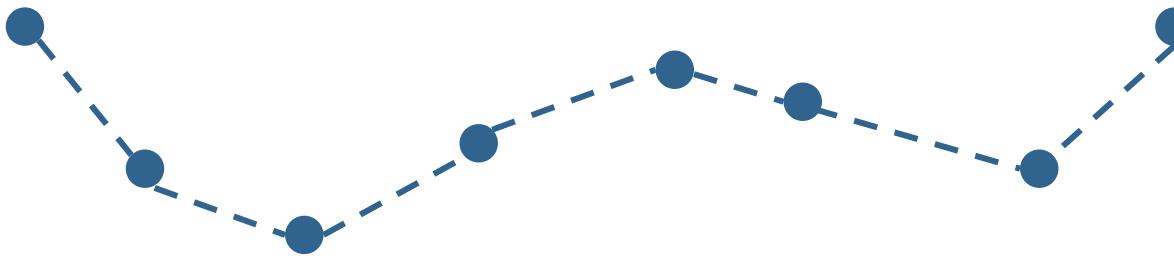
Simplification



Simplification

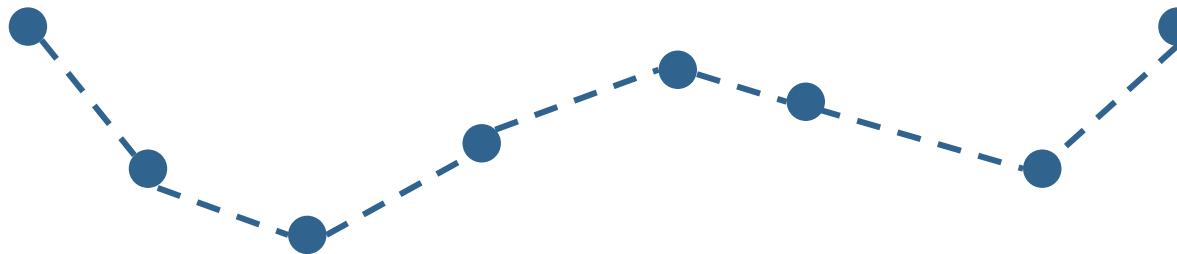


Simplification: Douglas-Peucker algorithm



Simplification: Douglas-Peucker algorithm

$$C = (P_1, P_3, P_5, \dots, P_n)$$

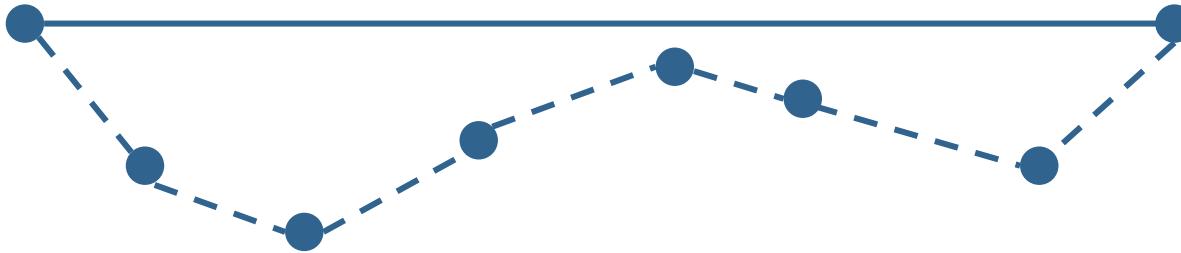


$$\varepsilon > 0$$

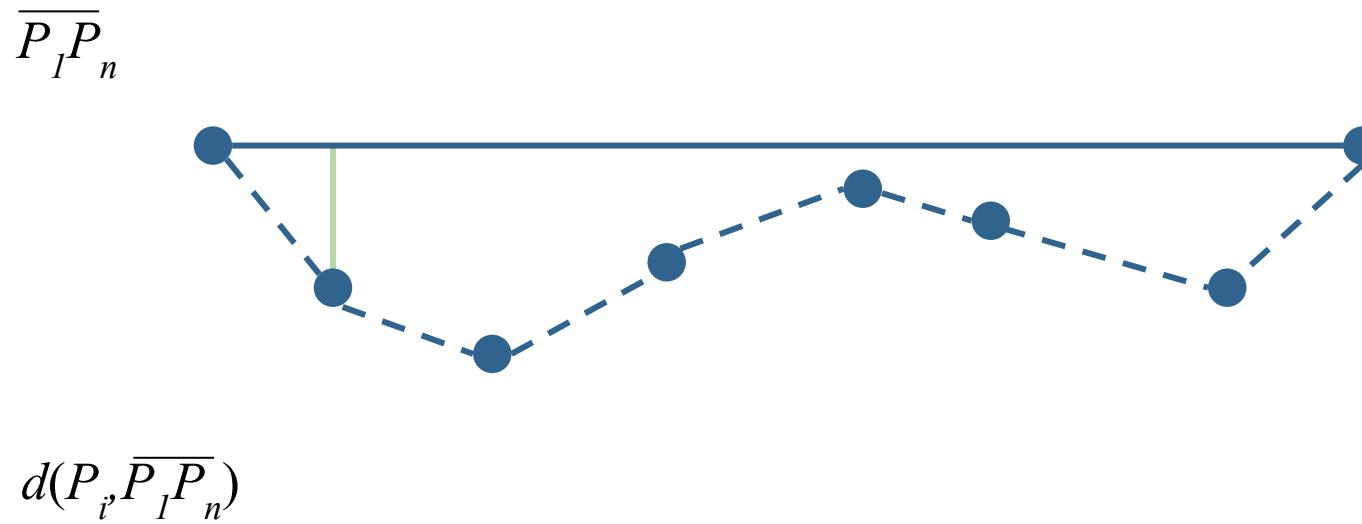


Simplification: Douglas-Peucker algorithm

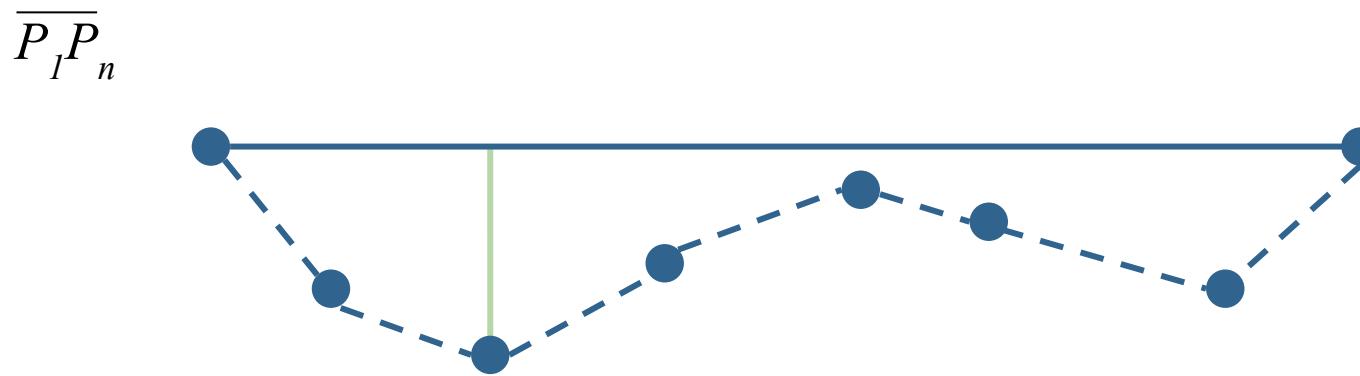
$\overline{P_l P_n}$



