Animation

DSC 106: Data Visualization

Sam Lau

UC San Diego

Announcements

Lab 8 due next week Friday.

Final Project Prototype due next week Tuesday.

Sam doesn't have OH today, but will hold extra OH next Wed 4-5pm.

No class (or OH) on Monday because of Memorial Day.

FAQs:

1. Can I change my project idea after the proposal? Yes.
2. Can I change my team after the proposal? No.

Animation

Animation Goals

Direct attention

Increase Engagement

Explain a Process

Understand a State Transition

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Motion as a visual cue

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

7.5 fps

15 fps

30 fps

60 fps

60 fps

30 fps

15 fps

7.5 fps

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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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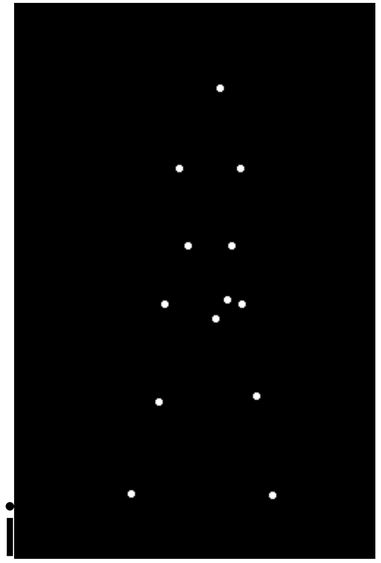

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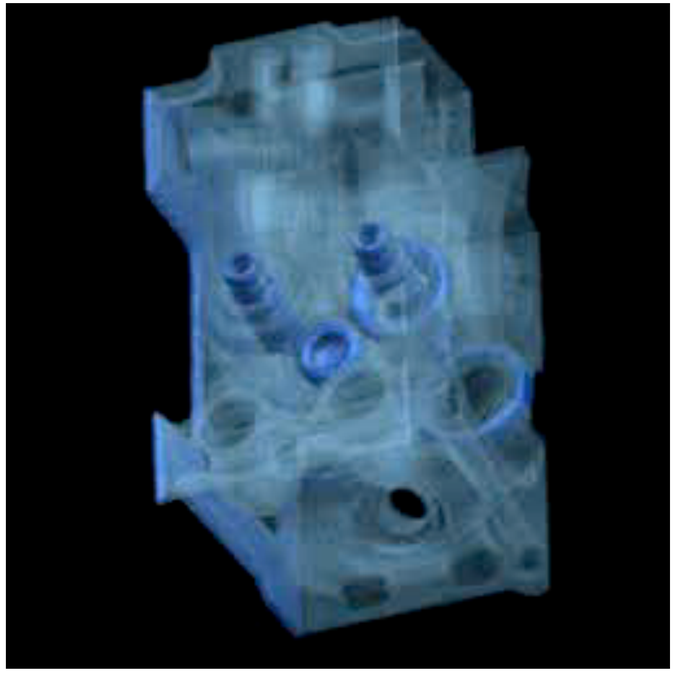

Animation Goals

Constructing narratives & anthropomorphizing

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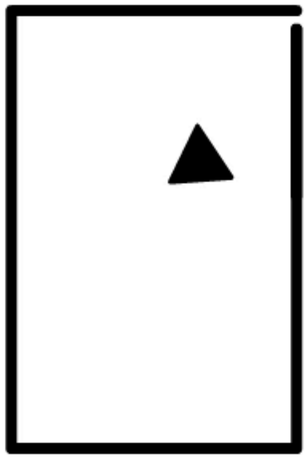
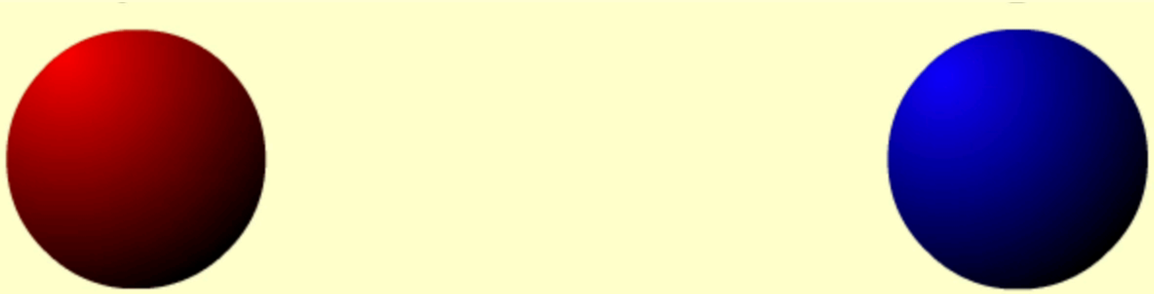


What's happening in this film?

tryclassbuzz.com
Code: **shapes**

Heider, Fritz, and Marianne Simmel. "An experimental study of apparent behavior." *The American journal of psychology* 57.2 (1944): 243-259.



[Michotte 1946]

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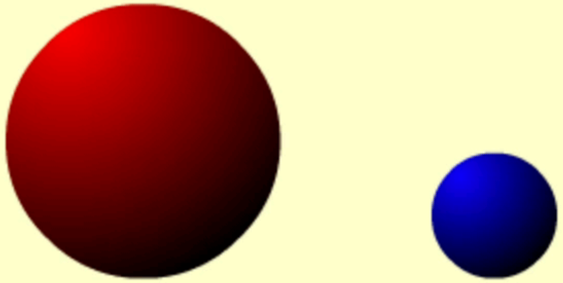
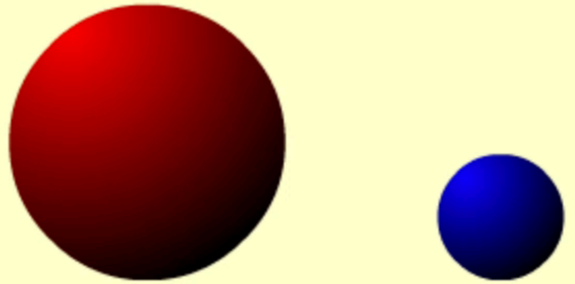


[Michotte 1946]



[Michotte 1946]

Animation Goals

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

Understand a State Transition

Animation Goals

Attribution of Causality.

