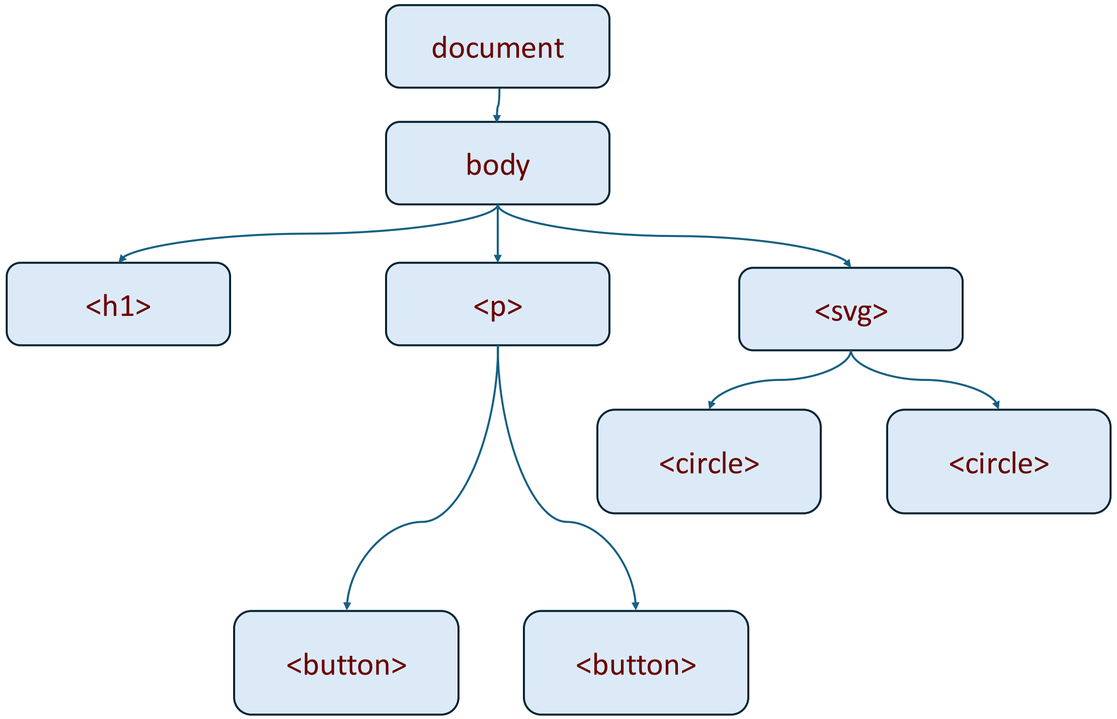
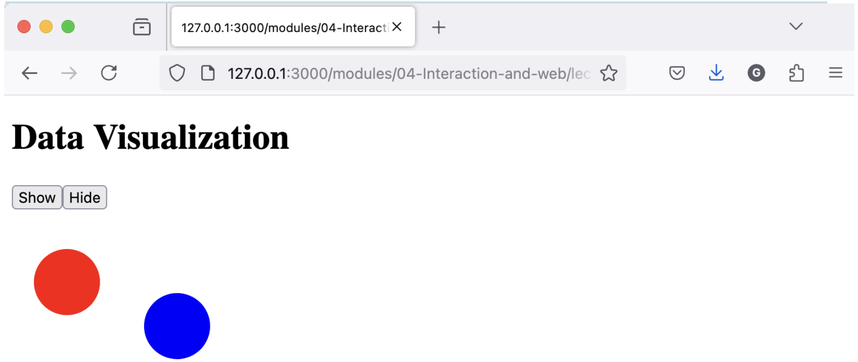
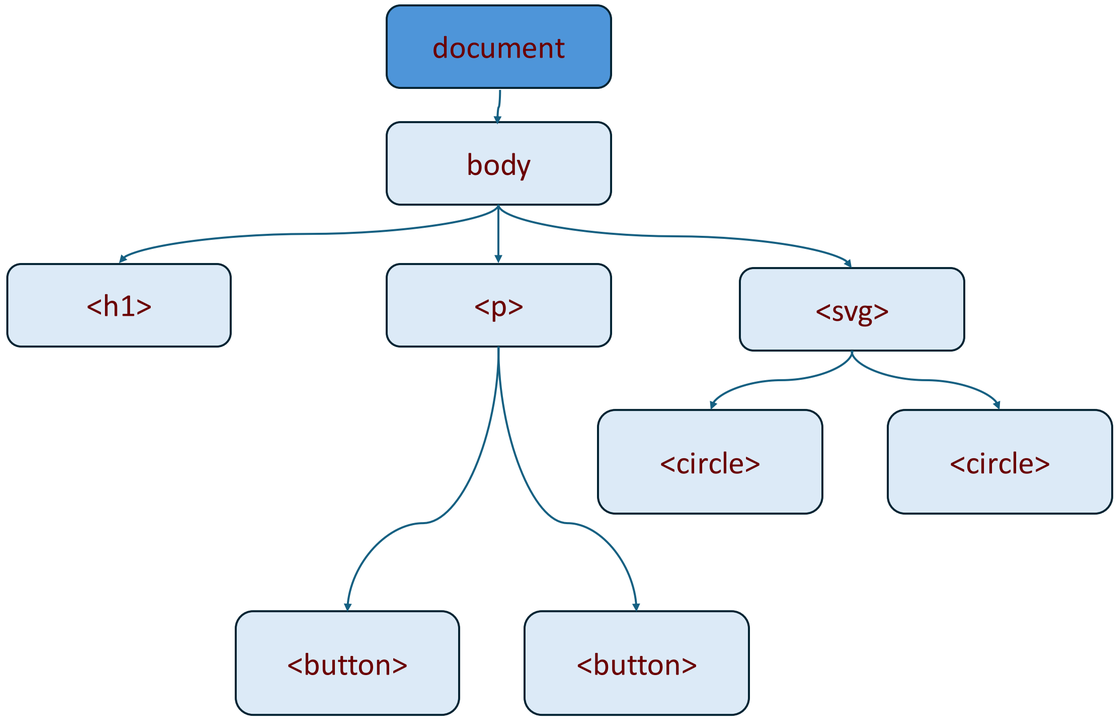
Dynamic visualization with Javascript

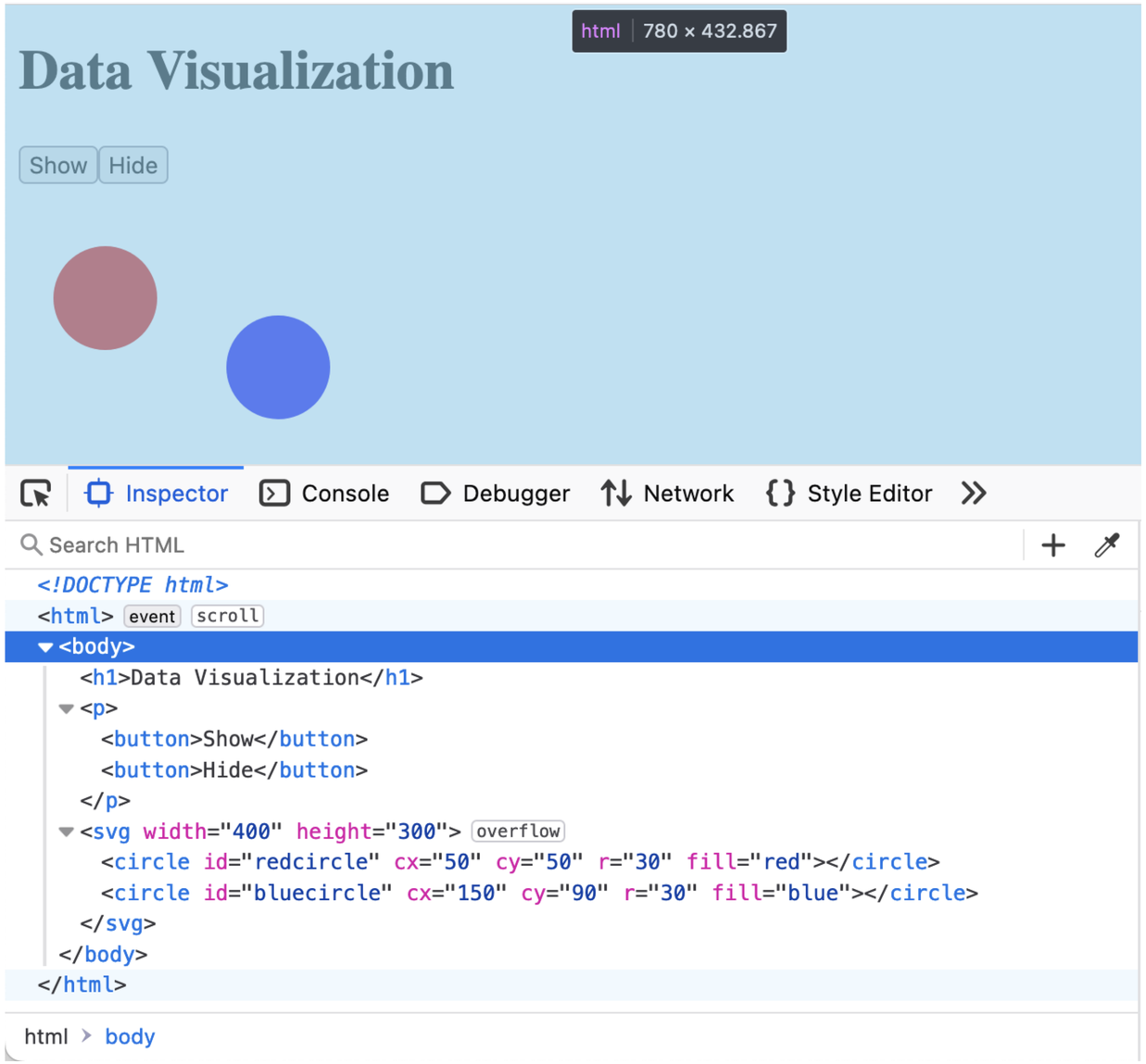
```
<!DOCTYPE html>
<html>
<body>
  <h1>Data Visualization</h1>
  <p>
    <button>Show</button>
    <button>Hide</button>
  </p>
  <svg width="400" height="300">
    <circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
    <circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
  </svg>
</body>
</html>
```





