

Animation

DSC 106: Data Visualization

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UC San Diego

Announcements

Lab 7 due today.

Final Project Proposal due next week Tuesday.

Final Project Team Registration due on Gradescope **today at 5pm**. We will randomly assign teams afterwards!

FAQs:

1. I see ~3 students who did not enter their groupmates in Gradescope for the Team Registration. The usernames are **ighosh, bawan, and amaxon**. Please resubmit and add your groupmates, otherwise our algorithm will split your team up!

Animation

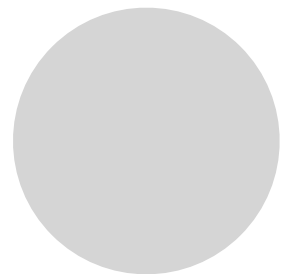
Animation Goals

Direct attention

Increase Engagement

Explain a Process

Understand a State Transition



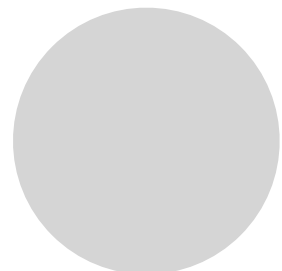
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Animation Goals

Motion as a visual cue

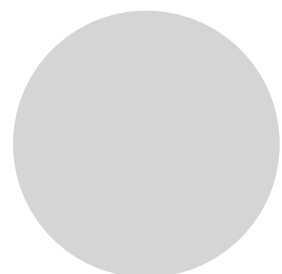
Smooth motion is perceived at ~10 frames / sec (1 frame every 100ms).

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7.5 fps



15 fps



30 fps



60 fps



60 fps



30 fps



15 fps



7.5 fps



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Smooth motion is perceived at ~10 frames / sec (1 frame every 100ms).

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Motion as a visual cue

Smooth motion is perceived at ~10 frames / sec (1 frame every 100ms).

Pre-attentive, stronger than color, shape, etc.

More sensitive to motion at our periphery.

Similar motions perceived as a group (gestalt principle of common fate).

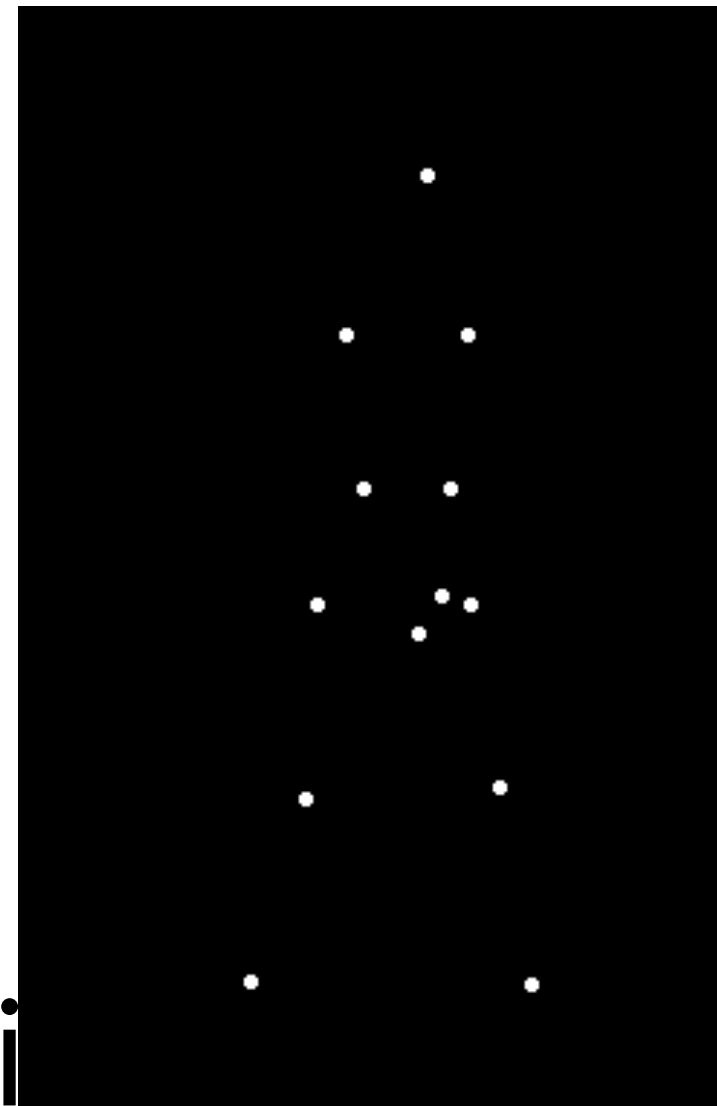
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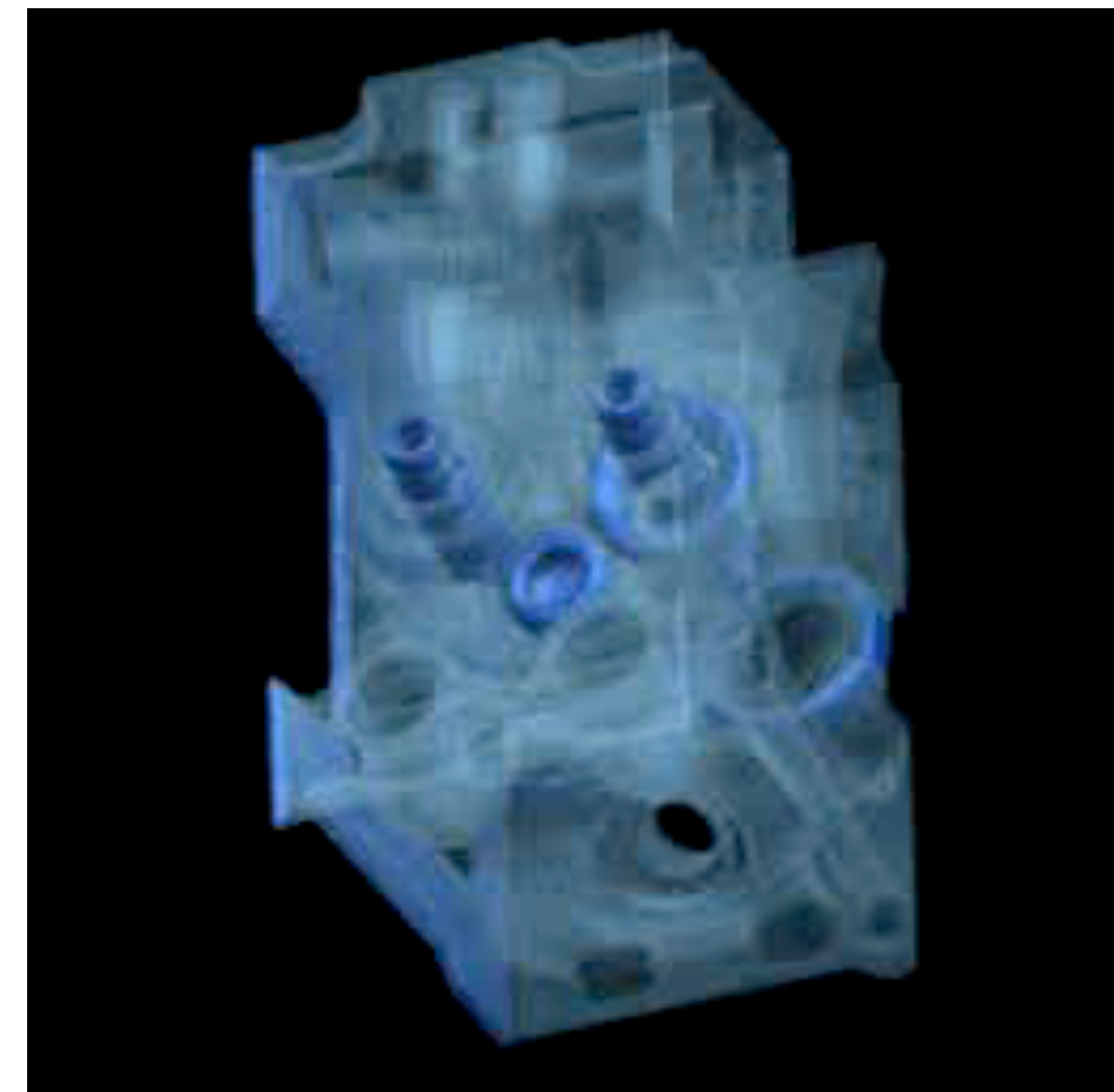
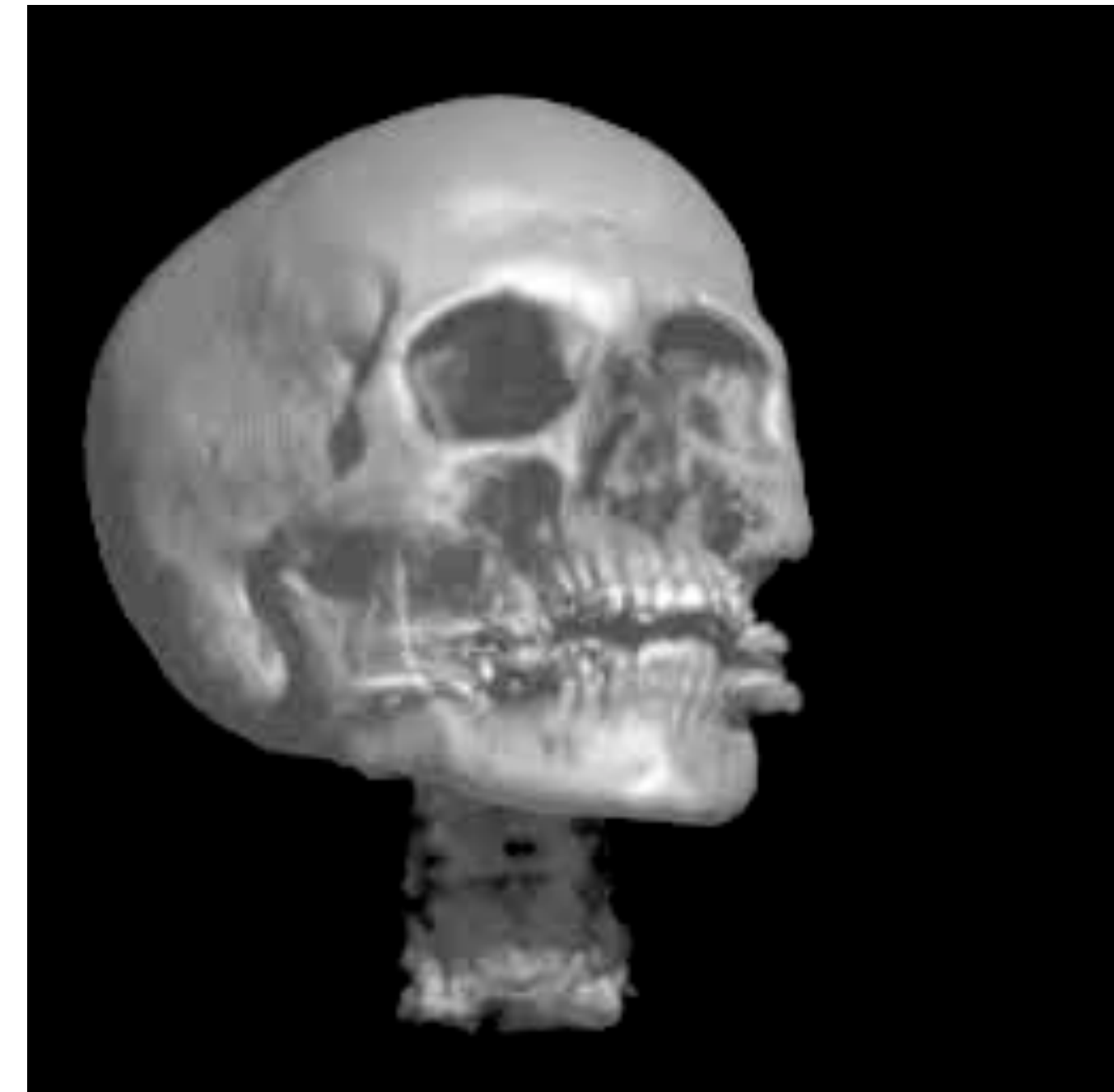
Animation Goals

