

Chapter 1, Episode 4: The problem of pixels and an intro to assistive technologies

Many assistive input technologies “navigate”



A person in a wheelchair operating an old computer using a desk-mounted sip and puff device called the POSSUM.

Image credit: [Wikipedia](#), Public Domain, 1960. Photographer: Possum Ltd.

Screen readers processes 1 input at a time

The screenshot shows the Wikipedia article for 'Cat'. A red box highlights the search bar and the 'Search' button. Another red box highlights the main title 'Cat' and the language link '262 languages'. A large red bracket on the left side groups the sidebar navigation links: 'Contents', 'Article', 'Talk', 'From Wikipedia, the free encyclopedia', 'This article is about the species commonly kept as a pet. For the cat family, see Felidae. For other uses, see Cat (disambiguation) and Cats (disambiguation)', 'The cat (Felis species in the f domestication o and farm cat, b companionship prey like mice e sense of smell are well developed. It is a social species, but a solitary hunter and a crepuscular predator. Cat communication includes vocalizations like meowing, purring, trilling, hissing, growling, and grunting as well as cat body language. It can hear sounds too faint or too high in frequency for human ears, such as those made by small mammals. It also secretes and perceives pheromones.', 'Female domestic cats can have kittens from spring to late autumn in temperate zones and throughout the year in equatorial regions, with litter sizes often ranging from two to five kittens. Domestic cats are bred and shown at events as registered pedigree cats, a hobby known as cat fancy. Animal population control of cats may be achieved by spaying and neutering, but their proliferation and the abandonment of pets has resulted in large numbers of feral cats worldwide, contributing to the extinction of bird mammal', and 'See also', 'Notes', 'References', and 'External links'. A red circle highlights the 'Felidae' link in the disambiguation section. A red bracket on the right side groups the image section: 'Cat Temporal range: 9,500 years ago – present' and four images of different cat breeds.

WIKIPEDIA
The Free Encyclopedia

Search Wikipedia Search

Cat 262 languages

Contents Article Talk From Wikipedia, the free encyclopedia This article is about the species commonly kept as a pet. For the cat family, see [Felidae](#). For other uses, see [Cat \(disambiguation\)](#) and [Cats \(disambiguation\)](#)

67 Nav points, ~32s

The cat (*Felis* species in the f domestication o and farm cat, b companionship prey like mice e sense of smell are well developed. It is a social species, but a solitary hunter and a crepuscular predator. Cat communication includes vocalizations like meowing, purring, trilling, hissing, growling, and grunting as well as cat body language. It can hear sounds too faint or too high in frequency for human ears, such as those made by small mammals. It also secretes and perceives pheromones.

Female domestic cats can have kittens from spring to late autumn in temperate zones and throughout the year in equatorial regions, with litter sizes often ranging from two to five kittens. Domestic cats are bred and shown at events as registered pedigree cats, a hobby known as cat fancy. Animal population control of cats may be achieved by spaying and neutering, but their proliferation and the abandonment of pets has resulted in large numbers of feral cats worldwide, contributing to the extinction of bird mammal

Cat Temporal range: 9,500 years ago – present

Movement between tasks becomes cognitively expensive

The screenshot shows the Wikipedia article for 'Cat'. A red box highlights the sidebar on the left, which contains 17 navigation points: 'Contents', 'Top', 'Etymology and naming', 'Taxonomy', 'Evolution', 'Characteristics', 'Senses', 'Behavior', 'Lifespan and health', 'Ecology', 'Interaction with humans', 'See also', 'Notes', 'References', and 'External links'. Above the sidebar, a red circle highlights the search bar. Another red circle highlights the 'Cat' link in the breadcrumb trail. A third red circle highlights the 'Felidae' link in the disambiguation section. The main content area features a large heading '67 Nav points, ~32s' and a sidebar with four cat images and the text 'Cat Temporal range: 9,500 years ago – present'.

WIKIPEDIA
The Free Encyclopedia

Search Wikipedia Search

Cat 262 languages

Contents Top

Etymology and naming

Taxonomy

Evolution

Characteristics

Senses

Behavior

Lifespan and health

Ecology

Interaction with humans

See also

Notes

References

External links

This article is about the species commonly kept as a pet. For the cat family, see [Felidae](#). For other uses, see [Cat \(disambiguation\)](#) and [Cats \(disambiguation\)](#).

67 Nav points, ~32s

cat, is the only domesticated have shown that the monly kept as a house pet is valued by humans for it is adapted to killing small eth, and its night vision and sense of smell are well developed. It is a social species, but a solitary hunter and a crepuscular predator. Cat communication includes vocalizations like meowing, purring, trilling, hissing, growling, and grunting as well as cat body language. It can hear sounds too faint or too high in frequency for human ears, such as those made by small mammals. It also secretes and perceives pheromones.

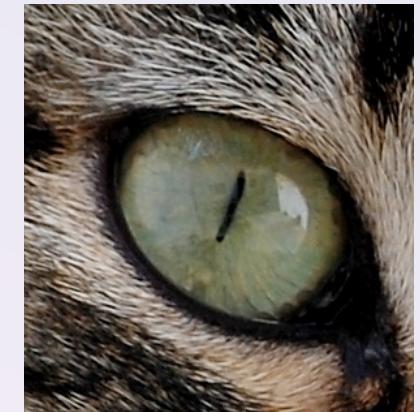
Female domestic cats can have kittens from spring to late autumn in temperate zones and throughout the year in equatorial regions, with litter sizes often ranging from two to five kittens. Domestic cats are bred and shown at events as registered pedigree cats, a hobby known as cat fancy. Animal population control of cats may be achieved by spaying and neutering, but their proliferation and the abandonment of pets has resulted in large numbers of feral cats worldwide, contributing to the extinction of bird, mammal

Cat Temporal range: 9,500 years ago – present

Why are pixels so much trouble?