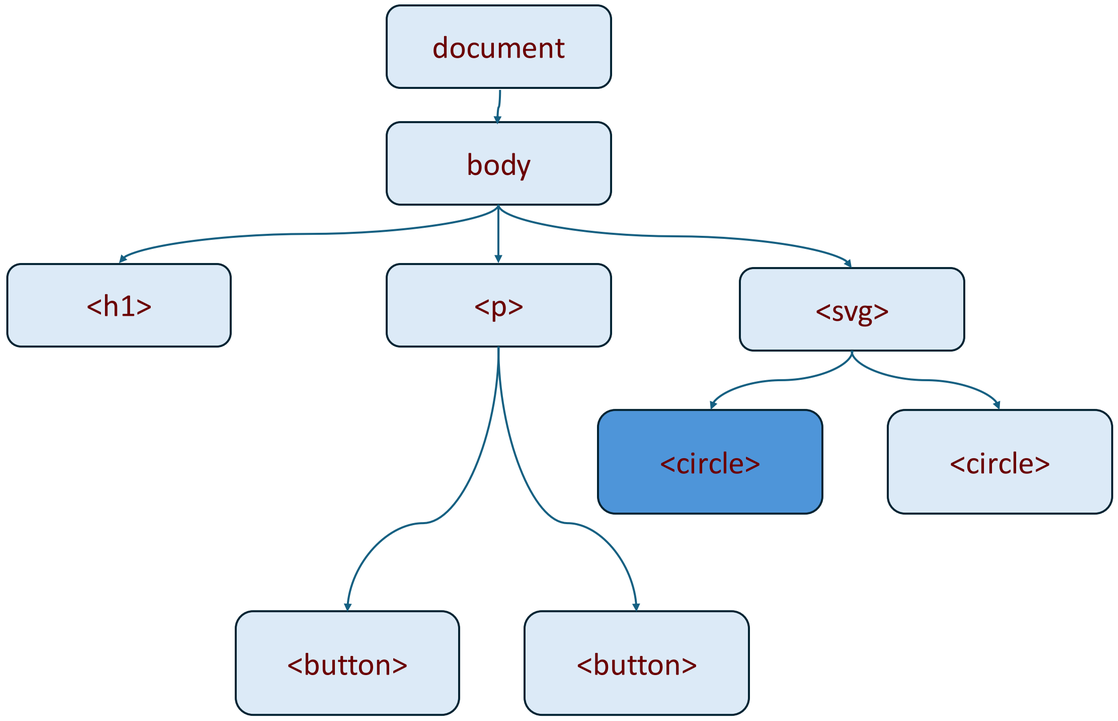

document
body
<h1>

<svg>
<circle>
<circle>
<button>
<button>


html | 780 × 432.867
Data Visualization
Show
Hide
Inspector
Console
Debugger
Network
Style Editor
Search HTML
<!DOCTYPE html>
<html> event scroll
<body>
<h1>Data Visualization</h1>

<button>Show</button>
<button>Hide</button>

<svg width="400" height="300"> overflow
<circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
<circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
</svg>
</body>
</html>
html > body



Data Visualization

Show Hide

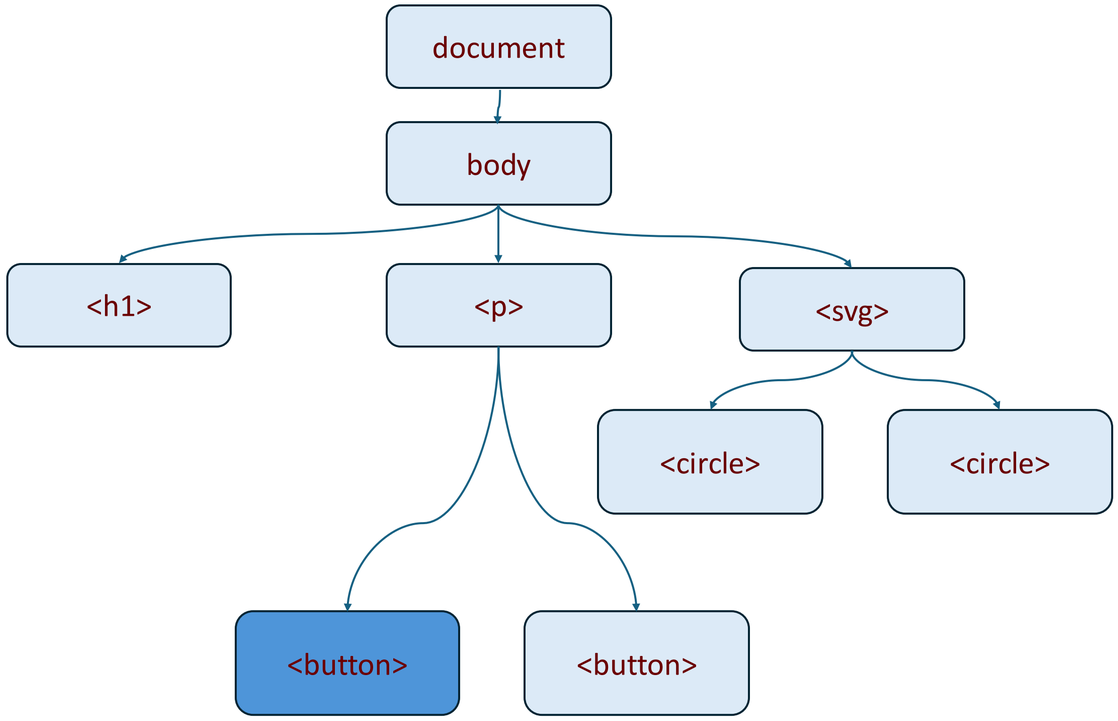
circle#redcircle 60 × 60

Inspector Console Debugger Network Style Editor

Search HTML

```
<!DOCTYPE html>
<html> event scroll
 <body>
   <h1>Data Visualization</h1>
  <p>
    <button>Show</button>
    <button>Hide</button>
   </p>
  <svg width="400" height="300"> overflow
    <circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
    <circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
   </svg>
 </body>
</html>
```

html › body › svg › circle#redcircle



Data Visualization

button 45.9 × 22

Show Hide

Inspector Console Debugger Network Style Editor

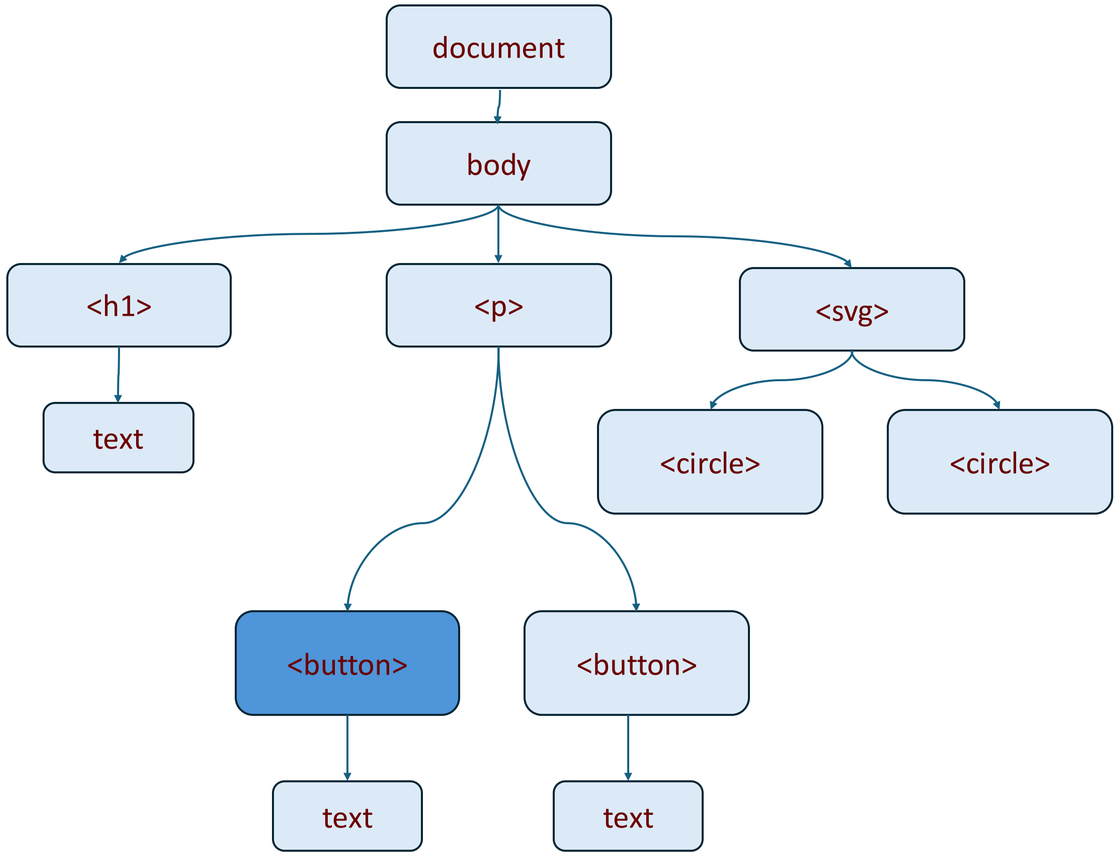
Search HTML

```
<!DOCTYPE html>
<html> event scroll
  <body>
    <h1>Data Visualization</h1>
    <p>
      <button>Show</button>
      <button>Hide</button>
    </p>
    <svg width="400" height="300"> overflow
      <circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
      <circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
    </svg>
  </body>
</html>
```