Simplification: Douglas-Peucker algorithm

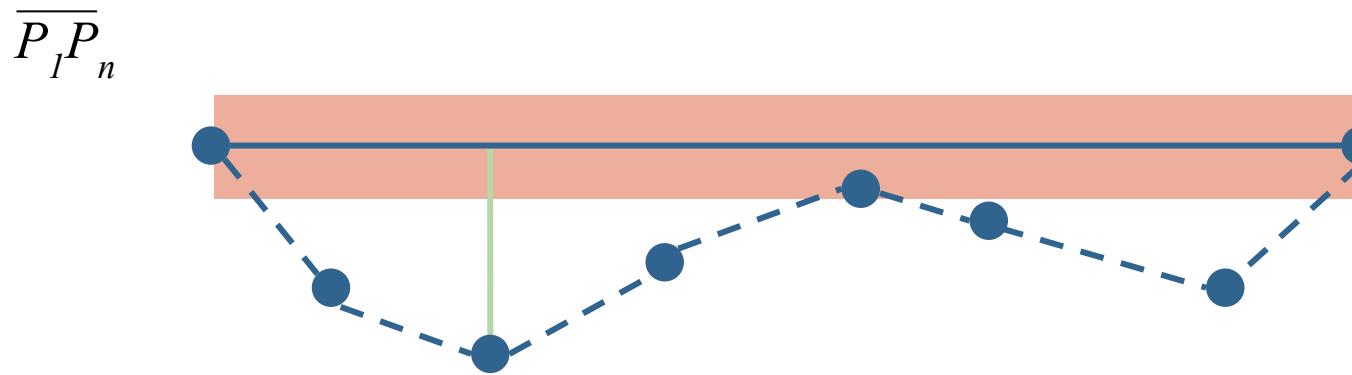


Simplification: Douglas-Peucker algorithm



$$d_{max} = \max_{i=2 \dots n-1} d(P_i \overline{P_1 P_n})$$

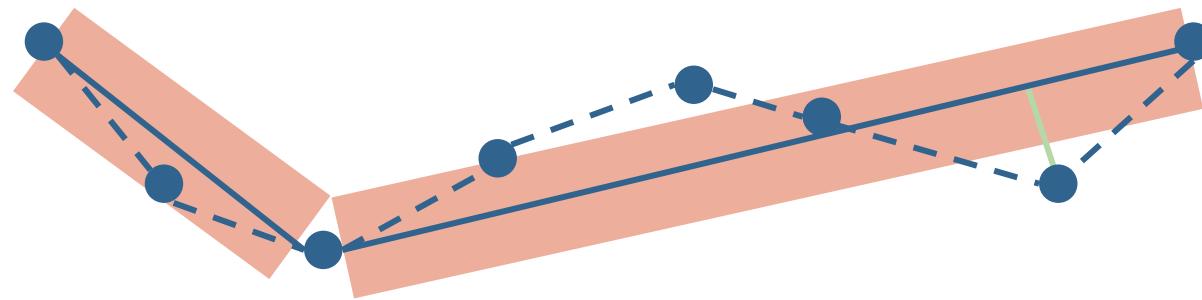
Simplification: Douglas-Peucker algorithm



$$d_{max} = \max_{i=2 \dots n-1} d(P_i, \overline{P_1 P_n}) \leq \varepsilon$$

Simplification: Douglas-Peucker algorithm

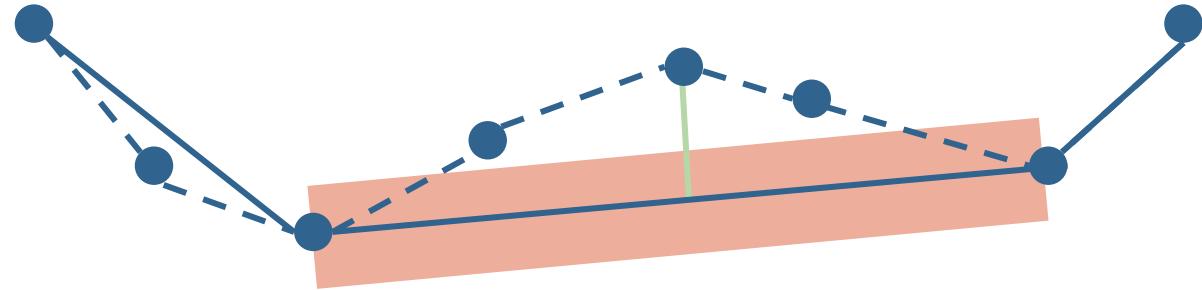
$\overline{P_l P_m}$ $\overline{P_m P_n}$