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Animation Goals

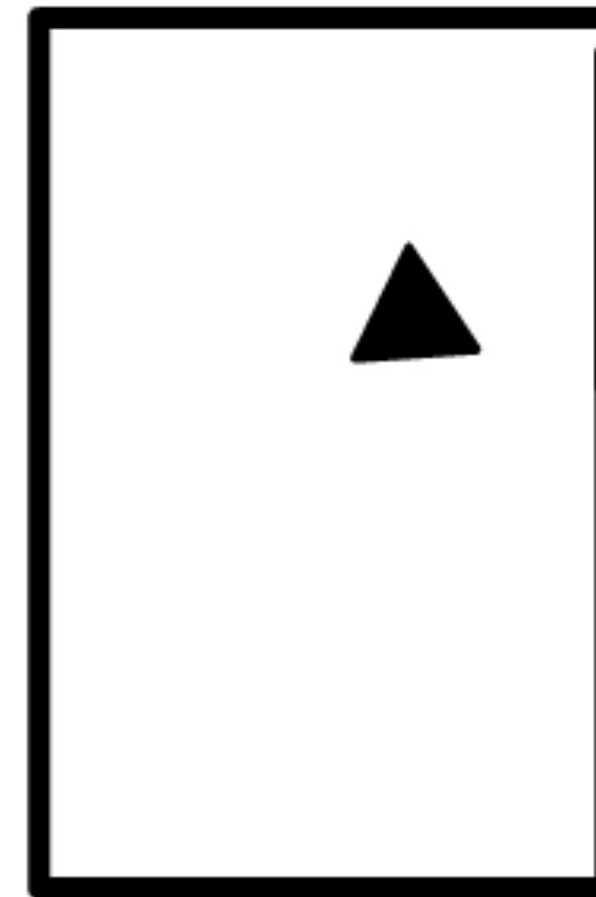
Constructing narratives & anthropomorphizing

Direct attention

Increase Engagement

Explain a Process

Understand a State Transition



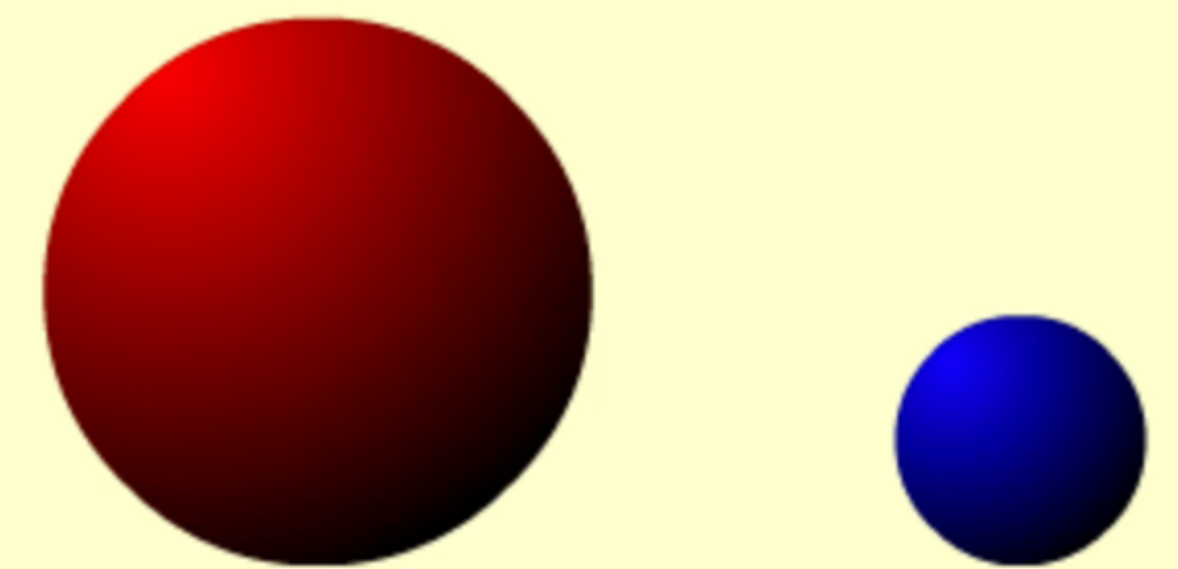
What's happening in this film? tryclassbuzz.com







[Michotte 1946]



Animation Goals

Direct attention

Increase Engagement

Explain a Process – the perception (or attribution) of causality.

Understand a State Transition

Animation Goals

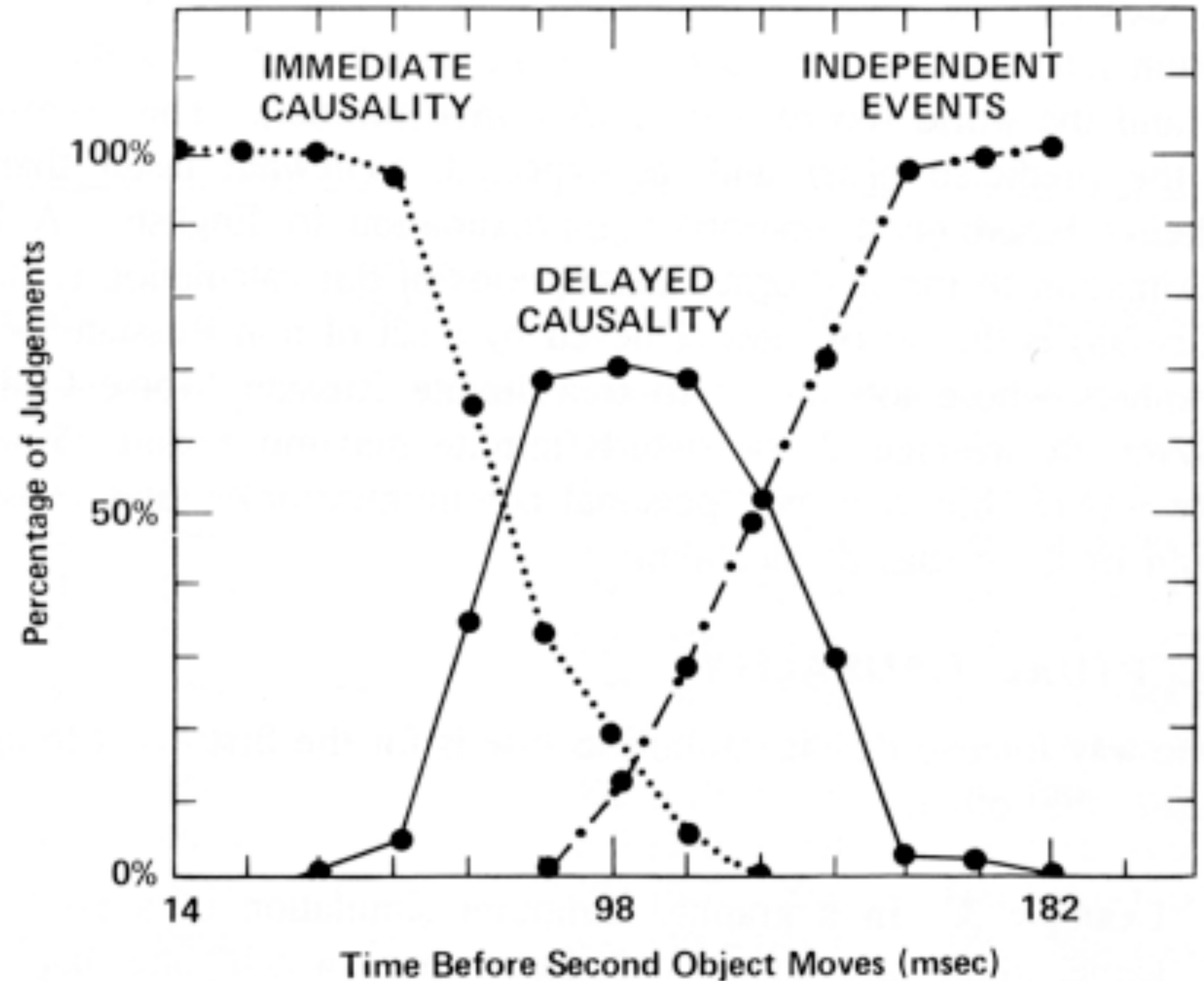
Attribution of Causality.