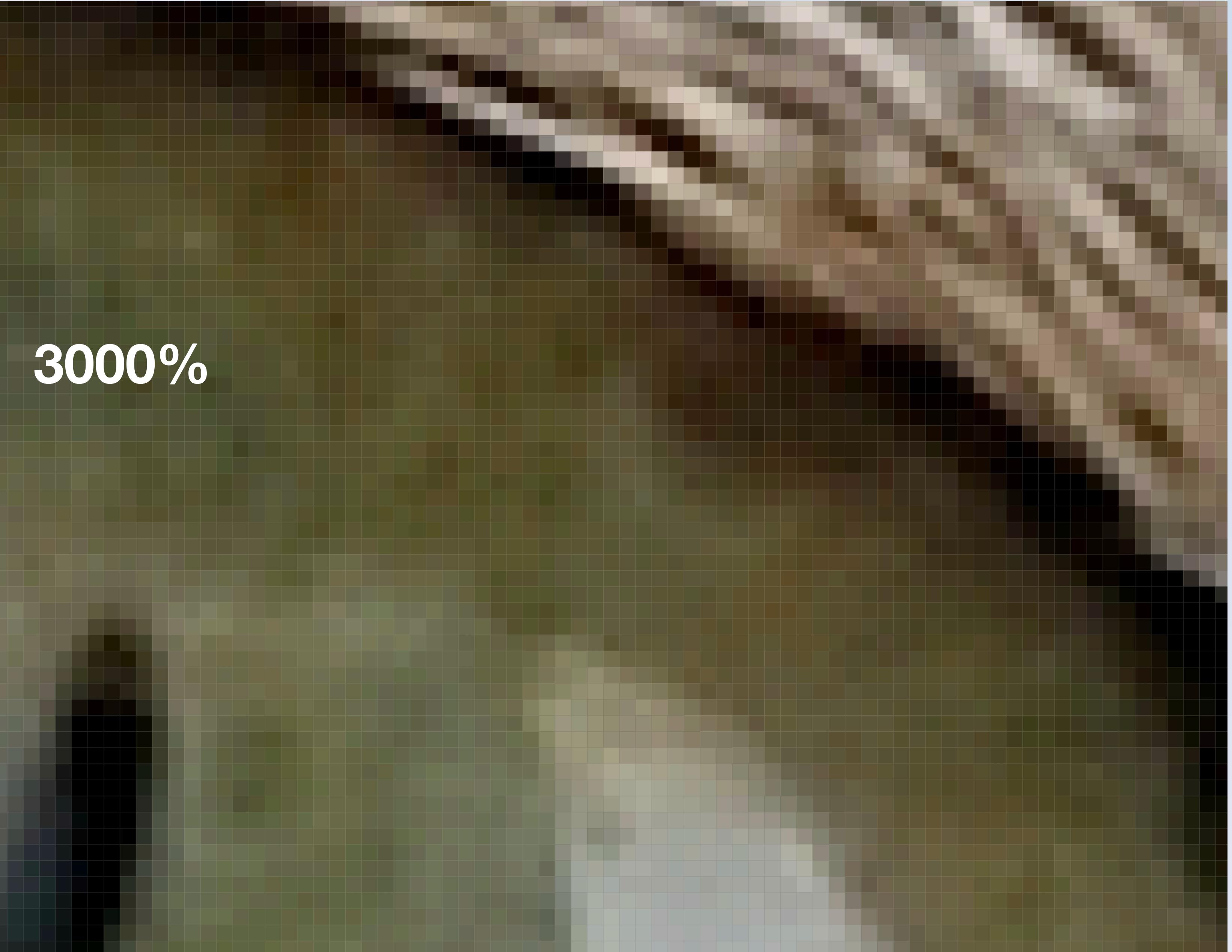
100%



500%



3000%



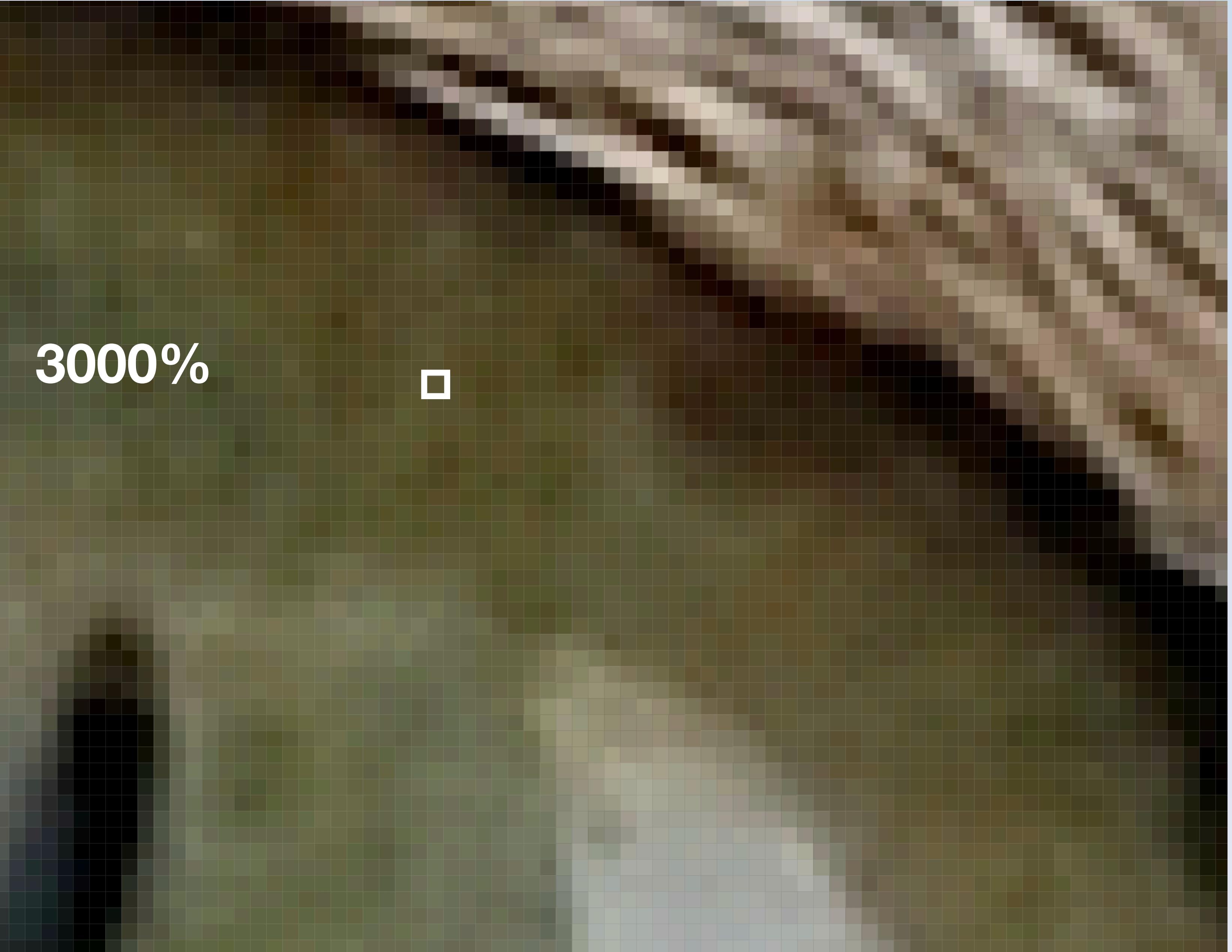
100%

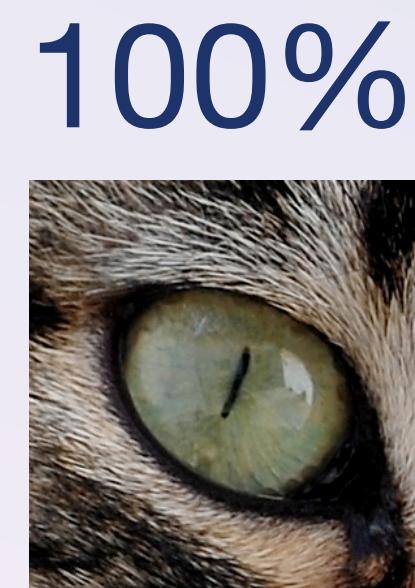


500%



3000%





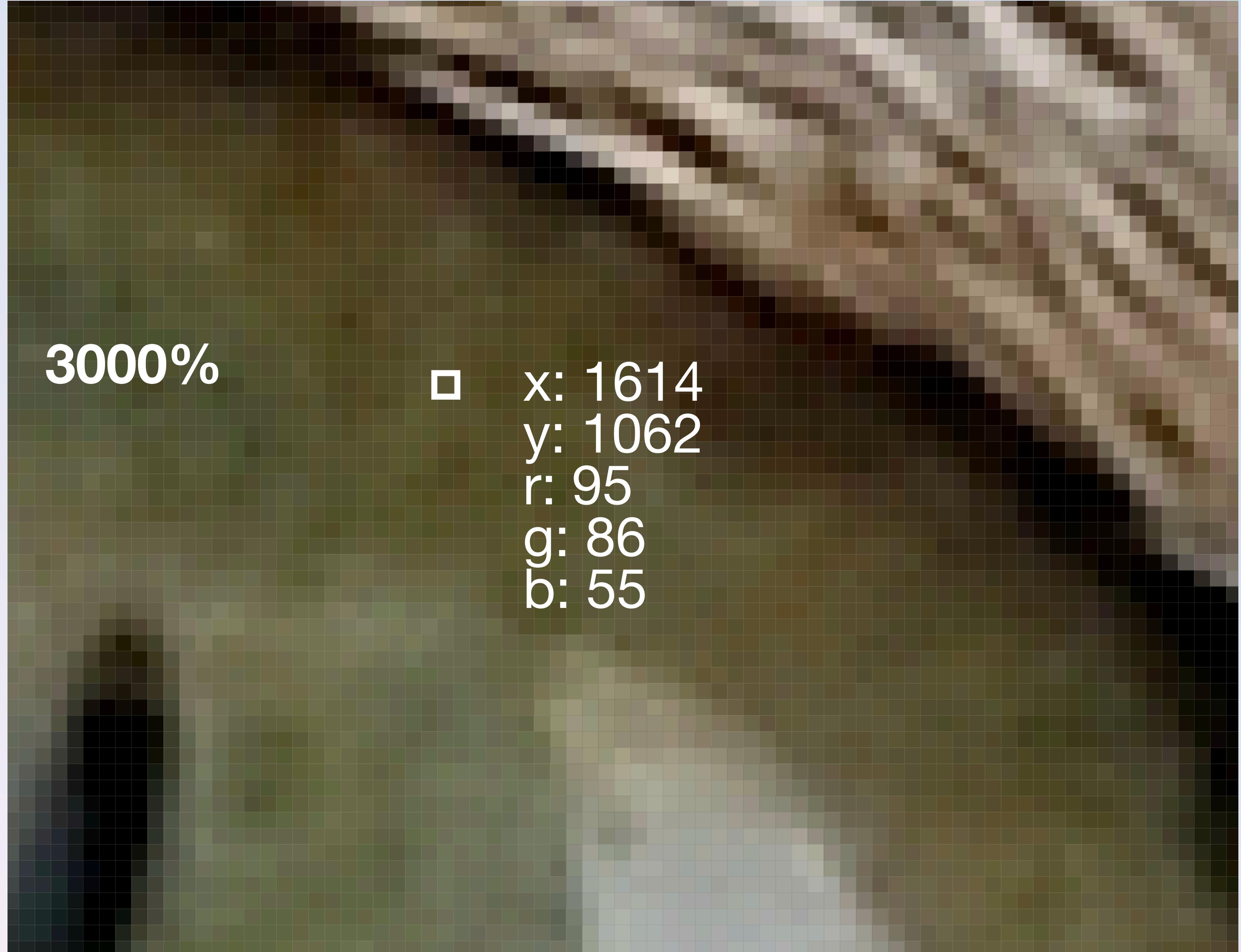
100%

500%