$$d_{max} = \max_{i=2 \dots n-1} d(P_i \overline{P_l P_n}) \leq \varepsilon$$

Simplification: Douglas-Peucker algorithm

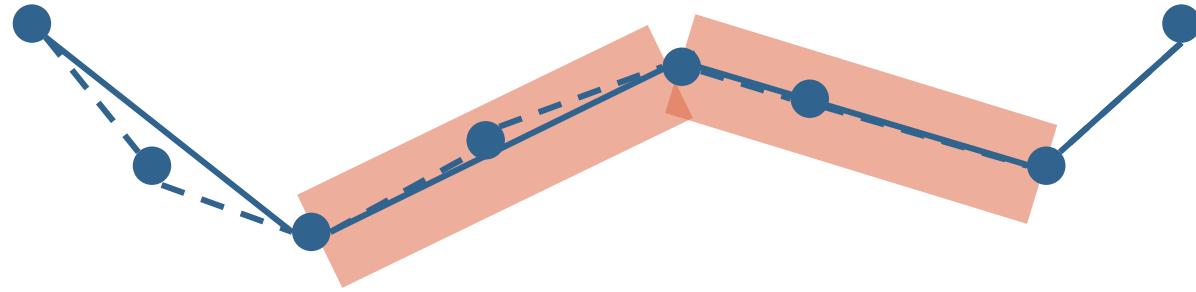
$$\overline{P_l P_m} \quad \overline{P_m P_n}$$



$$d_{max} = \max_{i=2 \dots n-1} d(P_{i'} \overline{P_l P_n}) \leq \varepsilon$$

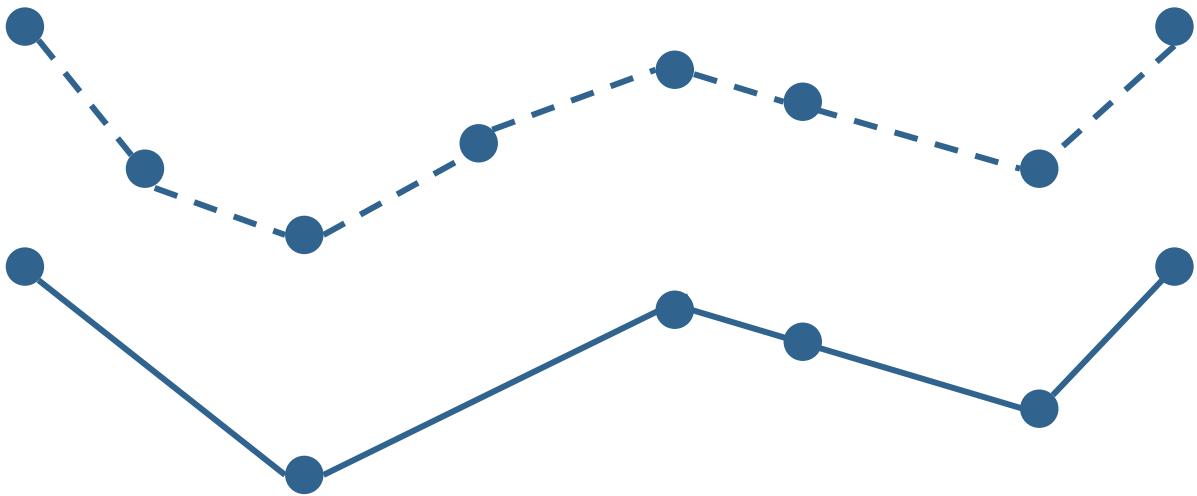
Simplification: Douglas-Peucker algorithm