Direct attention

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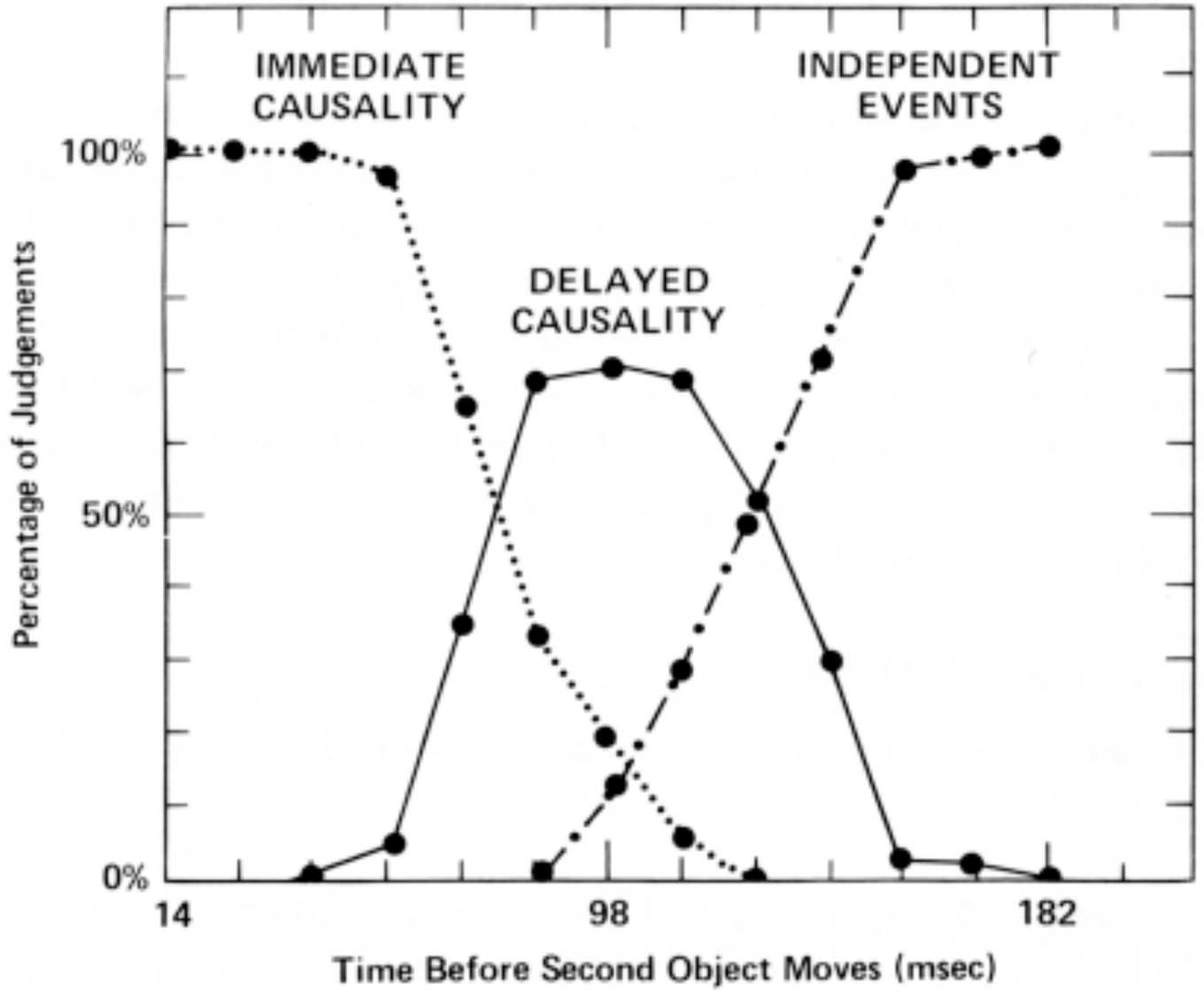
Explain a Process

Understand a State Transiti



[Reprint from Ware 2004]

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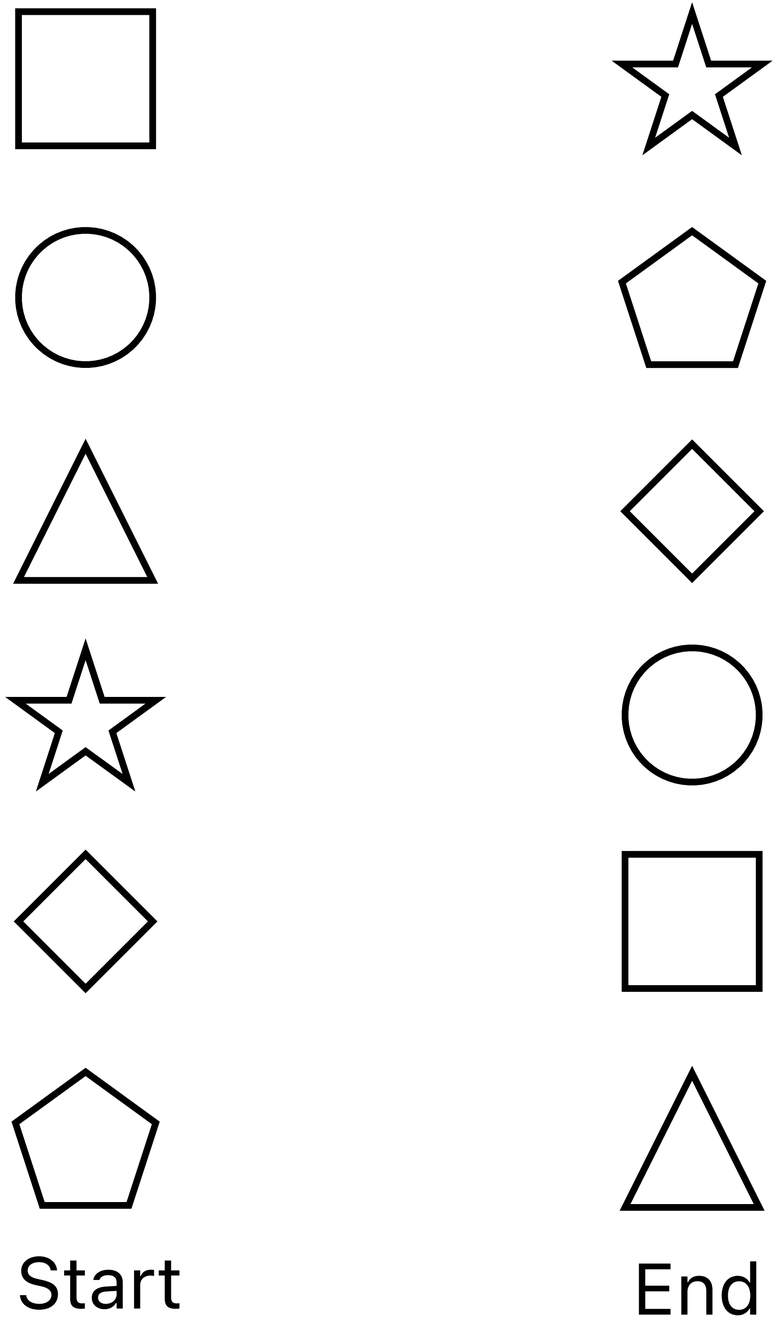

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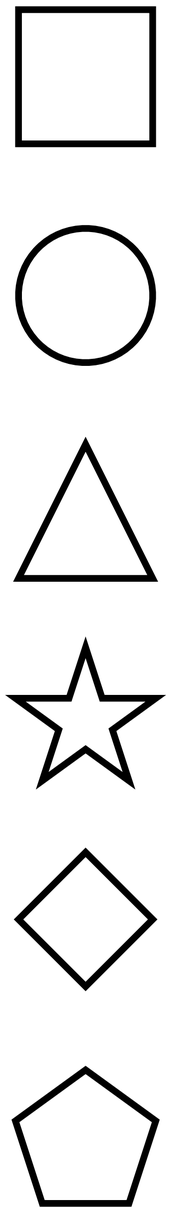
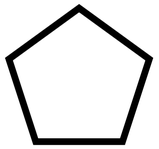


Start

End

Animation Goals



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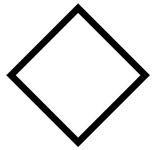

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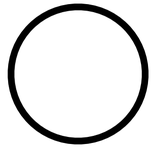
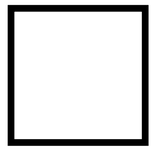


Explain a Process

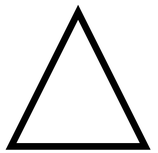


Understand a State Transition

Animation can show transition better, but…

May be too fast or too slow.