Direct attention

Increase Engagement

Explain a Process

Understand a State Transiti



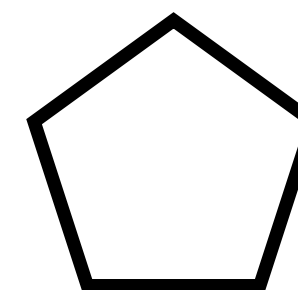
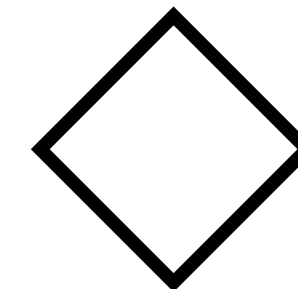
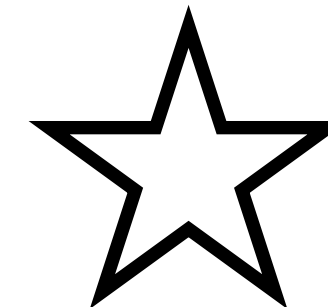
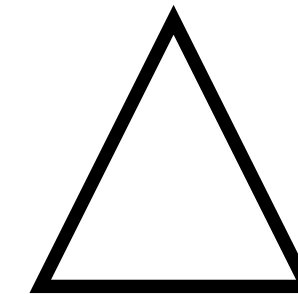
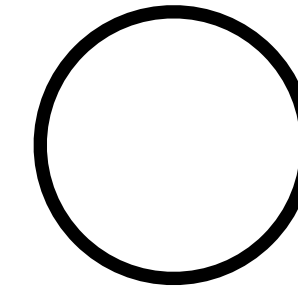
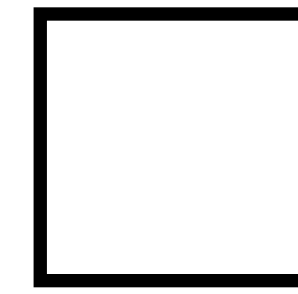
Animation Goals

Direct attention

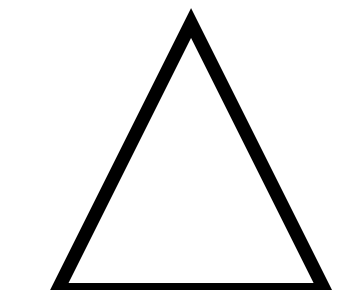
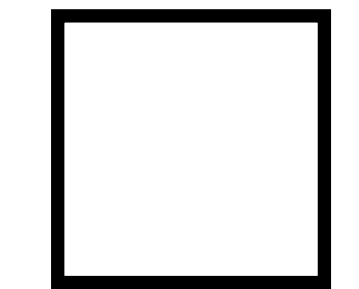
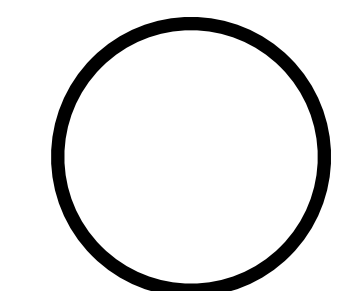
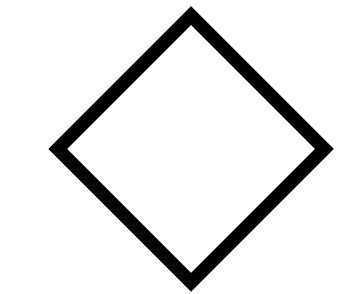
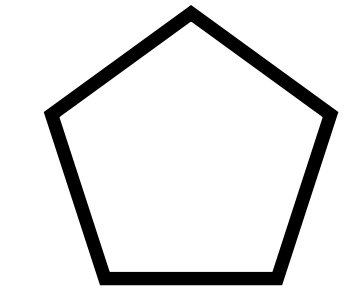
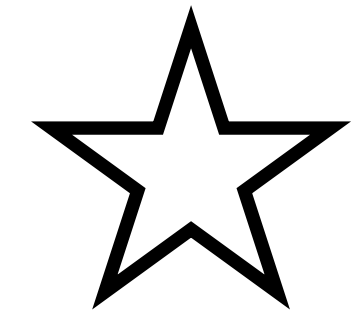
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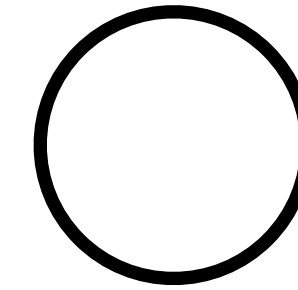
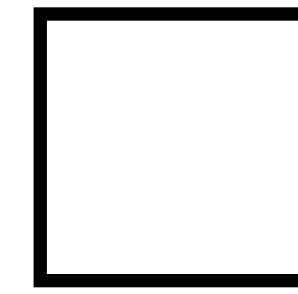


Start

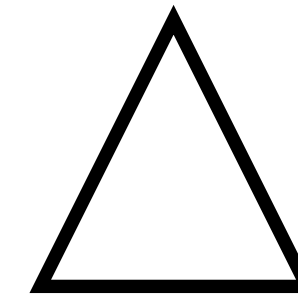


End

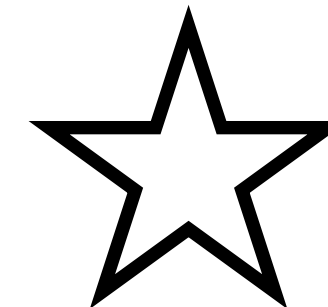
Animation Goals



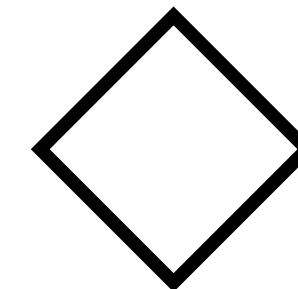
Direct attention



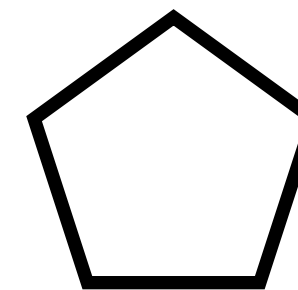
Increase Engagement



Explain a Process



Understand a State Transition



Start

End

Animation Goals

Direct attention

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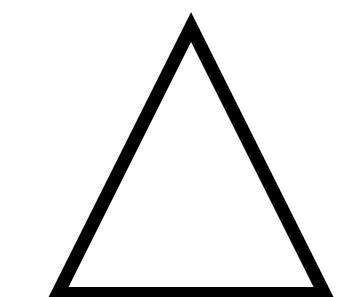
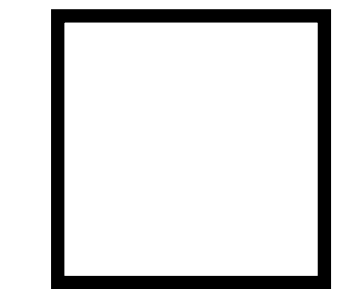
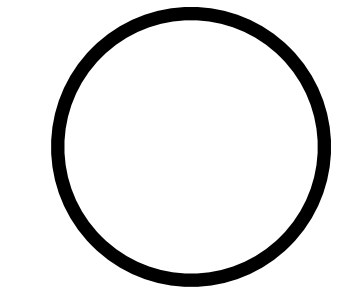
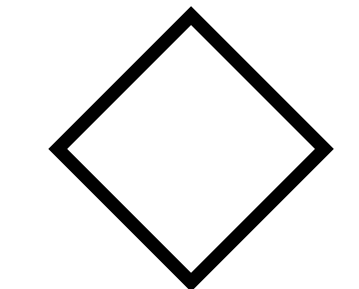
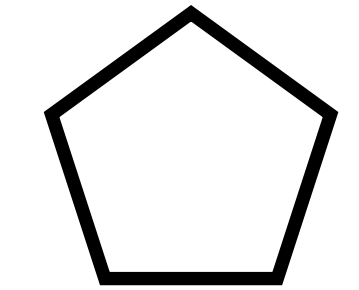
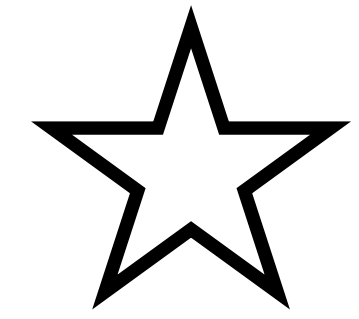
Explain a Process

Understand a State Transition

Animation can show transition better, but...

May be too fast or too slow.

Too many objects may move at once.



End

Animation Goals

How many dots can we track at once?