3000%

□ x: 1614
y: 1062
r: 95
g: 86
b: 55



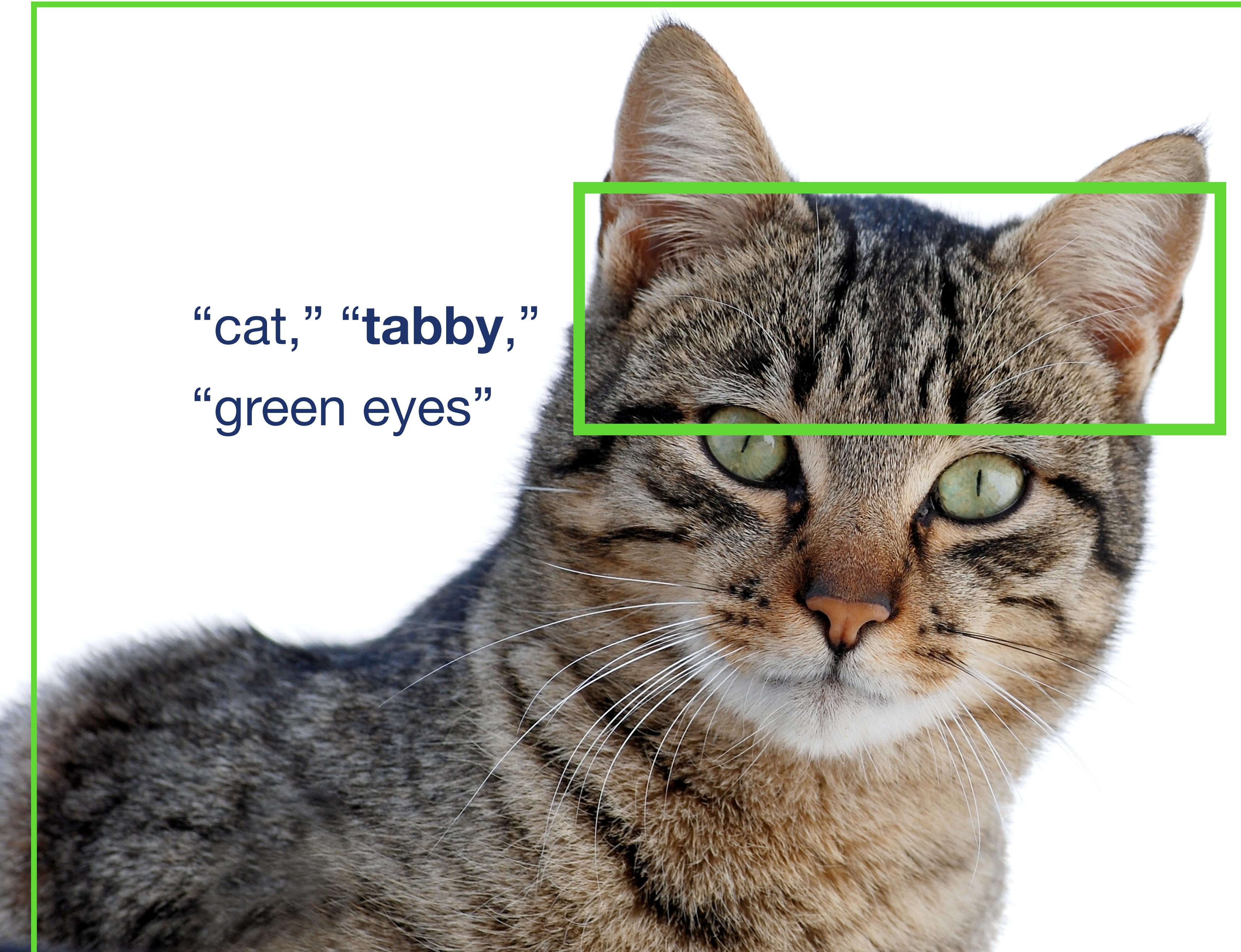
“cat,” “tabby,”
“green eyes”

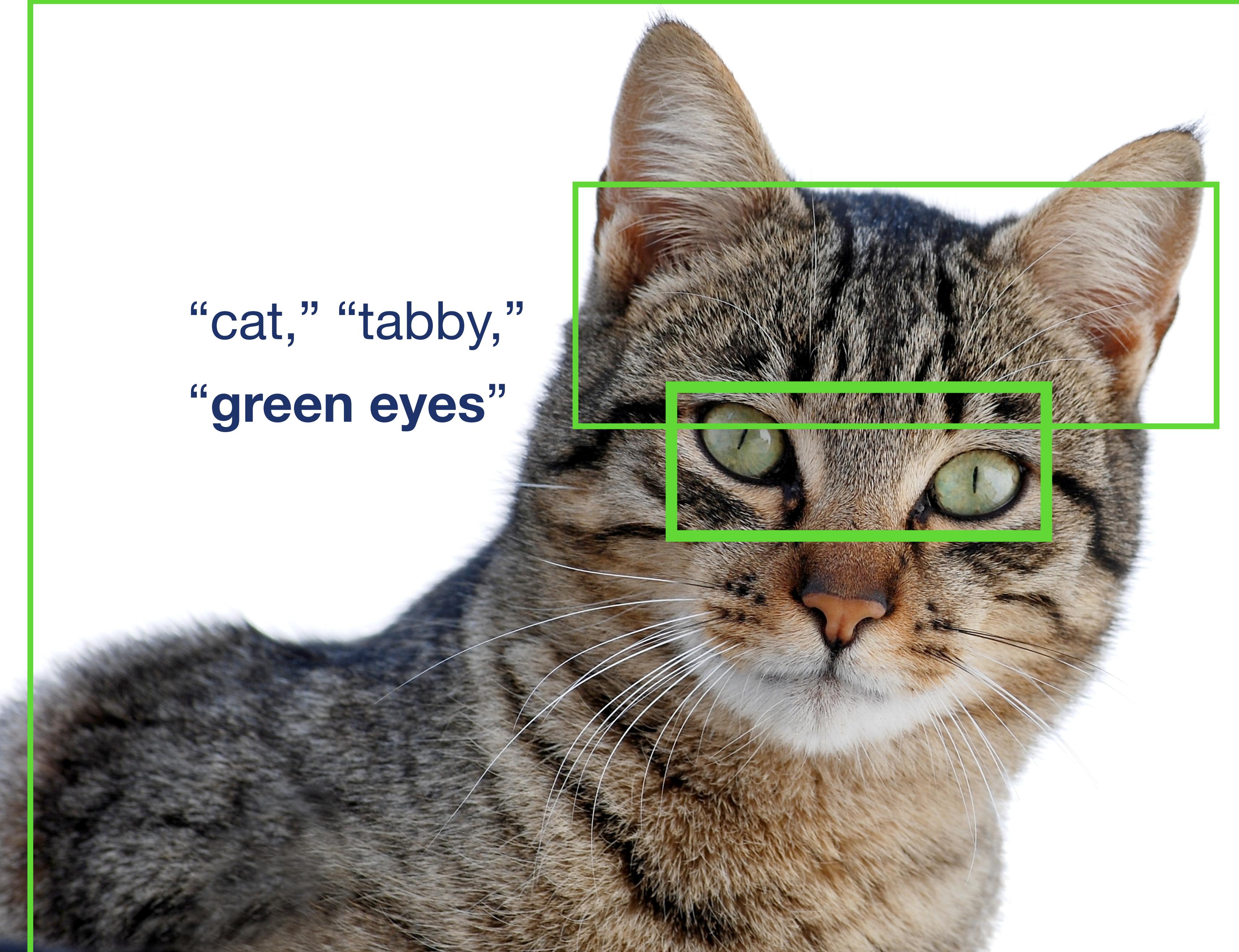


“cat,” “tabby,”
“green eyes”



“cat,” “**tabby**,”
“green eyes”