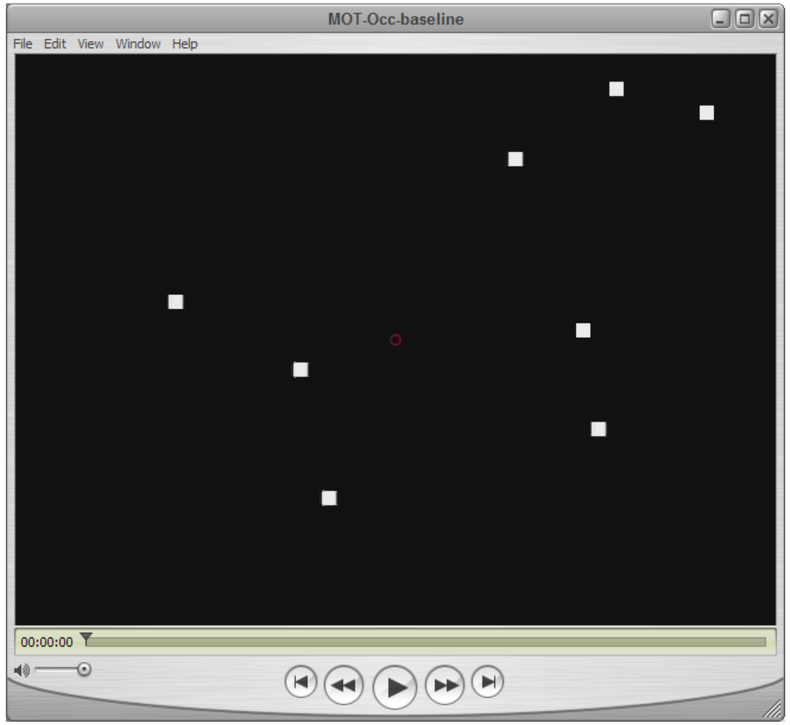
Too many objects may move at once.



End

Animation Goals

How many dots can we track at once?



