

Designing and Implementing an Interactive Scatterplot Visualization for a Tablet Computer



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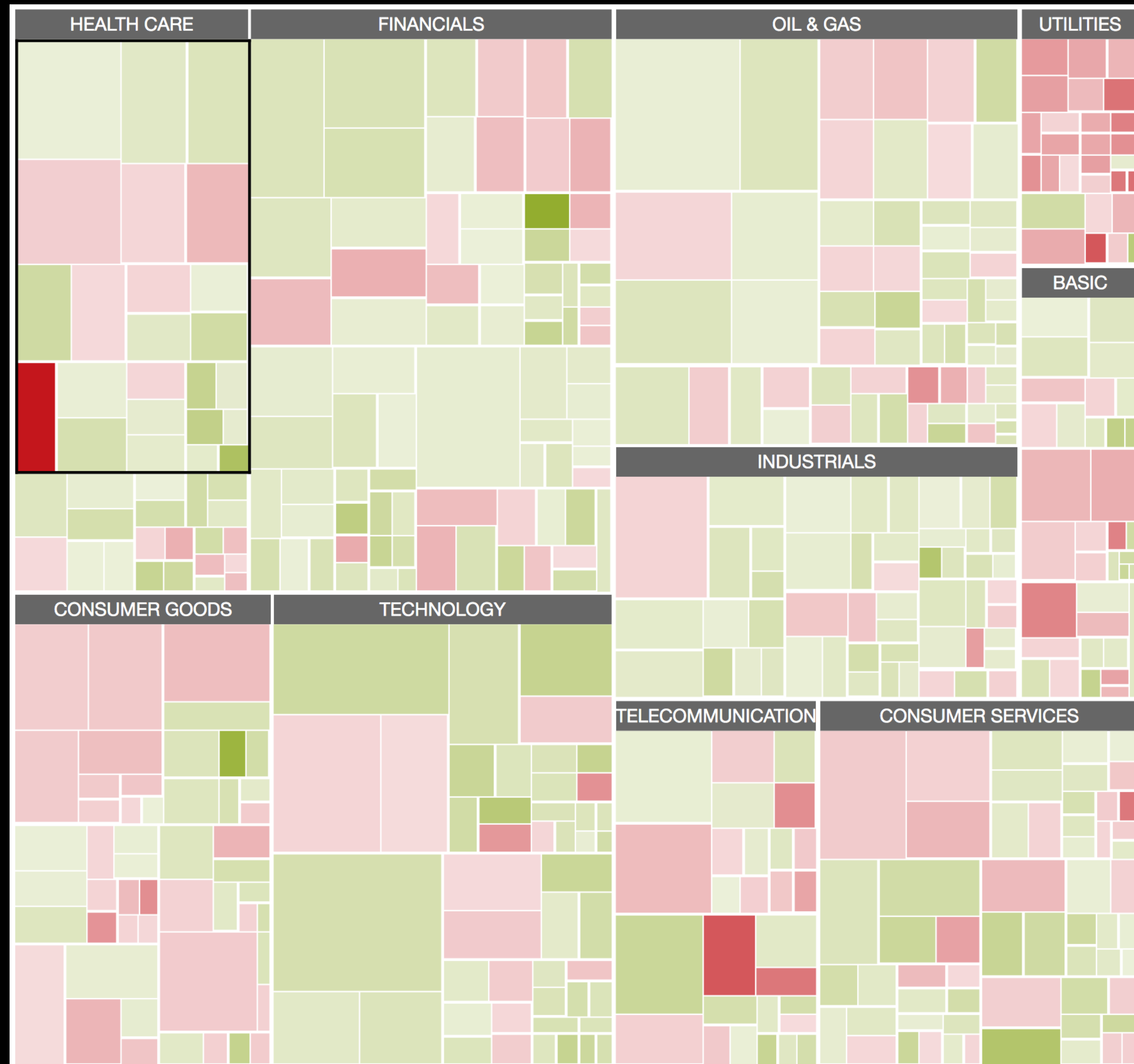
Norms in visualization systems

Norms in visualization systems

- Cursor driven

Norms in visualization systems

- Cursor driven
- WIMP based



Data-Driven Documents



Logging_and_Monitoring_example.dxp - TIBCO Spotfire

File Edit View Insert Tools Help

Cover Page **Open Files vs. Performance Counters** Performance Counters Document Cache & Open Files Audit & User Sessions Spotfire Server Library

Open Files

Data table: **OpenFilesStatisticsLog**

Color by: **Analysis Name**

- 22_USACounties
- Baseball
- ReferenceArchitecture 10M
- ReferenceArchitecture 1k
- ReferenceArchitecture 1M

Time	Files
4/21/2010 12:00:00 PM	6
4/21/2010 12:05:00 PM	38
4/21/2010 12:10:00 PM	31
4/21/2010 12:15:00 PM	42
4/21/2010 12:20:00 PM	53
4/21/2010 12:25:00 PM	47
4/21/2010 12:30:00 PM	34
4/21/2010 12:35:00 PM	26
4/21/2010 12:40:00 PM	40
4/21/2010 12:45:00 PM	32
4/21/2010 12:50:00 PM	32
4/21/2010 12:55:00 PM	27
4/21/2010 1:00:00 PM	20
4/21/2010 1:05:00 PM	17
4/21/2010 1:10:00 PM	9
4/21/2010 1:15:00 PM	14
4/21/2010 1:20:00 PM	8
4/21/2010 1:25:00 PM	6
4/21/2010 1:30:00 PM	8
4/21/2010 1:35:00 PM	8
4/21/2010 1:40:00 PM	11
4/21/2010 1:45:00 PM	18
4/21/2010 1:50:00 PM	22
4/21/2010 1:55:00 PM	16
4/21/2010 2:00:00 PM	26
4/21/2010 2:05:00 PM	26
4/21/2010 2:10:00 PM	18
4/21/2010 2:15:00 PM	10
4/21/2010 2:20:00 PM	6
4/21/2010 2:25:00 PM	11
4/21/2010 2:30:00 PM	26
4/21/2010 2:35:00 PM	58
4/21/2010 2:40:00 PM	82
4/21/2010 2:45:00 PM	105
4/21/2010 2:50:00 PM	91
4/21/2010 2:55:00 PM	48
4/21/2010 3:00:00 PM	29
4/21/2010 3:05:00 PM	14
4/21/2010 3:10:00 PM	5