$\overline{P_l P_m}$ $\overline{P_m P_n}$

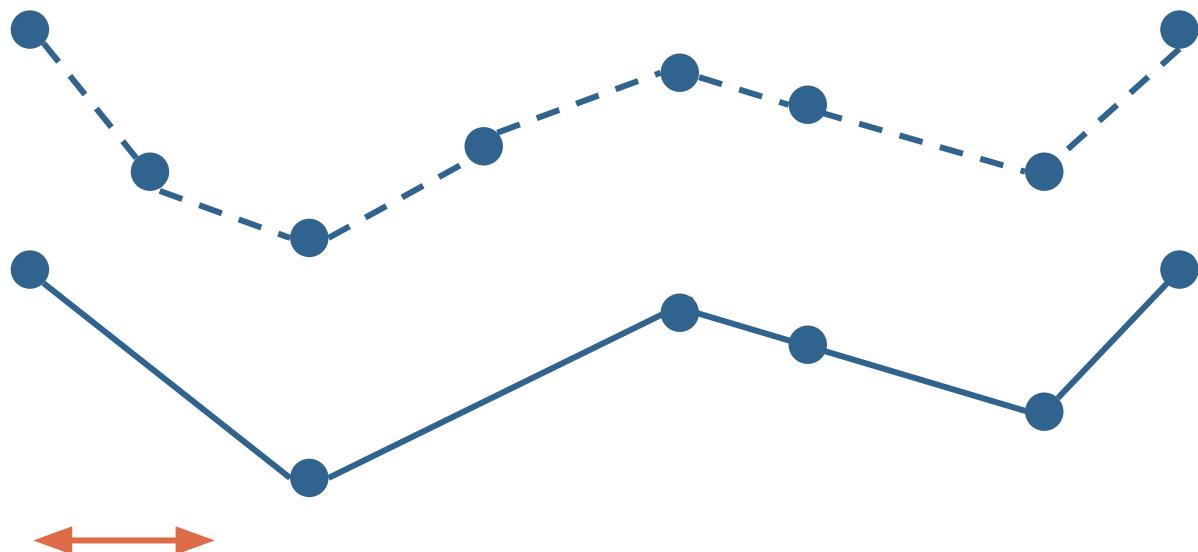


$$d_{max} = \max_{i=2 \dots n-1} d(P_i \overline{P_l P_n}) \leq \varepsilon$$

Simplification: Douglas-Peucker algorithm

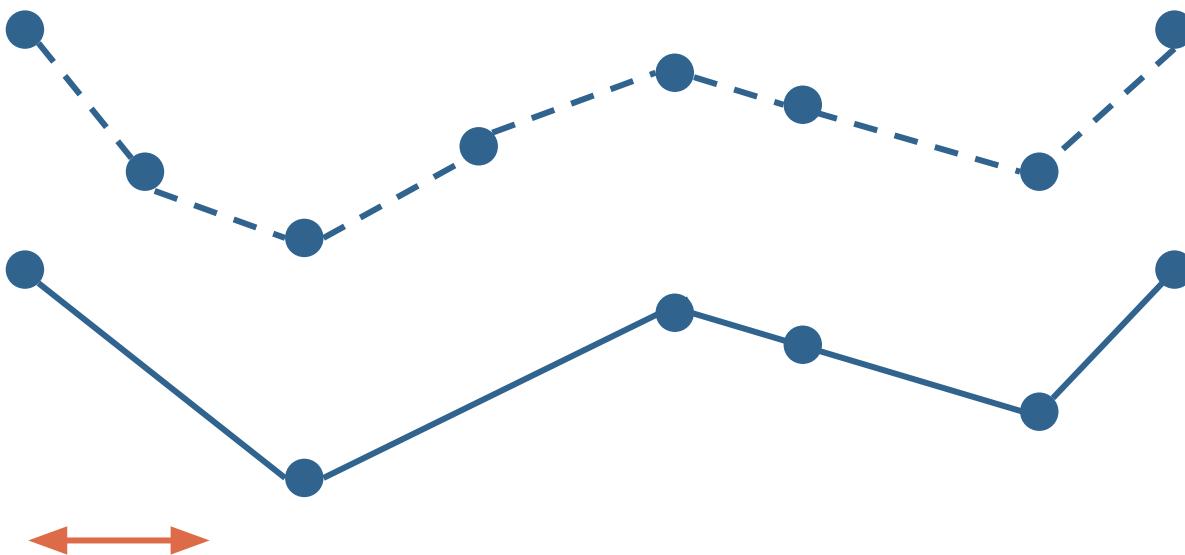


Simplification: Douglas-Peucker algorithm

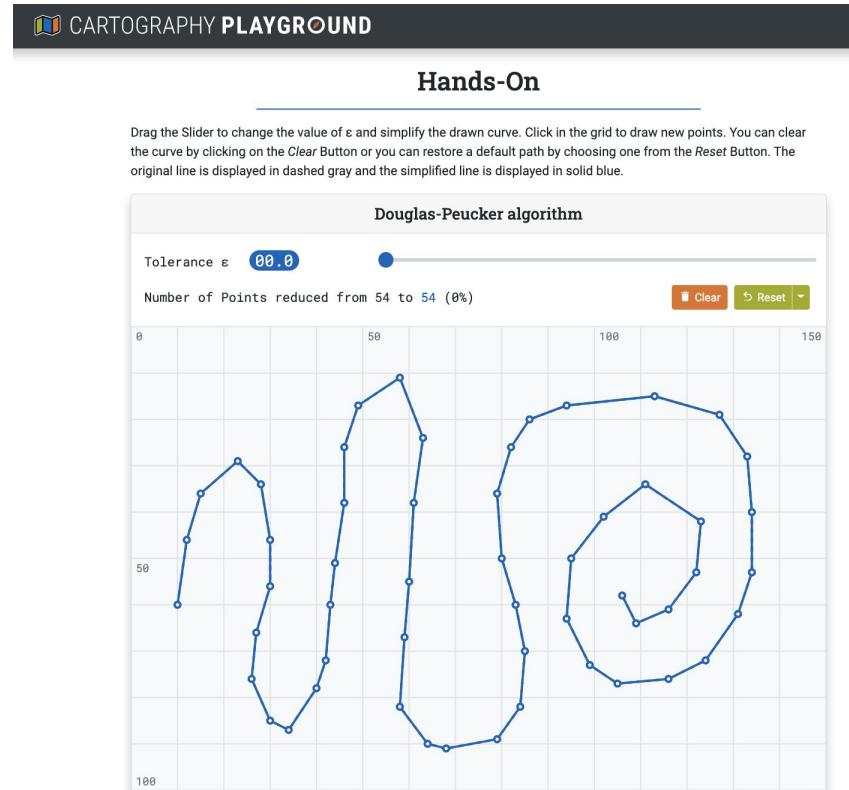


$\varepsilon > 0$

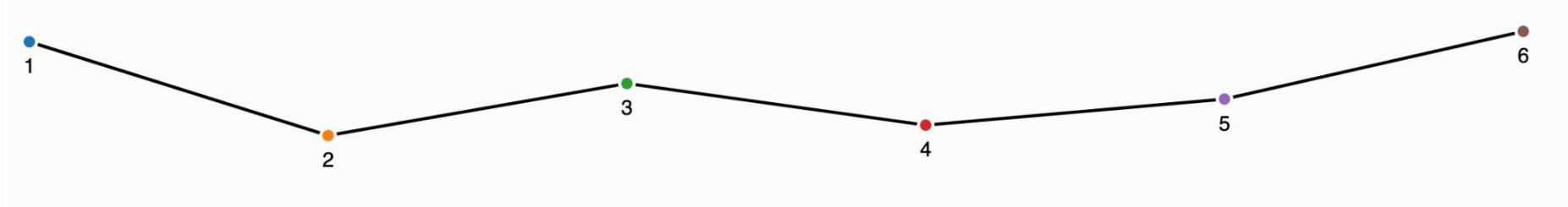
Simplification: Douglas-Peucker algorithm



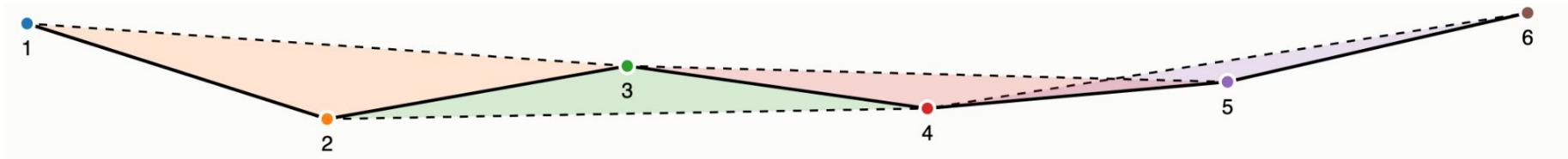
Simplification: Douglas-Peucker algorithm