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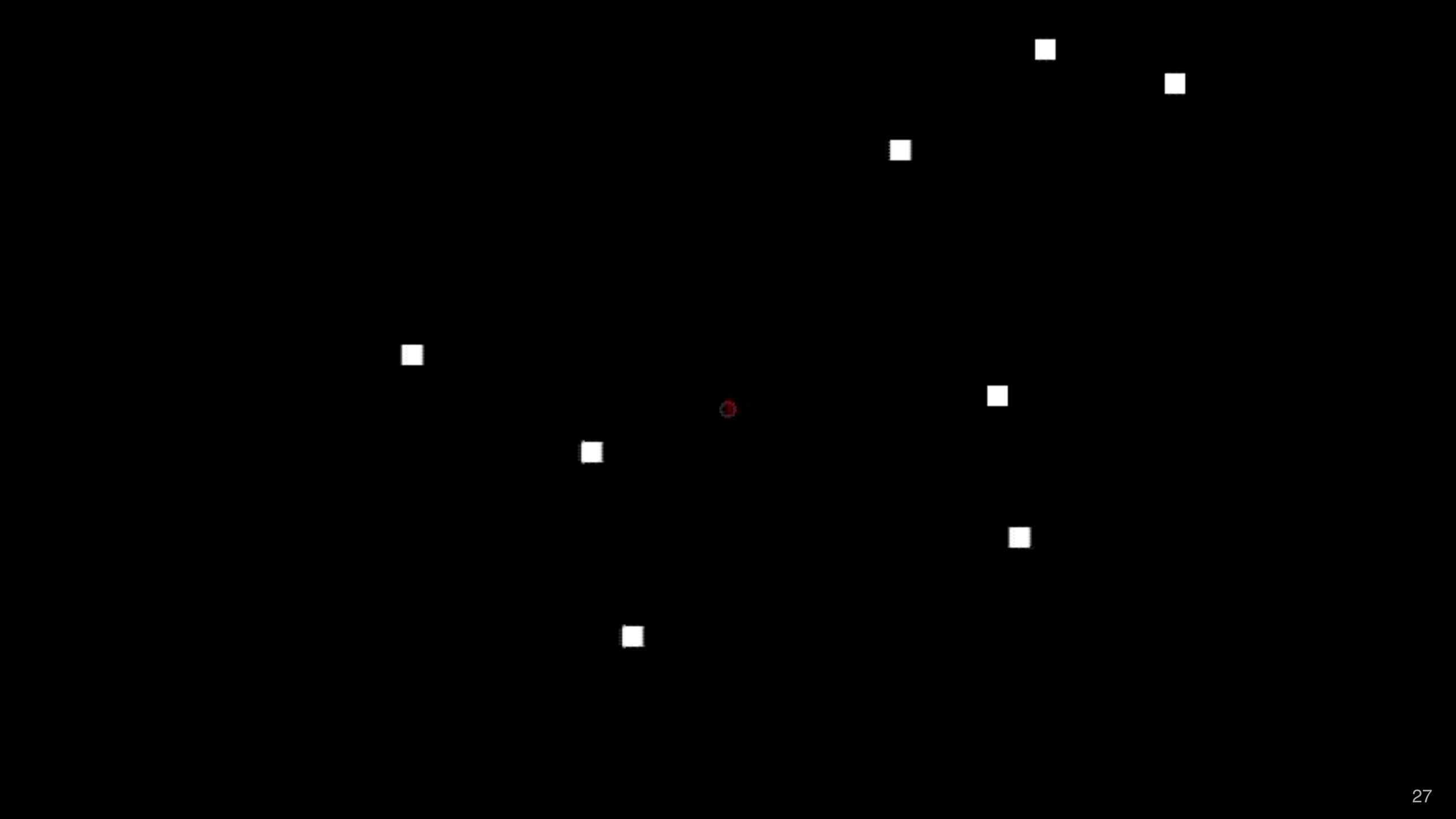
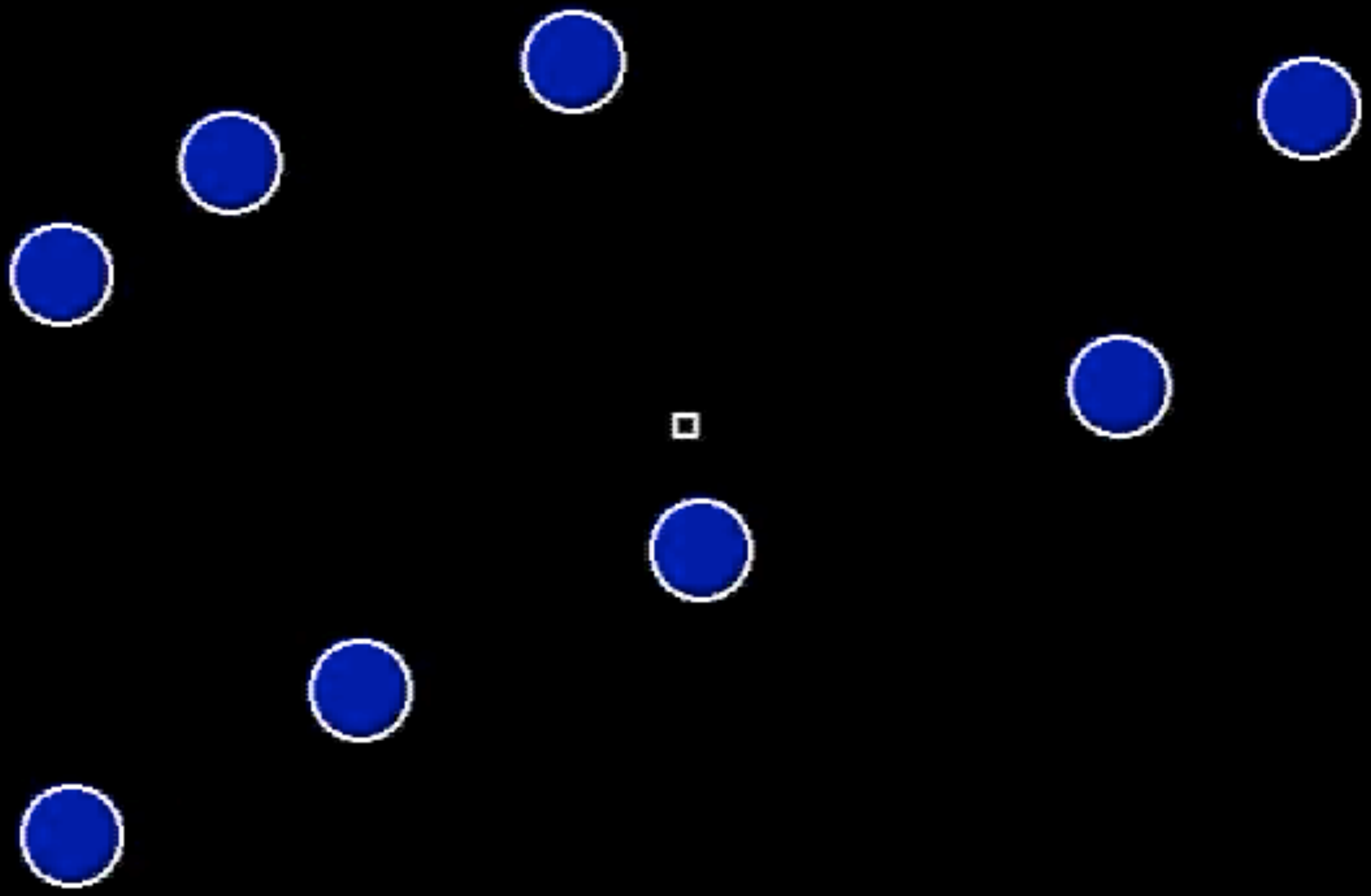