Direct attention

Increase Engagement

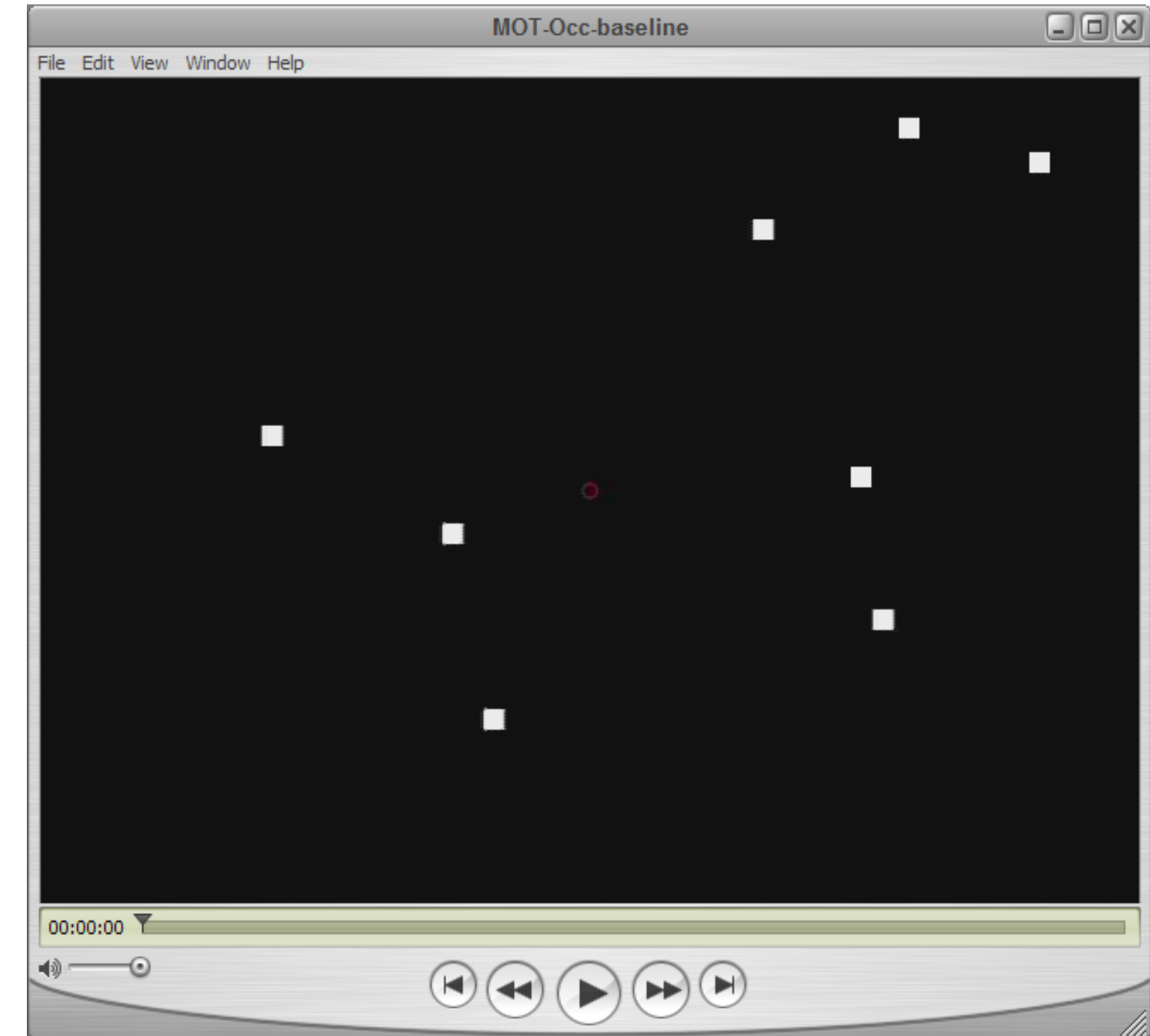
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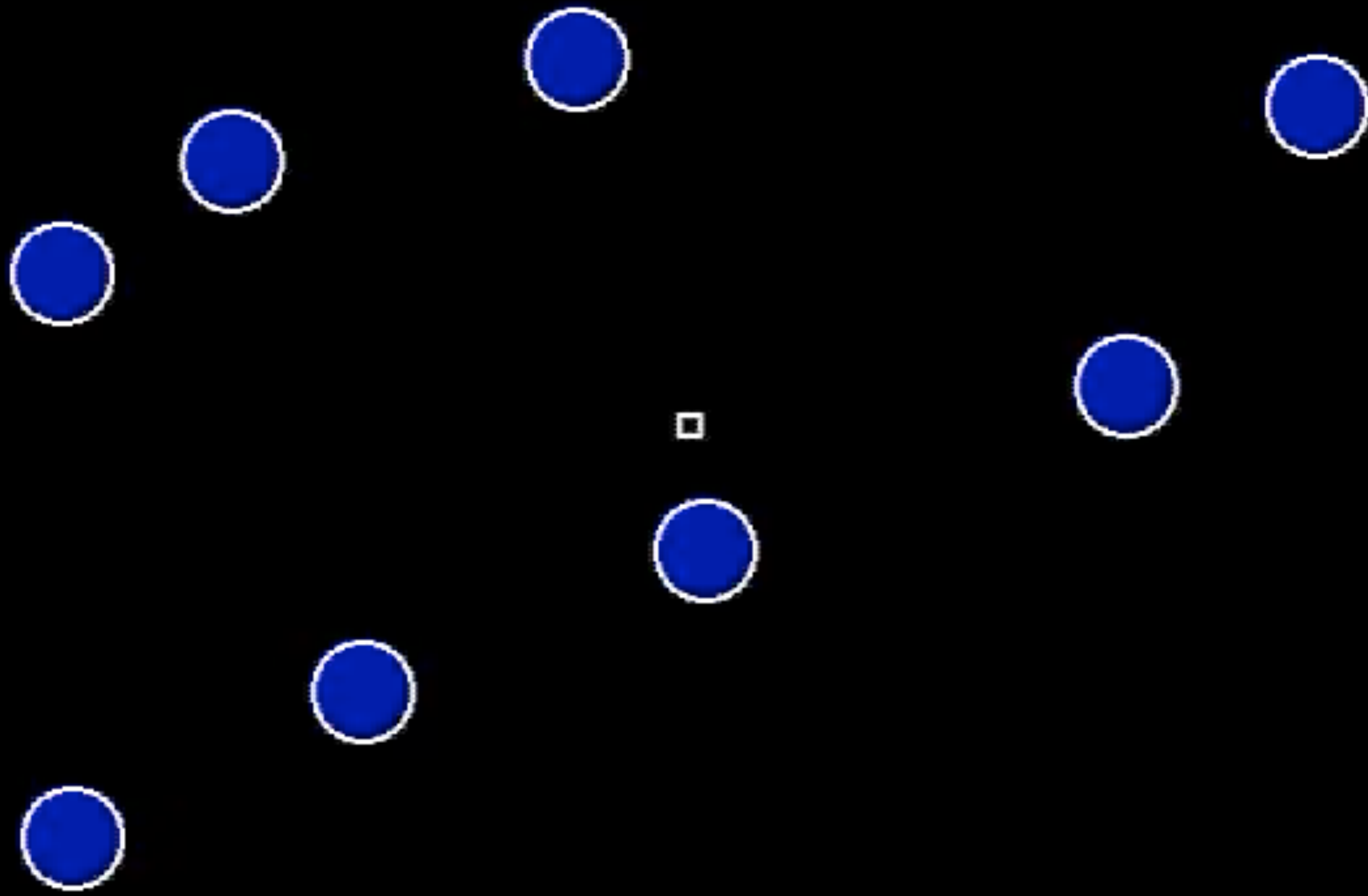
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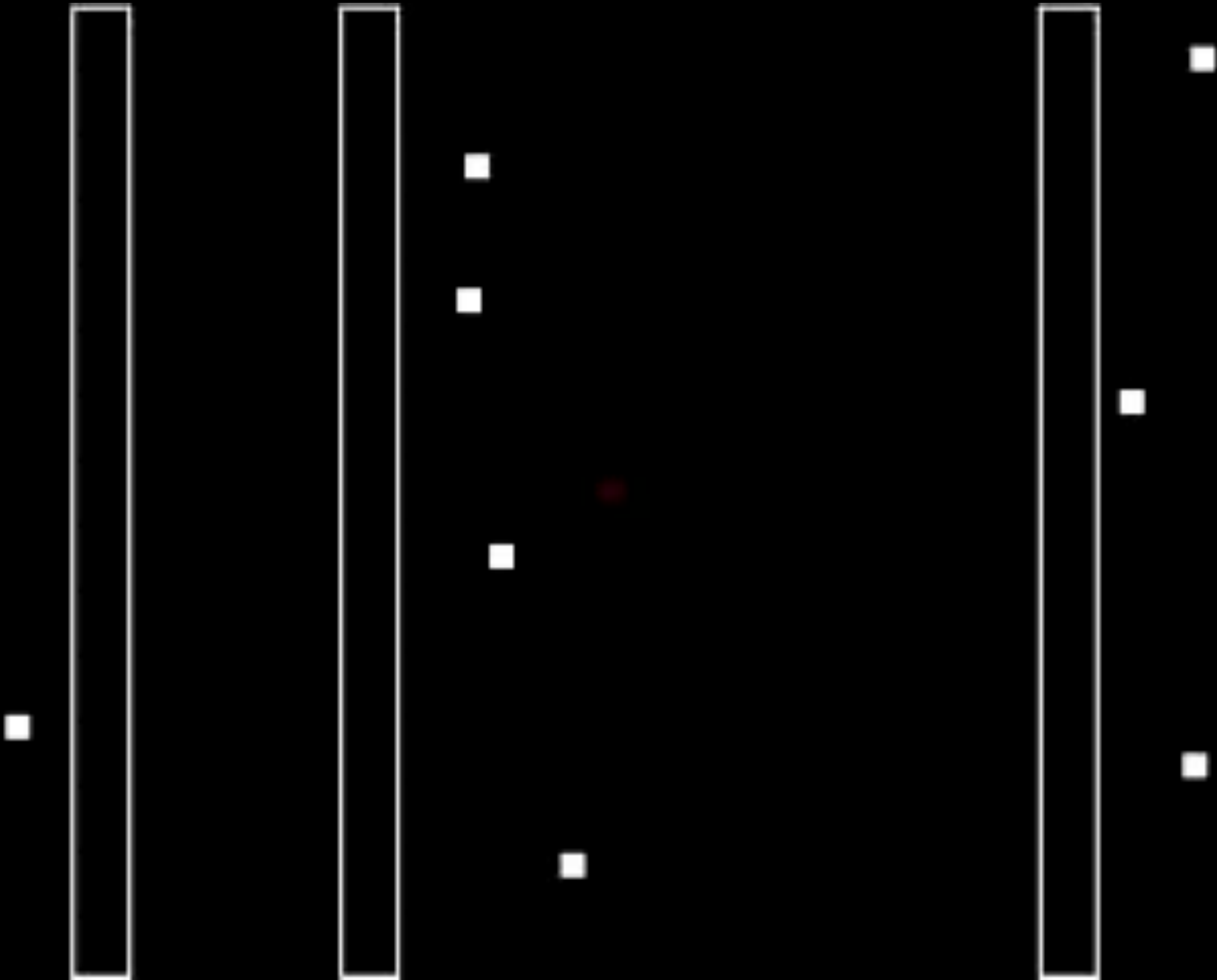
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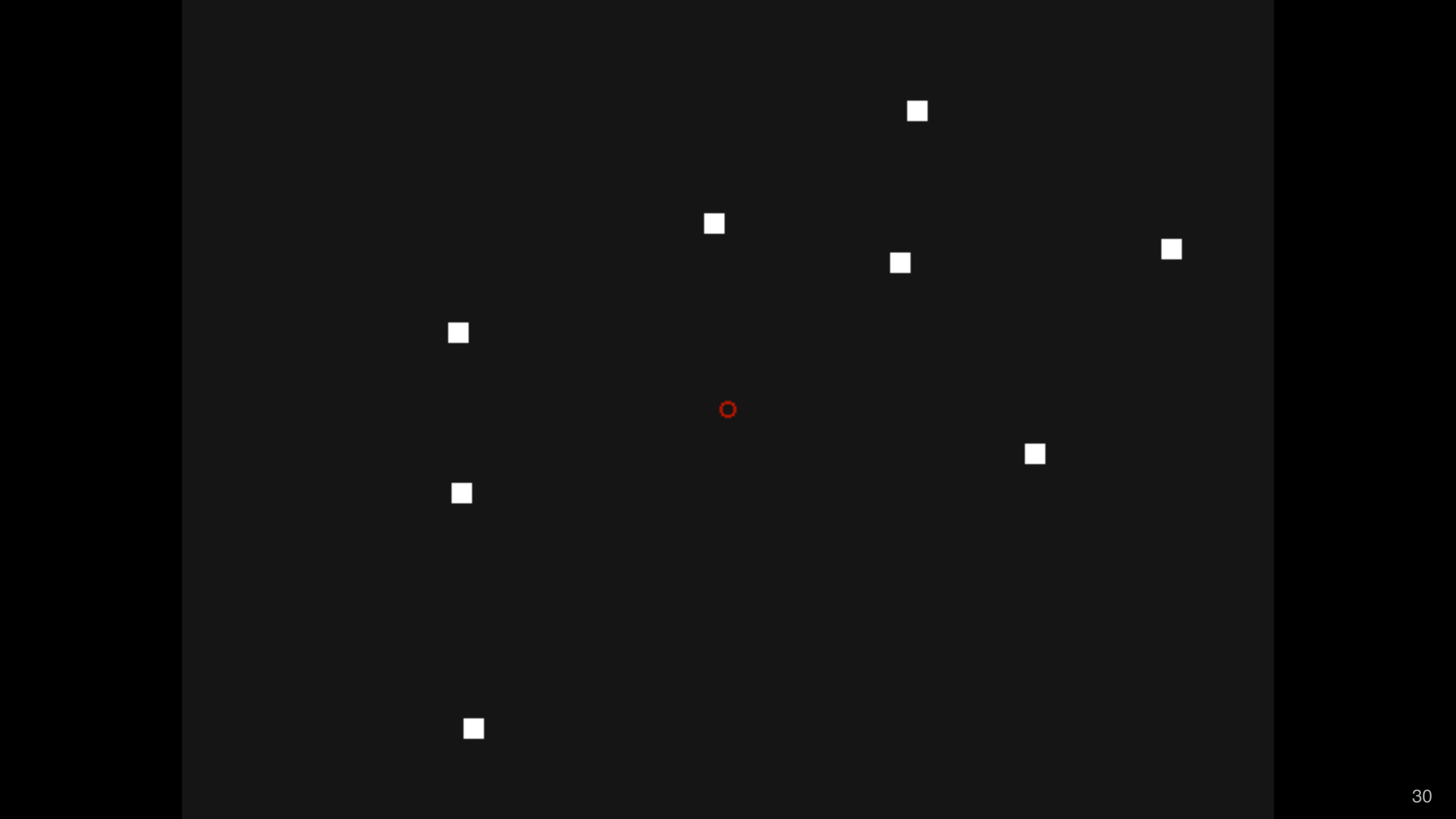
Too many objects may move at once.