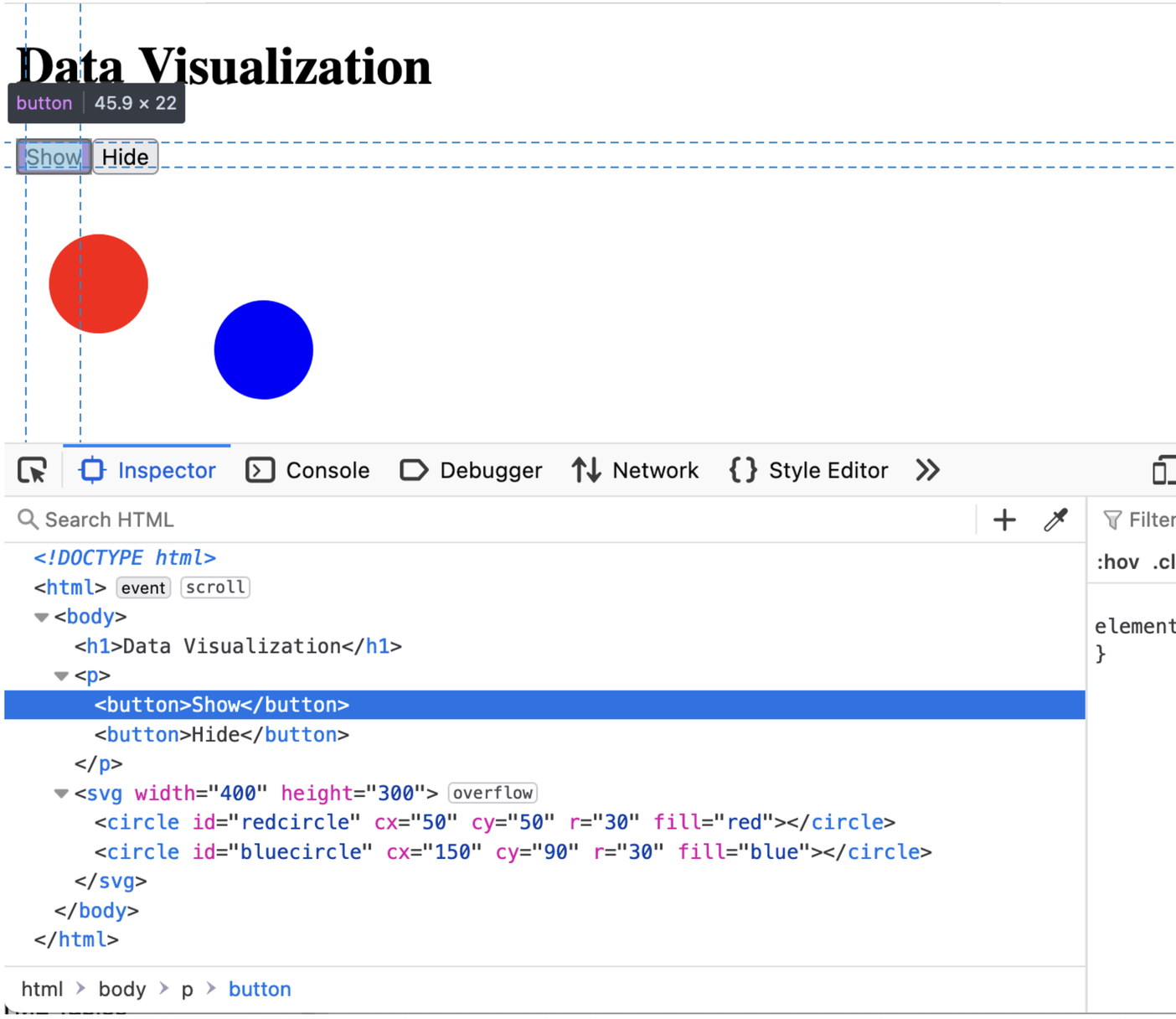
html › body › p › button

:hov .cl

element
}


document
body
<h1>

<svg>
text
<circle>
<circle>
<button>
<button>
text
text


Data Visualization
button 45.9 × 22
Show
Hide
Inspector
Console
Debugger
Network
Style Editor
Search HTML
<!DOCTYPE html>
<html> event scroll
<body>
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<button>Show</button>
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<svg width="400" height="300"> overflow
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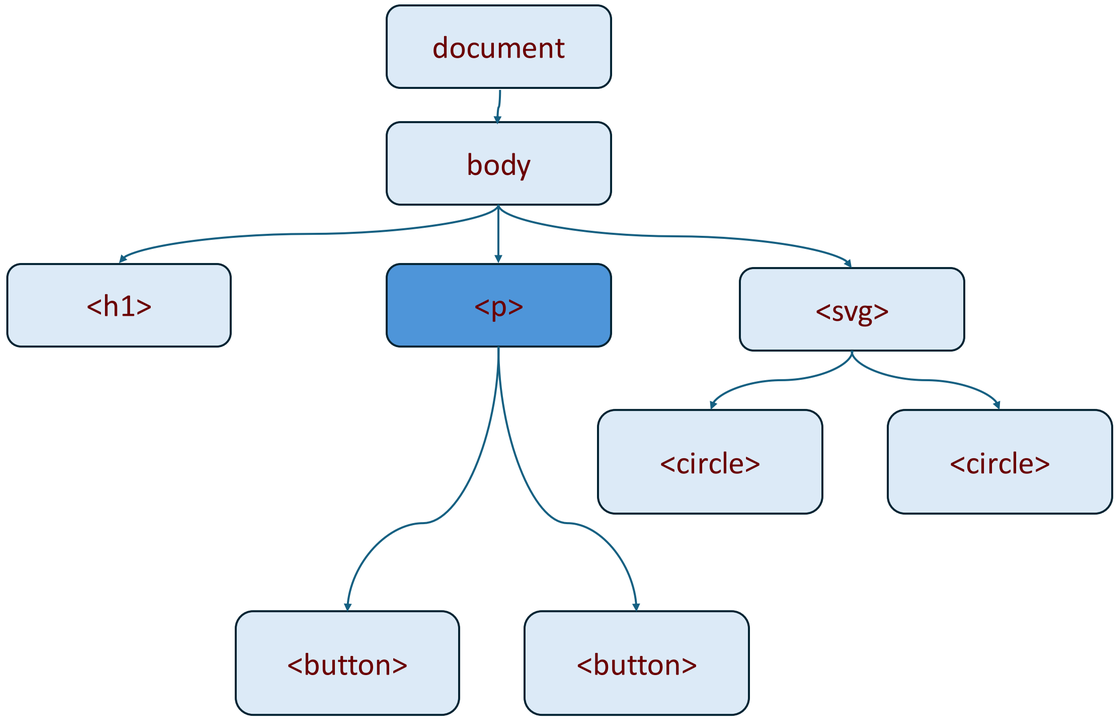
<circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
</svg>
</body>
</html>
html › body › p › button



Data Visualization

p | 764 × 22

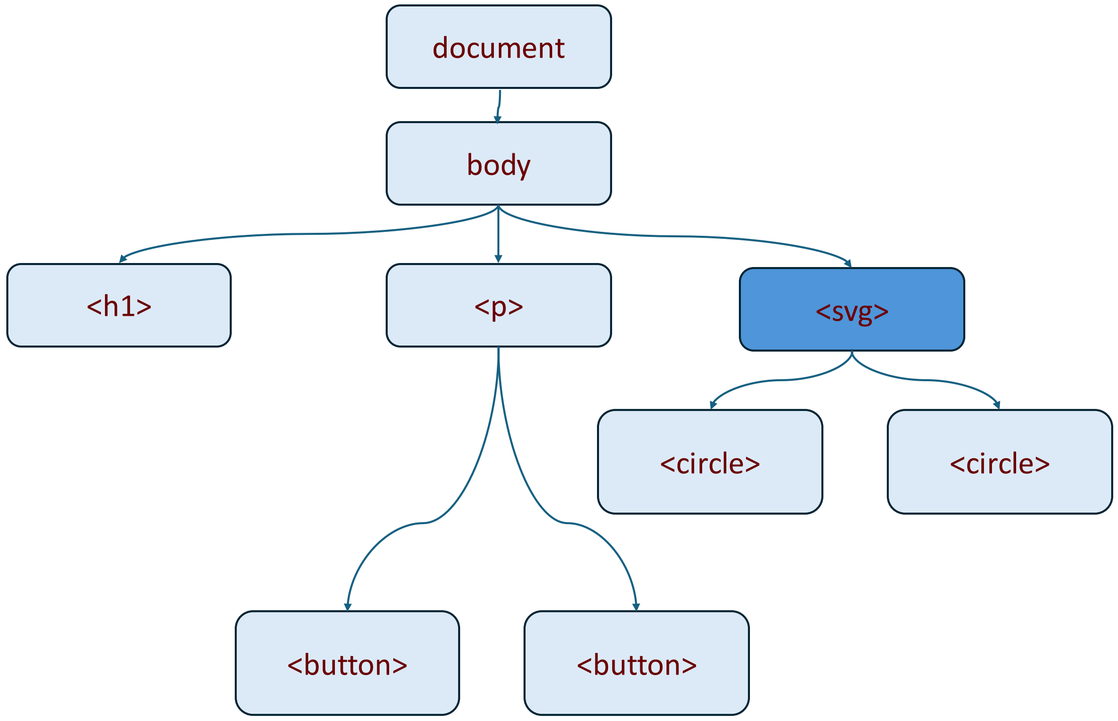
Show Hide

Inspector Console Debugger Network Style Editor

Search HTML

```
<!DOCTYPE html>
<html> event scroll
<body>
  <h1>Data Visualization</h1>
  <p>
    <button>Show</button>
    <button>Hide</button>
  </p>
  <svg width="400" height="300"> overflow
    <circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
    <circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
  </svg>
</body>
</html>
```