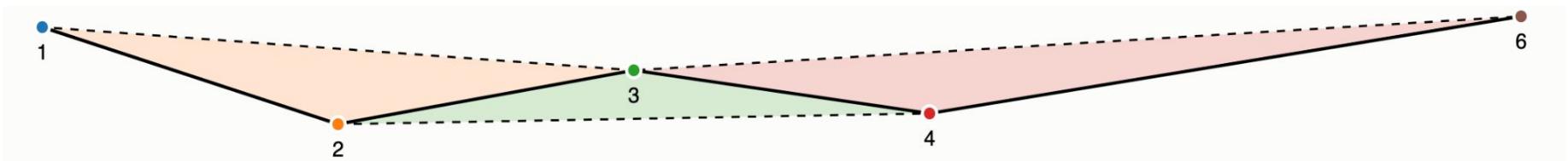
Simplification: Visvalingam's algorithm



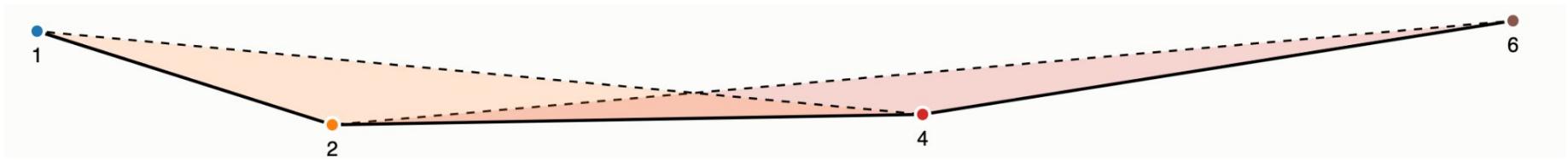
Simplification: Visvalingam's algorithm



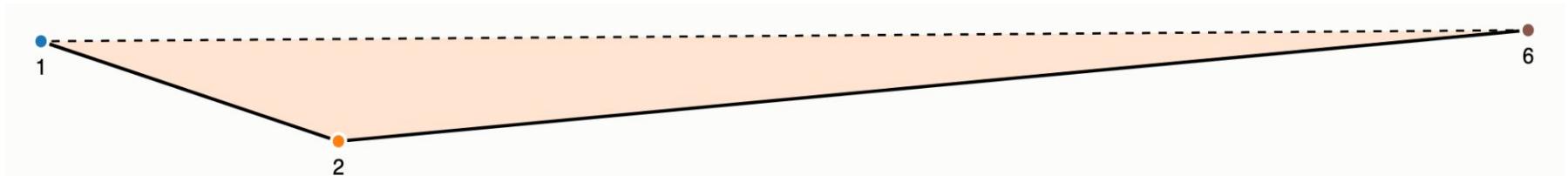
Simplification: Visvalingam's algorithm



Simplification: Visvalingam's algorithm



Simplification: Visvalingam's algorithm



Simplification: Visvalingam's algorithm



Simplification: Visvalingam's algorithm

June 1, 2012 / [Mike Bostock](#)