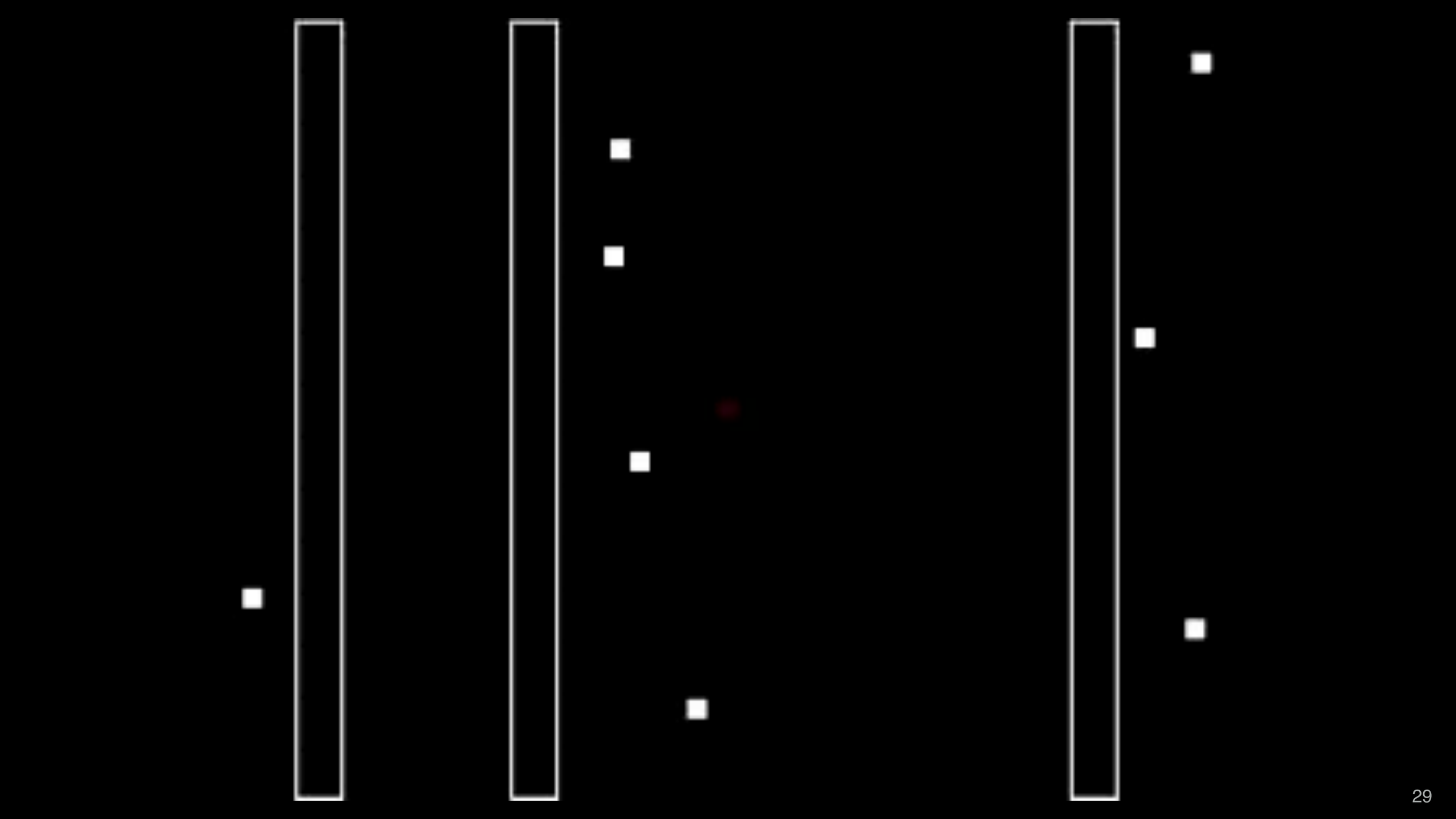
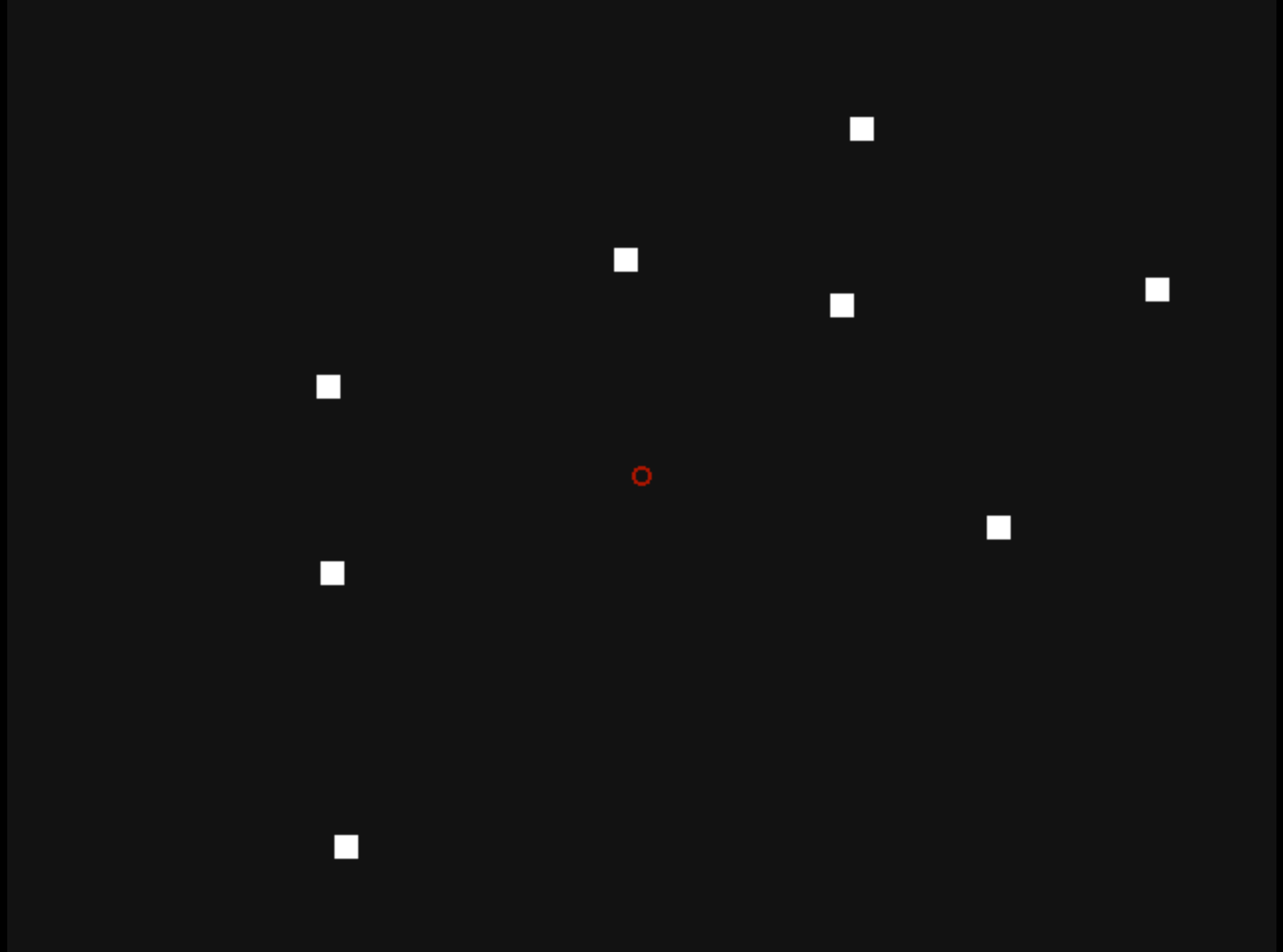
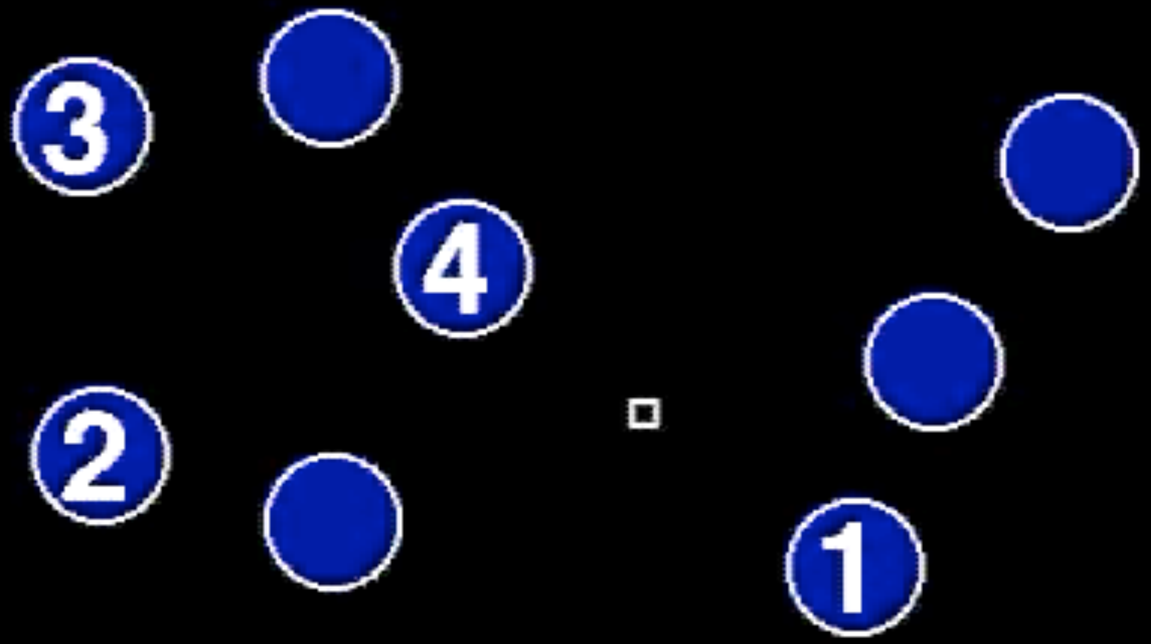