html › body › p



Data Visualization

Show Hide

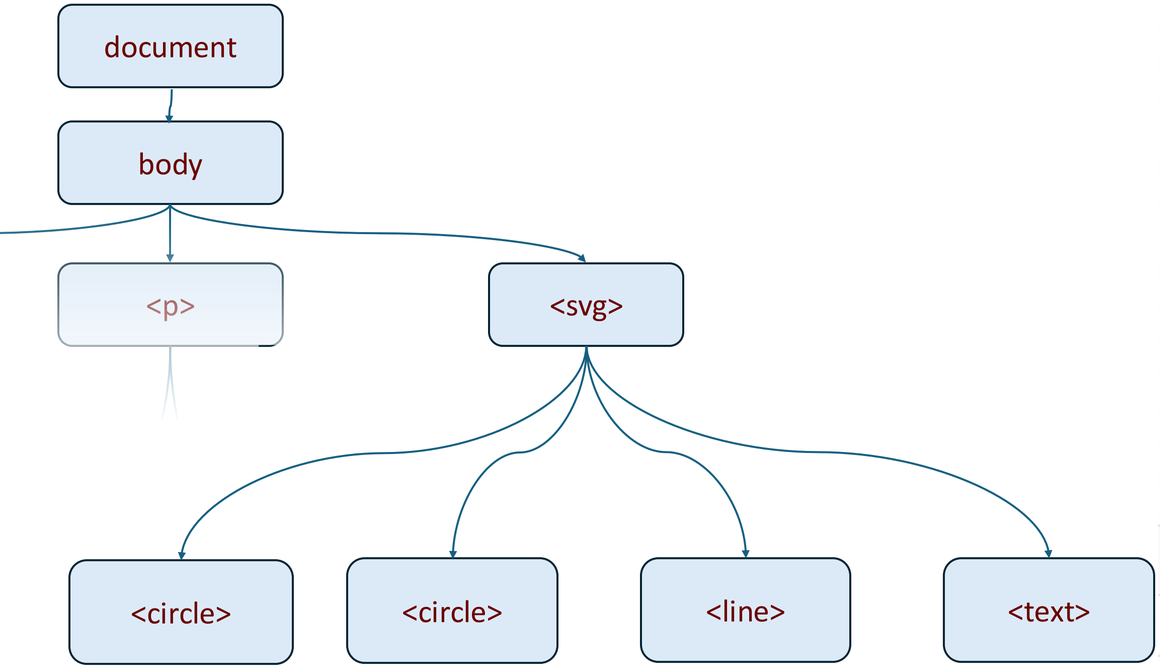
svg | 400 × 300

Inspector Console Debugger Network Style Editor

Search HTML

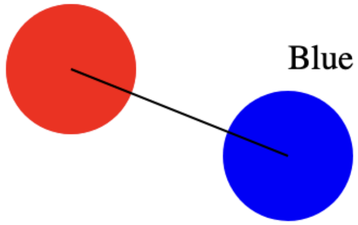
```
<!DOCTYPE html>
<html> event scroll
 <body>
   <h1>Data Visualization</h1>
  <p>
    <button>Show</button>
    <button>Hide</button>
   </p>
  <svg width="400" height="300"> overflow
    <circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
    <circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
   </svg>
 </body>
</html>
```

html › body › svg



Data Visualization

Show Hide

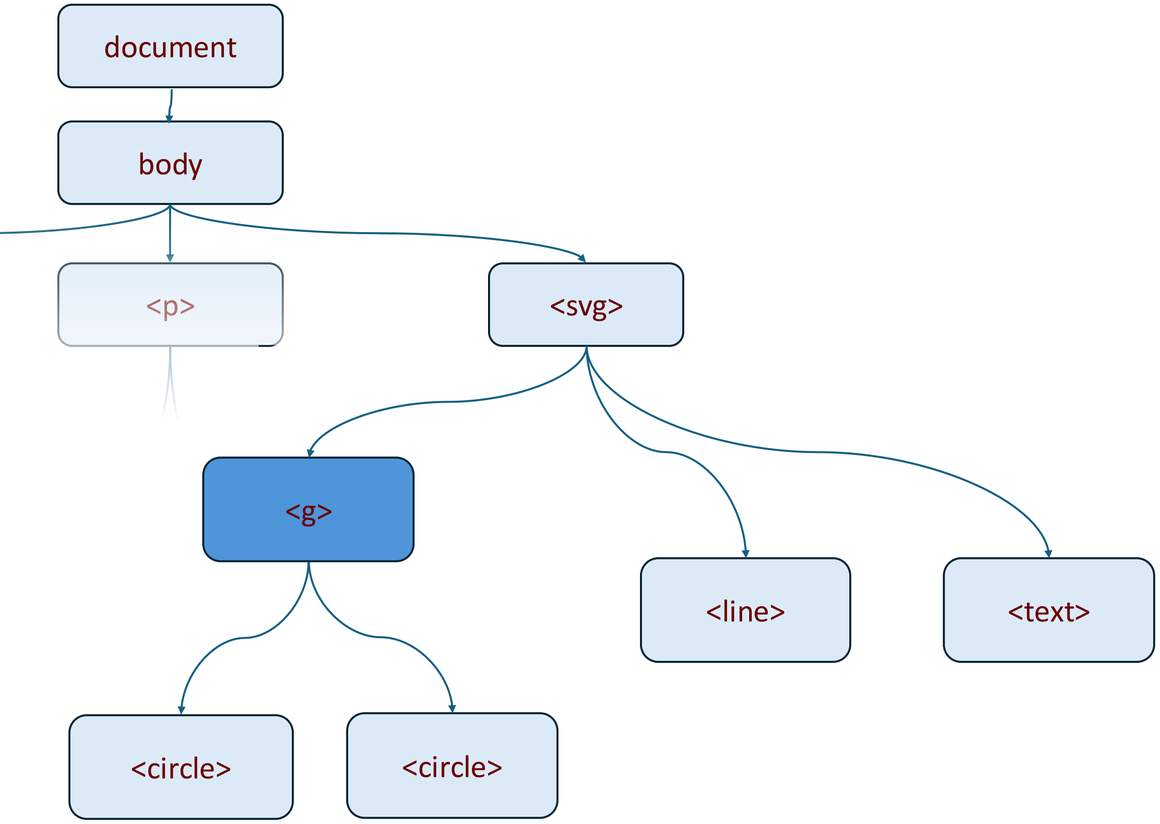


Inspector Console Debugger Network Style Editor

Search HTML

```
<!DOCTYPE html>
<html> event scroll
  <head></head>
  <body>
    <script type="text/javascript" src="/___vscode_livepreview_injected_script"></
    script>
    <h1>Data Visualization</h1>
    <p> ··· </p>
    <svg width="400" height="300"> overflow
      <circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
      <circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
      <text id="label" x="150" y="50">Blue</text>
      <line x1="50" y1="50" x2="150" y2="90" stroke="black"></line>
    </svg>
```

html › body › svg



Data Visualization

Show Hide

g#circles | 160 × 100

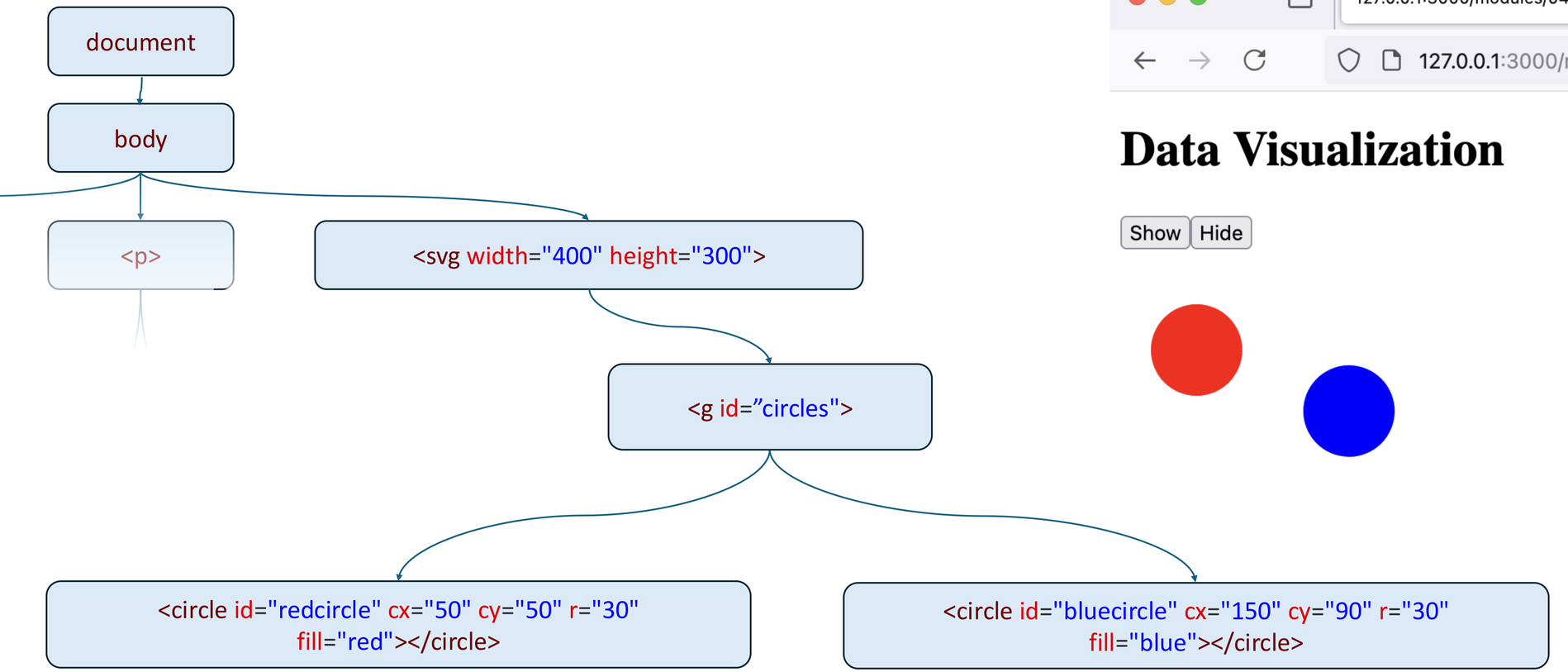
Blue

Inspector Console Debugger Network Style Editor

Search HTML

```
<script type="text/javascript" src="/___vscode_livepreview_injected_script"></
script>
<h1>Data Visualization</h1>
<p> ··· </p>
<svg width="400" height="300"> overflow
<g id="circles">
<circle id="redcircle" cx="50" cy="50" r="30" fill="red"></circle>
<circle id="bluecircle" cx="150" cy="90" r="30" fill="blue"></circle>
</g>
<text id="label" x="150" y="50">Blue</text>
<line x1="50" y1="50" x2="150" y2="90" stroke="black"></line>
</svg>
</body>
</html>
```