Line Simplification



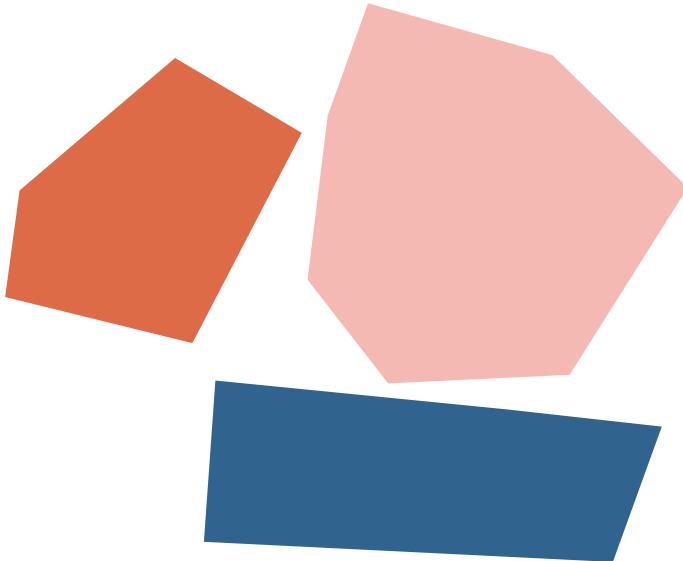
Simplification



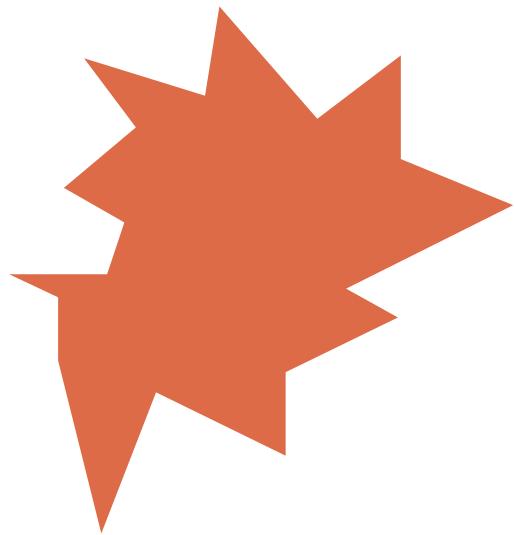
Simplification



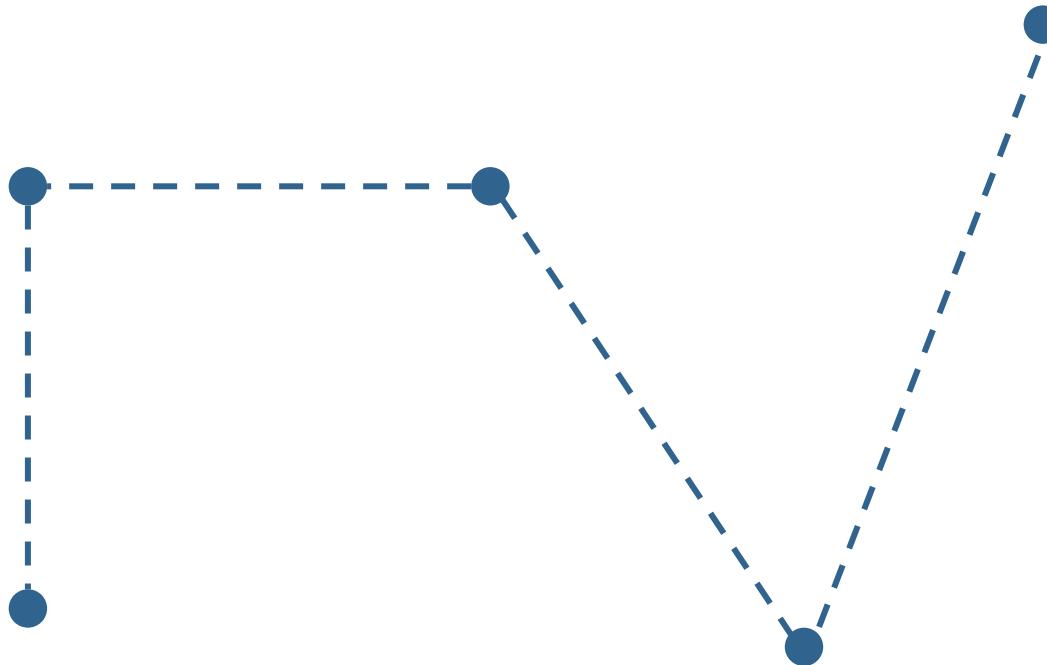
Simplification



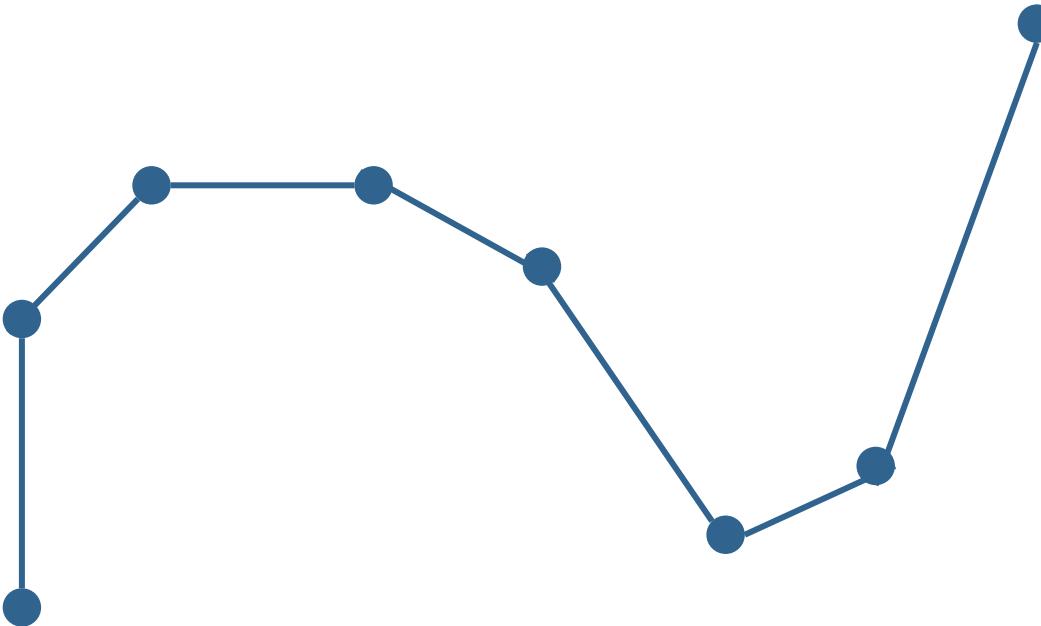
Smoothing



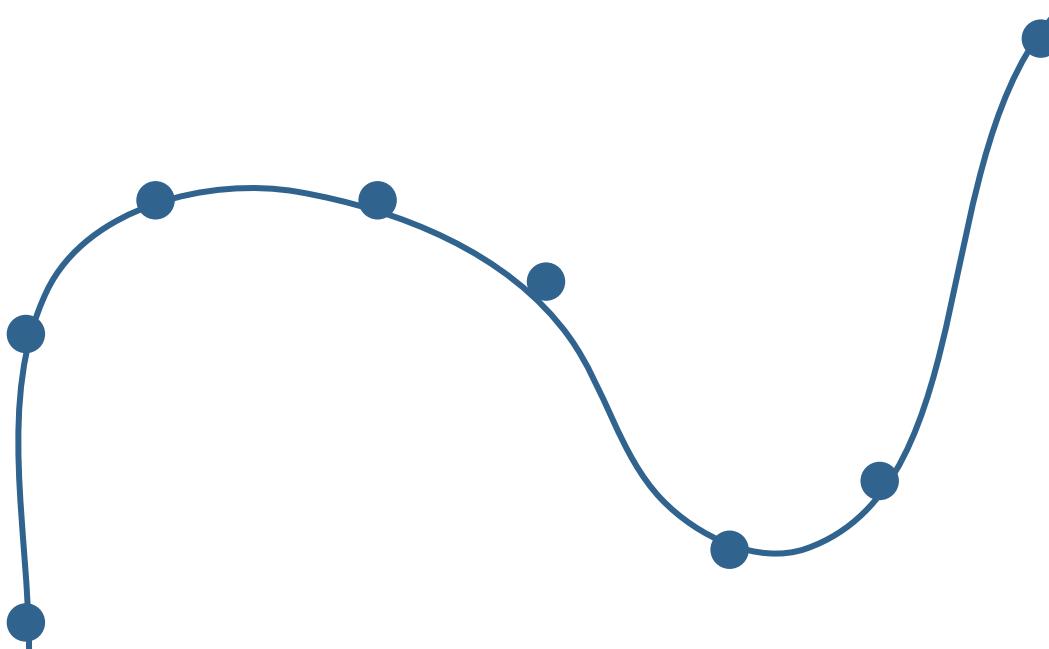
Smoothing: Chaikin's corner cutting algorithm