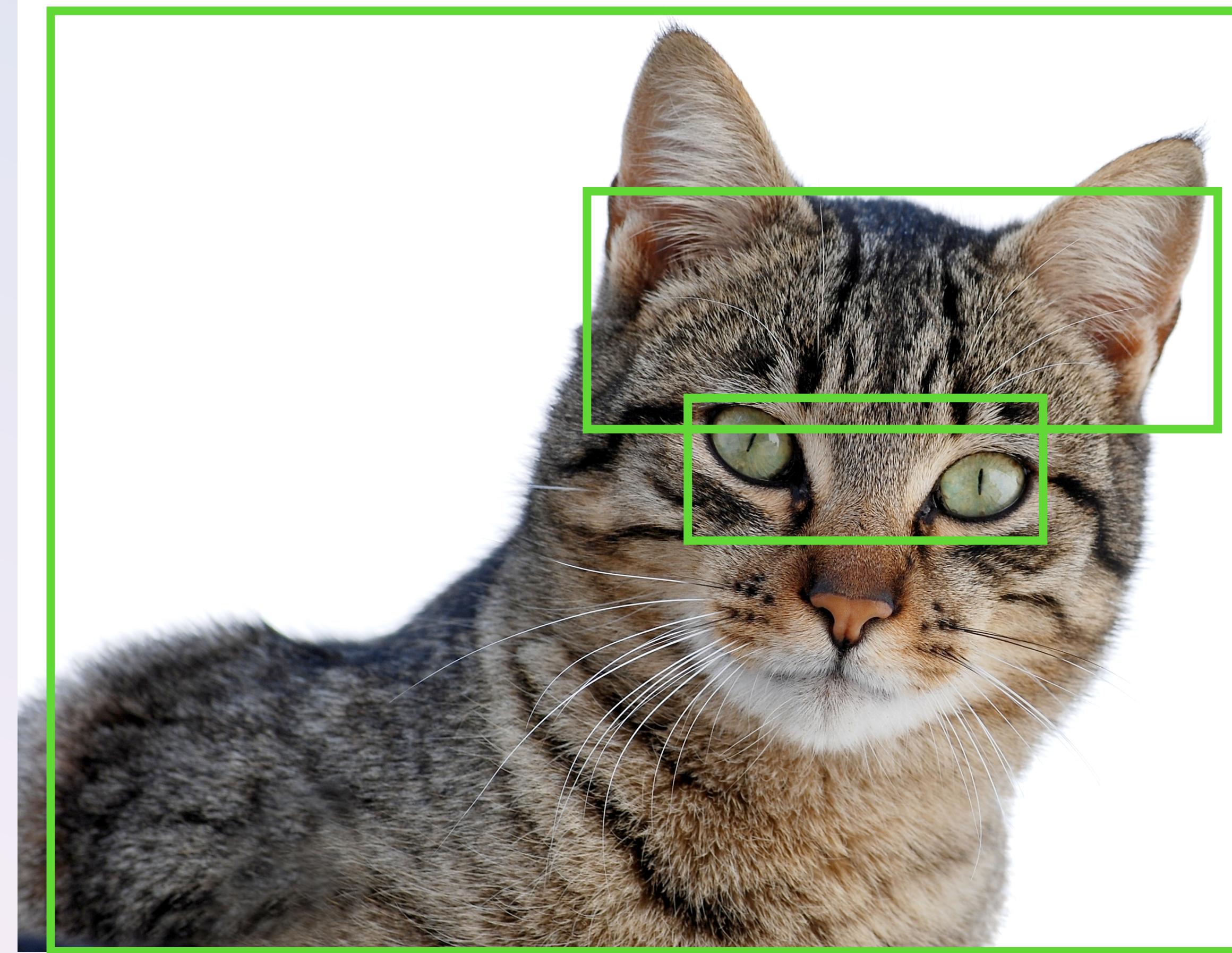


**“cat,” “tabby,”
“green eyes”**

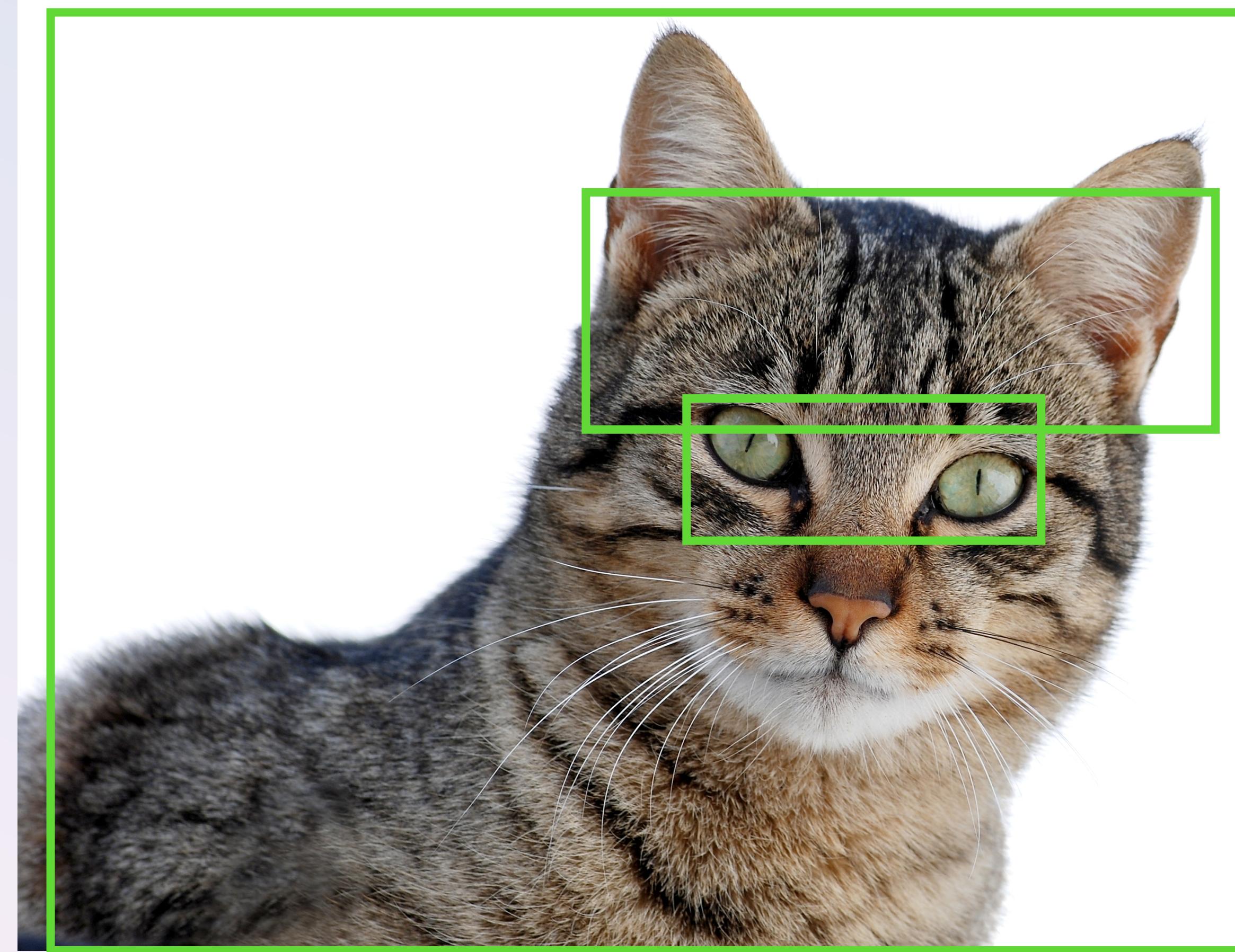
Computer vision is helpful when we don't have a ground truth



Computer vision is helpful when we don't have a ground truth



Computer vision is helpful when we don't have a ground truth



“cat,” “tabby,”
“green eyes”

But visualizations *do* have a ground truth: human-interpretable data

From data to pixels to ?? (three demos)

Product AC is trending up, Product AB is tanking

Product AC initiated its launch with 12 clients and our internal marketing personnel cultivated 27 new acquisitions by the close of the calendar year. Product AB started with 42 clients and after a controversy in June, dropped to 4 by December.