Server Performance

Data table: **PerformanceCounterLog**

Marking: **Marking**

Line by: **(None)**

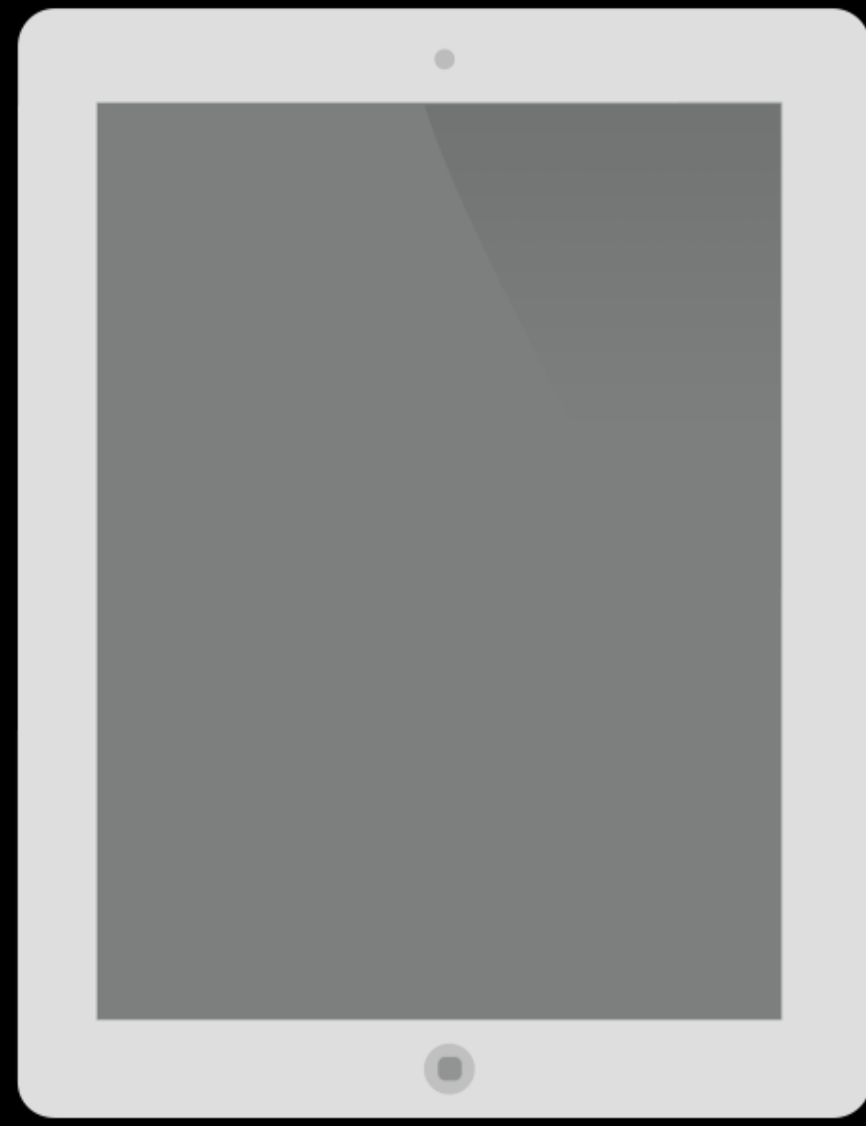
Color by: **Counter**

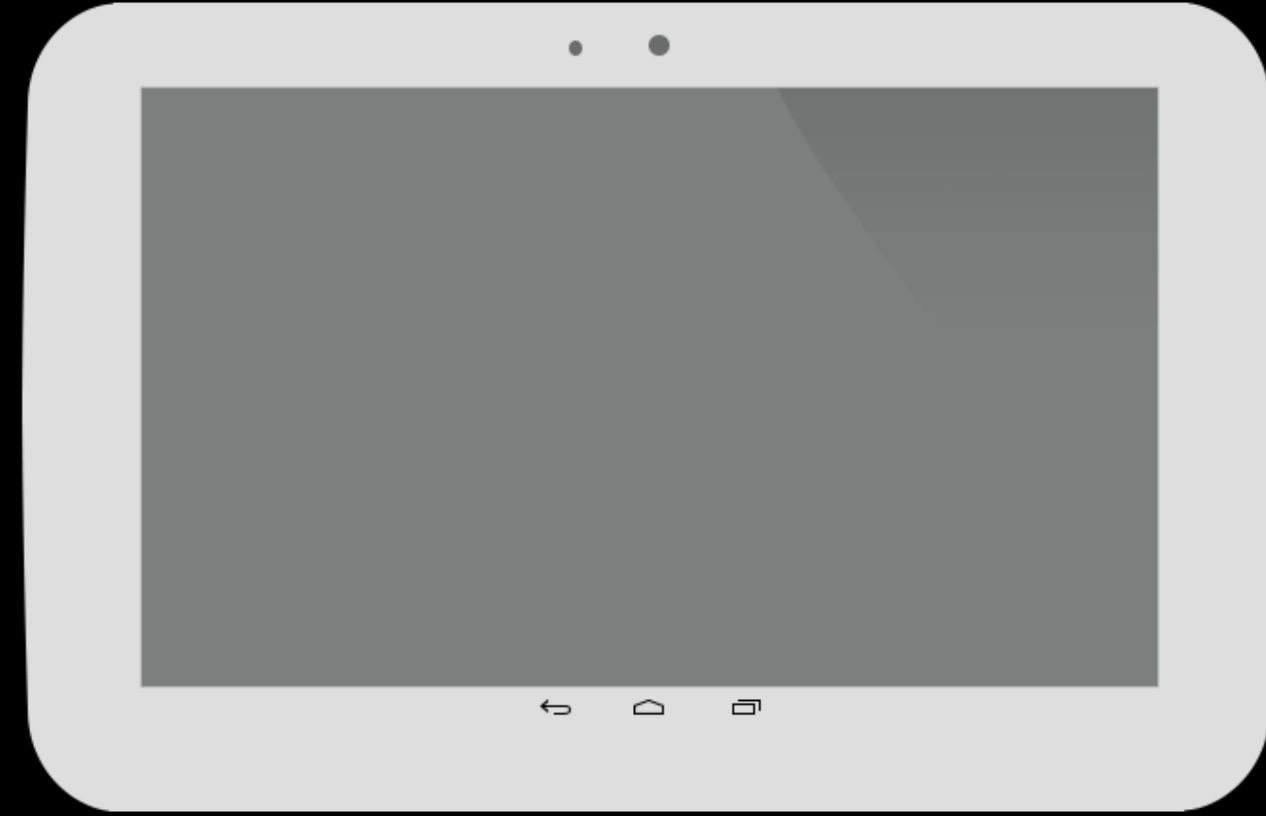
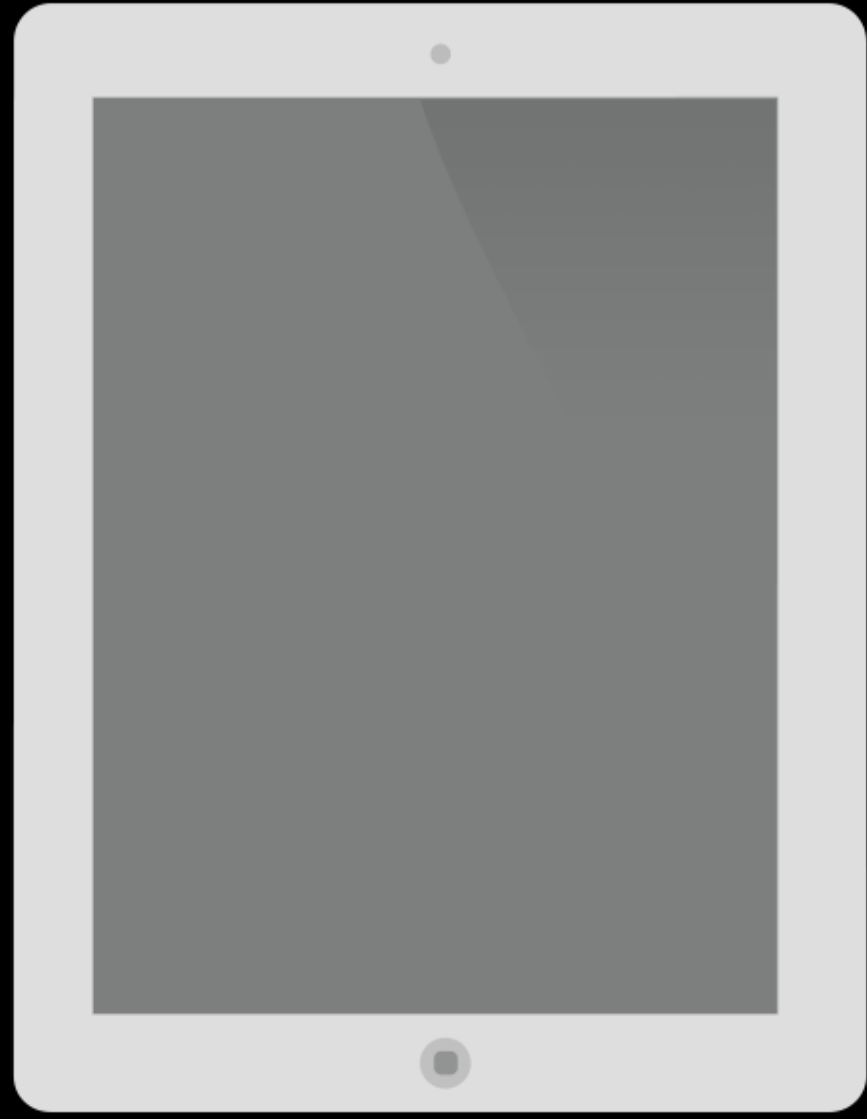
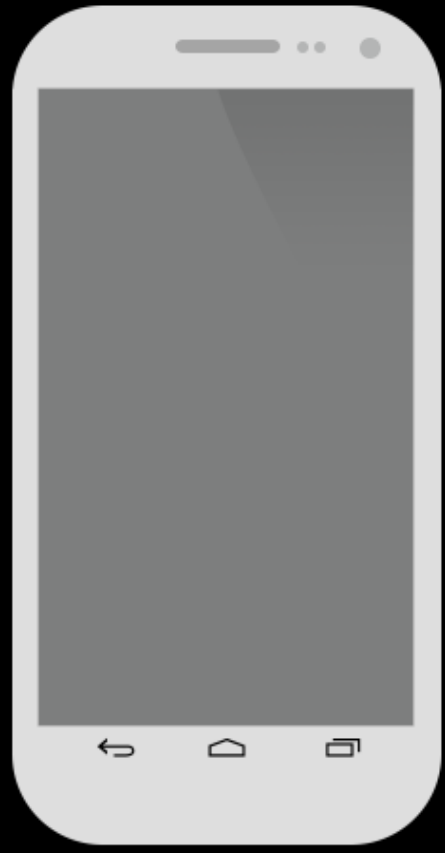
- # accumulated open doc
- % Processor Time
- Available Bytes
- Context Switches/sec

Time	# accumulated open doc	% Processor Time	Available Bytes	Context Switches/sec
4/21/2010 12:59:00 PM	700	38.3	9.5k	526
4/21/2010 1:09:00 PM	526	28.8	7.4k	350
4/21/2010 1:19:00 PM	350	19.3	5.3k	180
4/21/2010 1:29:00 PM	180	9.9	3.2k	5
4/21/2010 1:39:00 PM	5	0.4	1.1k	

Offline

1204 of 1204 rows | 0 marked | 9 columns | OpenFilesStatisticsLog





+



Why is 'data + touch' hard?

Why is 'data + touch' hard?

- Compensate for lack of mouse

Why is 'data + touch' hard?

- Compensate for lack of mouse
- # of features can to be too many

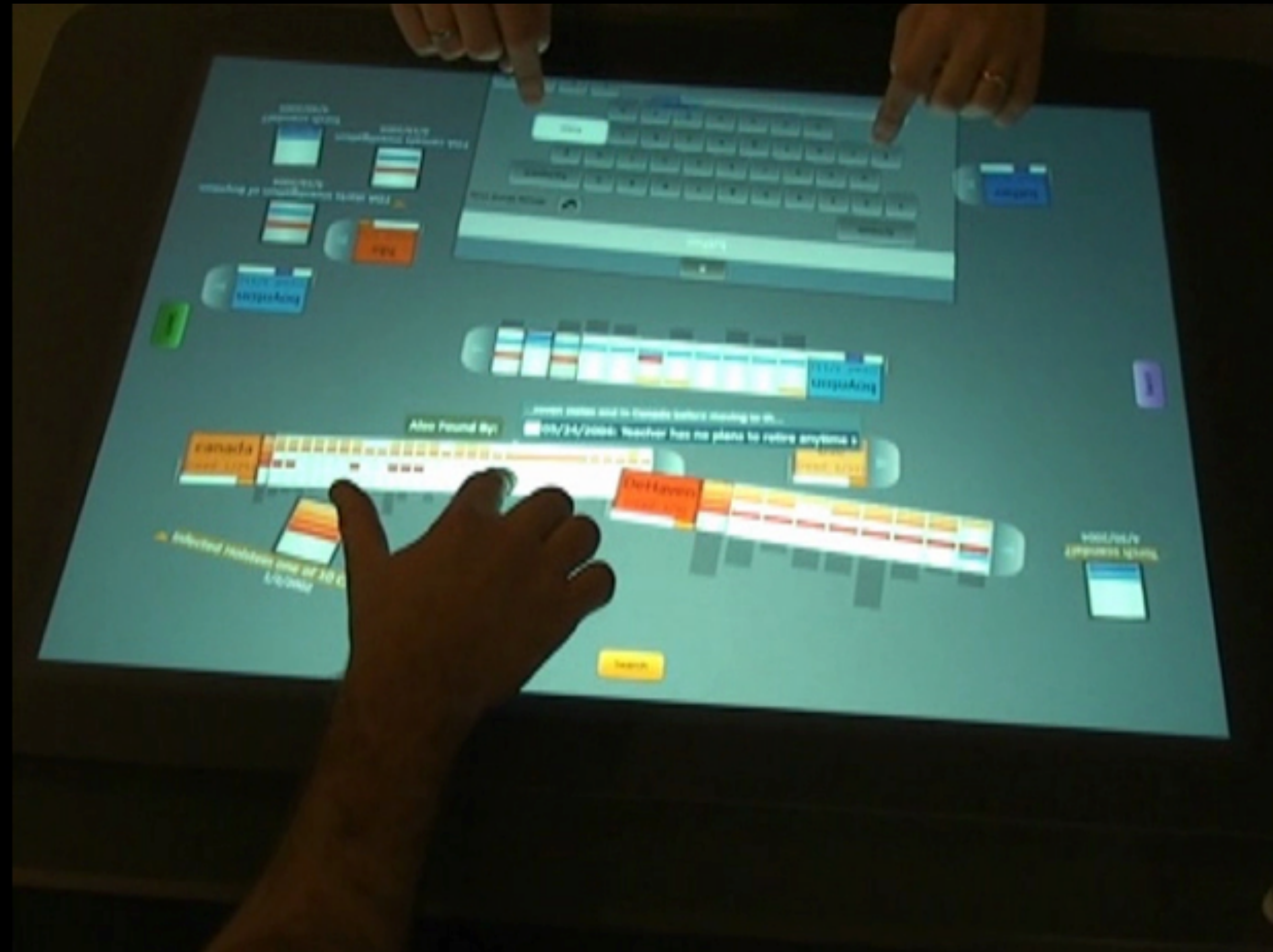
Why is 'data + touch' hard?