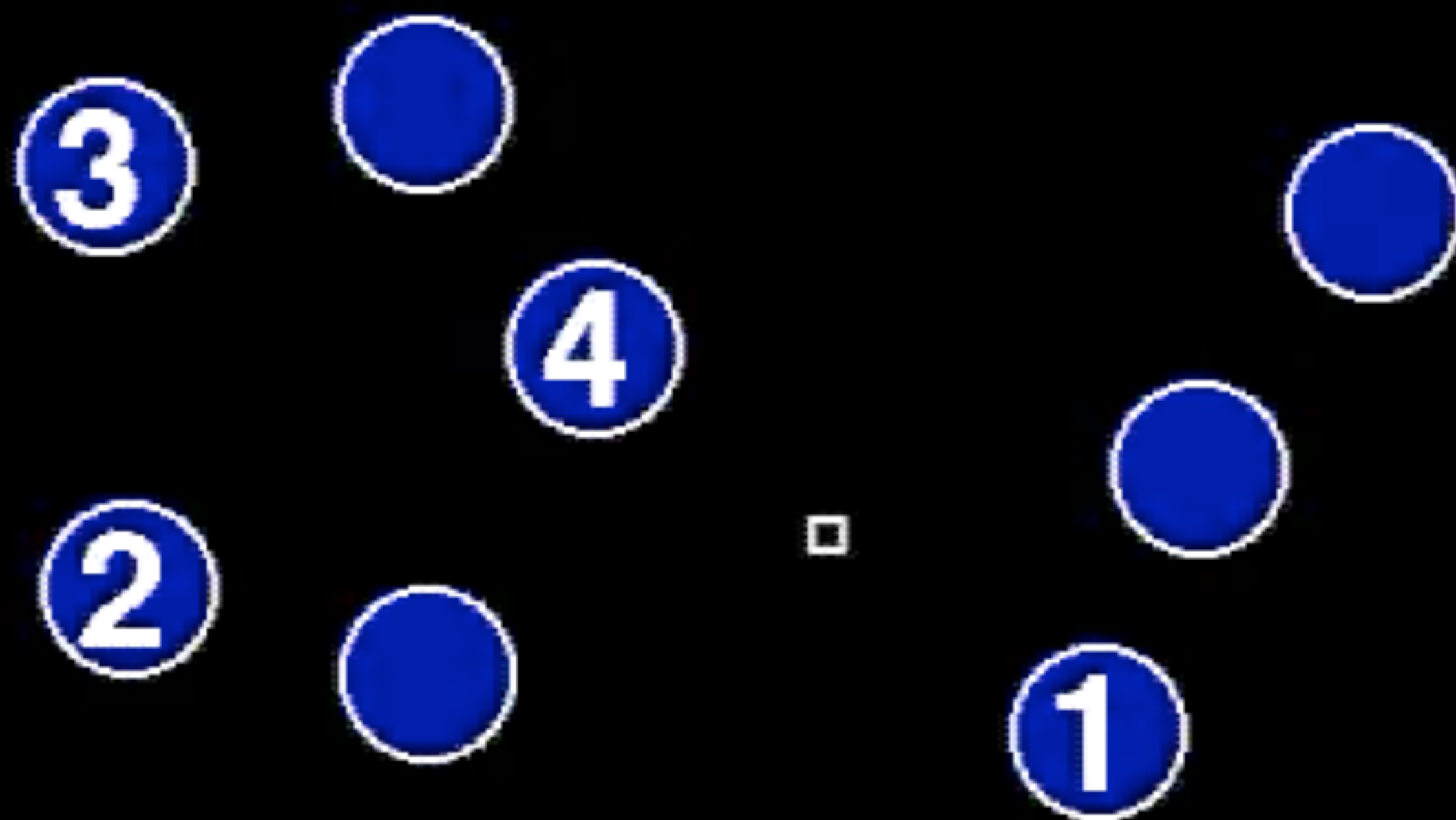












Animation Goals

How many dots can we track at once?

4-6. Difficulty increases significantly at 6.

Direct attention

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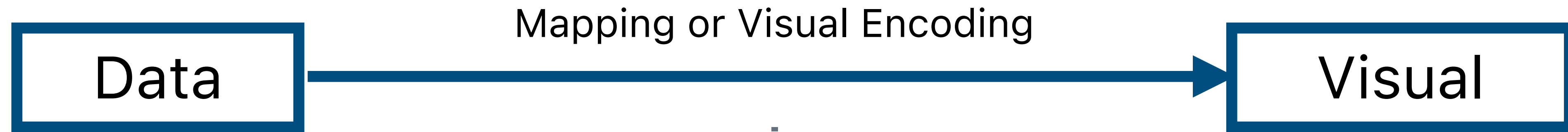
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Too many objects may move at once.



Effective Animations



Expressiveness

A set of facts is *expressible* in a visual language if the sentences (i.e. the visualizations) in the language express *all the facts in the set of data, and only the facts in the data.*

Effectiveness

A visualization is more *effective* than another if the information it conveys *is more readily perceived* than the information in the other visualization

Principles of Visualization

Expressiveness

A set of facts is *expressible* in a visual language if the sentences (i.e. the visualizations) in the language express all the facts in the set of data, and only the facts in the data.

Principles of Animation

Congruence

The structure and content of the external representation should correspond to the desired structure and content of the internal representation.

Effectiveness

A visualization is more *effective* than another if the information it conveys is more readily perceived than the information in the other visualization

Apprehension

The structure and content of the external representation should be readily and accurately perceived and comprehended

Principles of Animation

Congruence

The structure and content of the external representation should correspond to the desired structure and content of the internal representation.

Apprehension

The structure and content of the external representation should be readily and accurately perceived and comprehended

Maintain **valid data graphics during transitions**

Respect **semantic correspondence**

Marks should always represent the same data tuples.