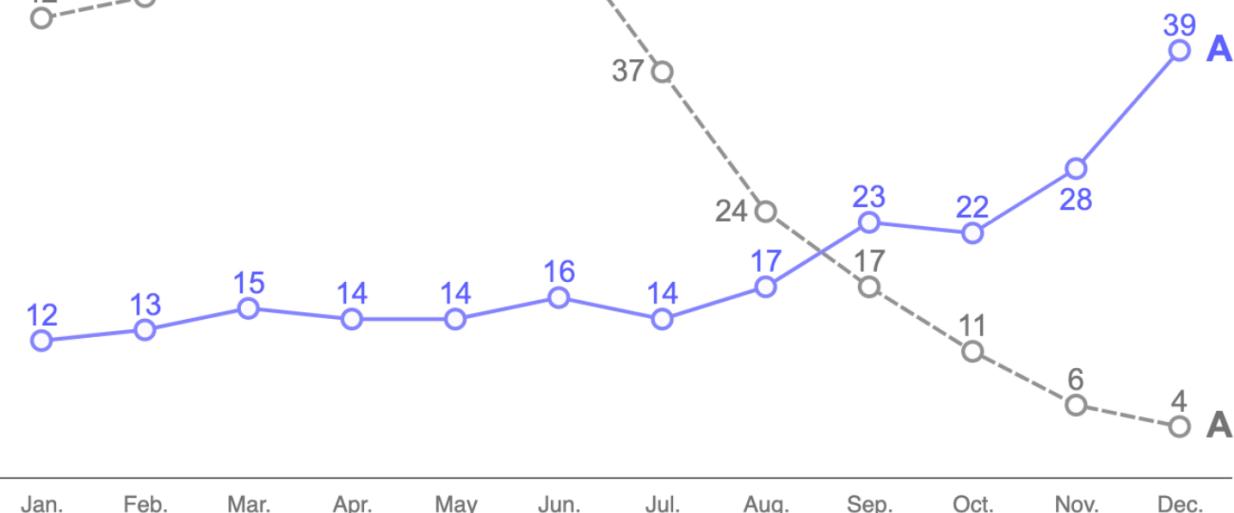
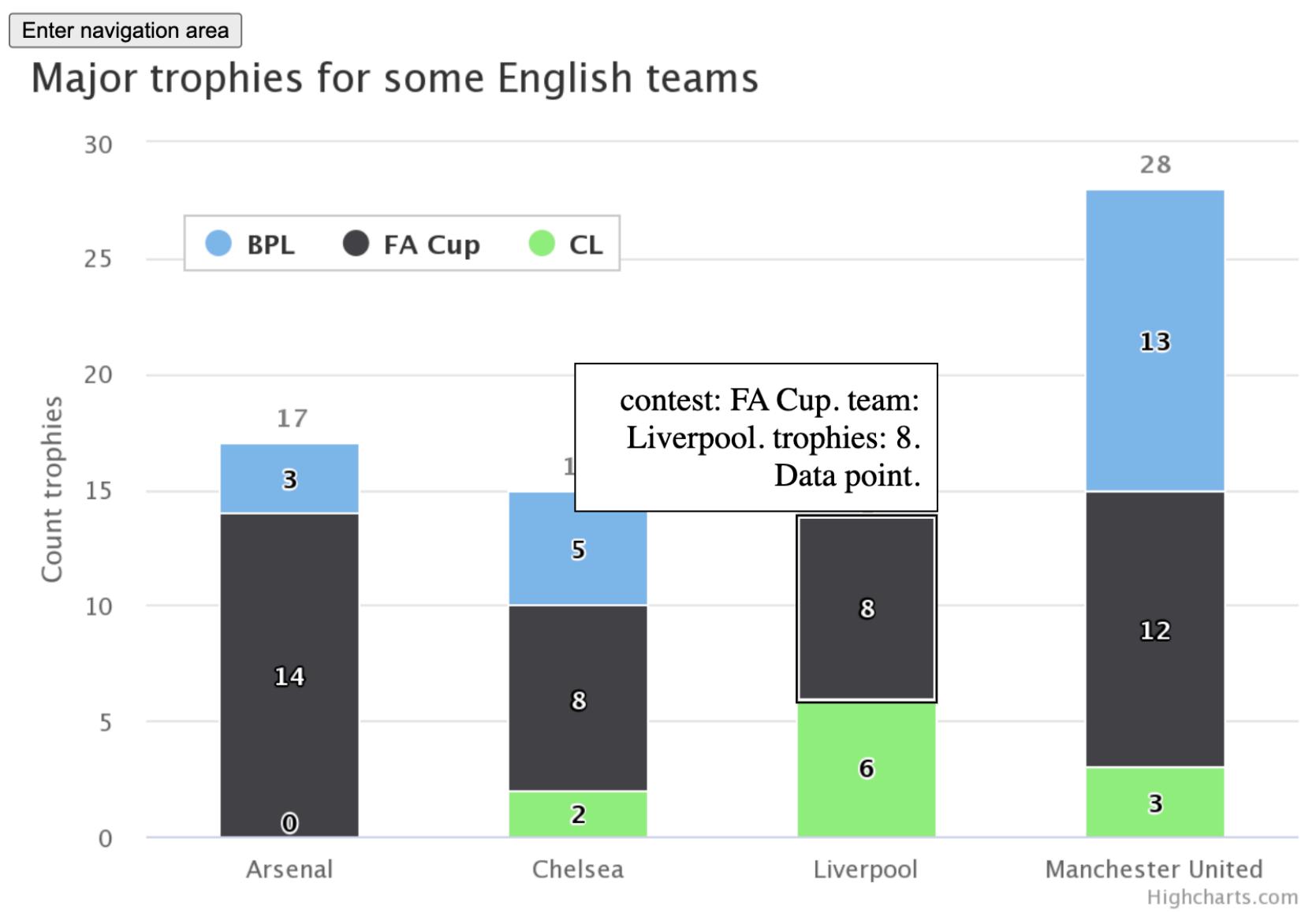
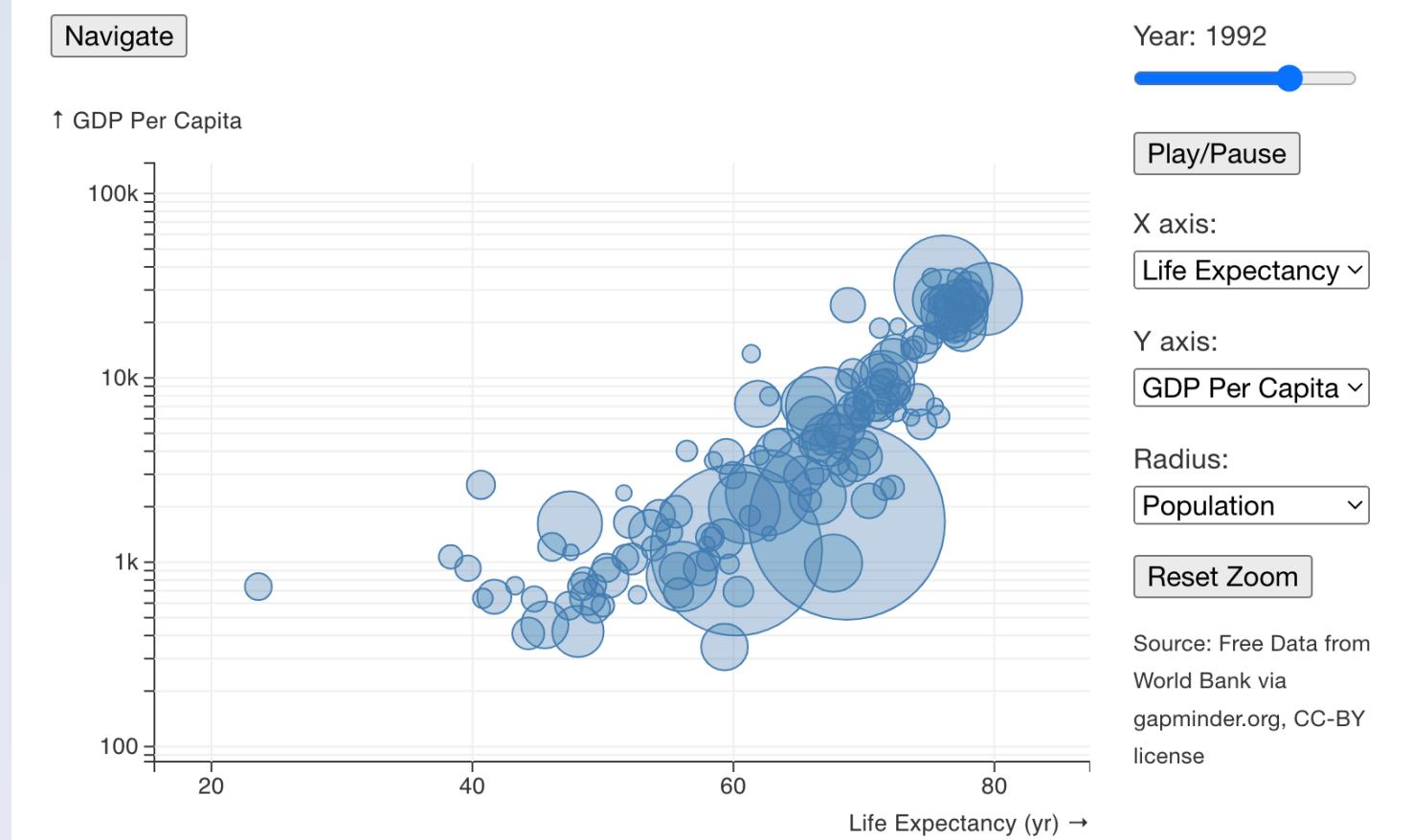


Figure 1: Last year's performance of Products AC and AB. Data is made possible by Sam Smith on the marketing data team.



Example: Accessible Gapminder Chart

Below is a responsive, screen-reader-navigable version of the chart shown on the [homepage](#). Press Navigate to enter keyboard navigation. Or, change your “prefers reduced motion” system setting to see fade animations instead of motion.

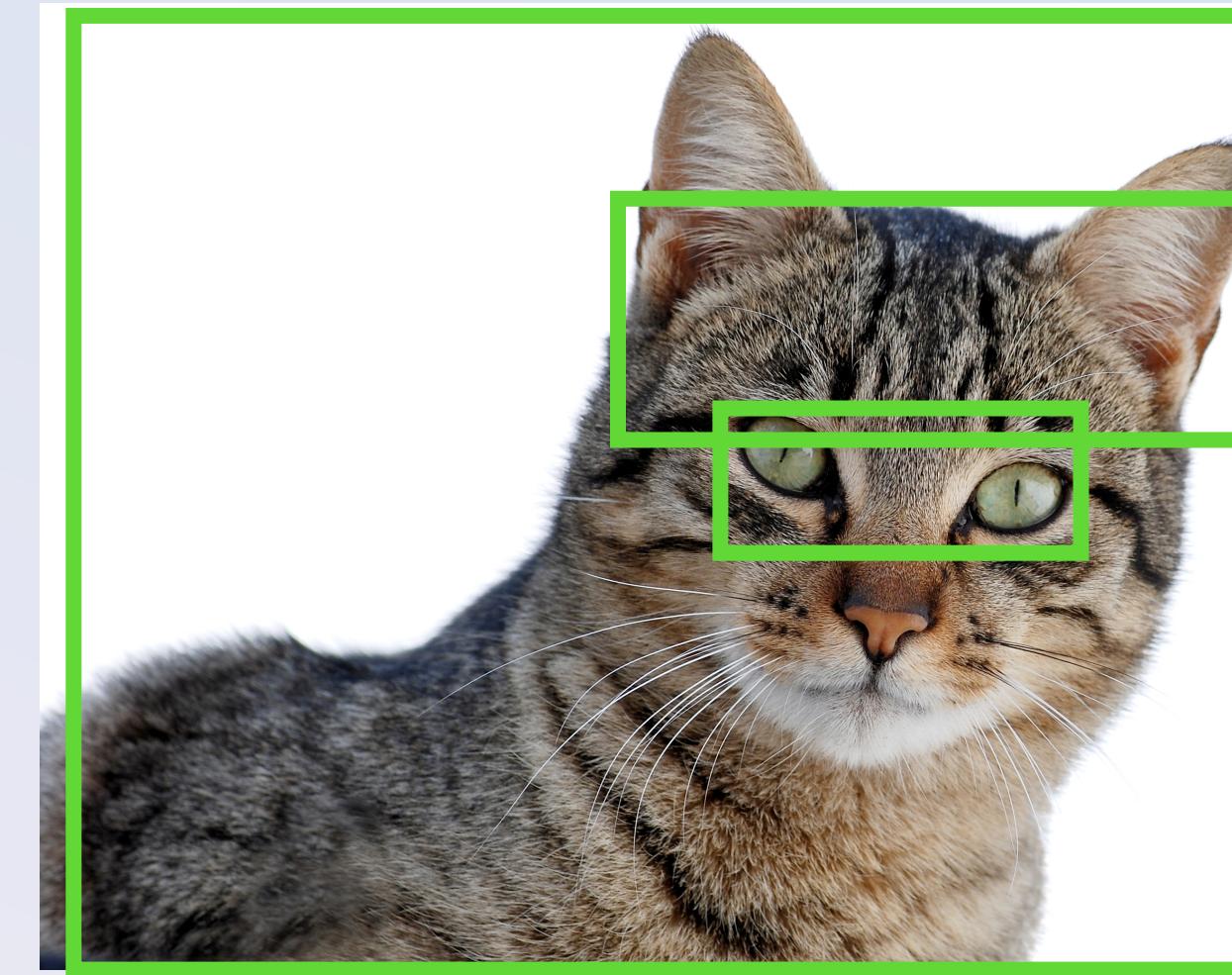
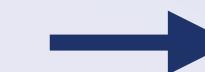