html › body › svg › g#circles


document
body
<p>
<svg width="400" height="300">
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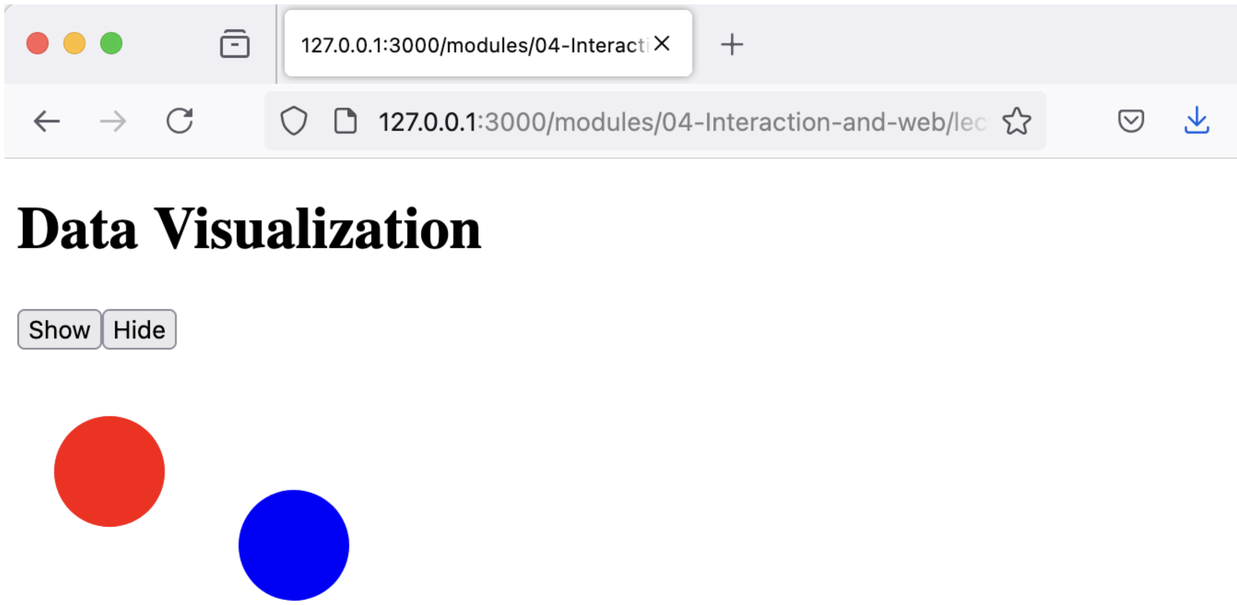
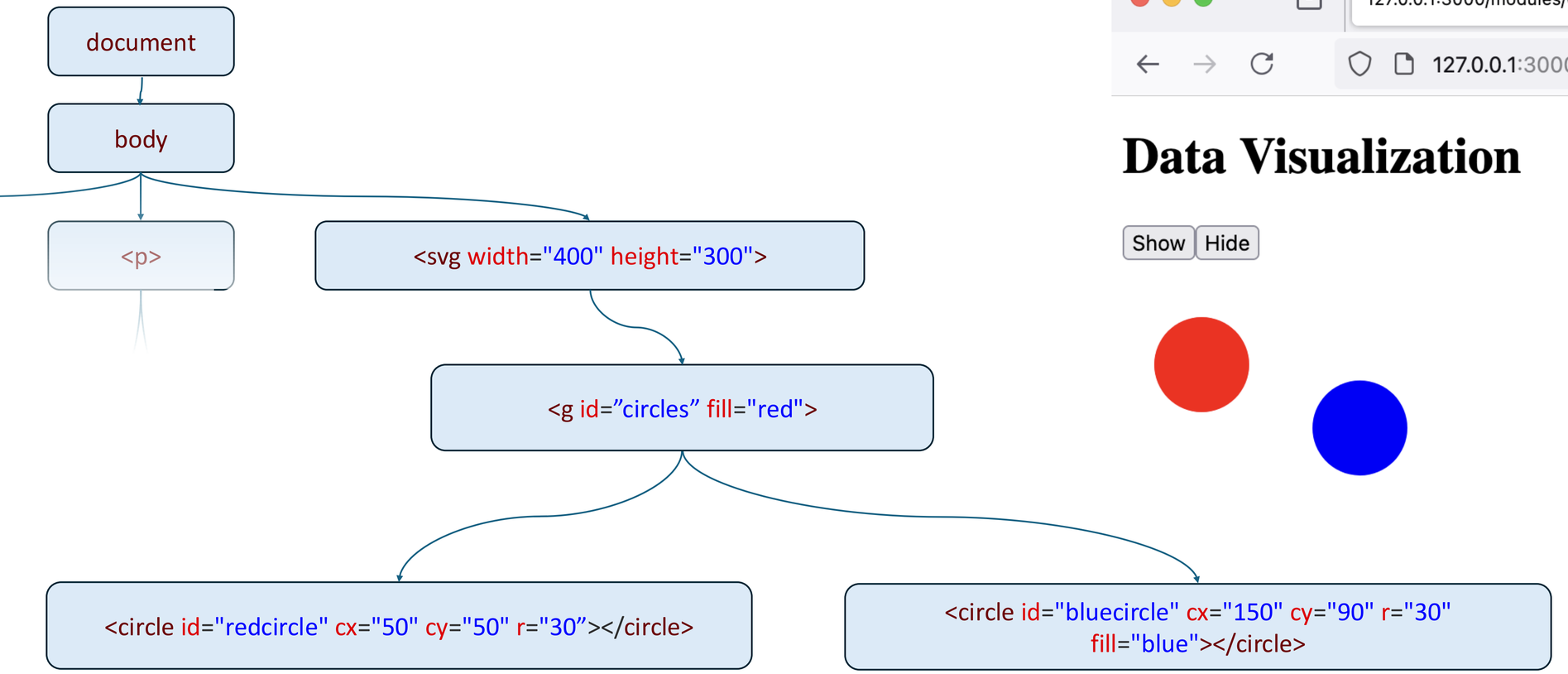
fill="red"></circle>
<circle id="bluecircle" cx="150" cy="90" r="30"
fill="blue"></circle>


127.0.0.1:3000/modules/04-Interact
127.0.0.1:3000/modules/04-Interaction-and-web/lec
Data Visualization
Show
Hide