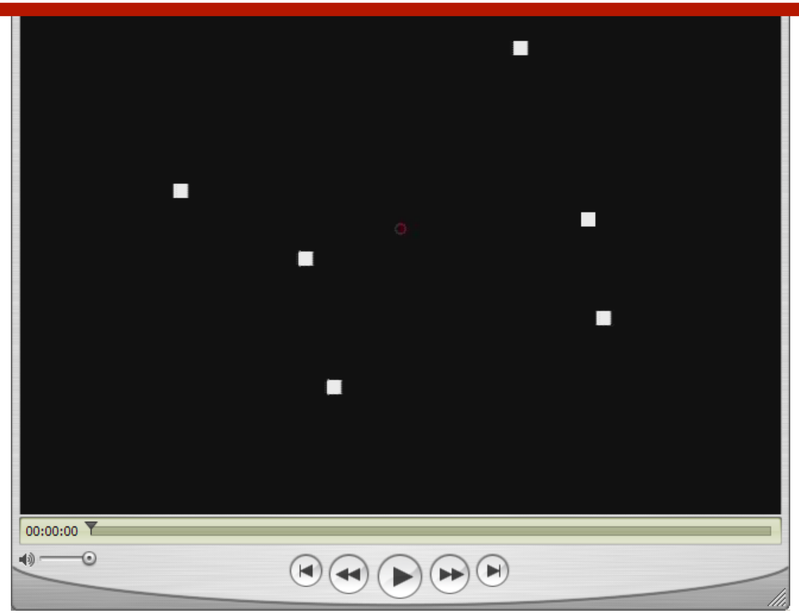



3
4
2
1

Animation Goals

How many dots can we track at once?

4-6. Difficulty increases significantly at 6.



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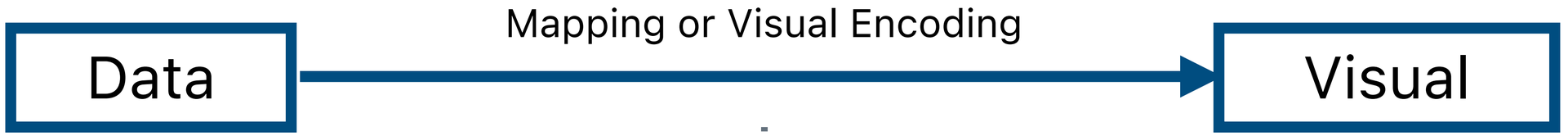
Effective Animations

Heer, Jeffrey, and George Robertson. "Animated transitions in statistical data graphics." 2007



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

Mackinlay, Jock. "Automating the design of graphical presentations of relational information." *Acm Transactions On Graphics (Tog)* 5.2 (1986): 110-141.