Smoothing: Chaikin's corner cutting algorithm

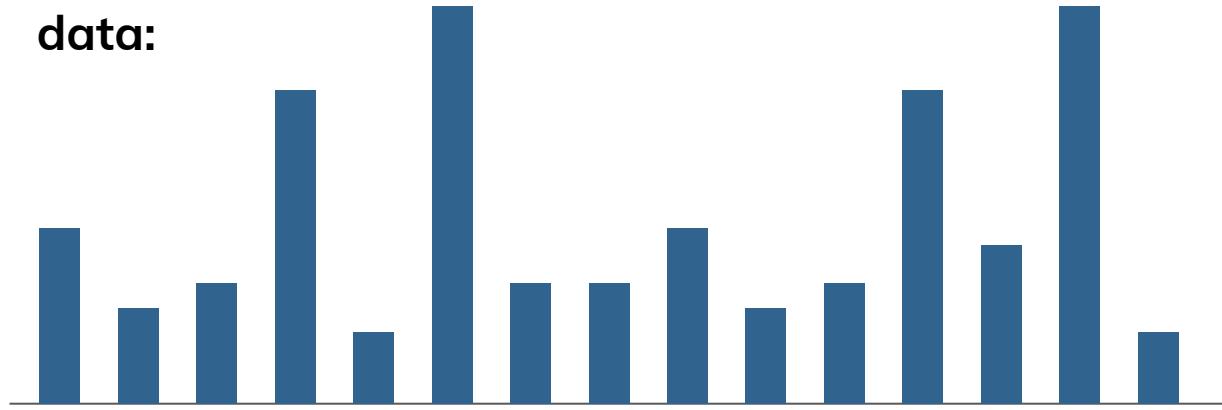


Smoothing: Chaikin's corner cutting algorithm



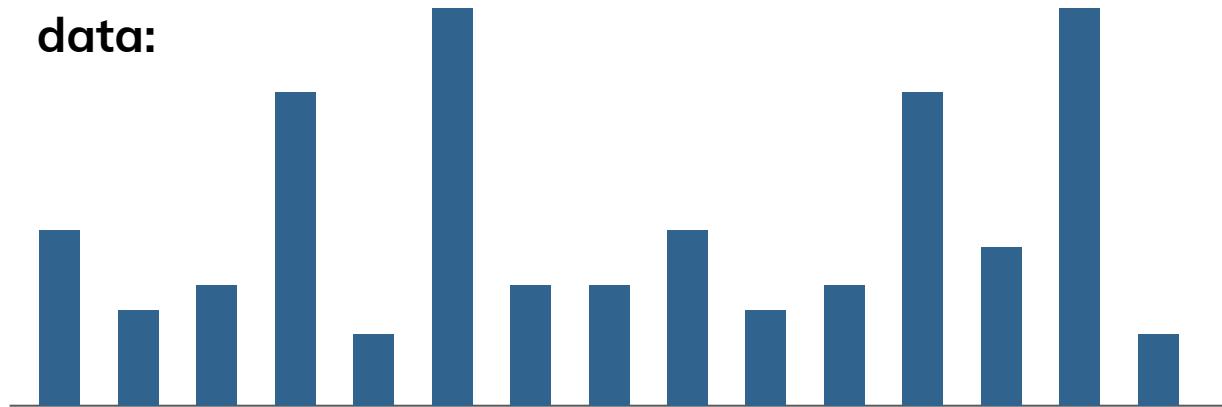
Smoothing: Gaussian kernel

data:

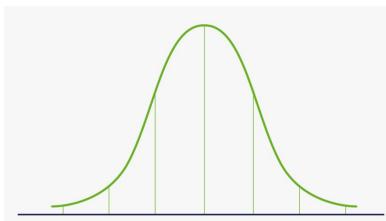


Smoothing: Gaussian kernel

data:

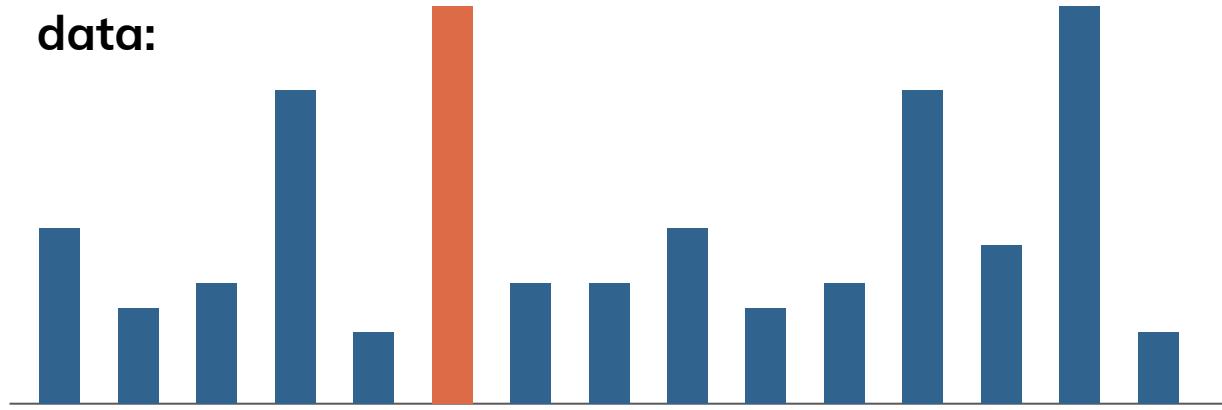


Gaussian distribution:



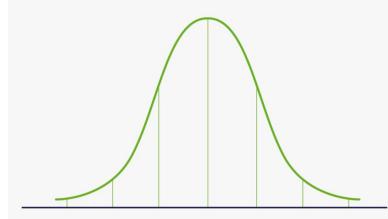
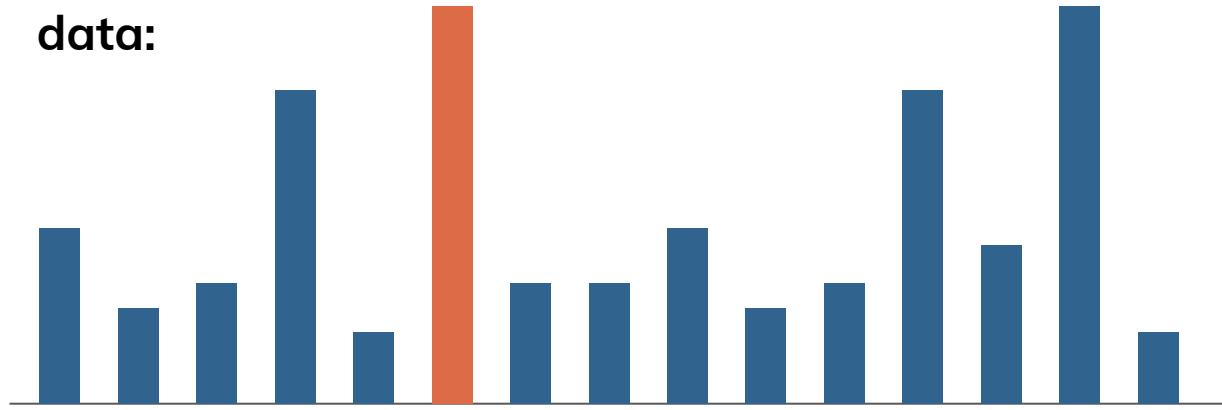
Smoothing: Gaussian kernel

data:



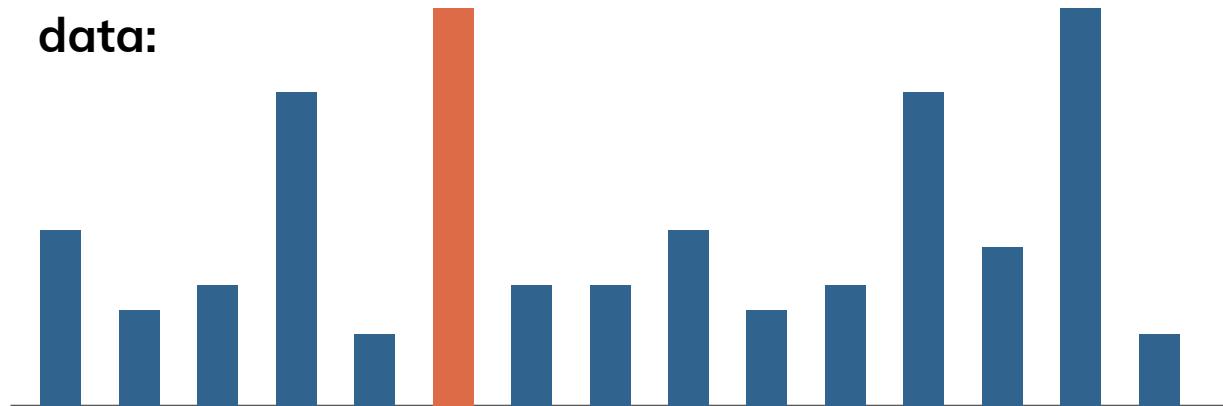
Smoothing: Gaussian kernel

data:

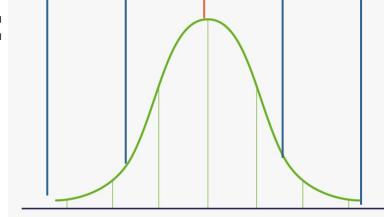


Smoothing: Gaussian kernel

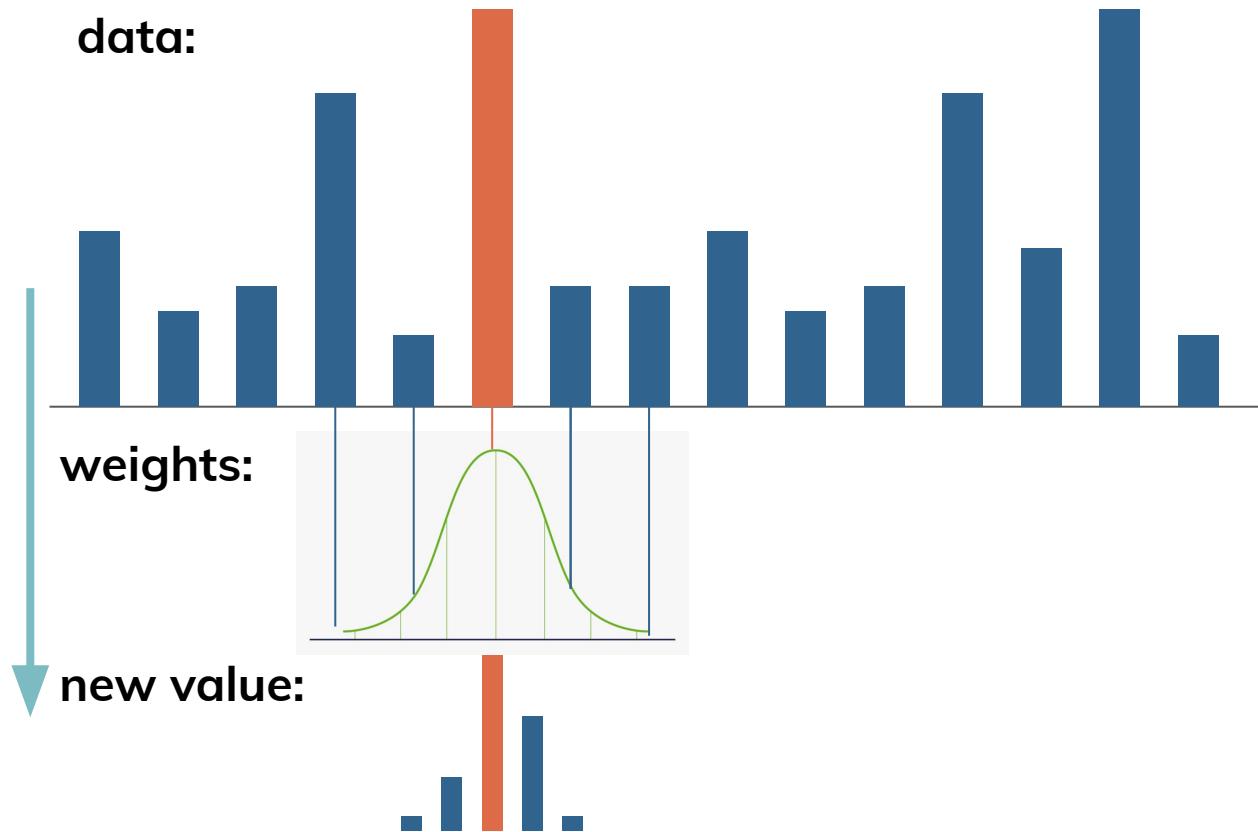
data:



weights:



Smoothing: Gaussian kernel



Toolbelt for solving spatial problems