[First demo link](#)

[Second demo link](#)

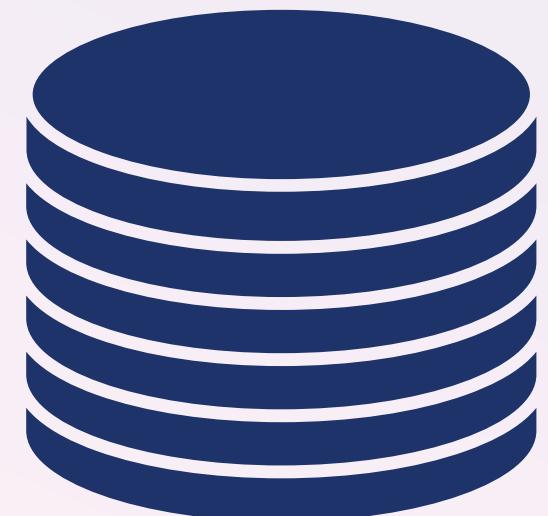
[Third demo link](#)

What is the ideal information flow for a visualization?



“cat,” “tabby,”
“green eyes”

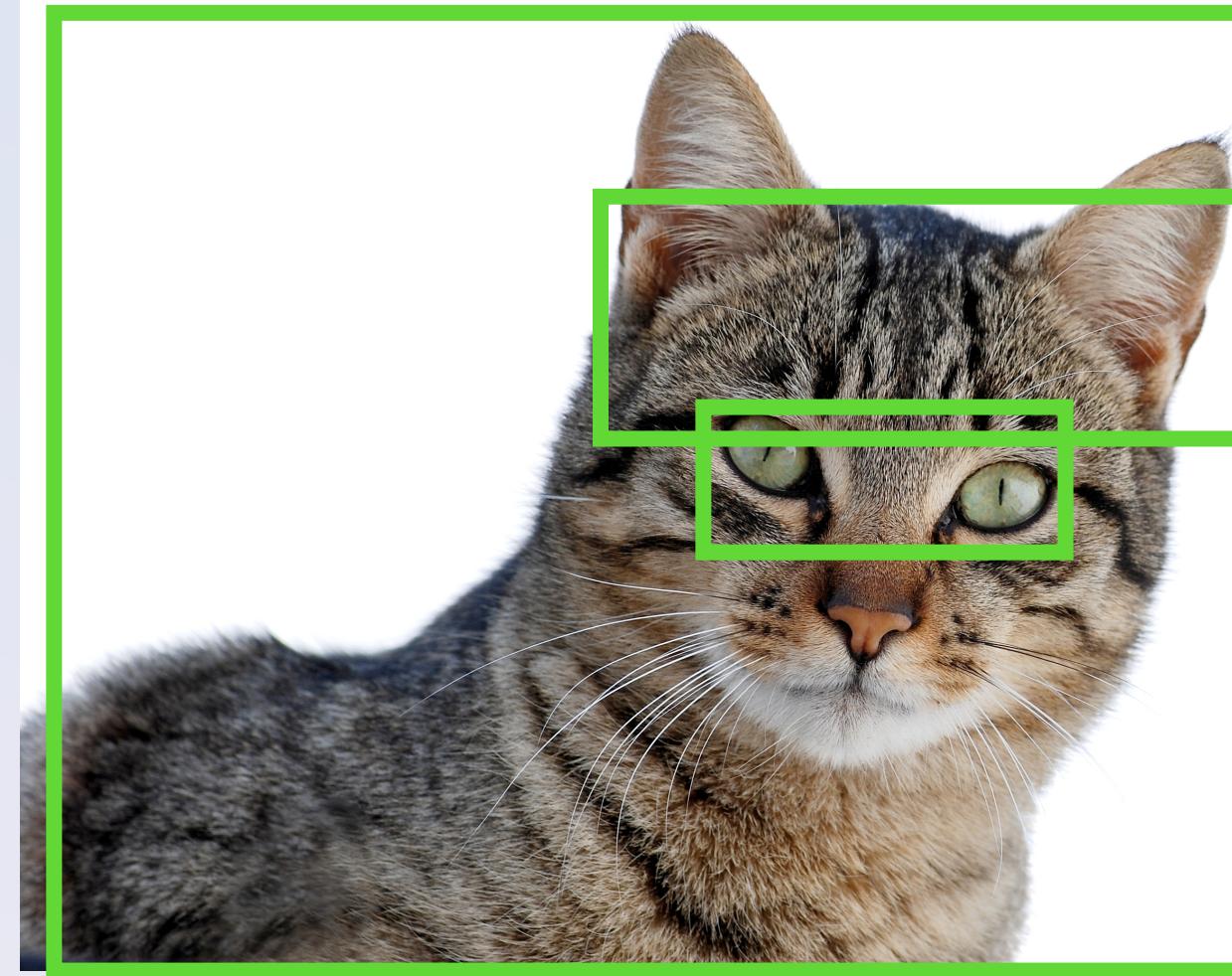
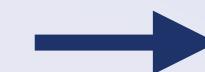
Data



Chart



What is the ideal information flow for a visualization?



“cat,” “tabby,”
“green eyes”



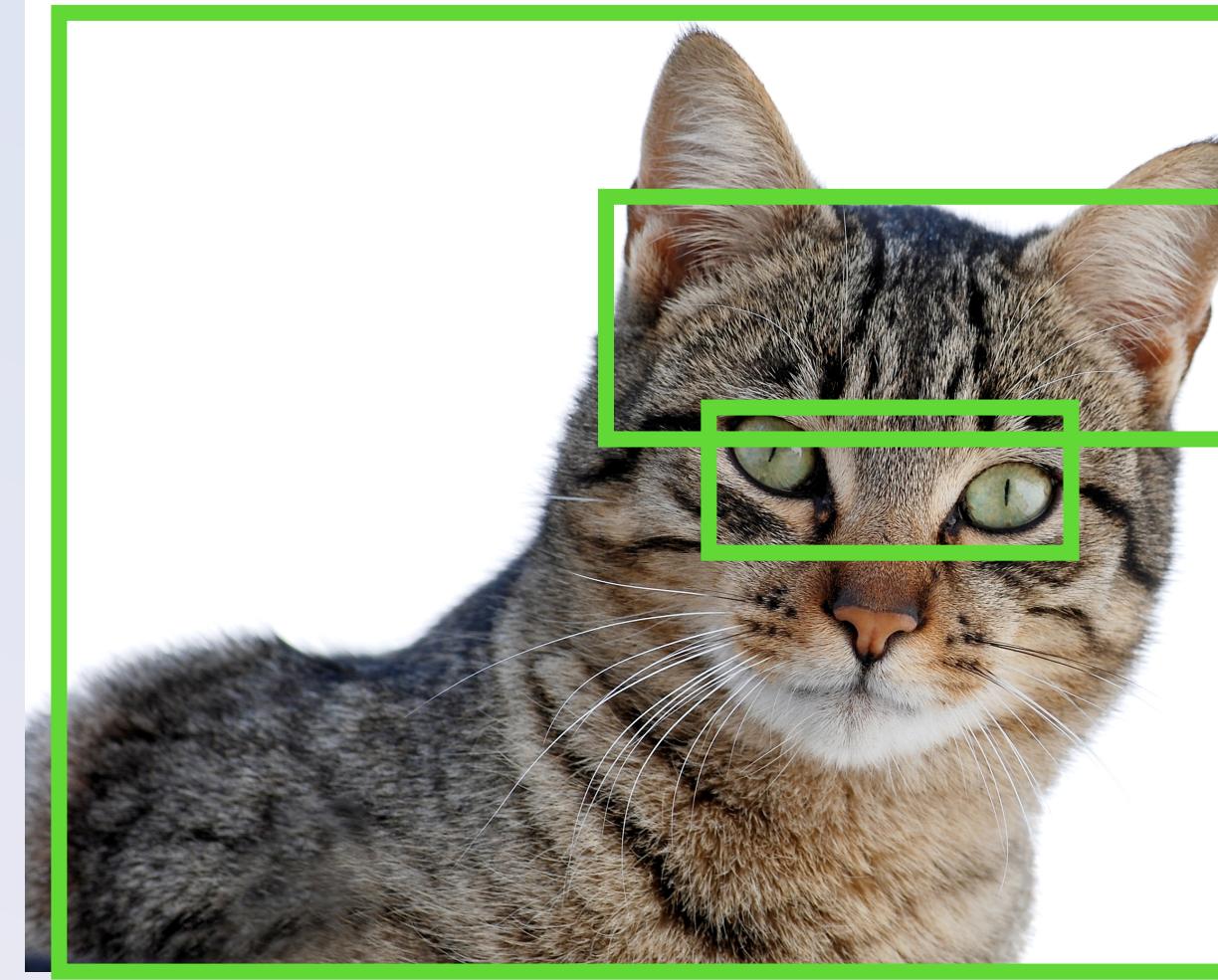
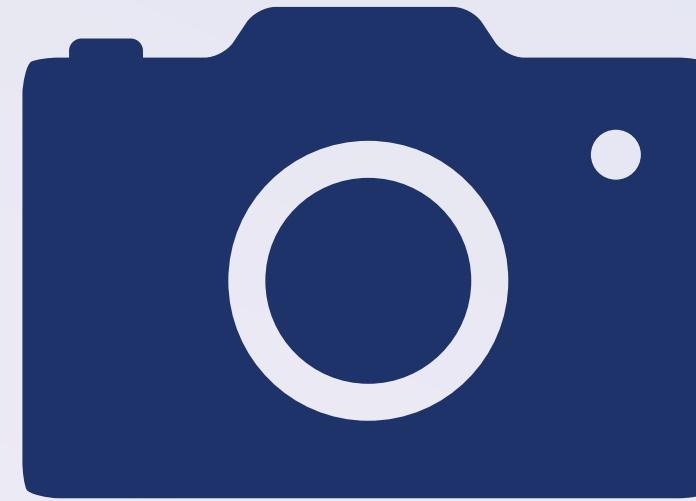
Data