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.*

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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

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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)

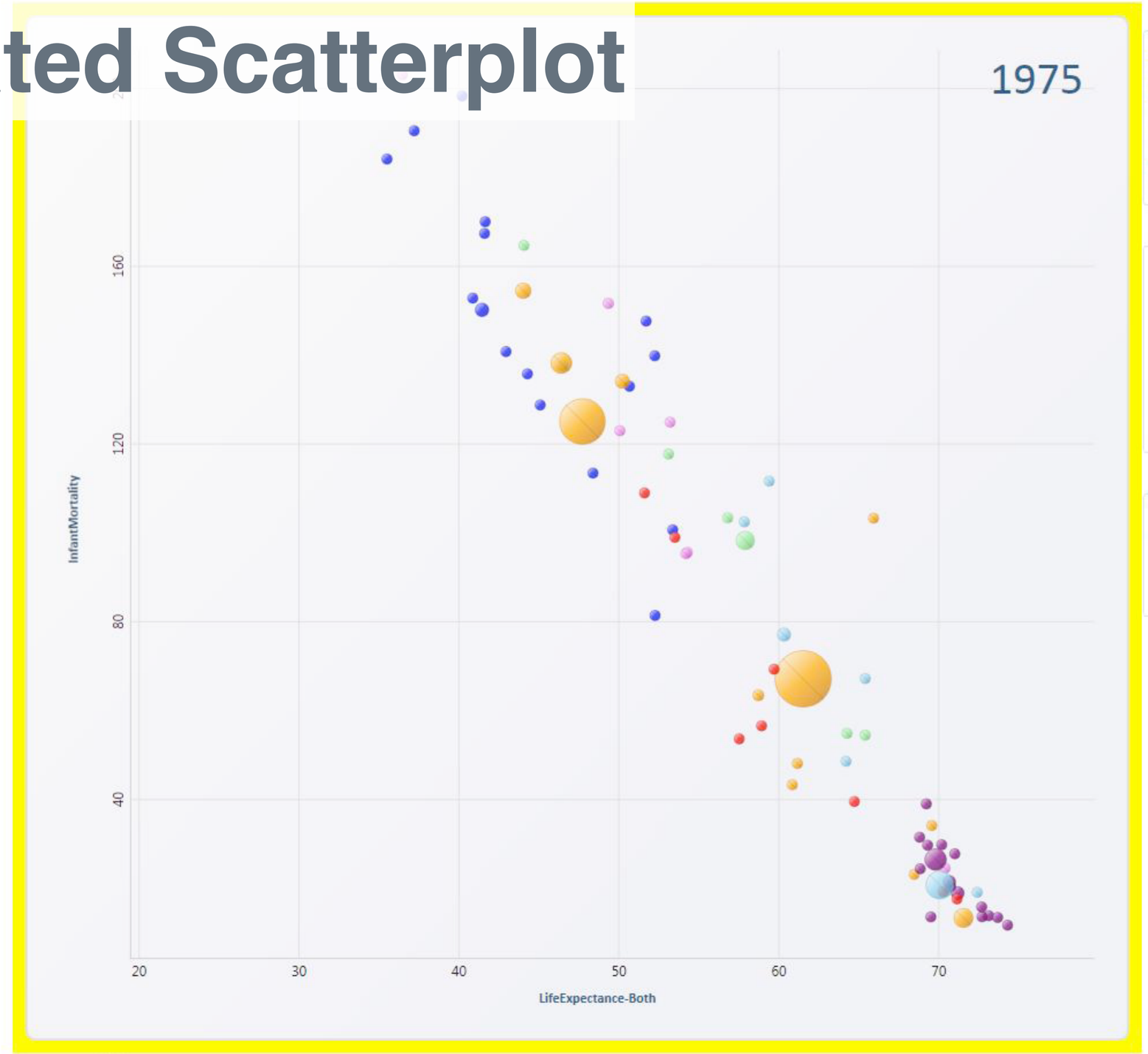
Subjects preferred animated transitions

2.5
3
3.5
6.5
7

1962
Life expectancy at birth, total
Fertility rate, total

2.5
3
3.5
6.5
7

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

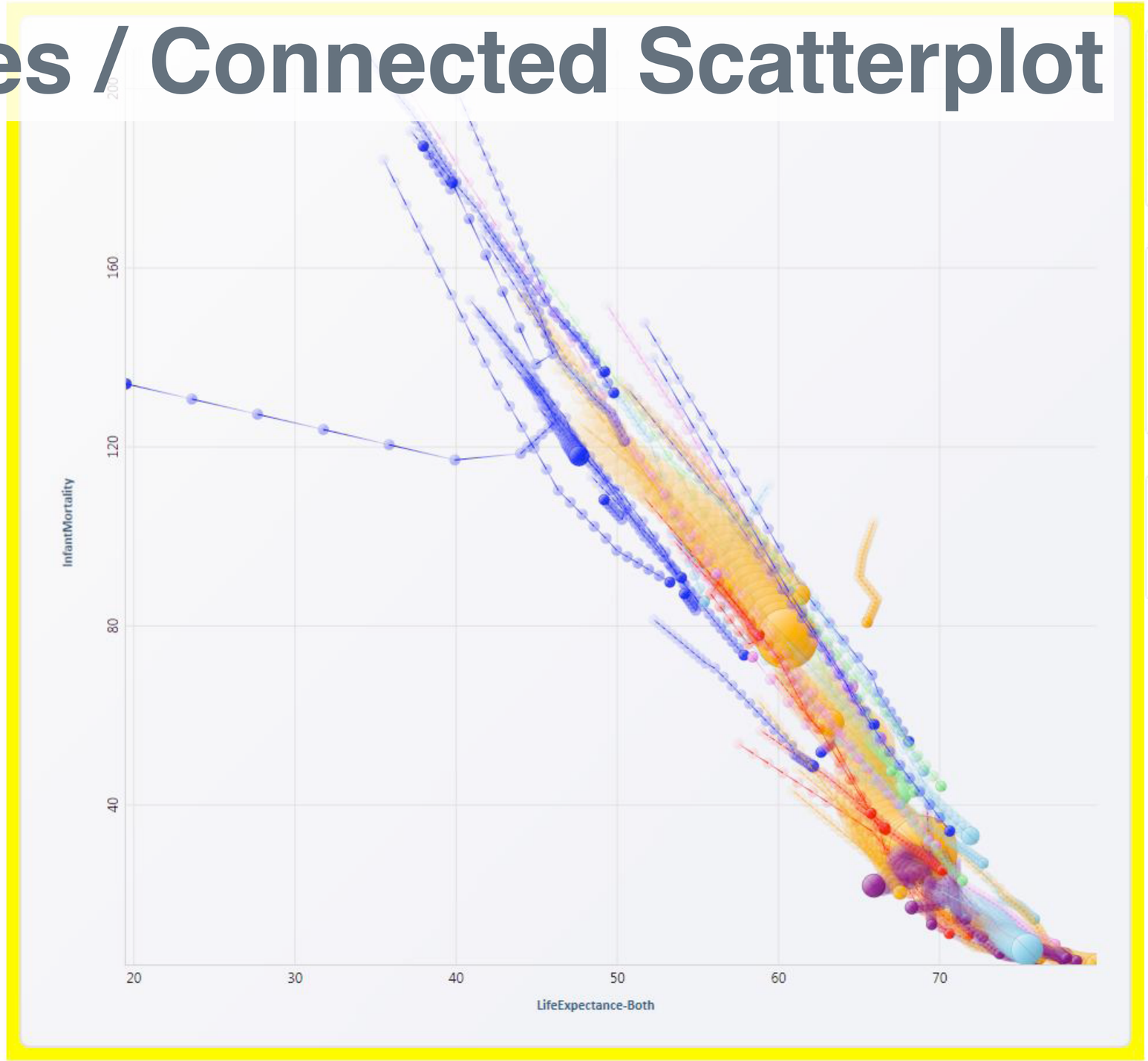
Next

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

Give Up | Next

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

Traces / Connected Scatterplot



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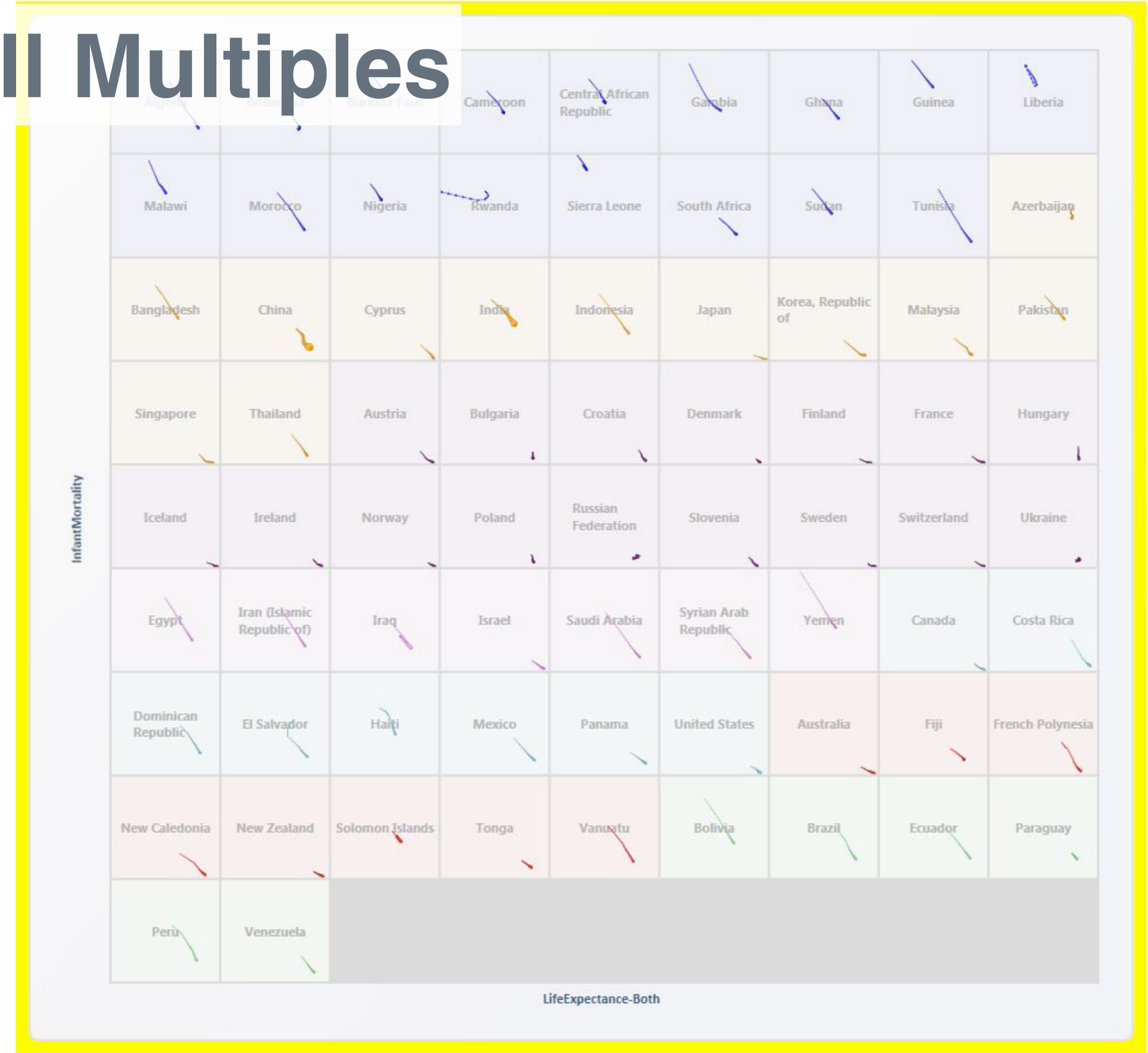
Small Multiples



Color Legend (continent)

- Africa
- Asia
- Europe
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- 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

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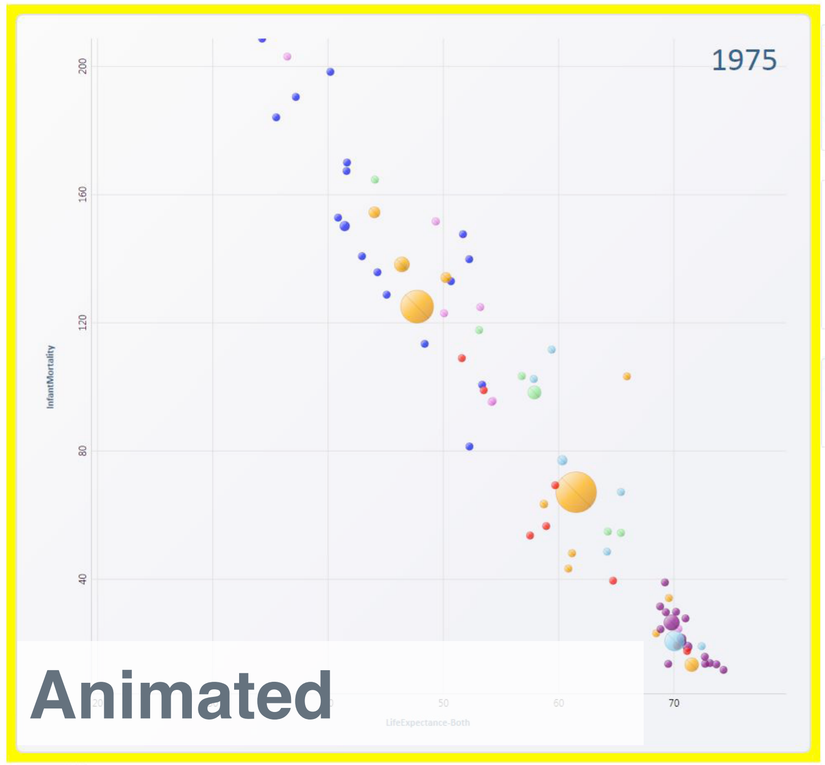
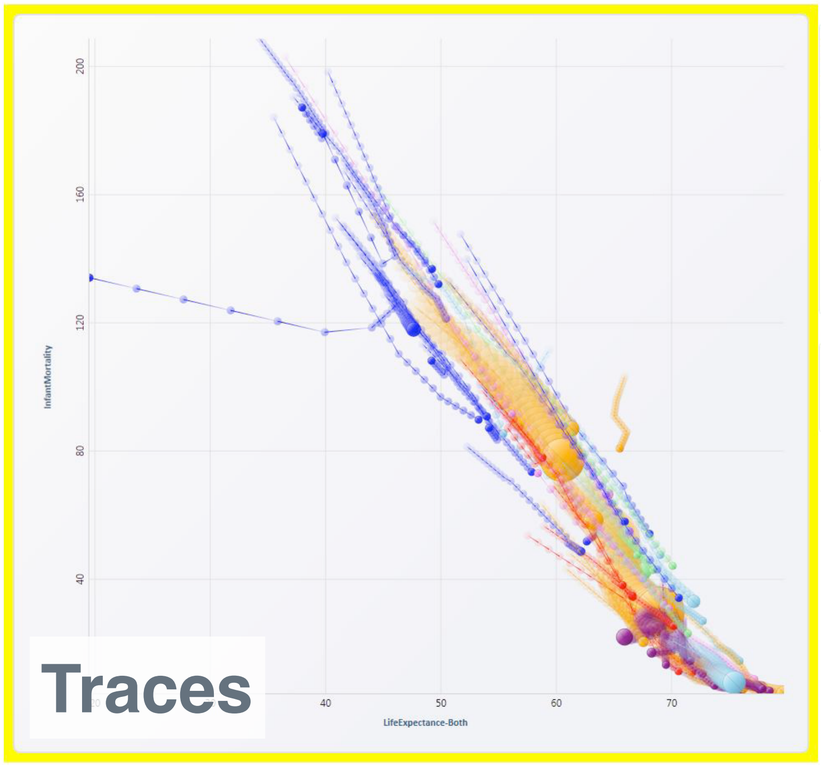
Study Conclusions