- Compensate for lack of mouse
- # of features can to be too many
- Isn't immediately clear how these systems should look

Existing apps



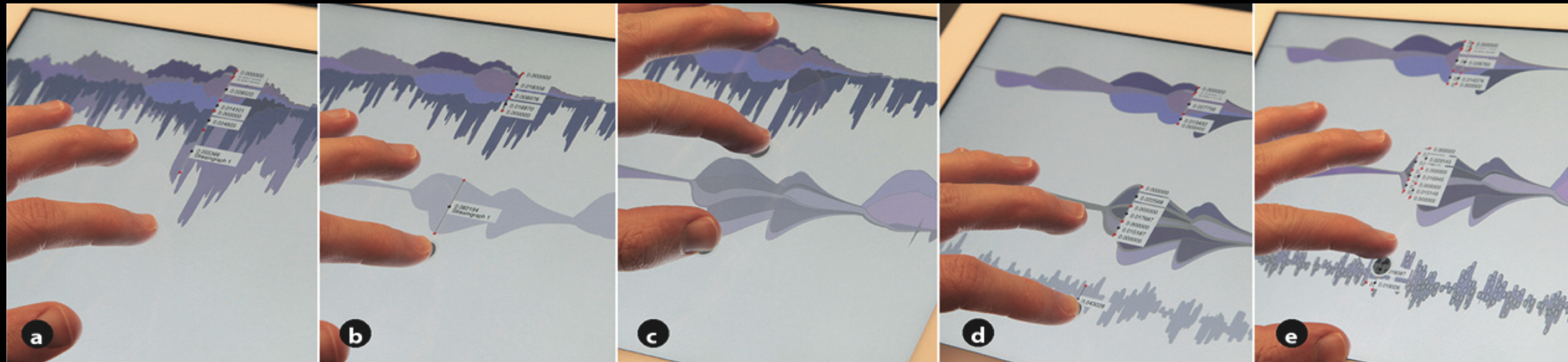
Past work



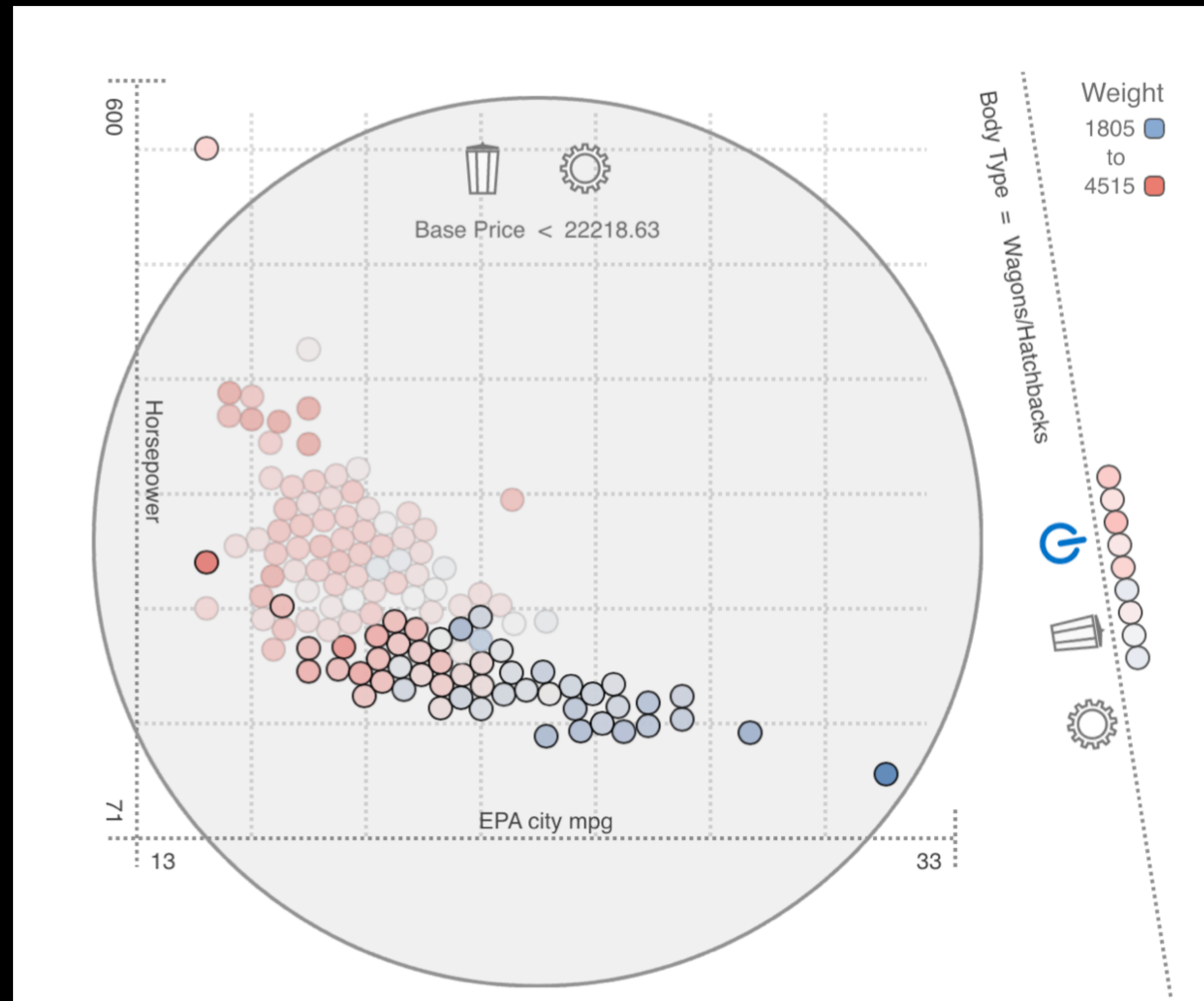
Past work



Past work



Past work



Our goal

Our goal

To design touch interactions for a comprehensive suite of visualization techniques

One size fits all?

One size fits all?

- Too complex with too many variables.
- Need to narrow the focus

One size fits all?

- Too complex with too many variables.
- Need to narrow the focus

Scatterplots

Scatterplots

Scatterplots

- Well known and widely used

Scatterplots

- Well known and widely used
- Glyph sizes impose particular constraints

What features?

What features?

Tableau and Spotfire

35 features

35 features

- Changing axis attribute
- Changing axis scale
- Legend
- Characterize distribution
- ...

Pruning the list

Pruning the list

- Primary features

Pruning the list

- Primary features
- Complexity

Pruning the list

- Primary features
- Complexity
- Redundancy

Pruning the list

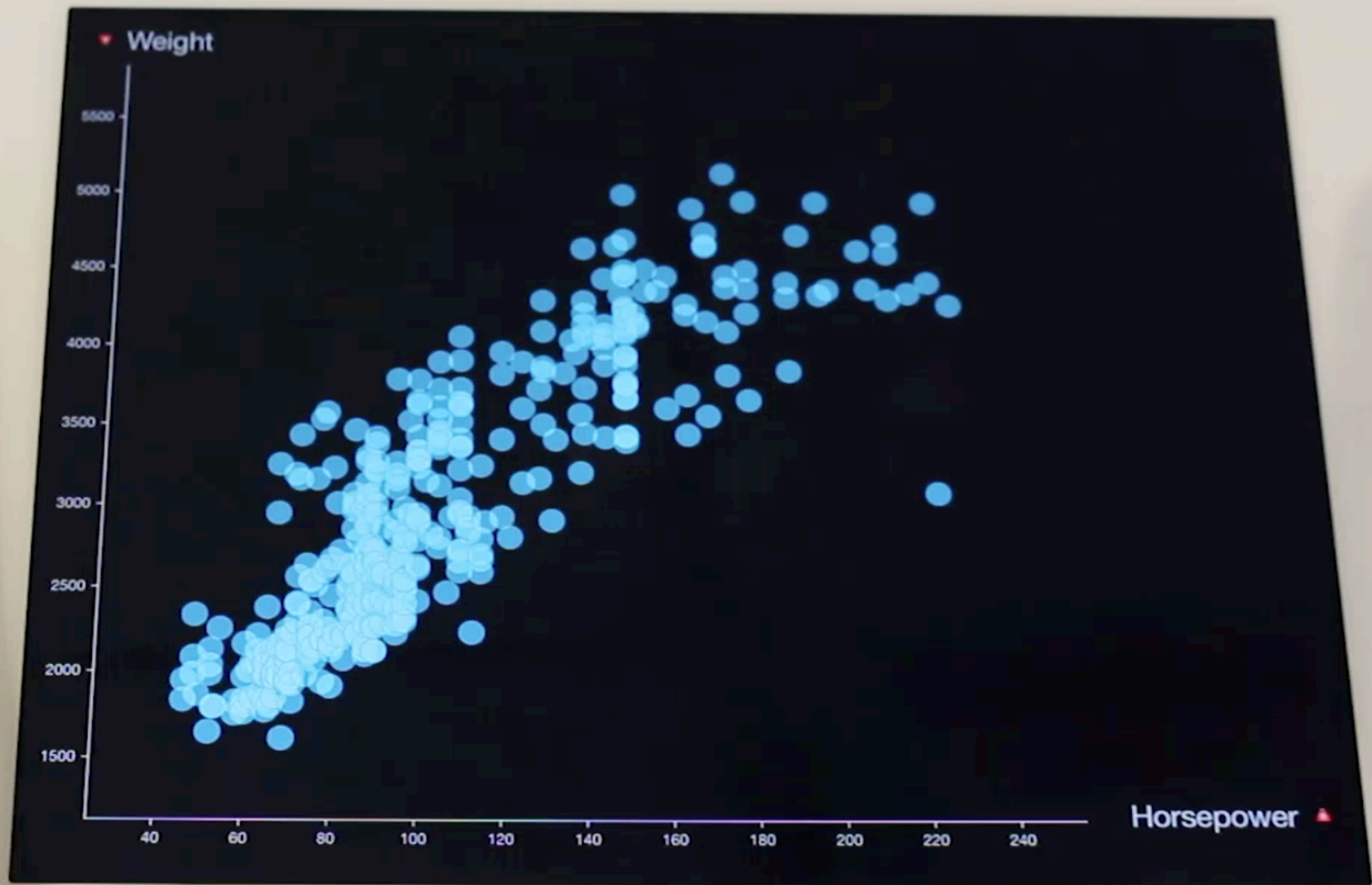
- Primary features
- Complexity
- Redundancy
- System-related functions

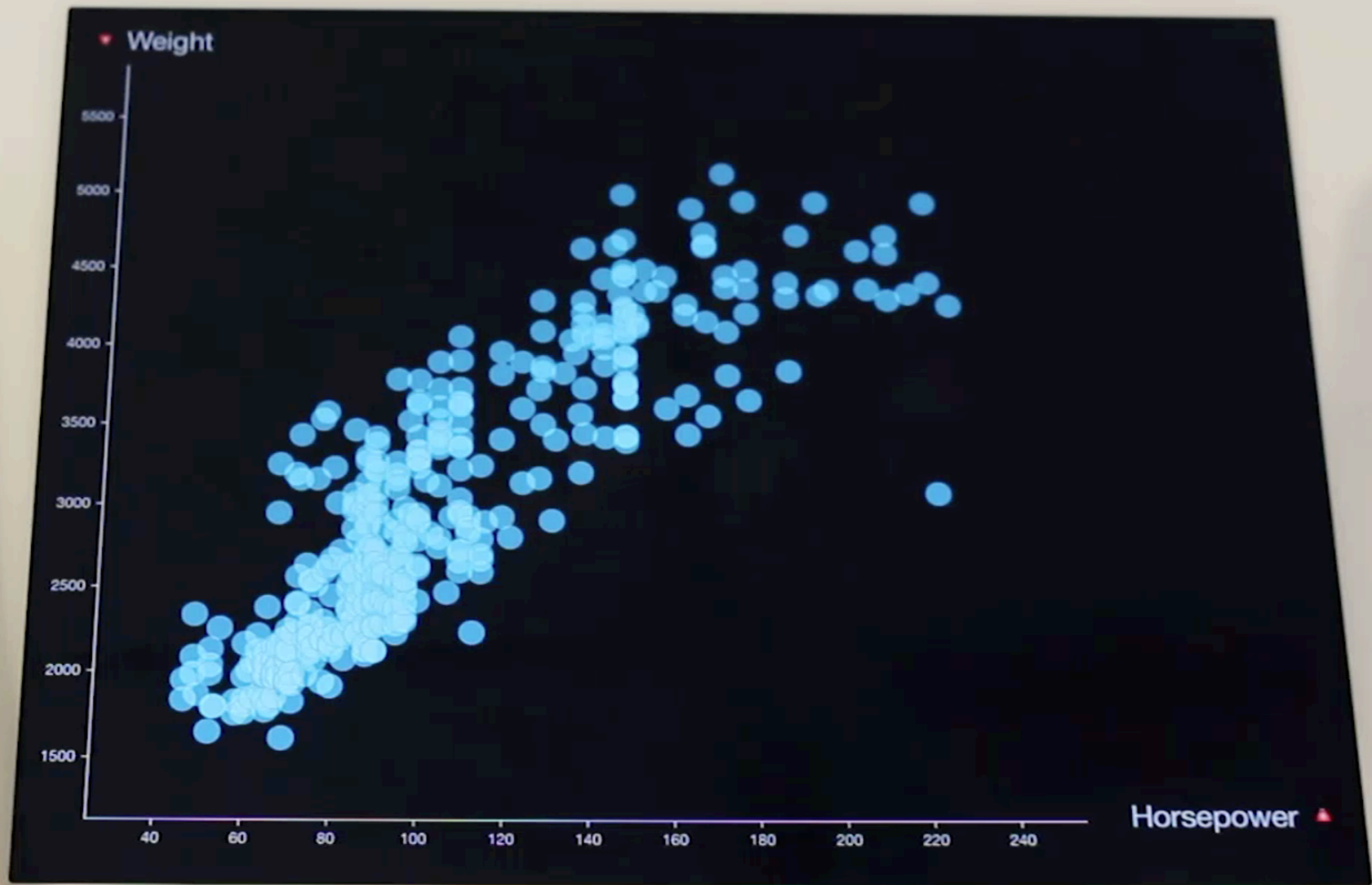
9 features

9 features

- Assign x and y
- Assign color
- Assign size
- Select
- Find detail
- Zoom
- Filter on points
- Filter on values
- Change axis scale