document
body
<p>
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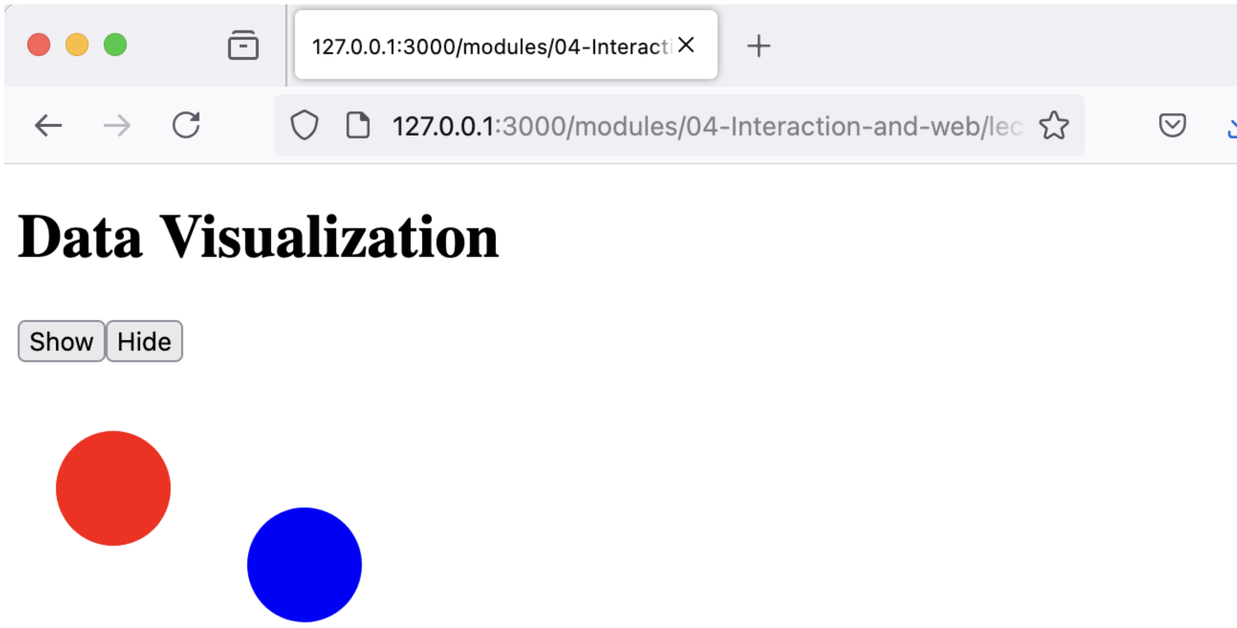
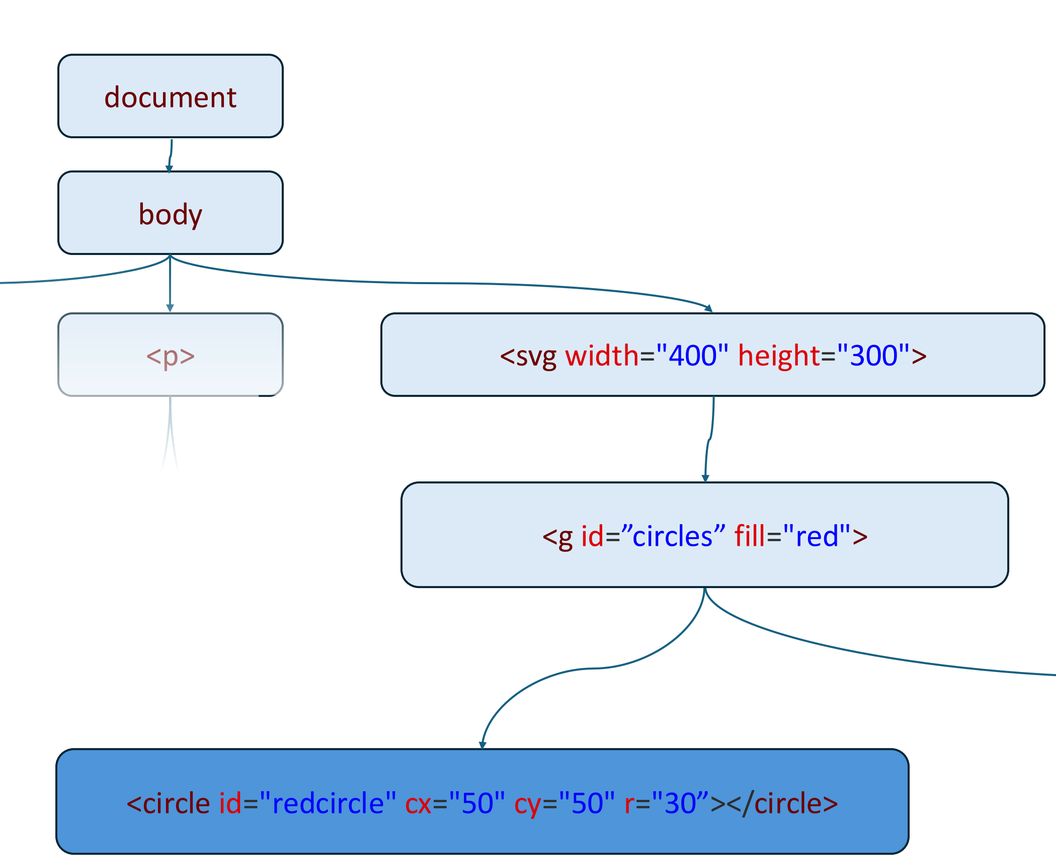
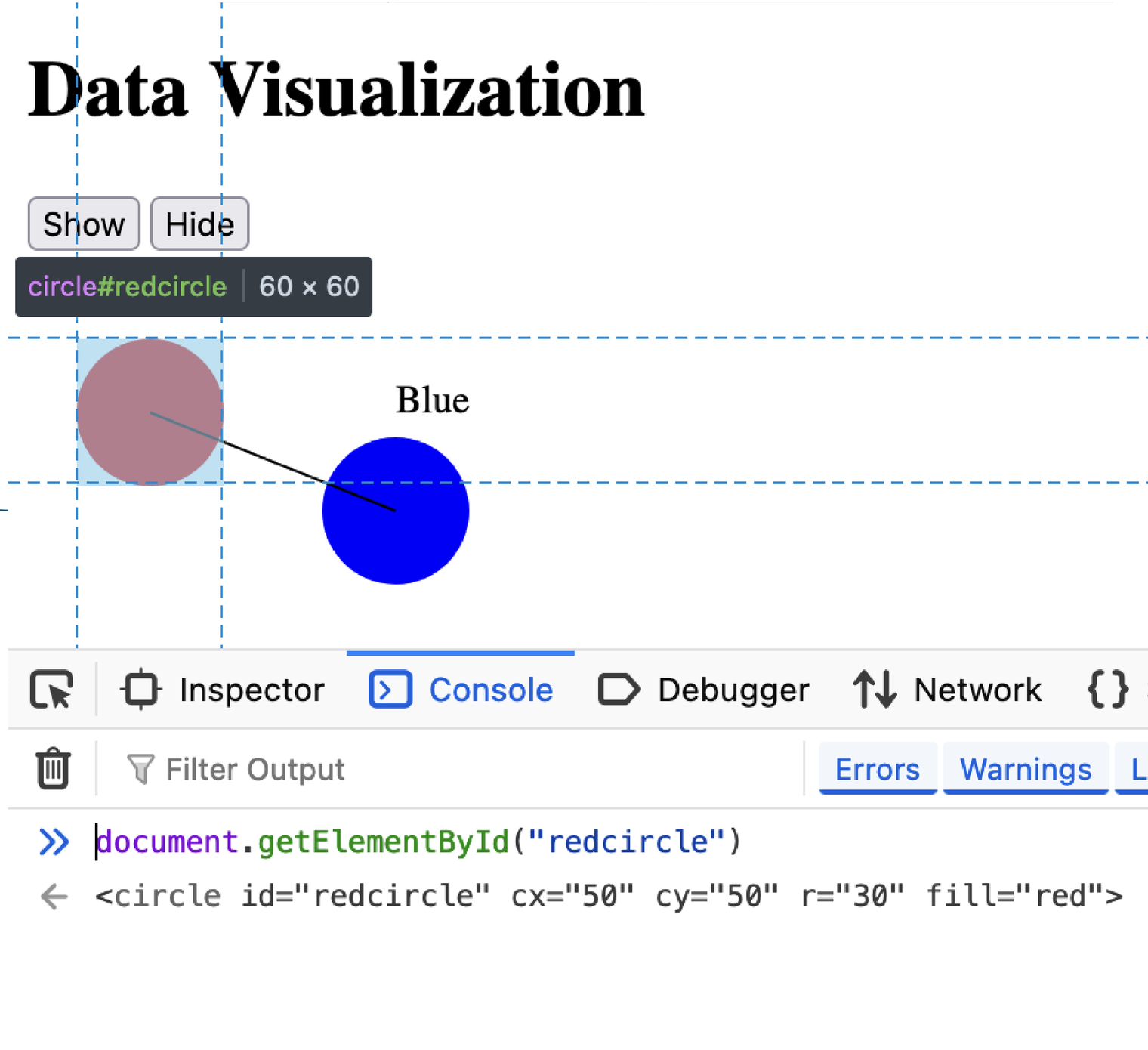
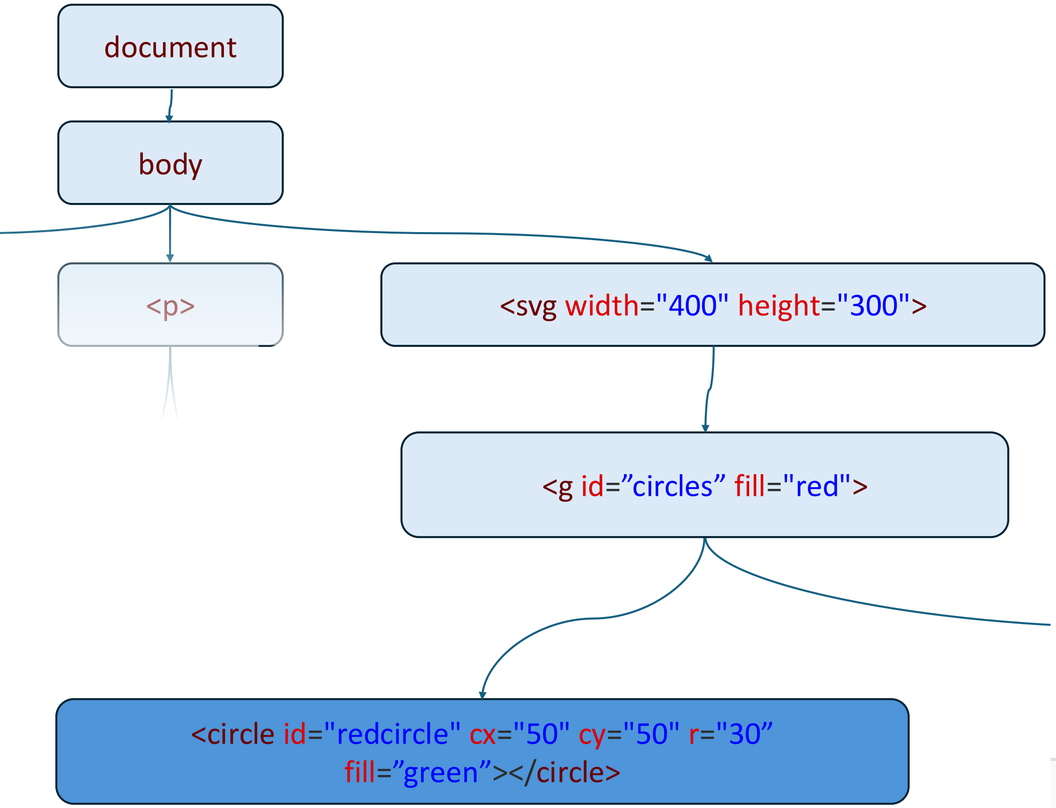
<circle id="bluecircle" cx="150" cy="90" r="30"
fill="blue"></circle>


127.0.0.1:3000/modules/04-Interact
127.0.0.1:3000/modules/04-Interaction-and-web/lec
Data Visualization
Show
Hide

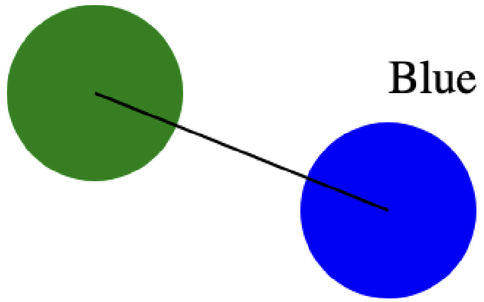

document
body
<p>
<svg width="400" height="300">
<g id=”circles” fill="red">
<circle id="redcircle" cx="50" cy="50" r="30”></circle>

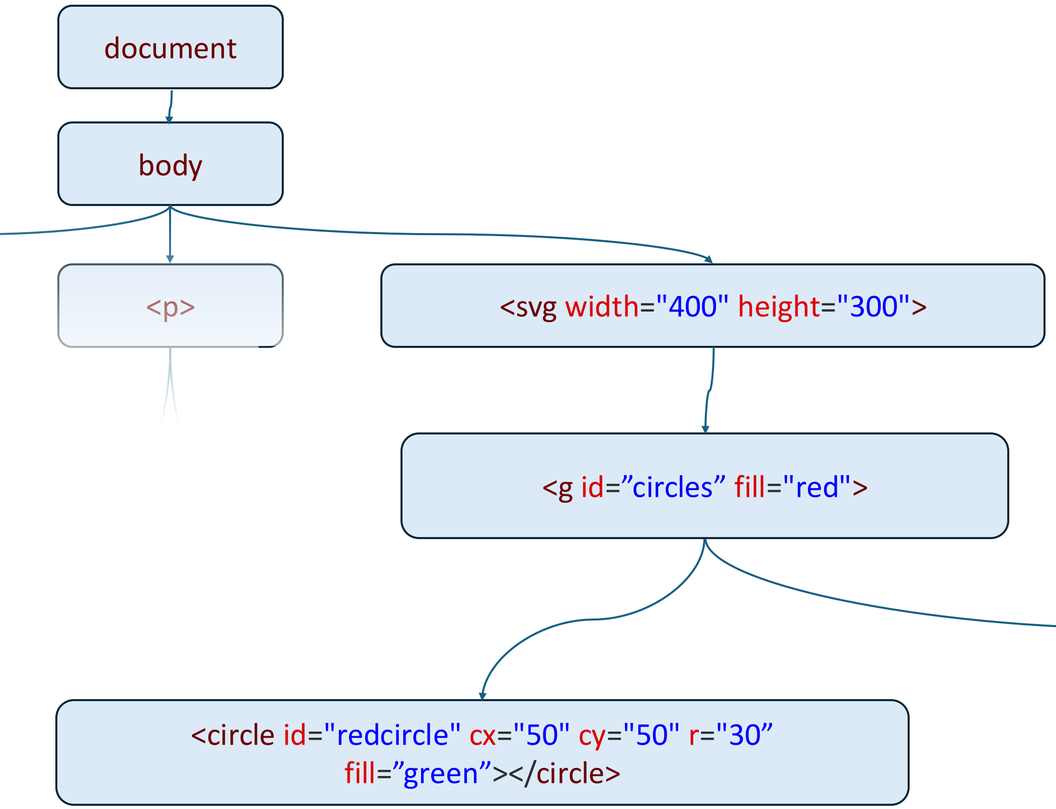

Data Visualization
Show
Hide
circle#redcircle | 60 × 60
Blue
Inspector
Console
Debugger
Network
Filter Output
Errors
Warnings
document.getElementById("redcircle")
<circle id="redcircle" cx="50" cy="50" r="30" fill="red">