Avoid **ambiguity**

Different operations should have distinct animations.

Experiments

Experiment 2

Study Conclusions / Principle of Apprehension

Appropriate animation **improves** graphical perception.

Simple transitions beat “do one thing at a time”

Simple staging was preferred and showed benefits

but timing important and in need of study.

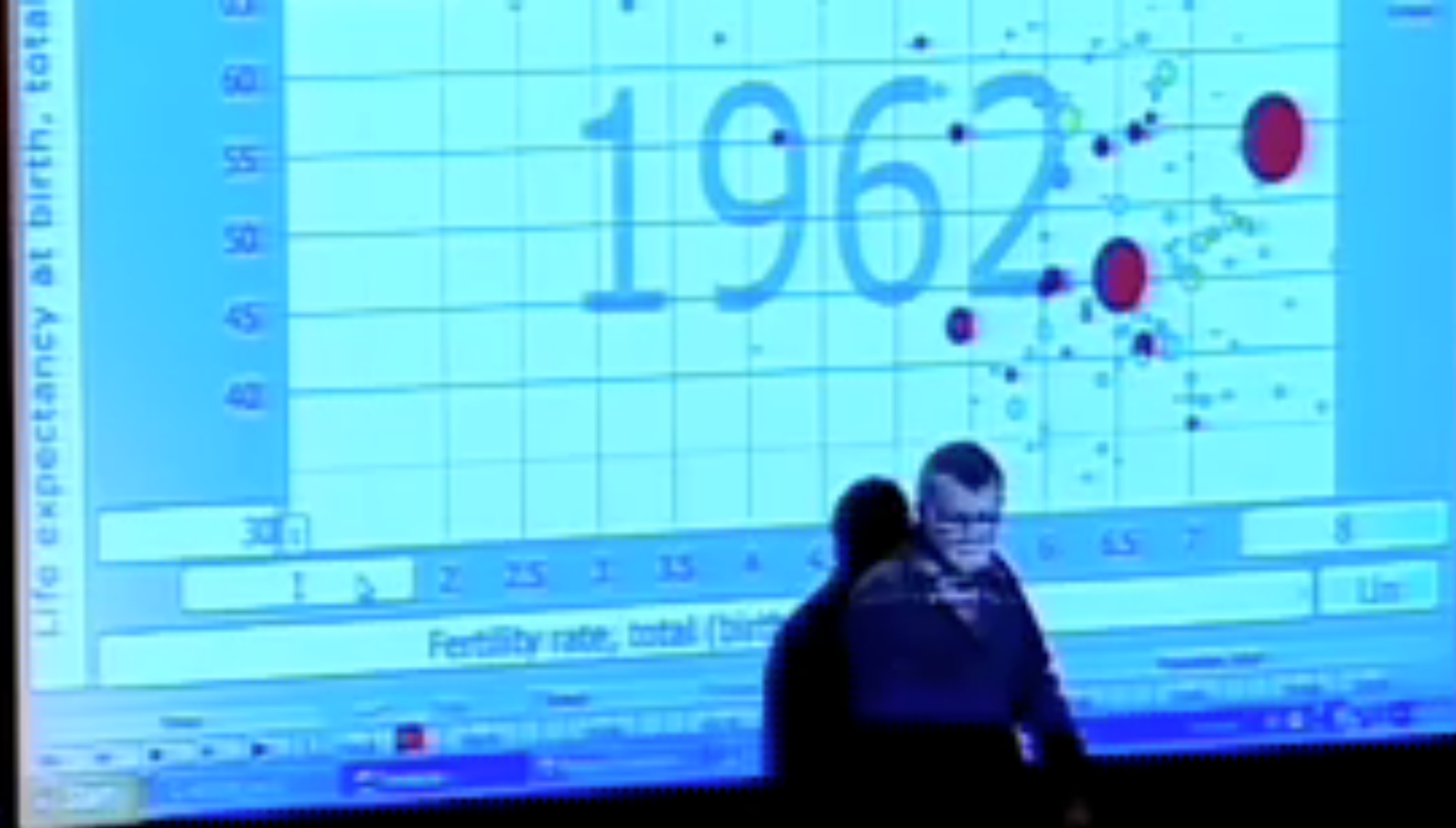
Axis **re-scaling hampers perception**

Avoid if possible (use common scale)

Maintain landmarks better (delay fade out of lines)

Subjects preferred animated transitions

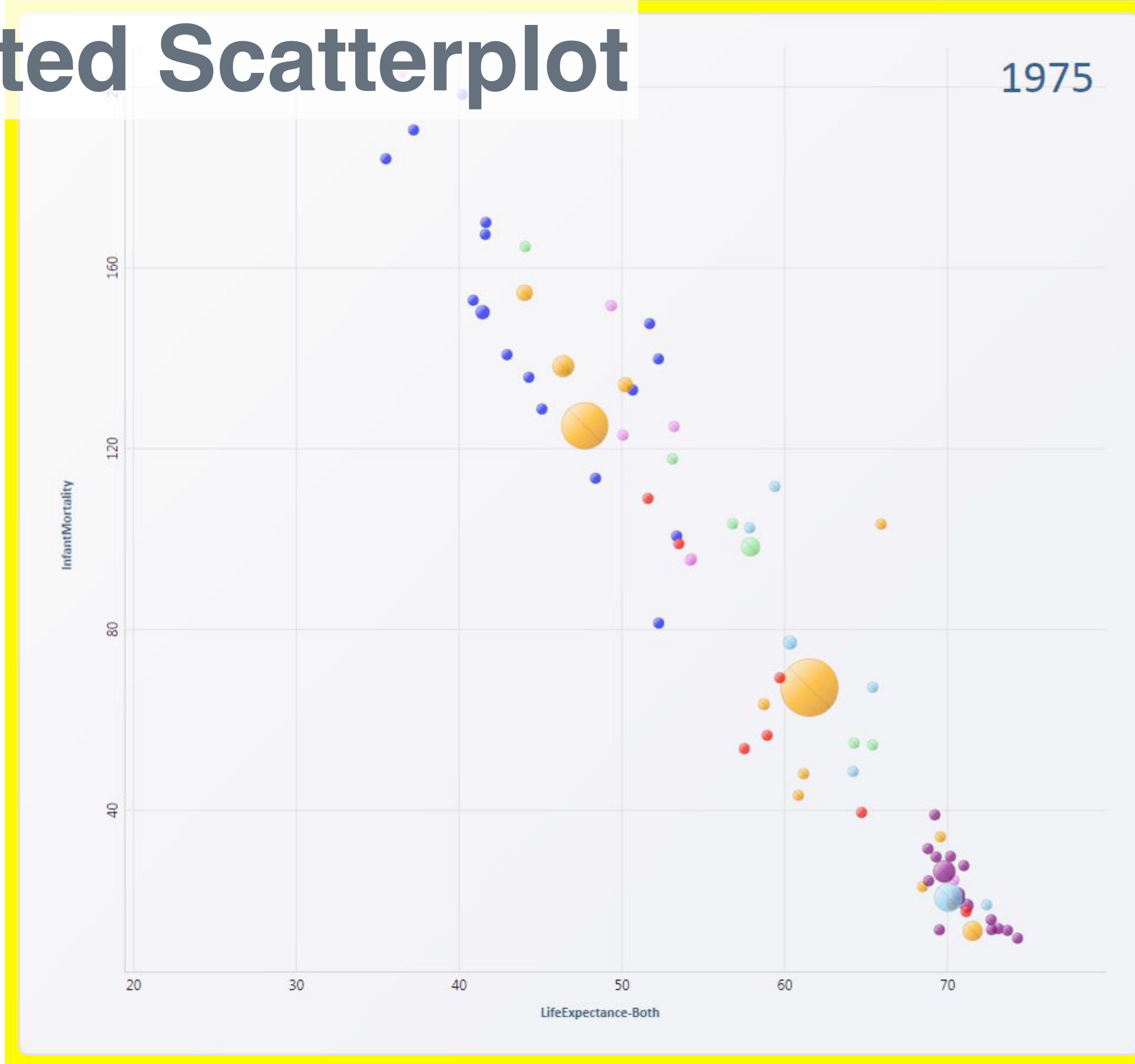




TED



Animated Scatterplot



Color Legend (continent)

- Africa
- Asia
- Europe
- Middle East
- North America
- Oceania
- South America

Task

Select two countries with decreasing InfantMortality, but little change in life expectancy.

Ctrl-Click on a country (in chart) to set an answer.