Demo





Designing interactions

Classifying features

Classifying features



Classifying features

View-driven



Classifying features

View-driven

Data-centric

Classifying features

View-driven

1. Select
2. Zoom
3. Filter on points
4. Find detail

Data-centric

Classifying features

View-driven

1. Select
2. Zoom
3. Filter on points
4. Find detail

Data-centric

1. Assign X & Y
2. Assign color
3. Assign size
4. Filter on values
5. Change axis scale

Classifying features

View-driven

1. Select
2. Zoom
3. Filter on points
4. Find detail

- Gestures -

Data-centric

1. Assign X & Y
2. Assign color
3. Assign size
4. Filter on values
5. Change axis scale

- WIMP -

Classifying features

Data-centric



Classifying features

Data-centric

Essential

1. Assign X & Y

Classifying features

Data-centric

Essential

1. Assign X & Y

On-demand

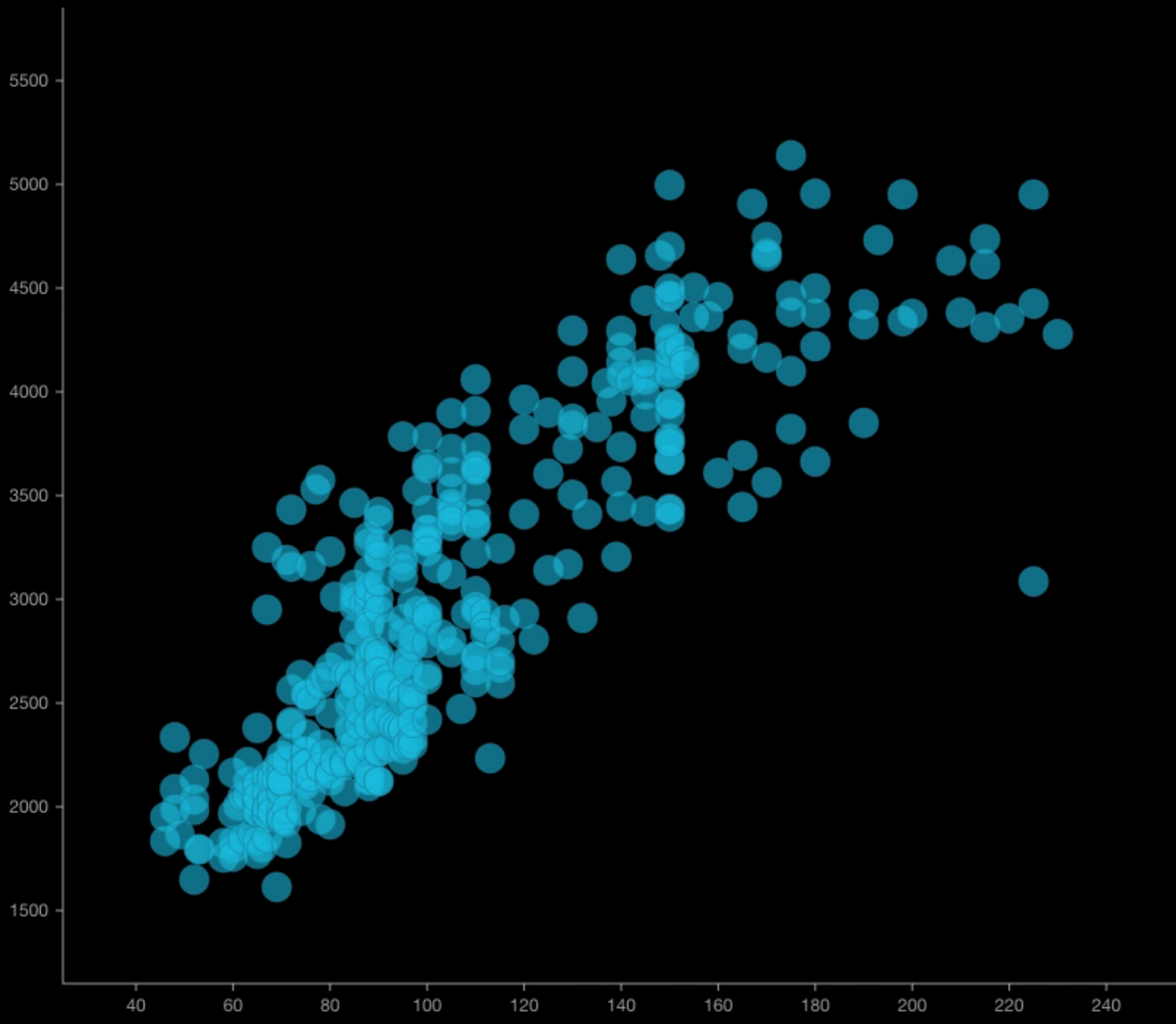
1. Assign color
2. Assign size
3. Filter on values
4. Change axis scale