Data Visualization

Show Hide

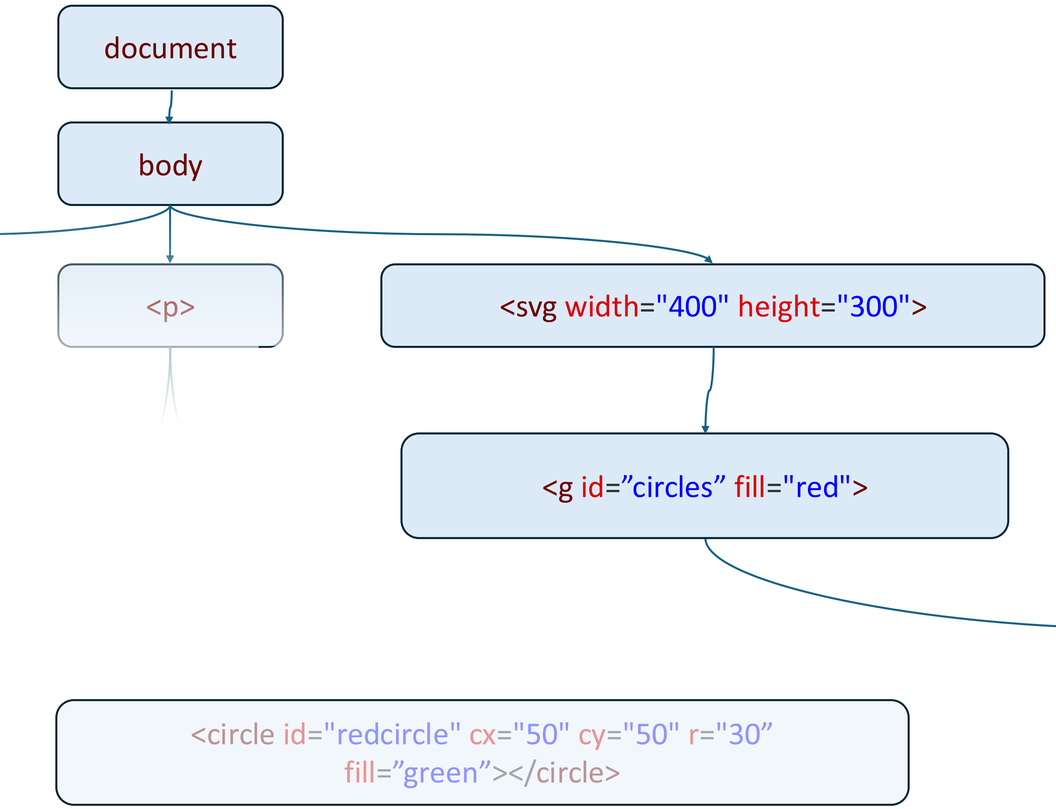





```
let redcircle = document.getElementById('redcircle');
let circles = document. getElementById(circles');

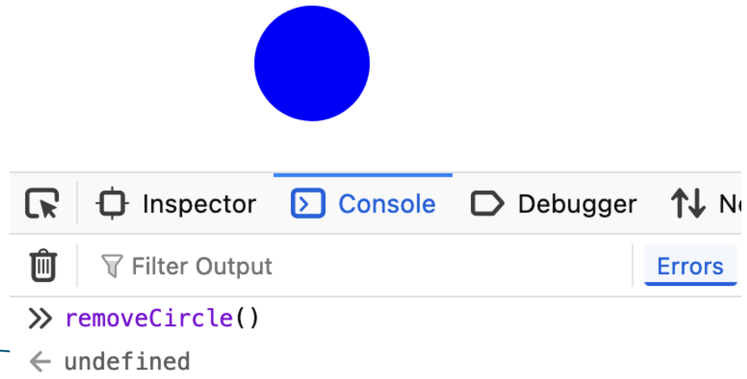
function removeCircle() {
    redcircle.remove()
}

function addCircle() {
    svg.appendChild(redcircle);
}
```



Data Visualization

Show Hide

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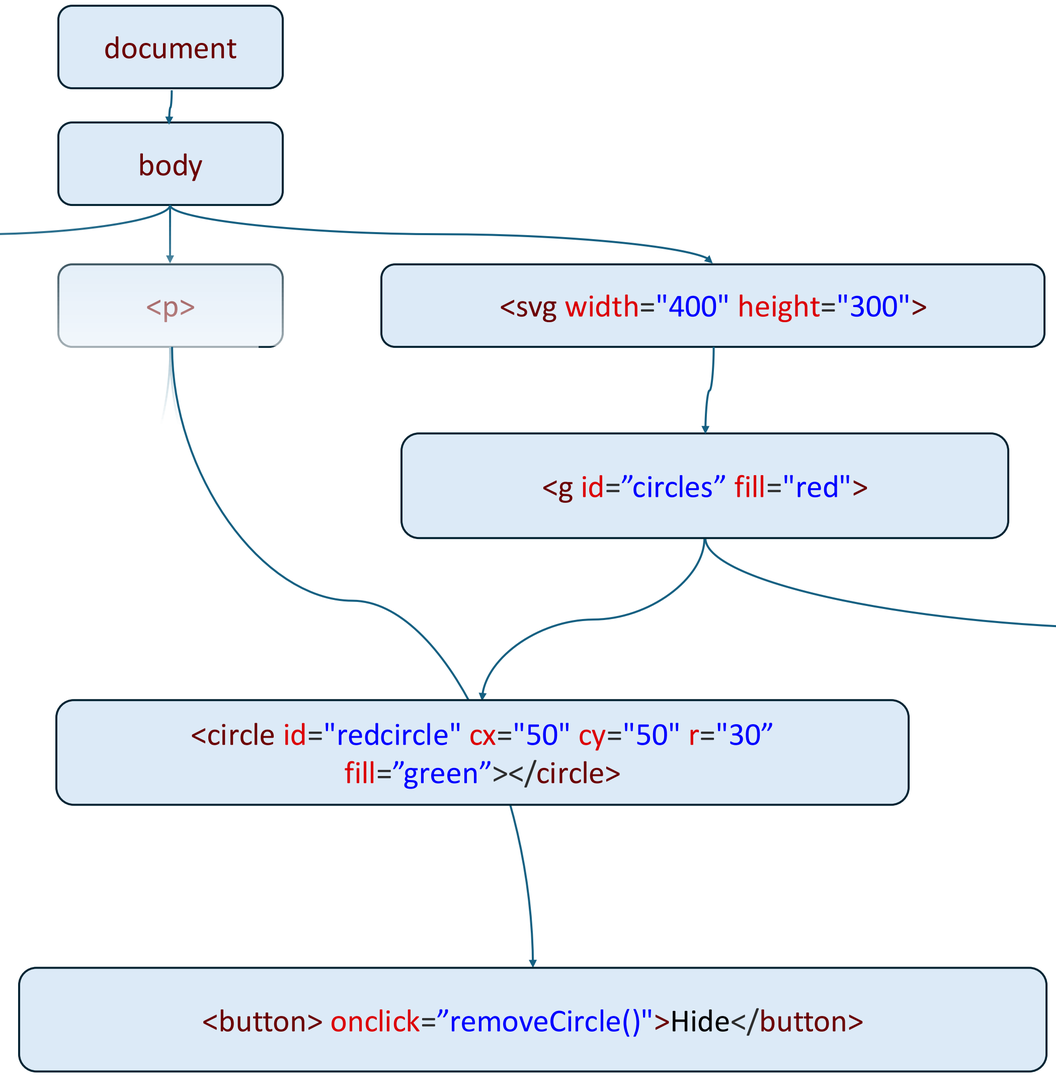
Data Visualization



Show Hide

```
let redcircle = document.getElementById('redcircle');
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function removeCircle() {
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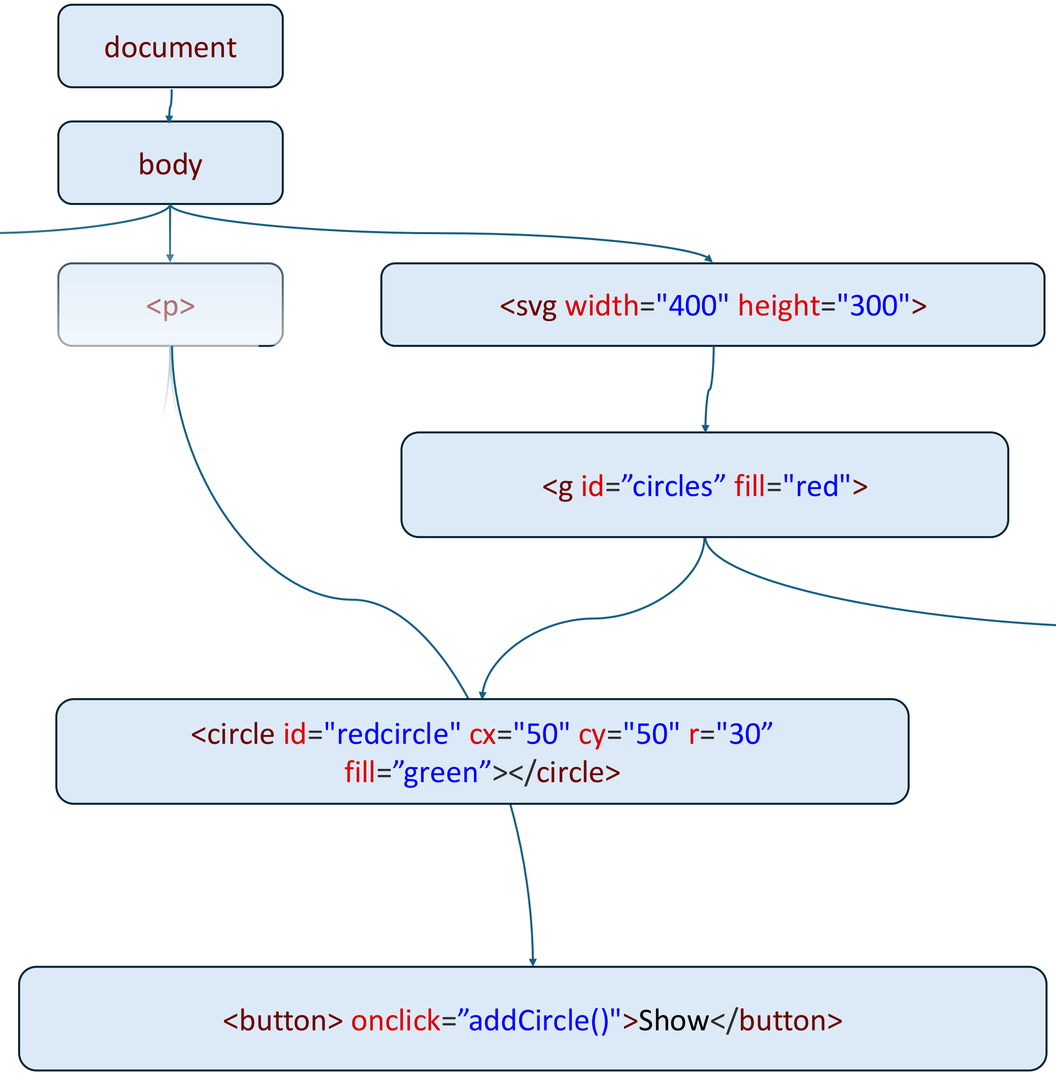
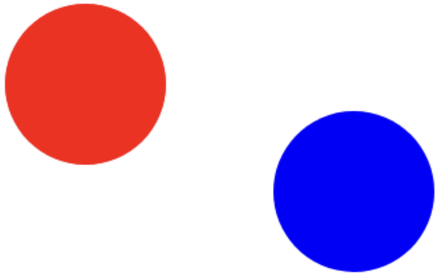


Data Visualization

Show Hide