Answers set: 0/2

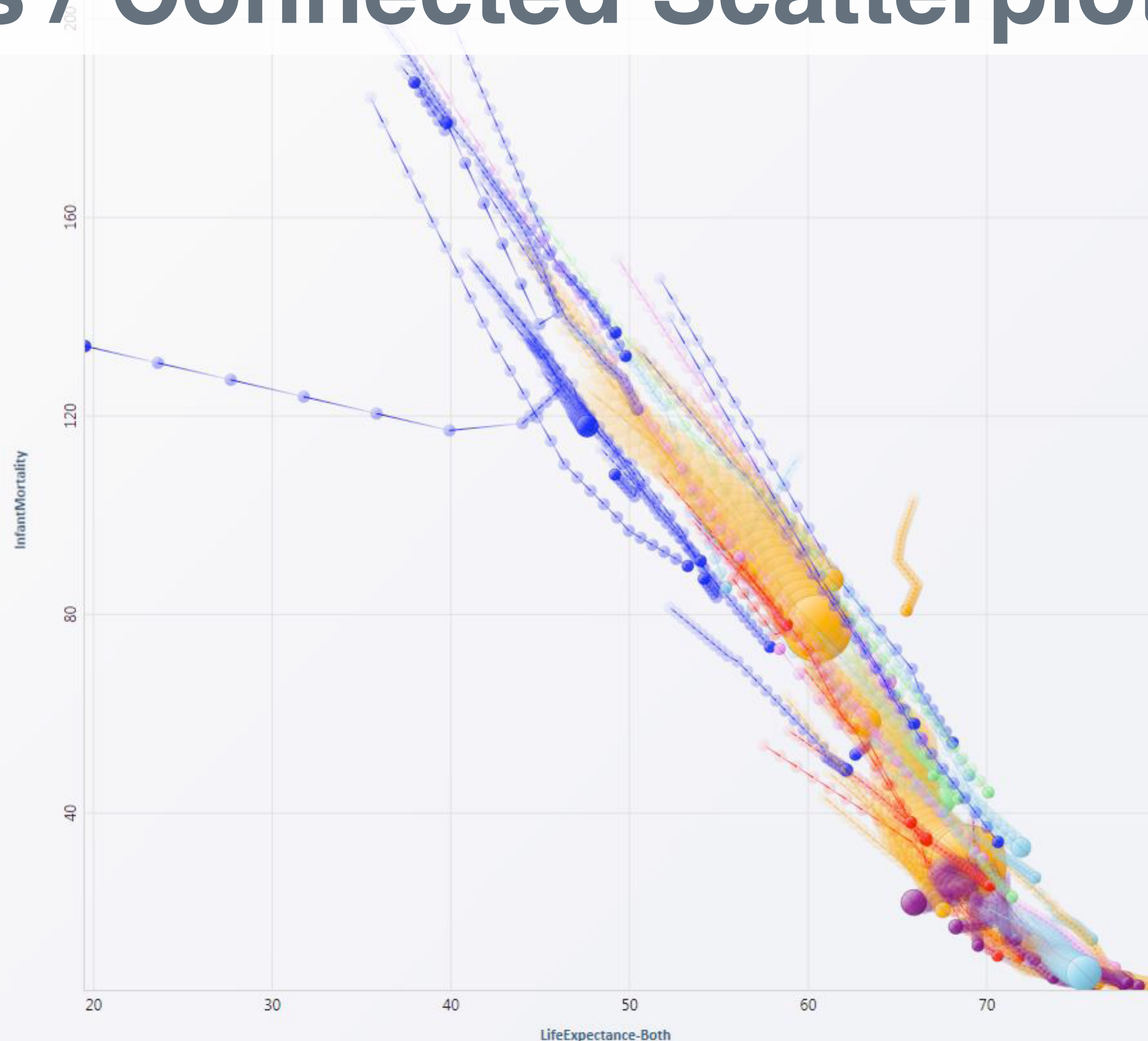
Next

Click on "Next" when finished (or "Give Up" if you cannot find all the answers)

Give Up

Next

Traces / Connected Scatterplot



Color Legend (continent)

Africa
Asia
Europe
Middle East
North America
Oceania
South America

Task

Select two countries whose InfantMortality dropped first, then increased later.

Ctrl-Click on a country (in chart) to set an answer.

Answers set: 0/2

Next

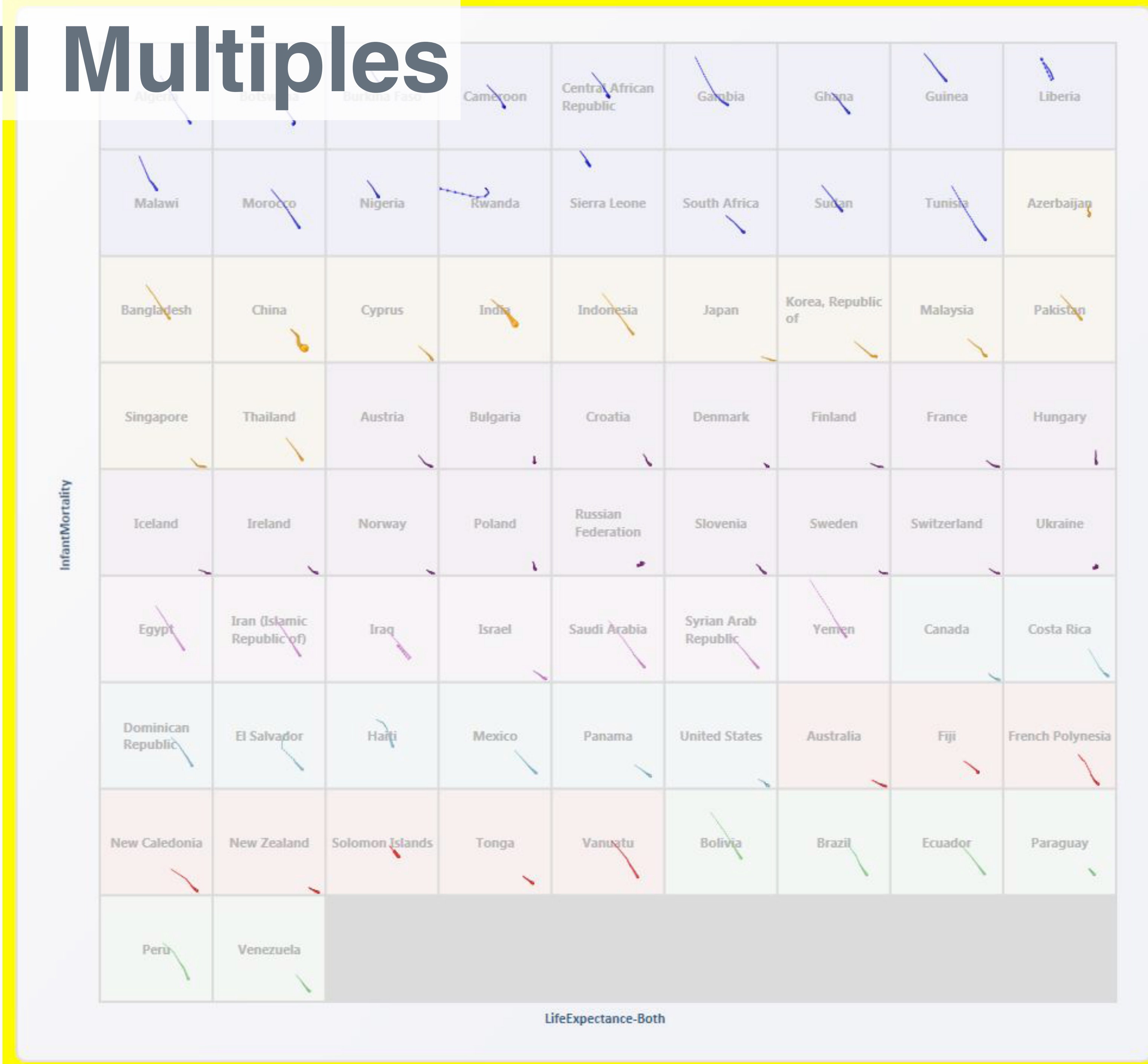
Click on "Next" when finished (or "Give Up" if you cannot find all the answers)

Give Up

Next

Robertson, George, et al. "Effectiveness of animation in trend visualization." 2008

Small Multiples



Color Legend (continent)

- Africa
- Asia
- Europe
- Middle East
- North America
- Oceania
- South America

Task

Select two countries whose InfantMortality dropped first, then increased later.

Ctrl-Click on a country (in chart) to set an answer.