Model

“bar chart,”
“trend up”

What is the ideal information flow for a visualization?



“cat,” “tabby,”
“green eyes”



Data



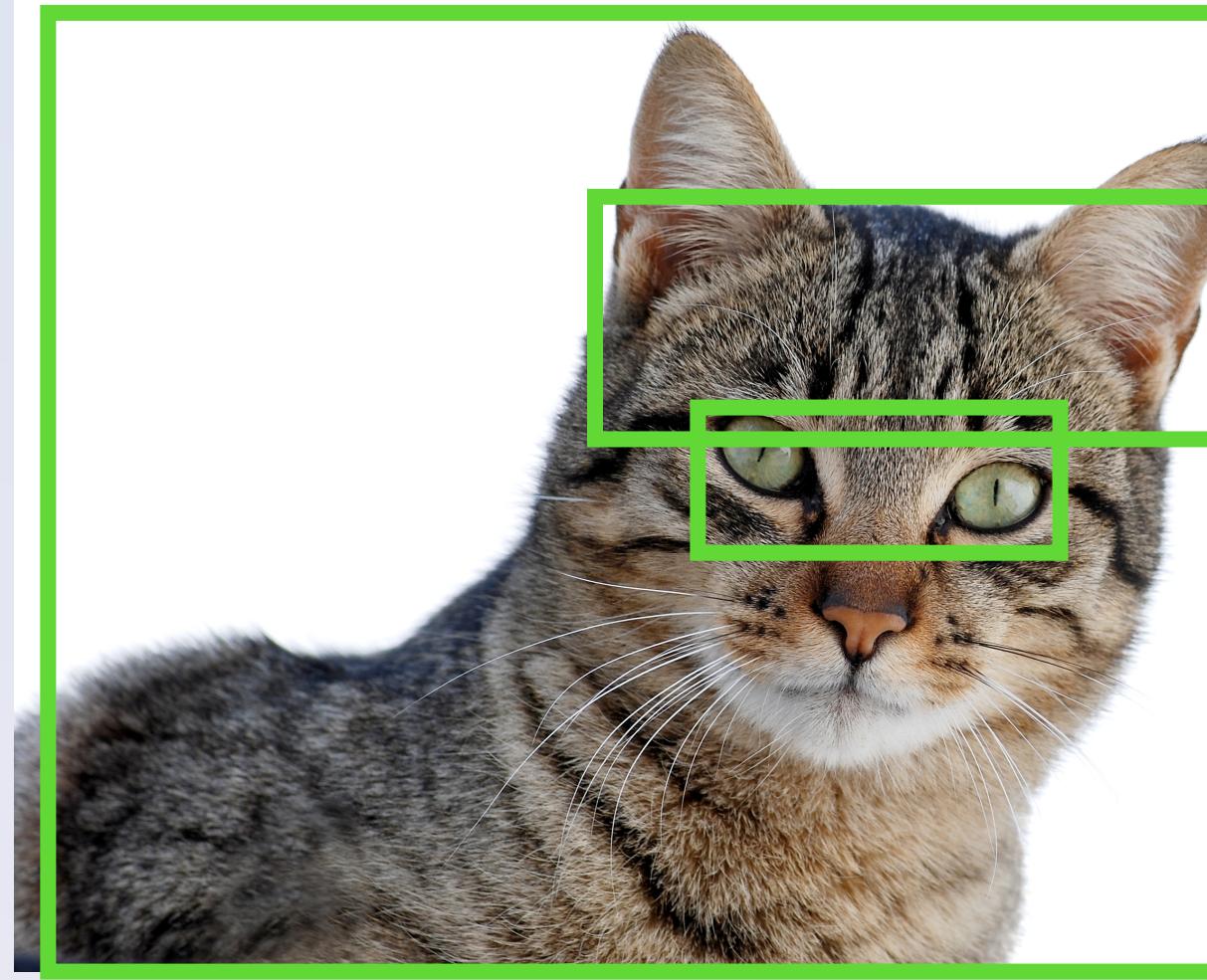
Error prone!



Model

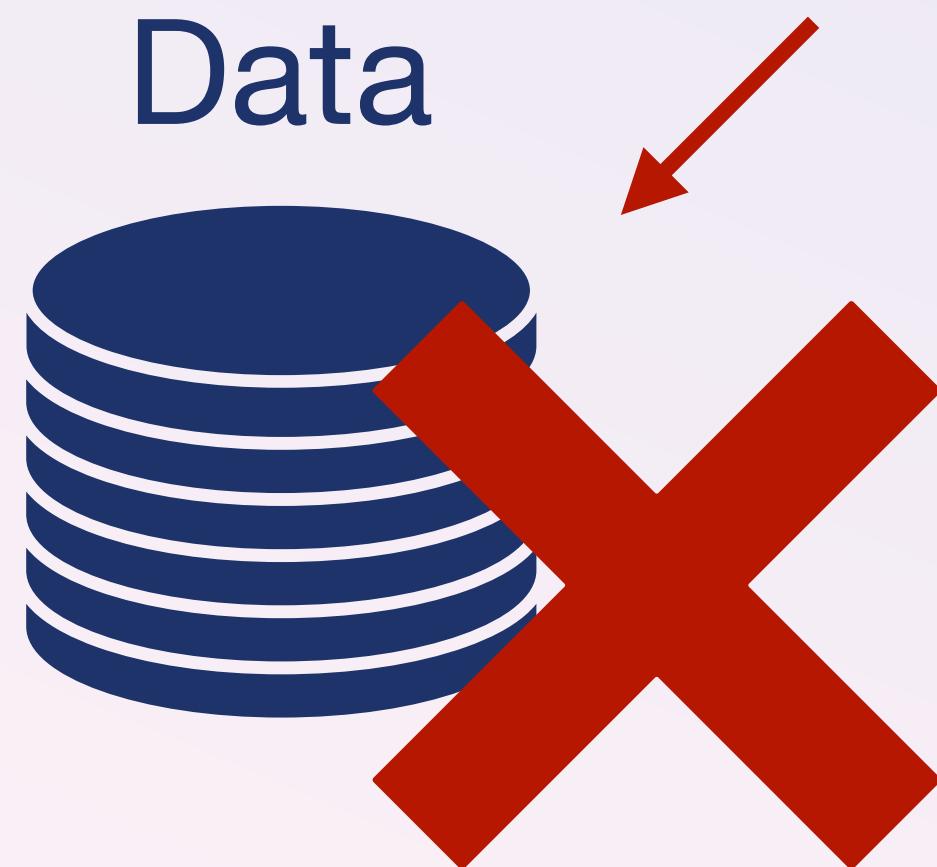
“bar chart,”
“trend up”

What is the ideal information flow for a visualization?



“cat,” “tabby,”
“green eyes”

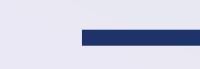
No ground truth?