Designing interactions

Designing interactions

Selection

▼ Weight

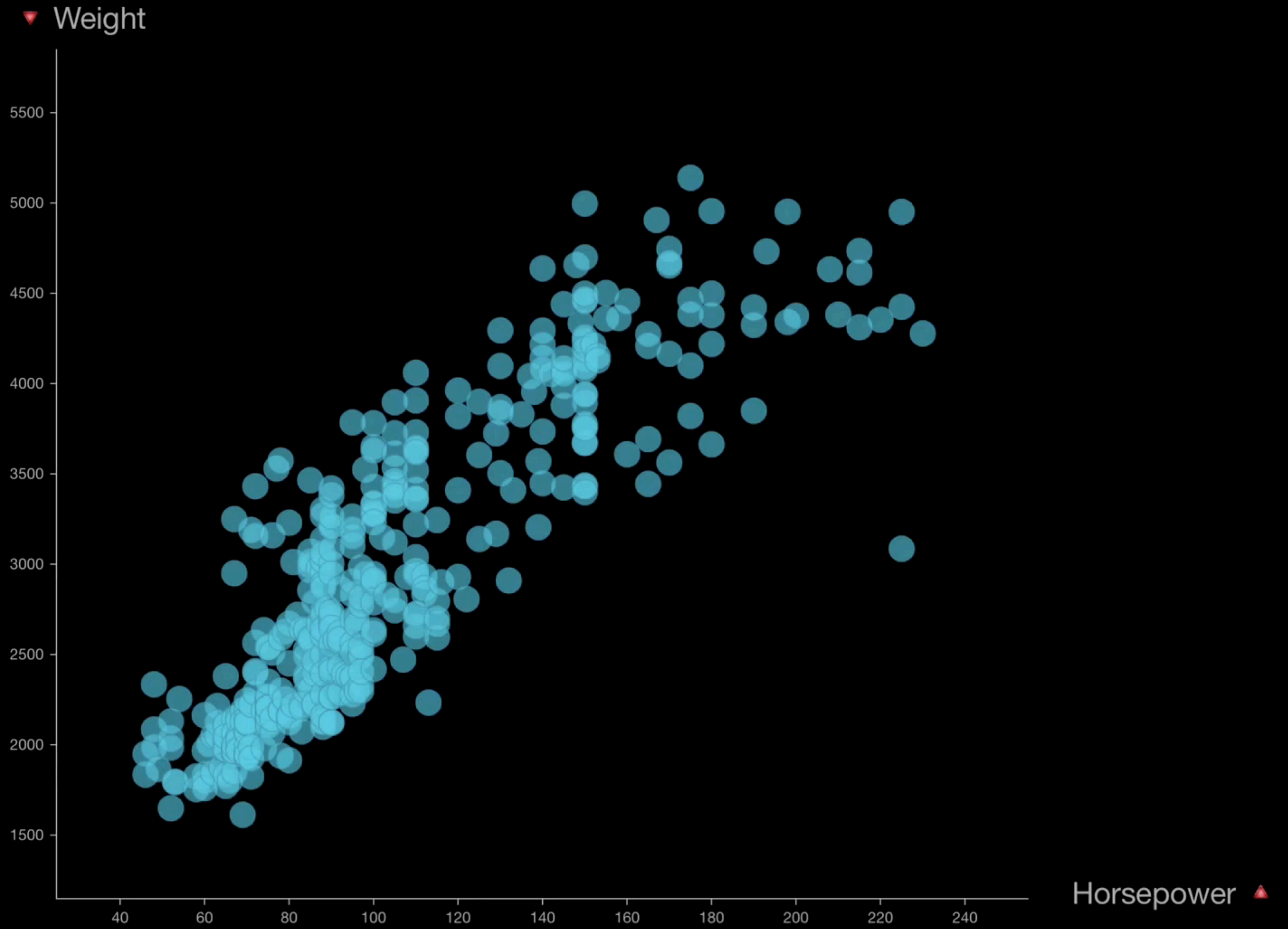


Horsepower ▲

1. Lasso



1. Lasso



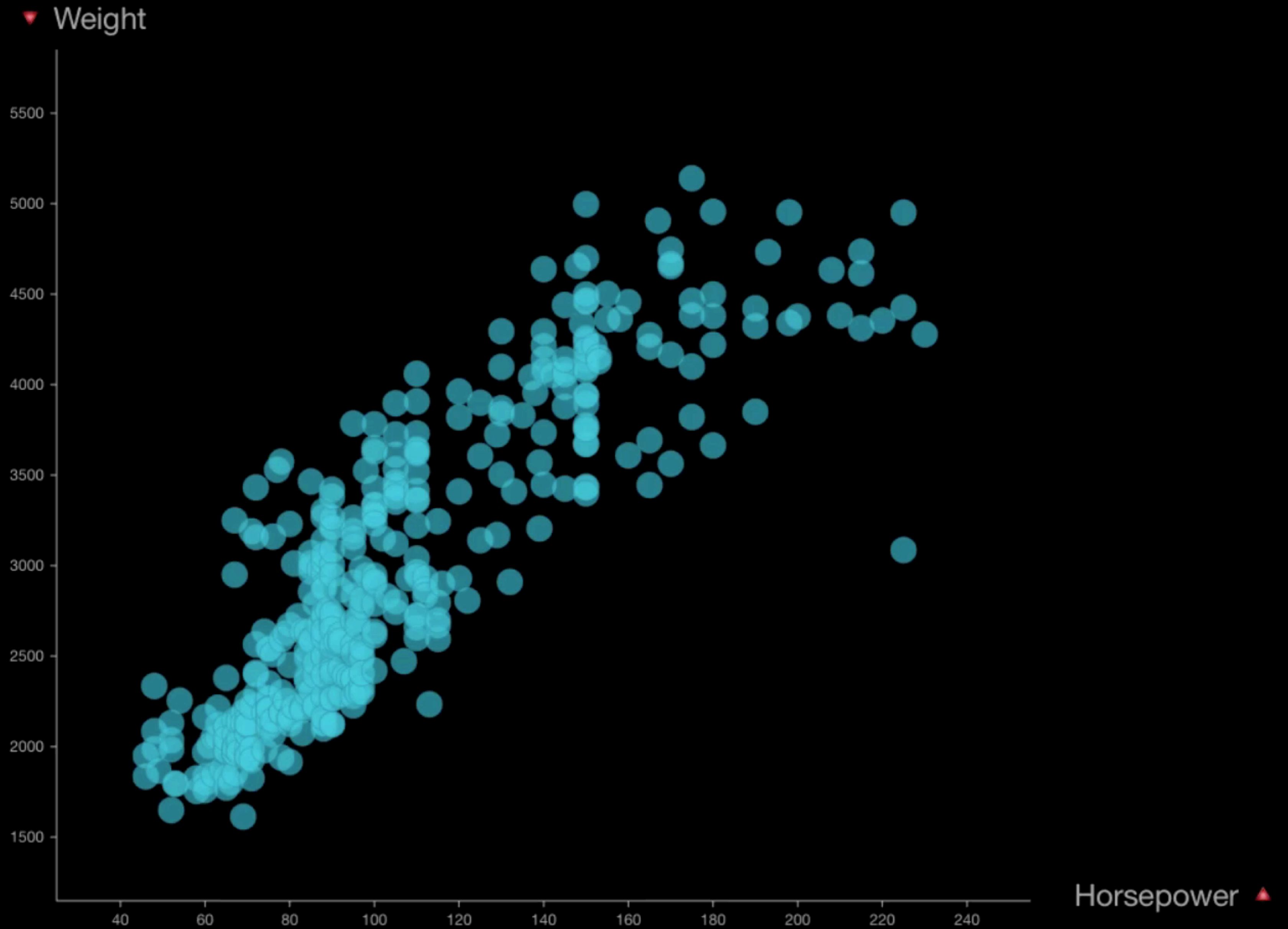
- 1. Lasso
- 2. Marquee



- 1. Lasso
- 2. Marquee

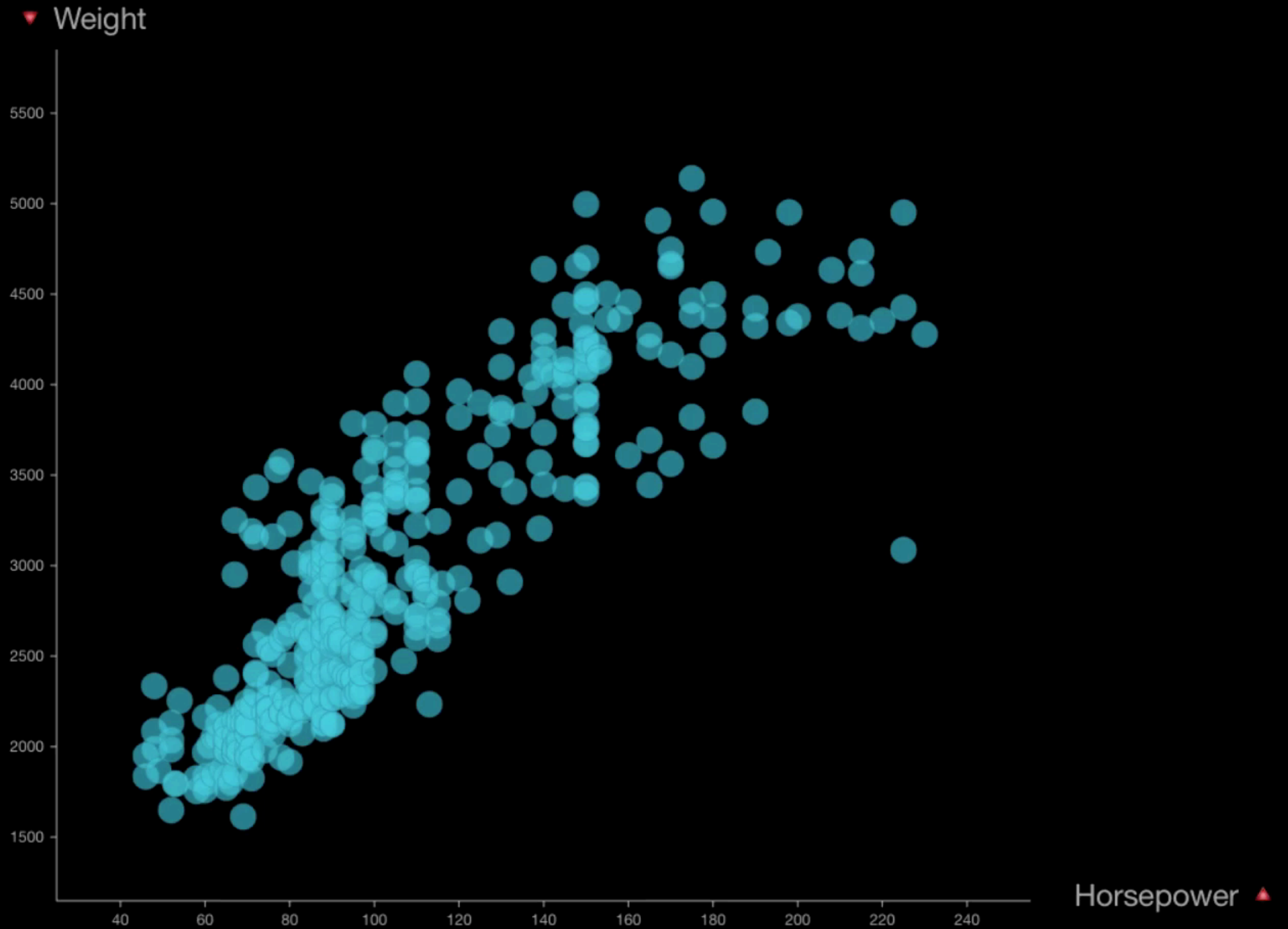


1. Lasso
2. Marquee
3. Off-centered Pointer



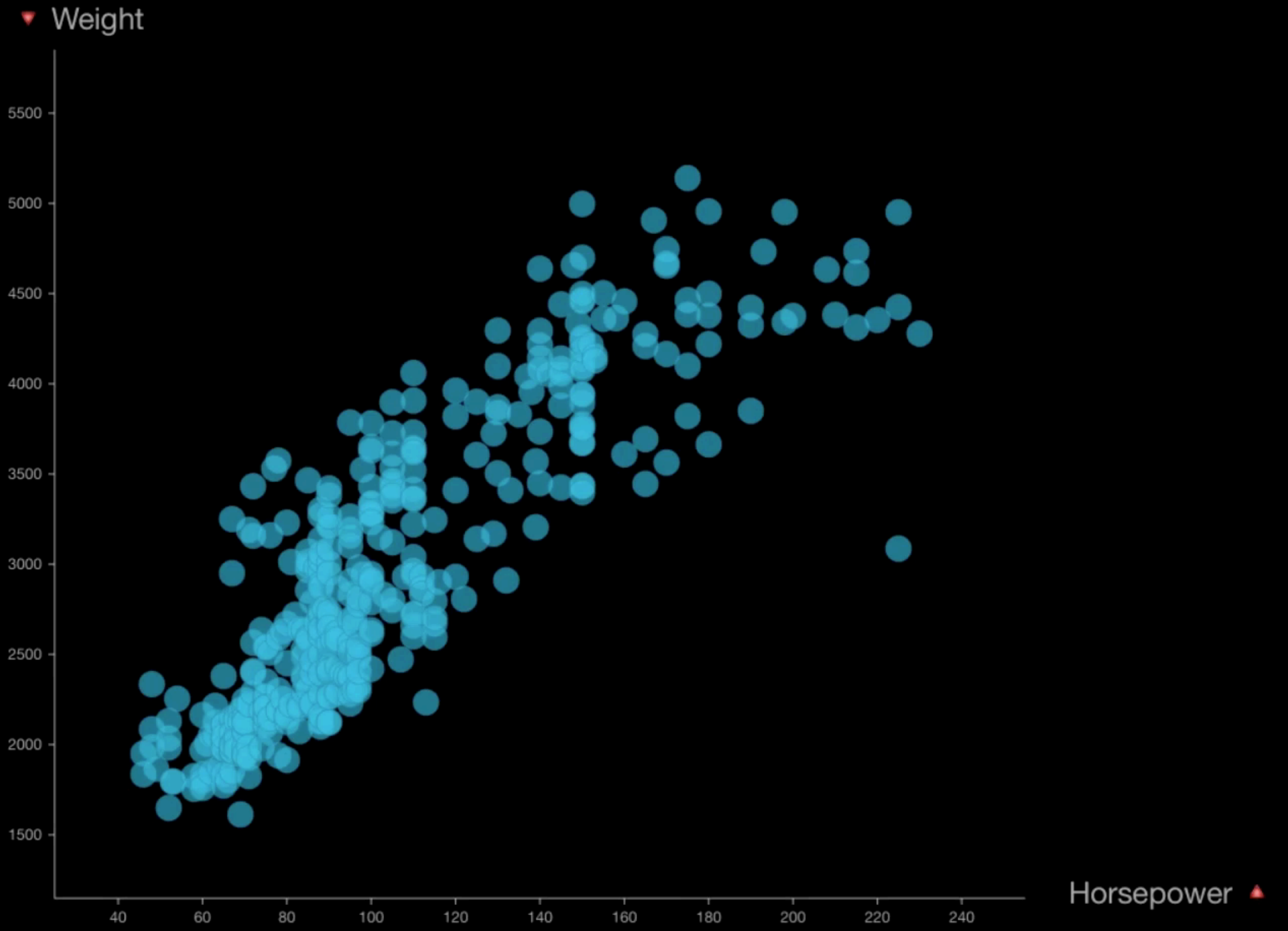
[Vogel et al., CHI 2007]