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
Code: **anim**

Study Conclusions

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Presentation condition included narration.
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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!).

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

Implementing Animation

Using CSS

Using CSS is the simplest way to animate

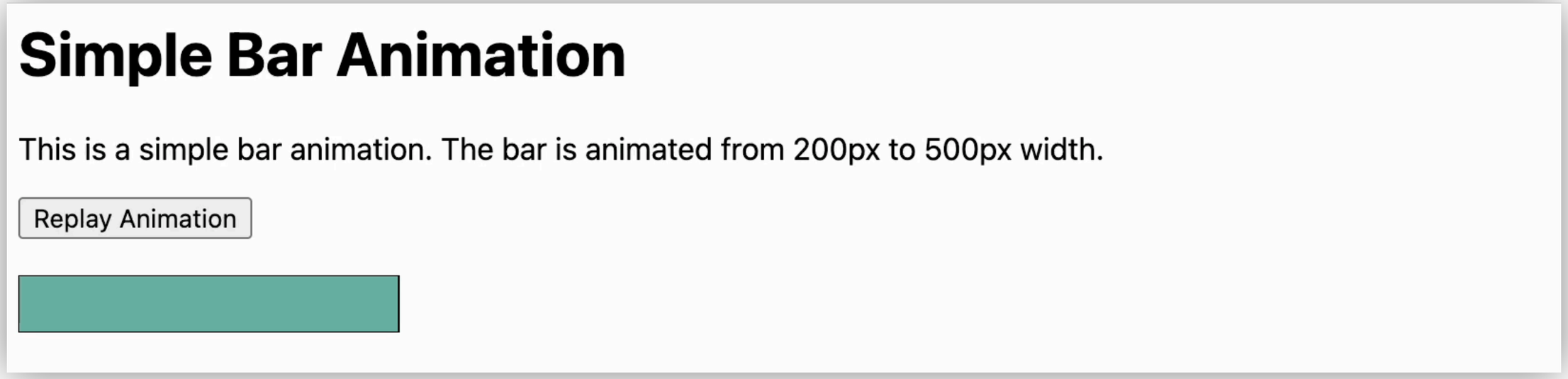
```
circle {
  transition: 200ms;
}
```

= 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



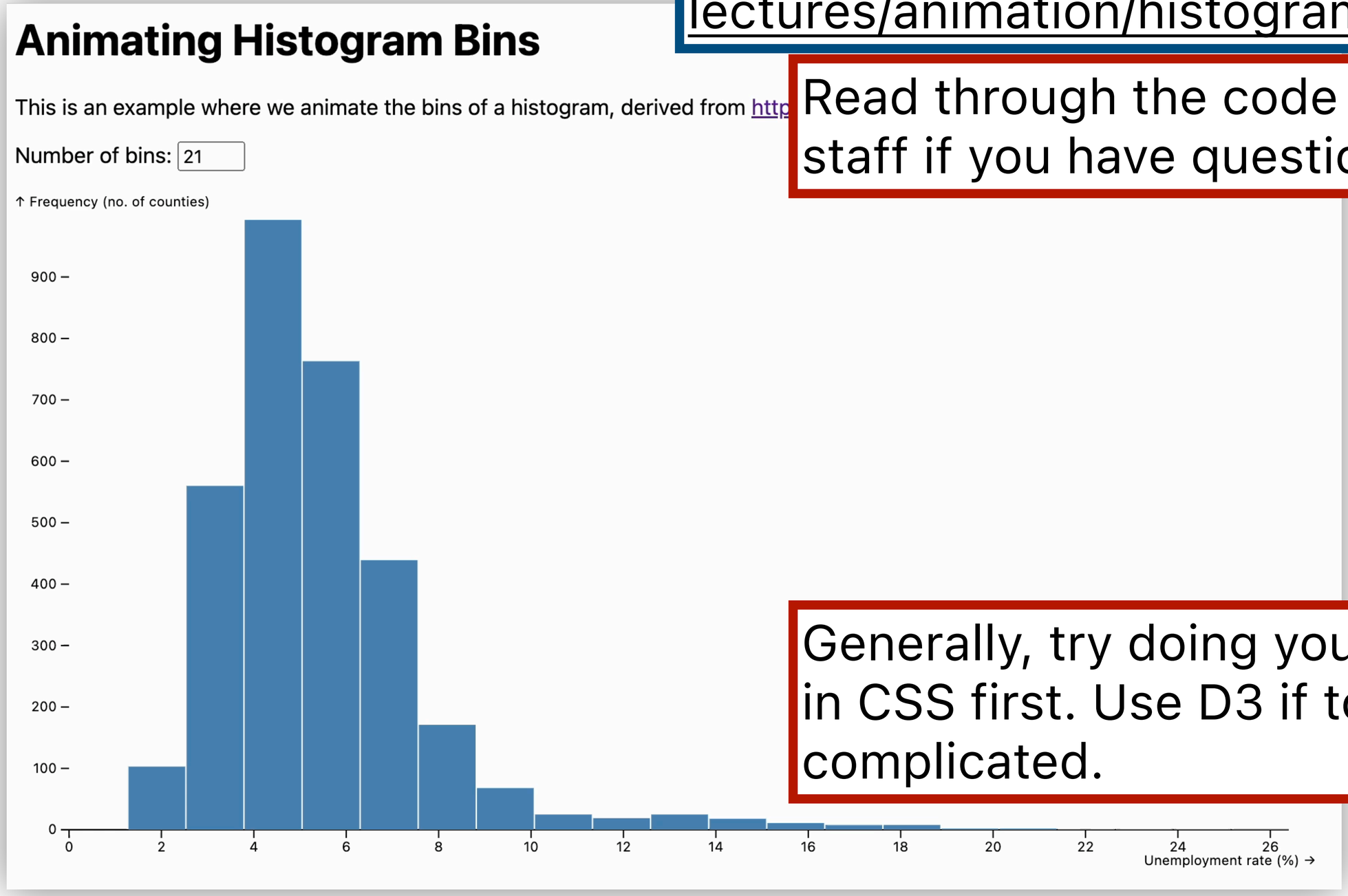
lectures/animation/simple-bar/main.js

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

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

lectures/animation/histogram-bins/main.js

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



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