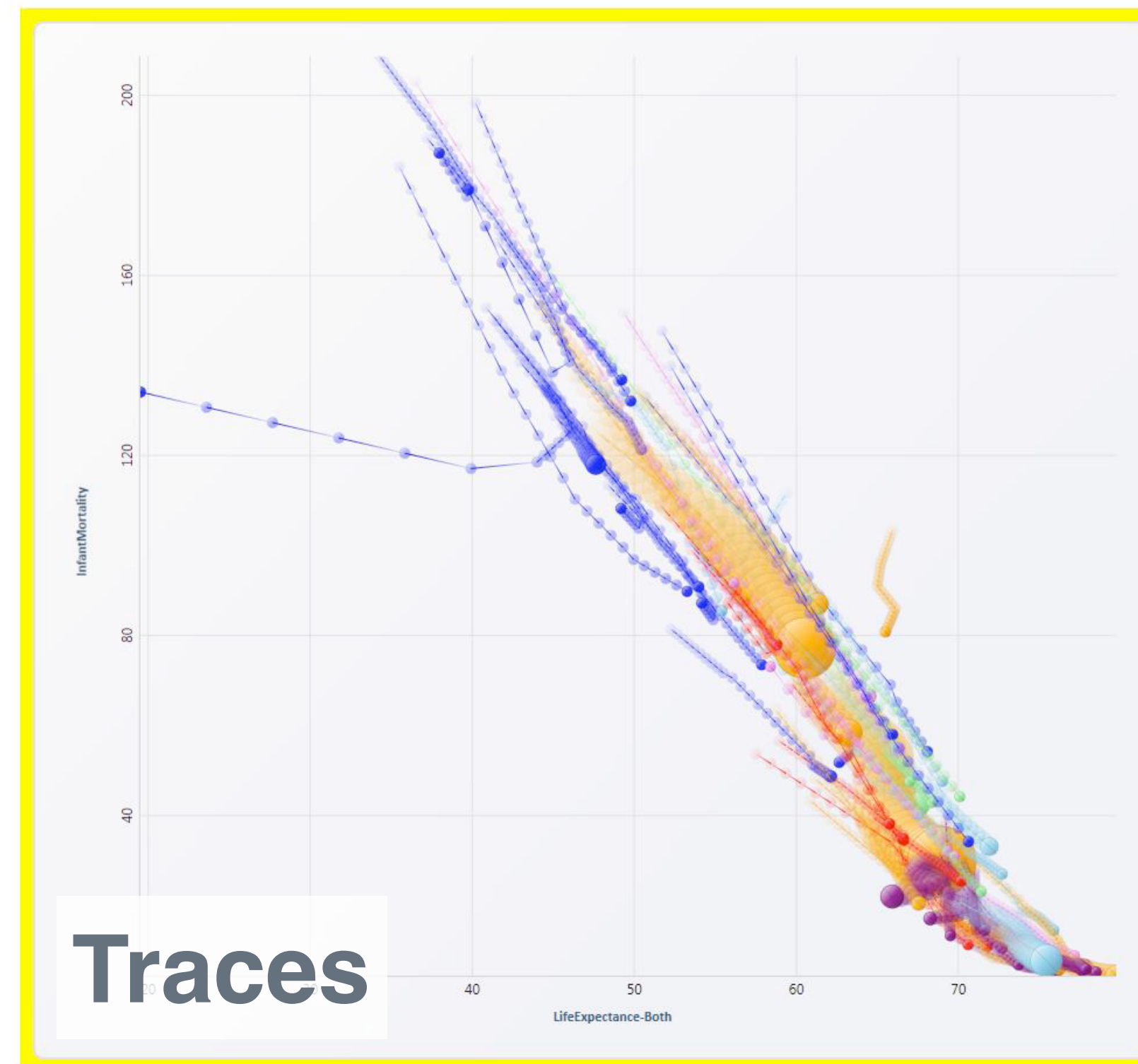
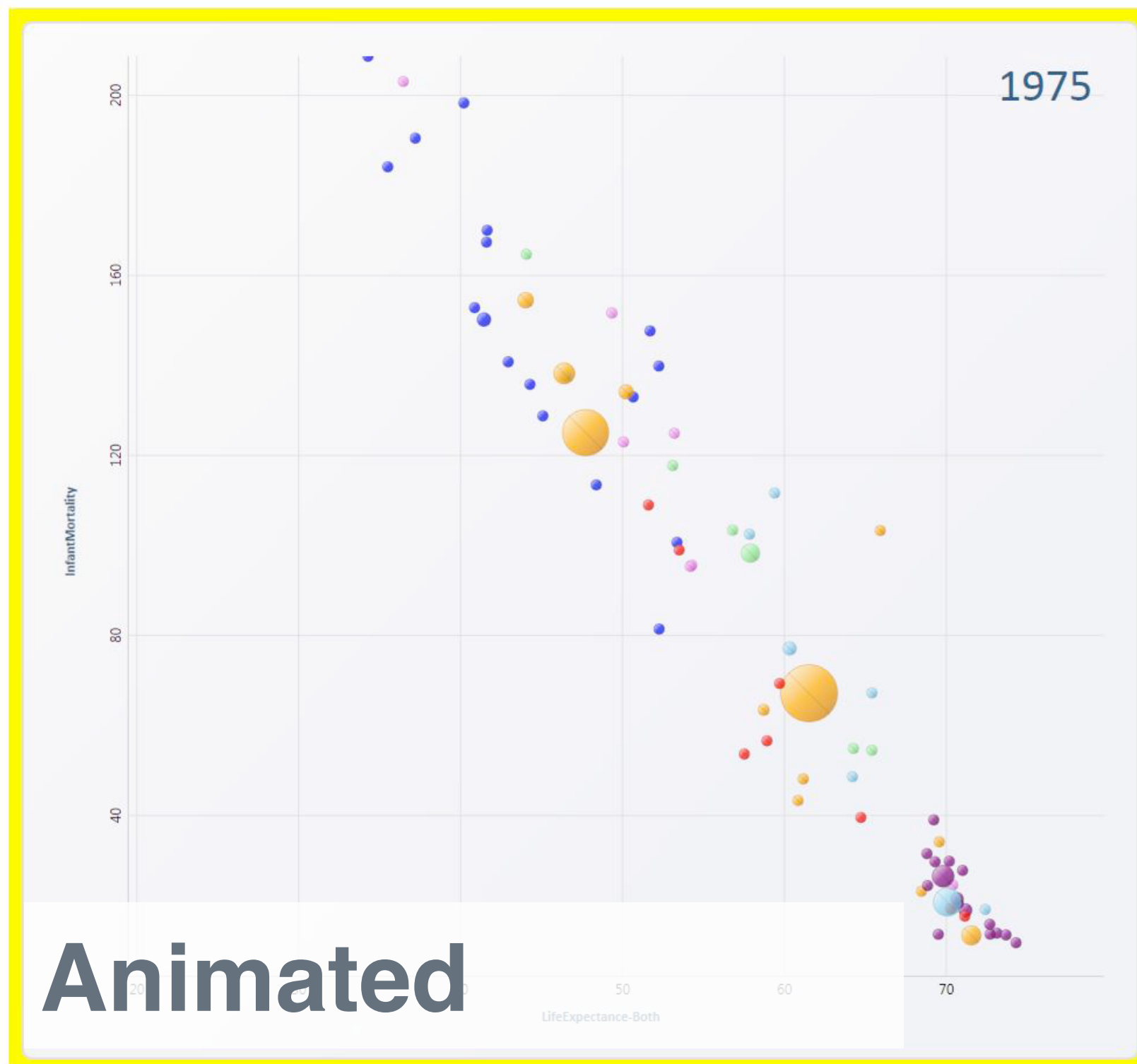
Answers set: 0/2

Next

Click on "Next" when finished (or "Give Up" if you cannot find all the answers)

Study Conclusions

Analysis Task and Presentation Task.
Presentation condition included narration.
Subjects asked comprehension questions.



Which condition would participants:
be more **accurate**, be **faster**, and **prefer**?

tryclassbuzz.com

Study Conclusions

Analysis Task and Presentation Task.
Presentation condition included narration.
Subjects asked comprehension questions.

Animations **10% less accurate** than small multiples.

Presentation: Animation **60% faster** than small multiples.

Analysis: Animation **82% slower** than small multiples.

User preferences favor animation
(even though less accurate and slower for analysis!).

Implementing Animation

Using CSS

Using CSS is the simplest way to animate

```
circle {  
  transition: 200ms;  
}
```

= Any time an attribute changes, animate it over 200ms instead of changing instantly

Three cases for animation: new element (enter), changing existing element (update), deleting element (exit).

transition generally only addresses changing existing element!

Using D3

Simple Bar Animation

This is a simple bar animation. The bar is animated from 200px to 500px width.

Replay Animation



[lectures/animation/simple-bar/main.js](#)

```
d3.select('#rect').transition().duration(2000).attr('width', '500');
```

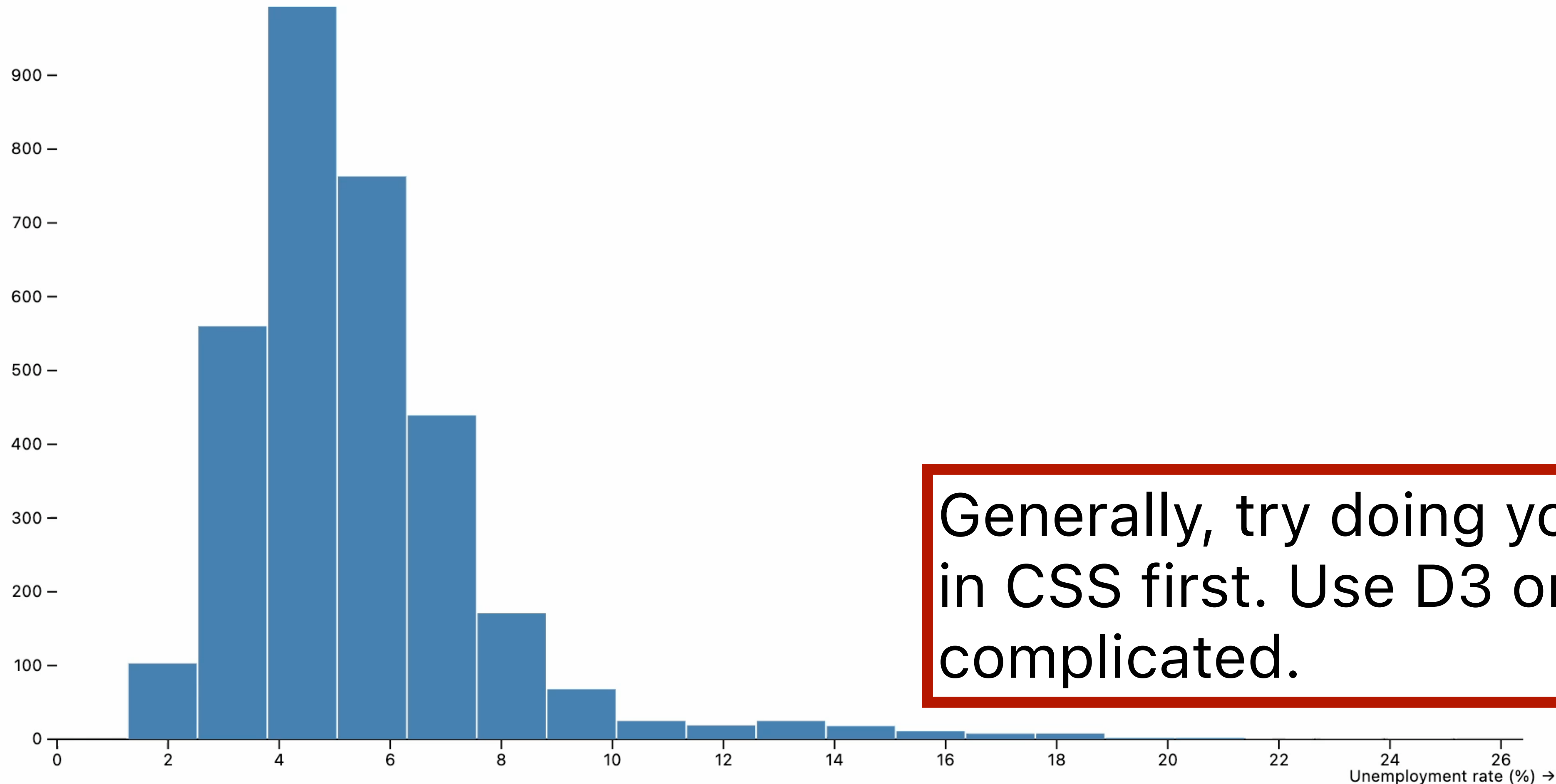
Add `.transition().duration(t)` before changing an attribute to animate it!

Animating Histogram Bins

This is an example where we animate the bins of a histogram, derived from <https://d3js.org/lectures/animation/histogram-bins/main.js>

Number of bins:

↑ Frequency (no. of counties)



Read through the code and ask a staff if you have questions about it!

Generally, try doing your animation in CSS first. Use D3 only if too complicated.