1. Lasso
2. Marquee
3. Off-centered Pointer

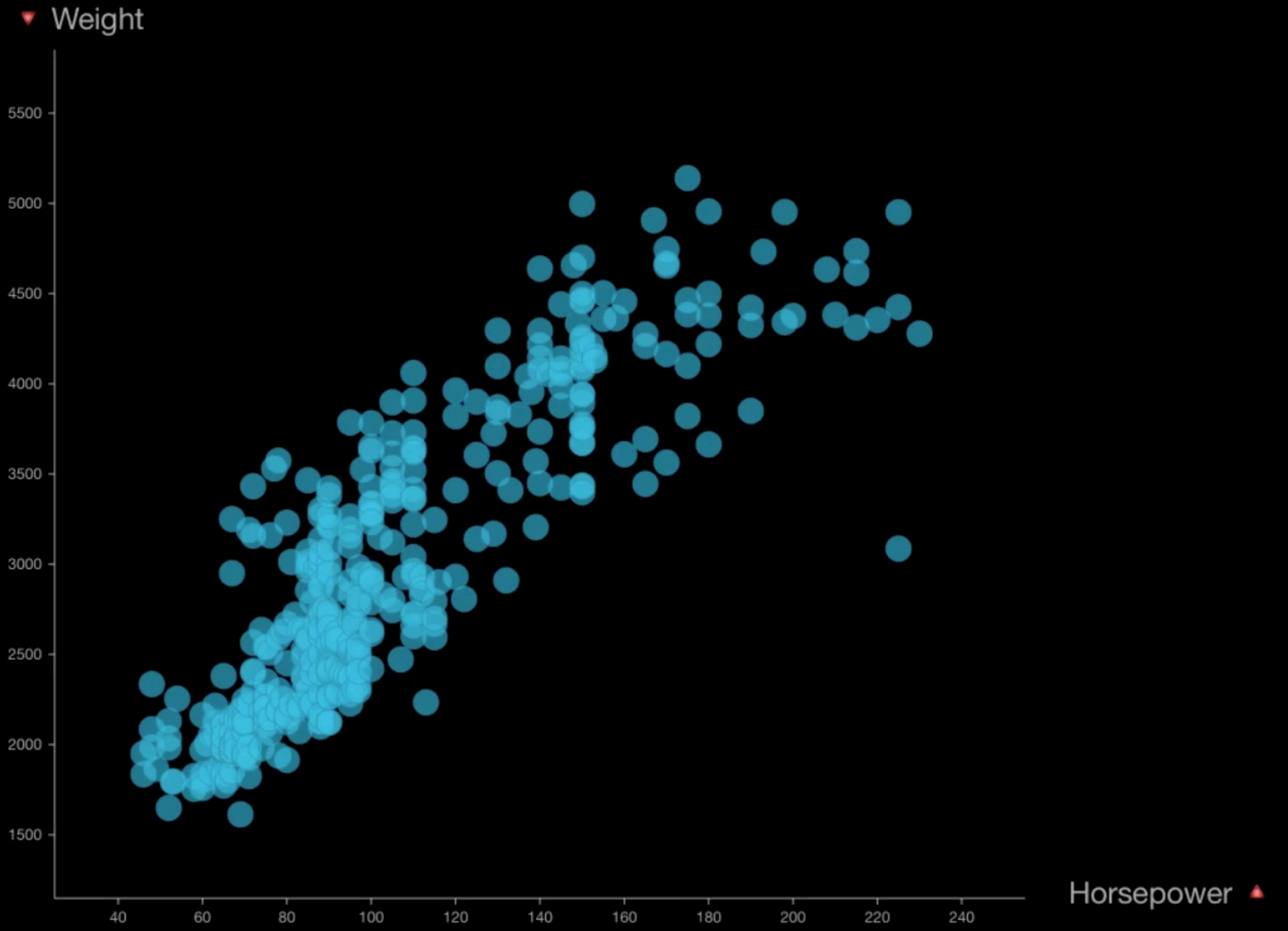


[Vogel et al., CHI 2007]

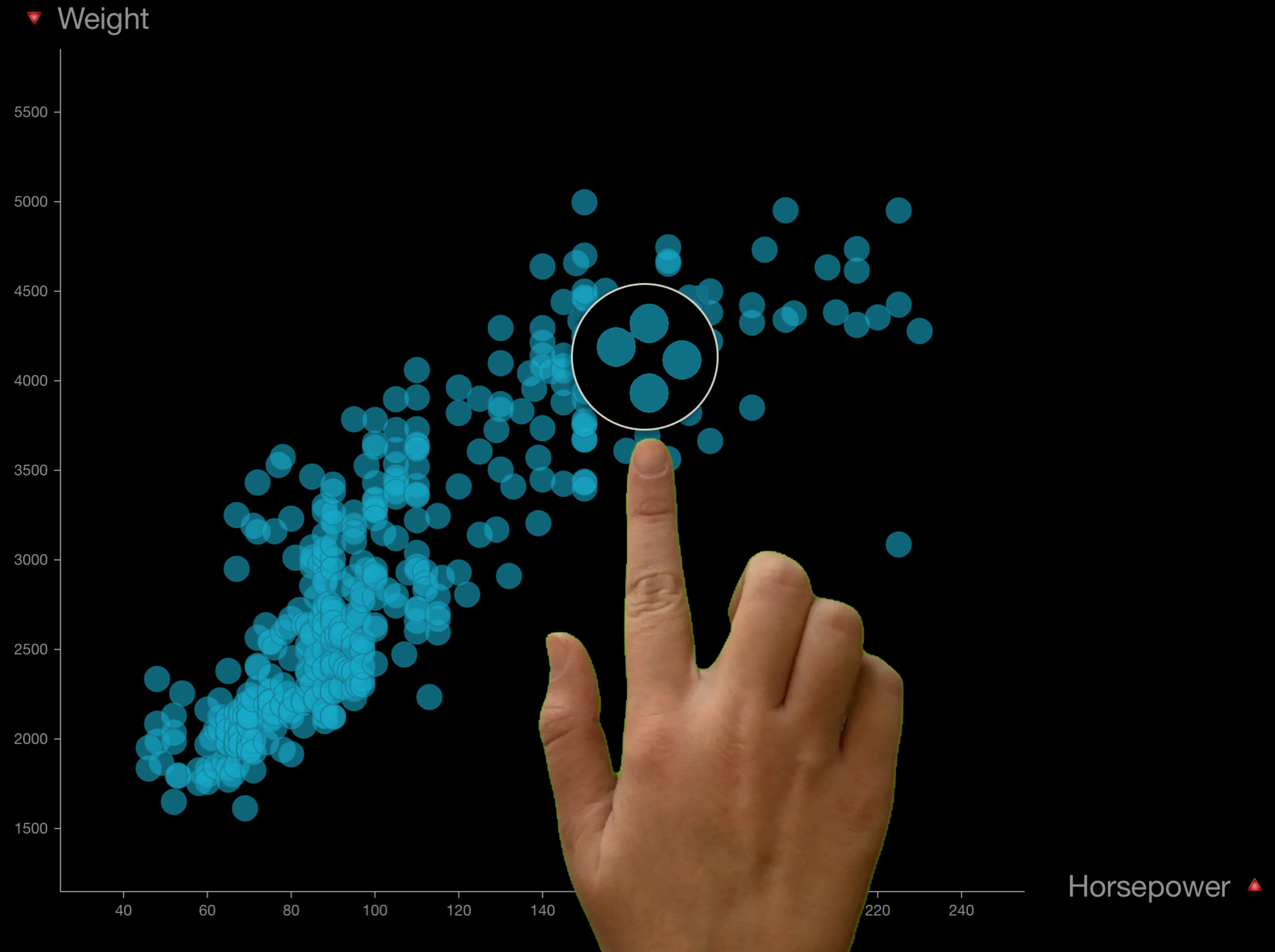
- 1. Lasso
- 2. Marquee
- 3. Off-centered Pointer
- 4. Axis Pan