Data



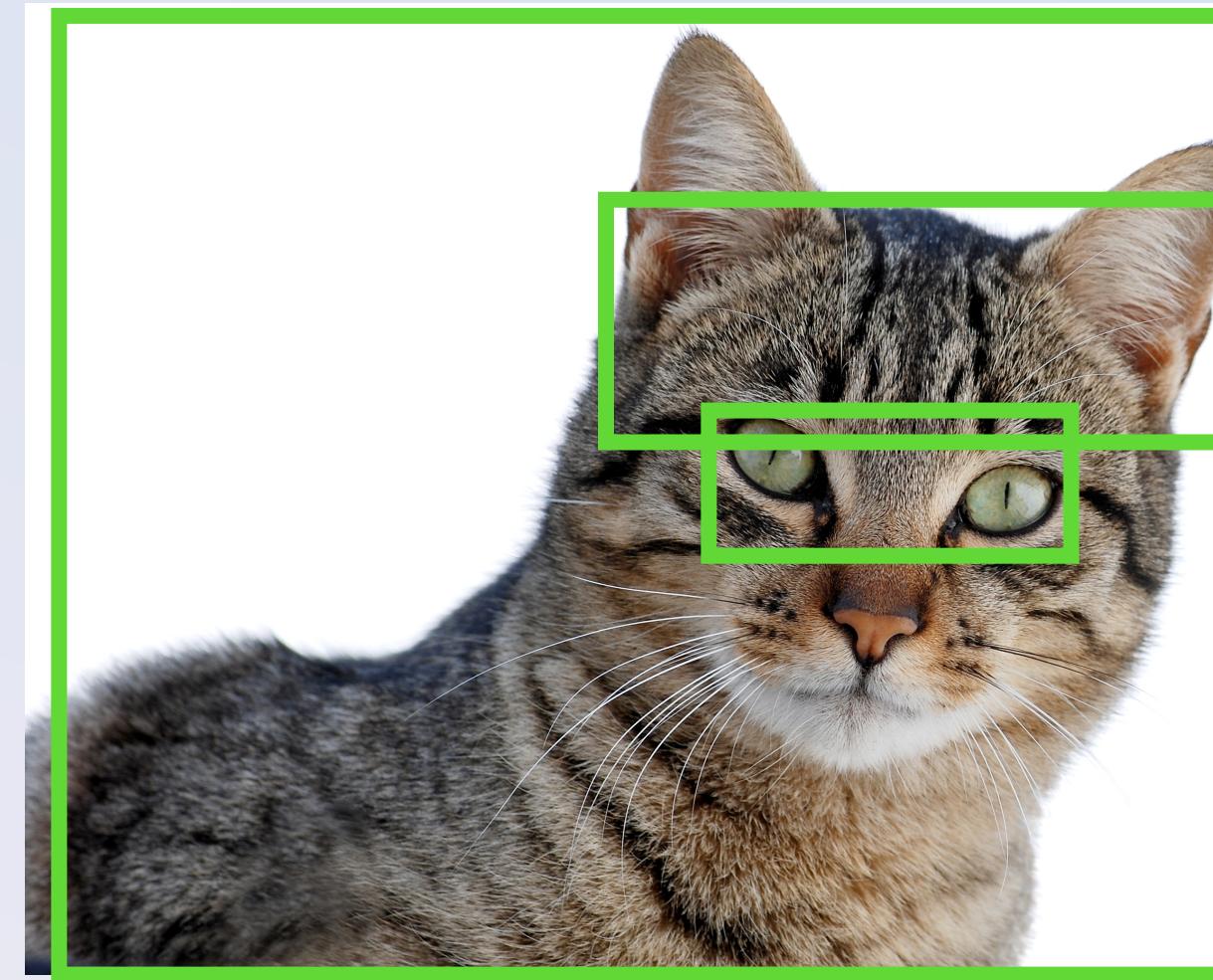
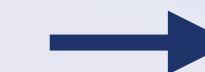
Chart



Model

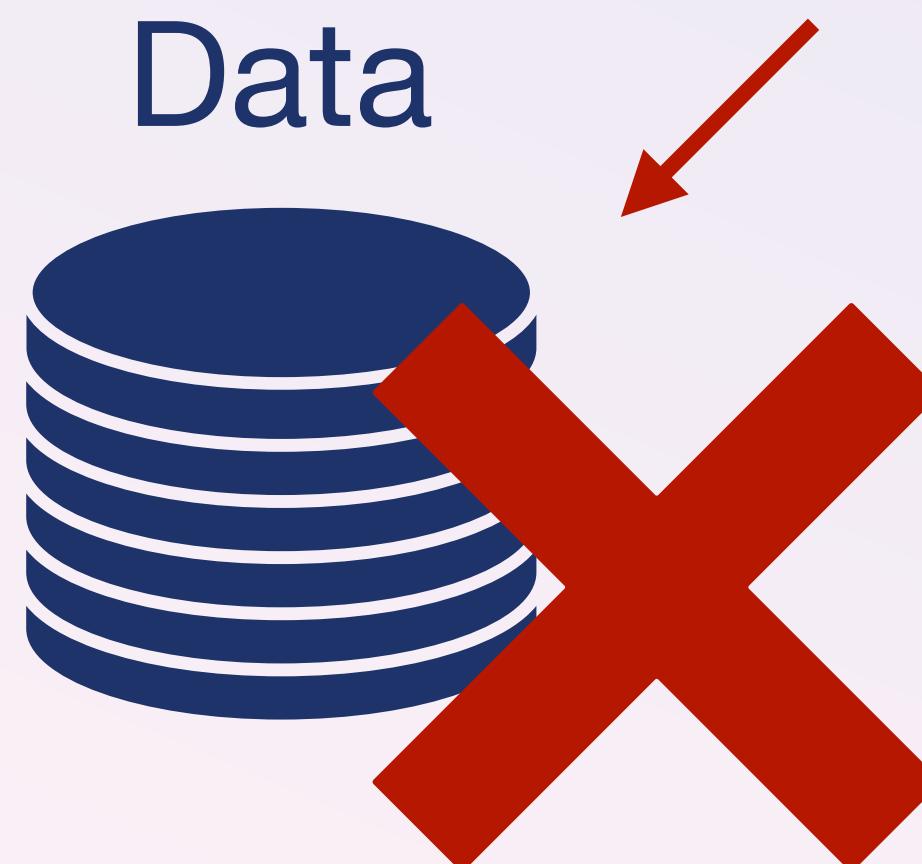
“bar chart,”
“trend up”

What is the ideal information flow for a visualization?

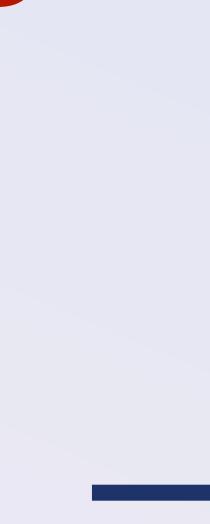


“cat,” “tabby,”
“green eyes”

No ground truth?



Error might be worth it?



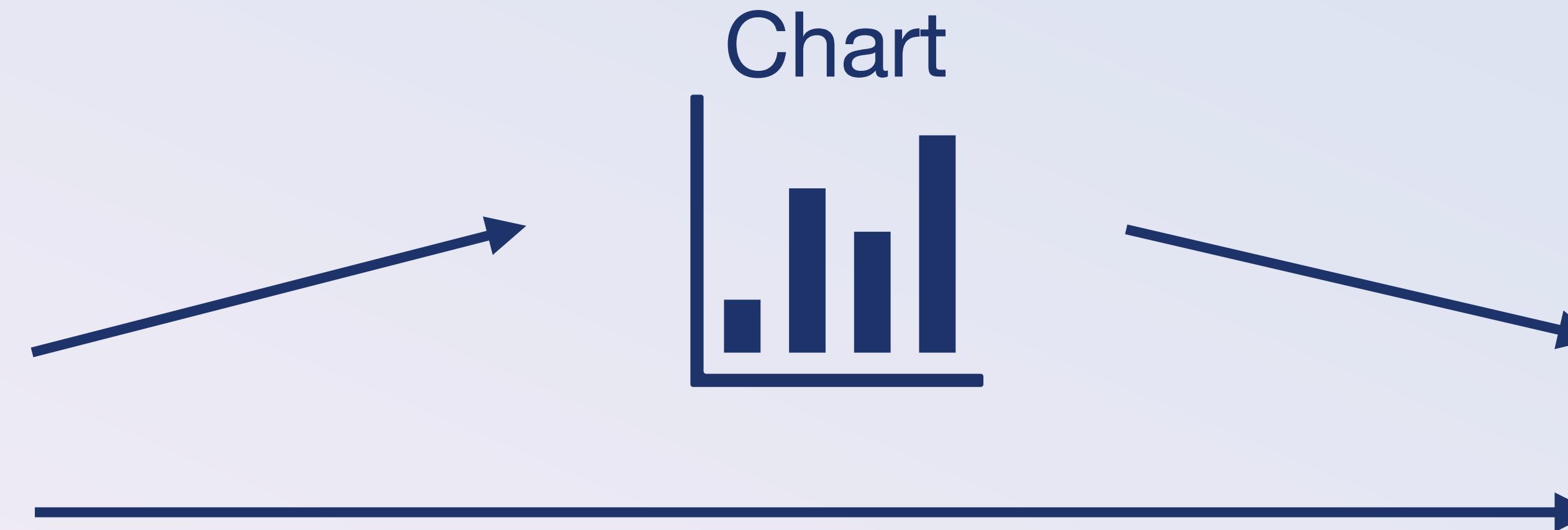
Model
“bar chart,”
“trend up”

What is the ideal information flow for a visualization?

Using the ground truth *and* the visualization!



Data



Chart

Model
“bar chart,”
“trend up,”
 $a = 5, b = 6,$
...