- 1. Lasso
- 2. Marquee
- 3. Off-centered Pointer
- 4. Axis Pan



1. Lasso
2. Marquee
3. Off-centered Pointer
4. Axis Pan
5. Lens



1. Lasso
2. Marquee
3. Off-centered Pointer
4. Axis Pan
5. Lens
6. Swipe + Lens



Designing interactions

Zoom

1. Pinch-to-zoom

A. Fixed-aspect ratio



1. Pinch-to-zoom

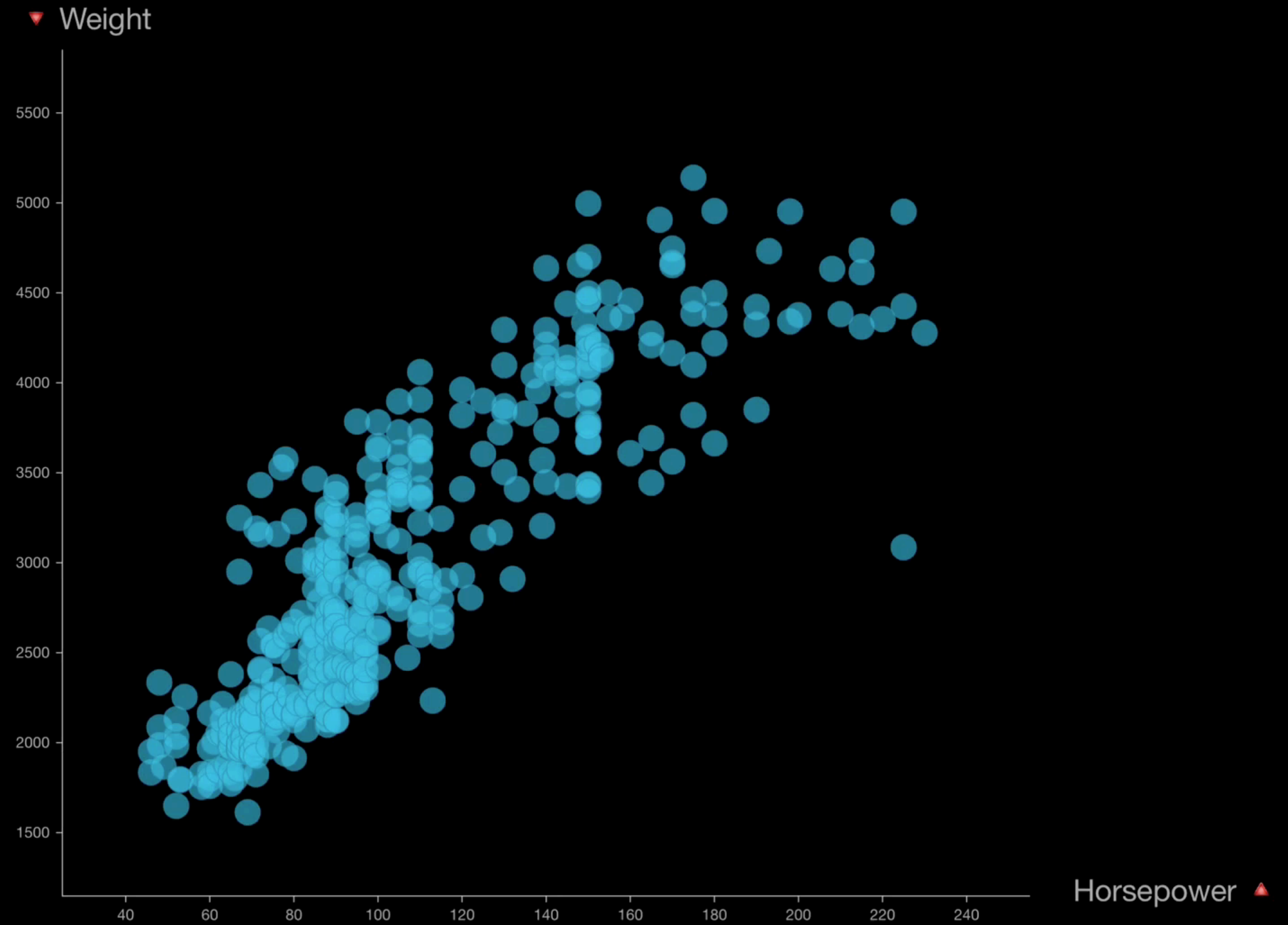
A. Fixed-aspect ratio



1. Pinch-to-zoom

A. Fixed-aspect ratio

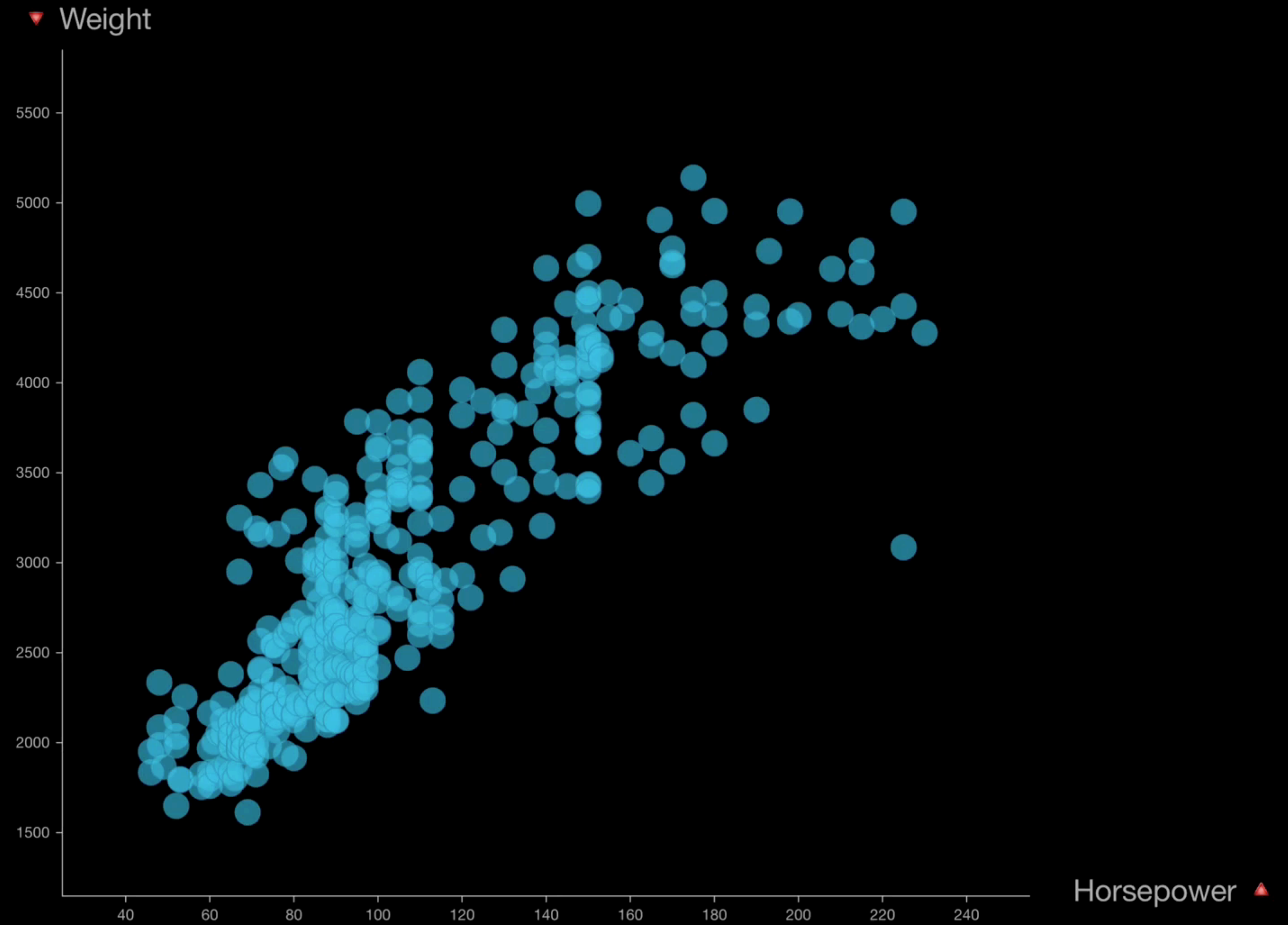
B. Flexible-aspect ratio



1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio



1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom



1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom



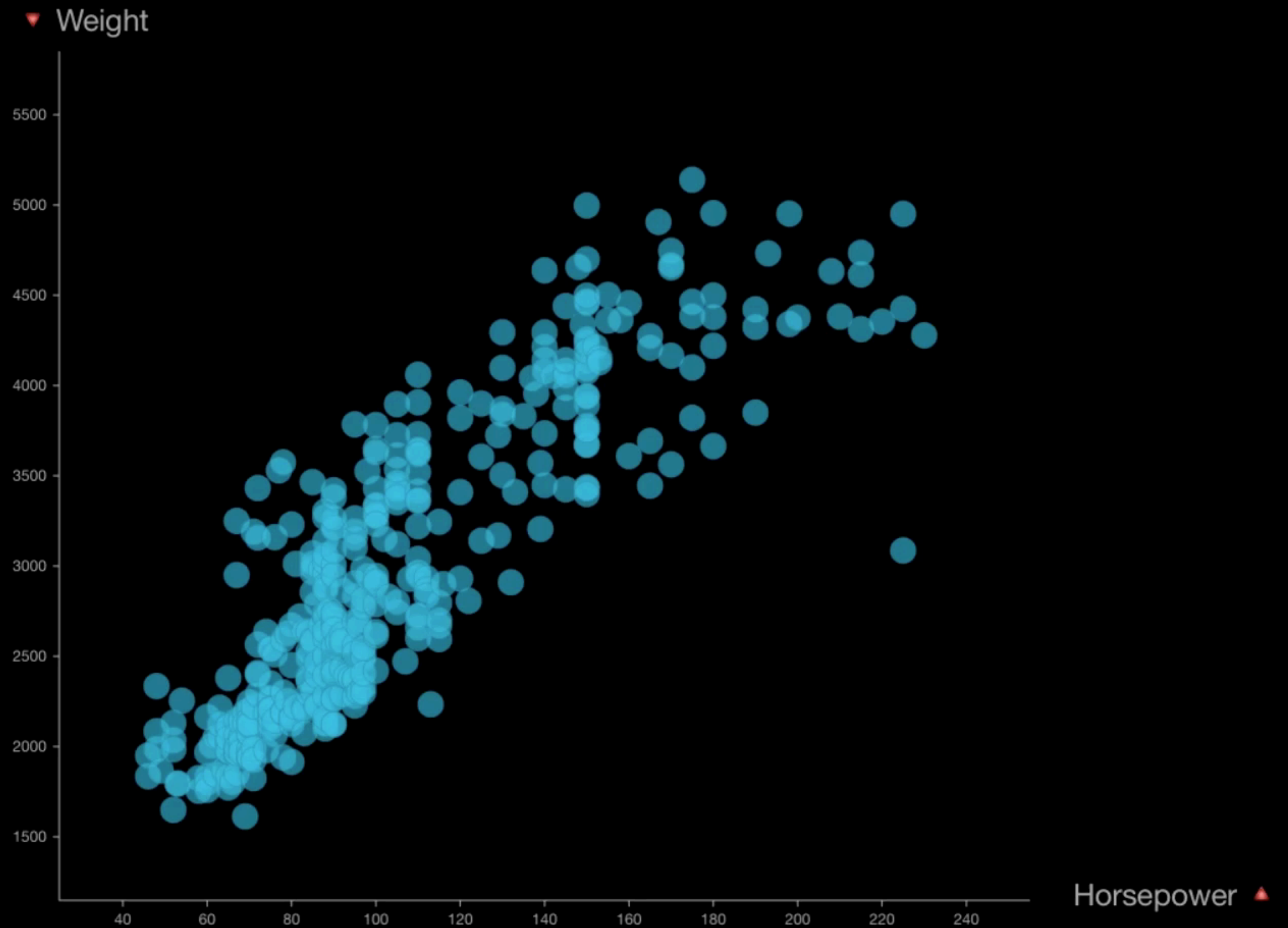
1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom

3. Select + zoom



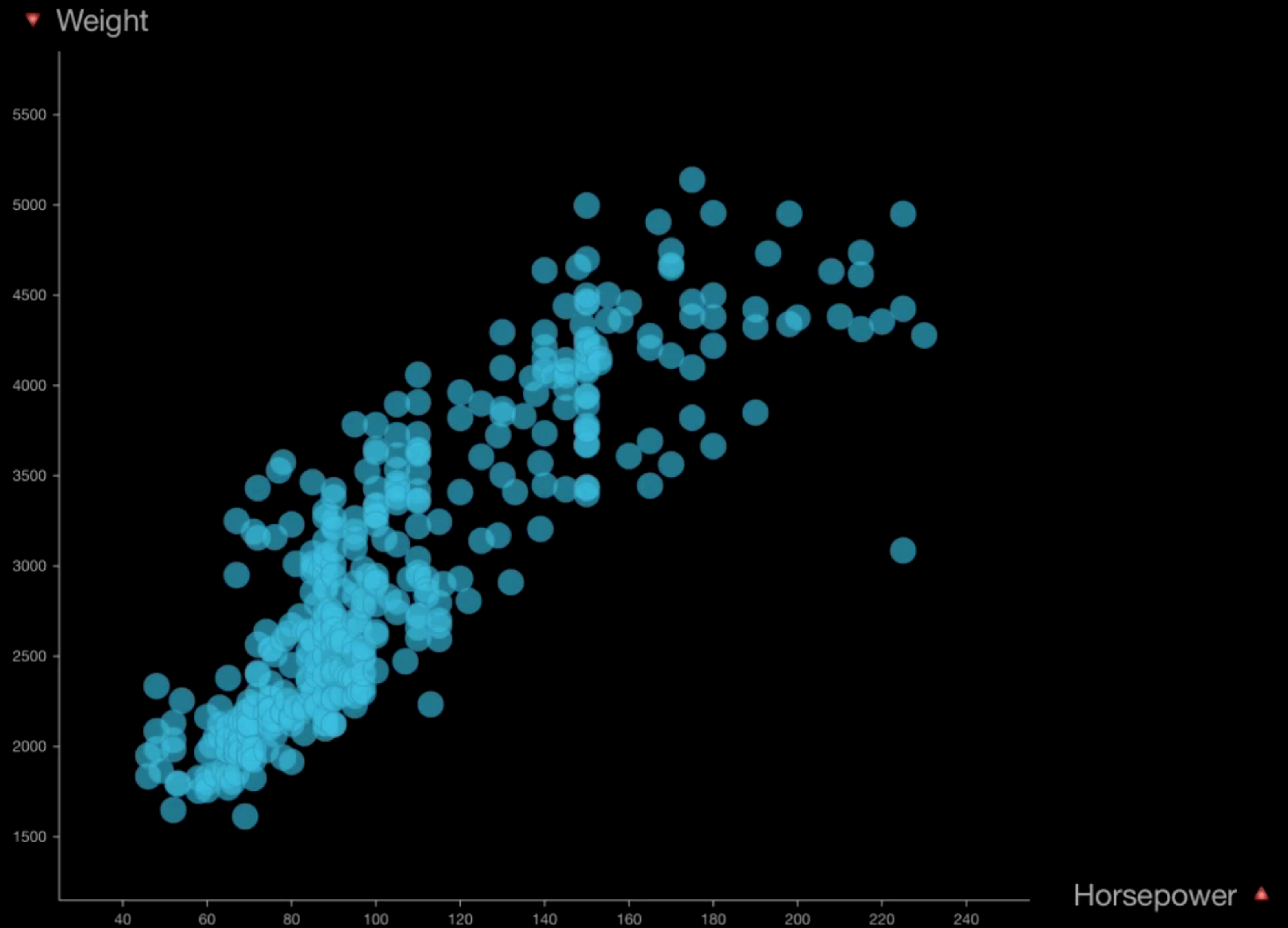
1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom

3. Select + zoom



1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom

3. Select + zoom

4. Zoom lens



1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom

3. Select + zoom

4. Zoom lens



1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom

3. Select + zoom

4. Zoom lens

5. Automatic zoom

▼ Acceleration



392

Weight ▲

1. Pinch-to-zoom

A. Fixed-aspect ratio

B. Flexible-aspect ratio

2. Axis-based zoom

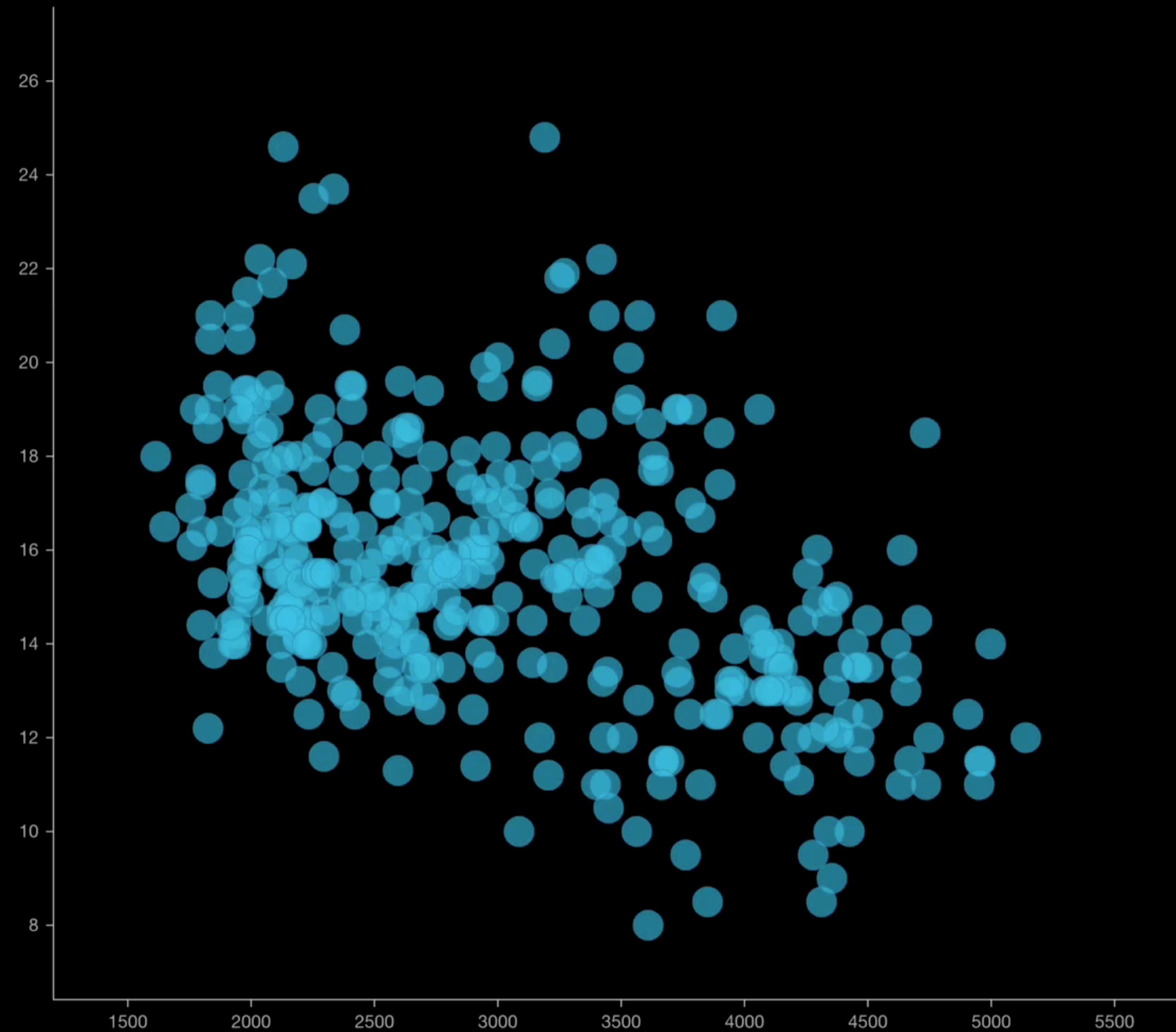
3. Select + zoom

4. Zoom lens

5. Automatic zoom

▼ Acceleration

392



Weight ▲

Other features

Other features

- Filter
- Changing attributes, data preview
- Modify visual mapping

Future work

Future work

- User evaluation

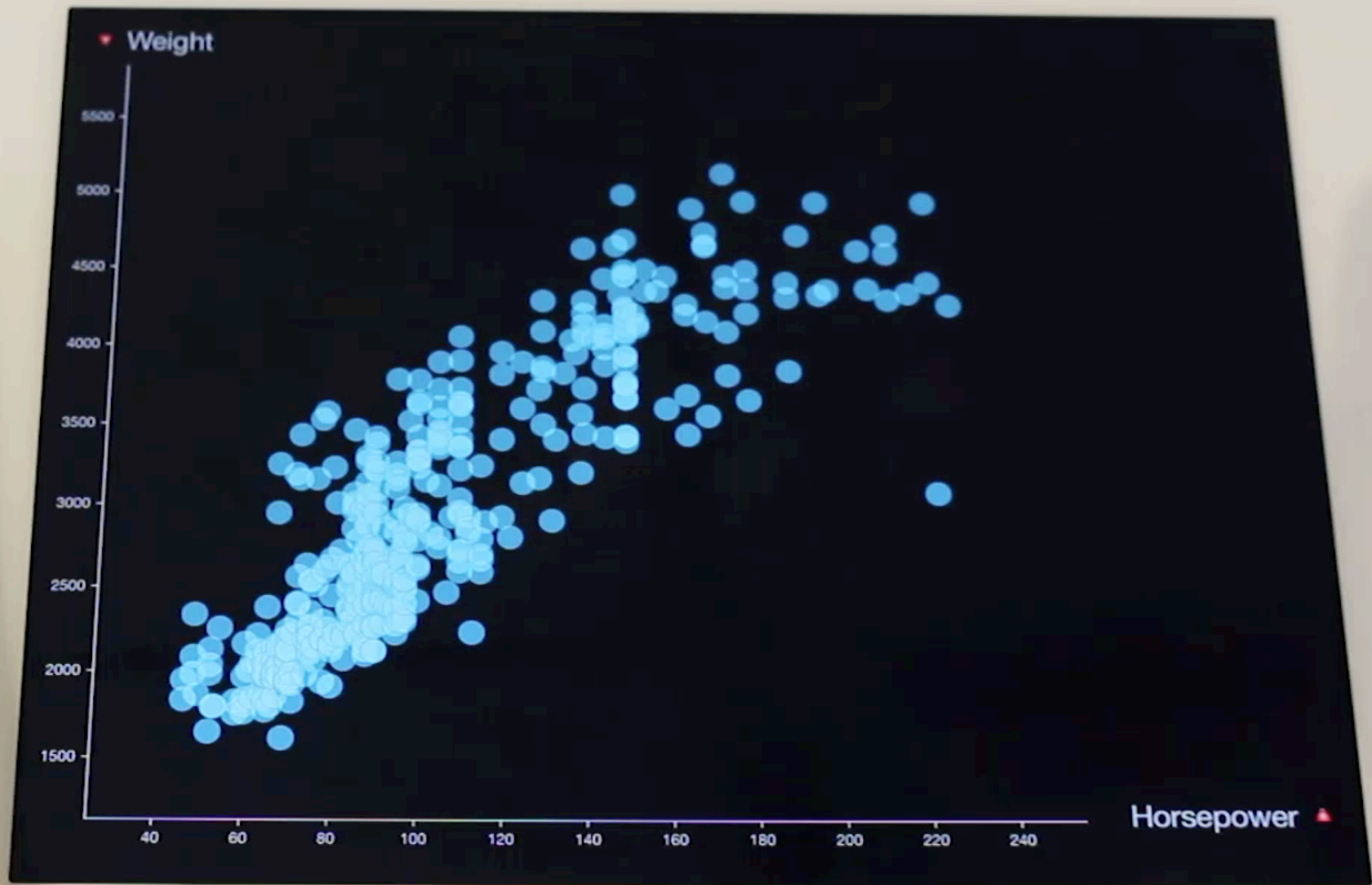
Future work

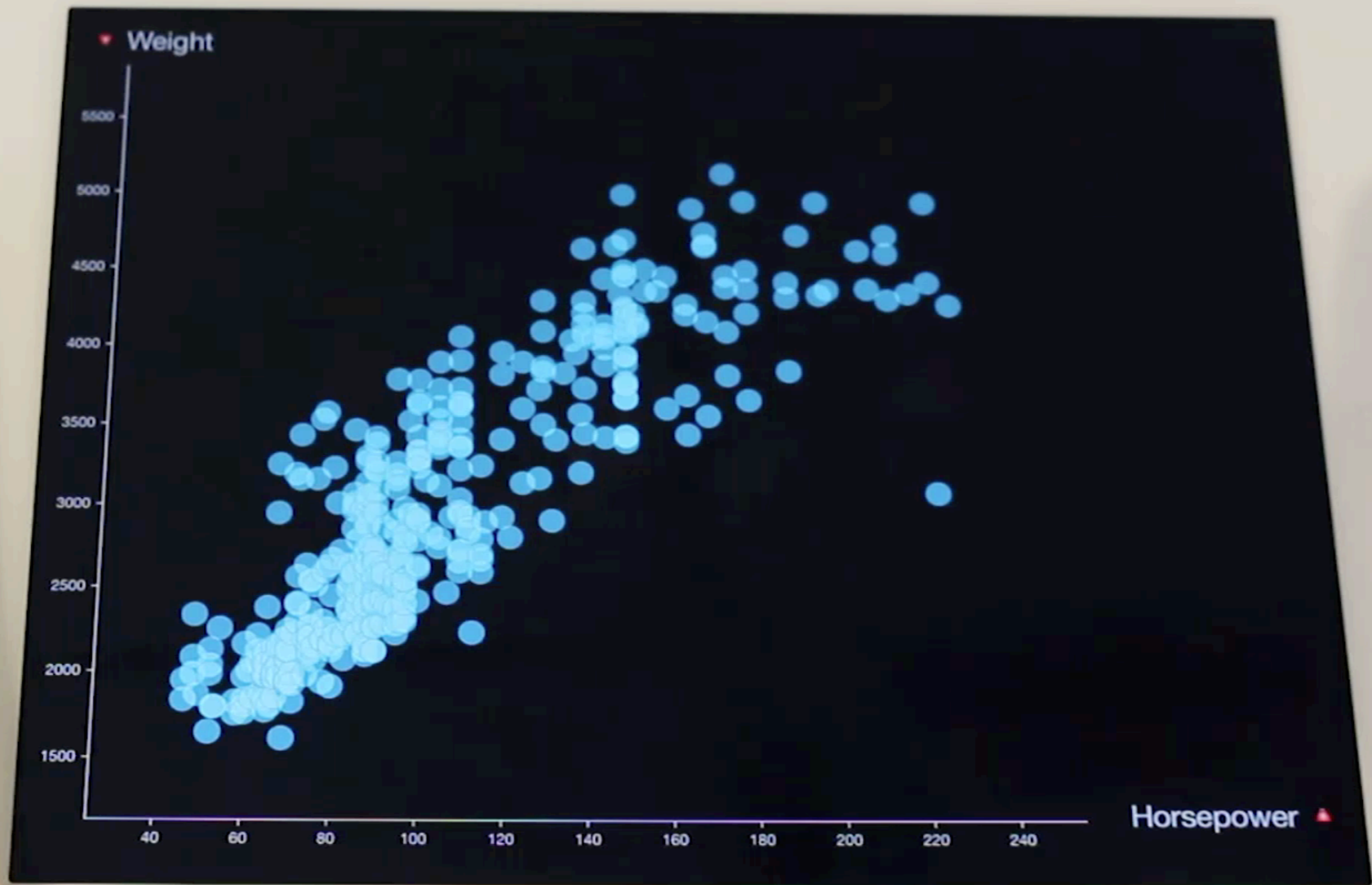
- User evaluation
- Other visualization techniques

Future work

- User evaluation
- Other visualization techniques
- Operating system constraints

Thank *you*!





Questions?