```
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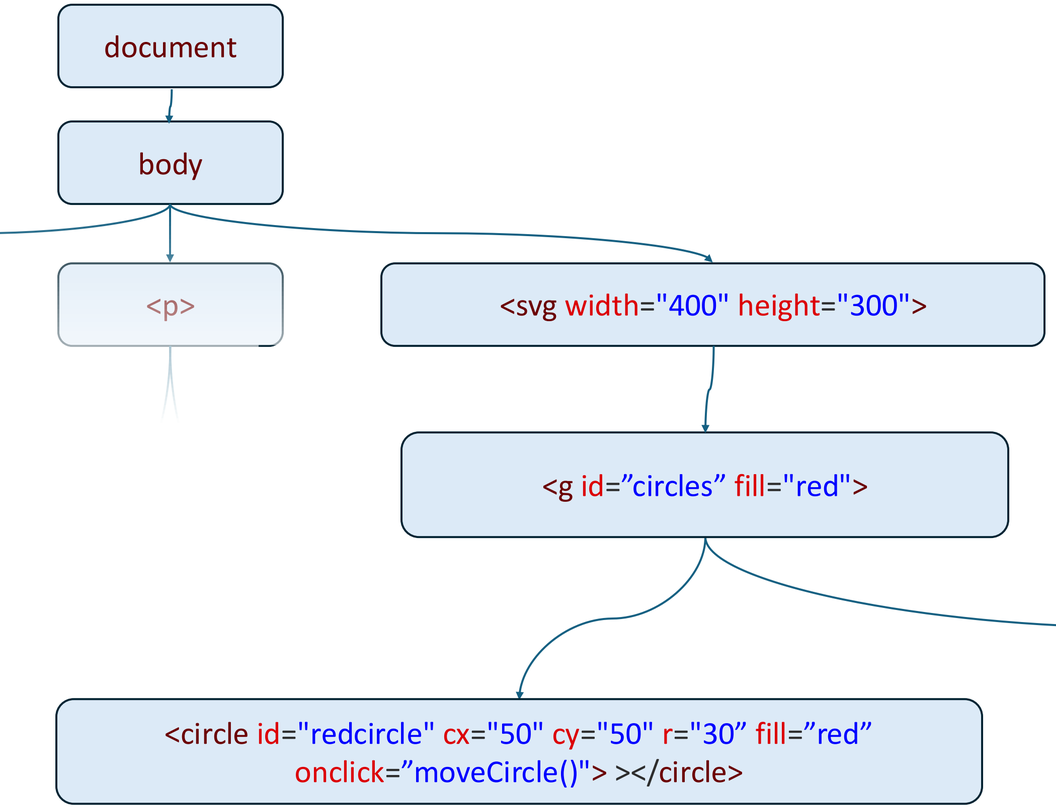
let circles = document. getElementById(circles');

function removeCircle() {
    redcircle.remove()
}

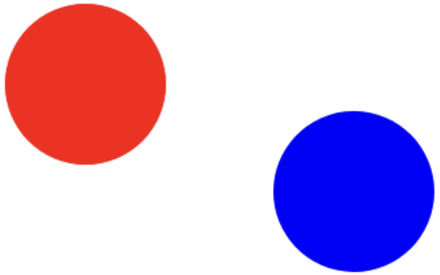
function addCircle() {
    svg.appendChild(redcircle);
}
```

Basic Animation



Data Visualization

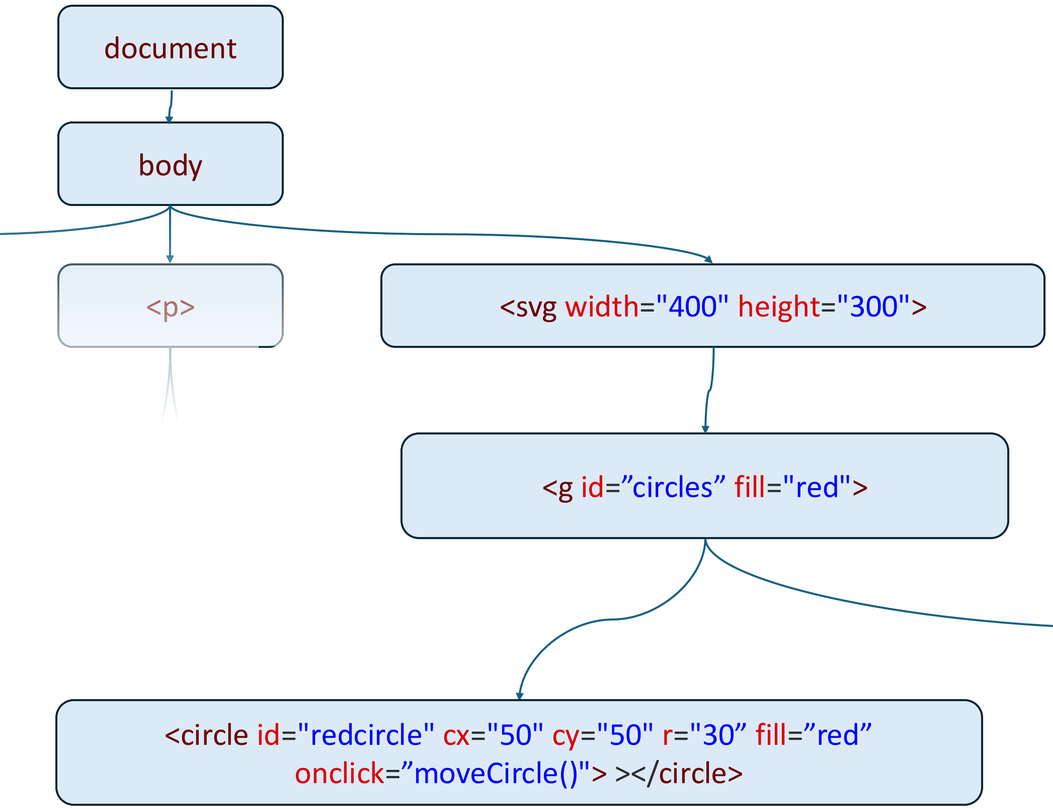
Show Hide



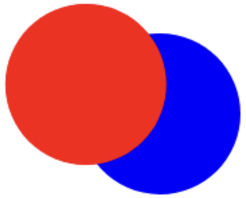
```
function moveCircle() {
    const duration = 1000;
    let i = 0;
    setInterval(() => {
        const t = Math.min(i++ / duration, 1);
        redcircle.setAttribute('cx', t * 150 + (1 - t) * 50);
        redcircle.setAttribute('cy', t * 90 + (1 - t) * 50);
        }, 1)
        }

redcircle.addEventListener('click', moveCircle);
```

Data Visualization



Show Hide



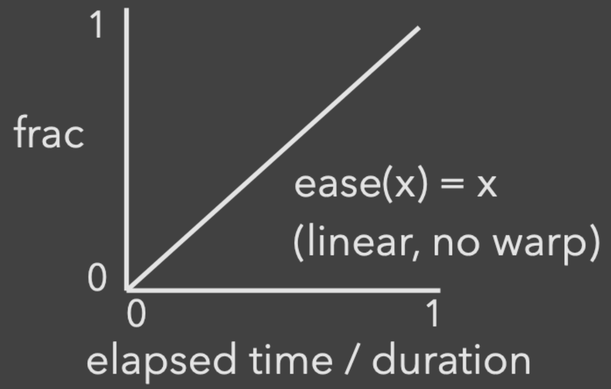
```
function moveCircle() {
    const duration = 1000;
    let i = 0;
    setInterval(() => {
        const t = Math.min(i++ / duration, 1);
        redcircle.setAttribute('cx', t * 150 + (1 - t) * 50);
        redcircle.setAttribute('cy', t * 90 + (1 - t) * 50);
        }, 1)
        }

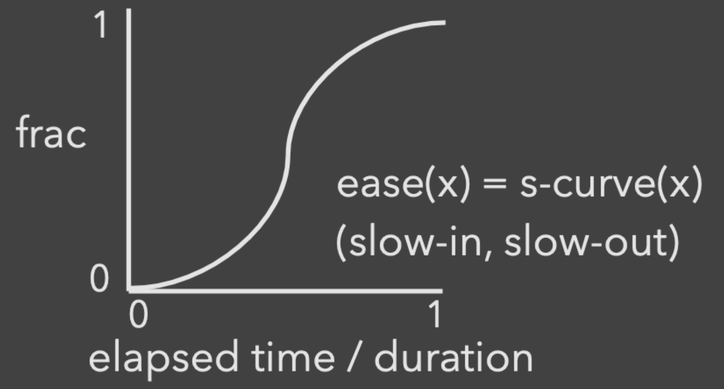
redcircle.addEventListener('click', moveCircle);
```

Easing (or “Pacing”) Functions

Goals: stylize animation, improve perception.

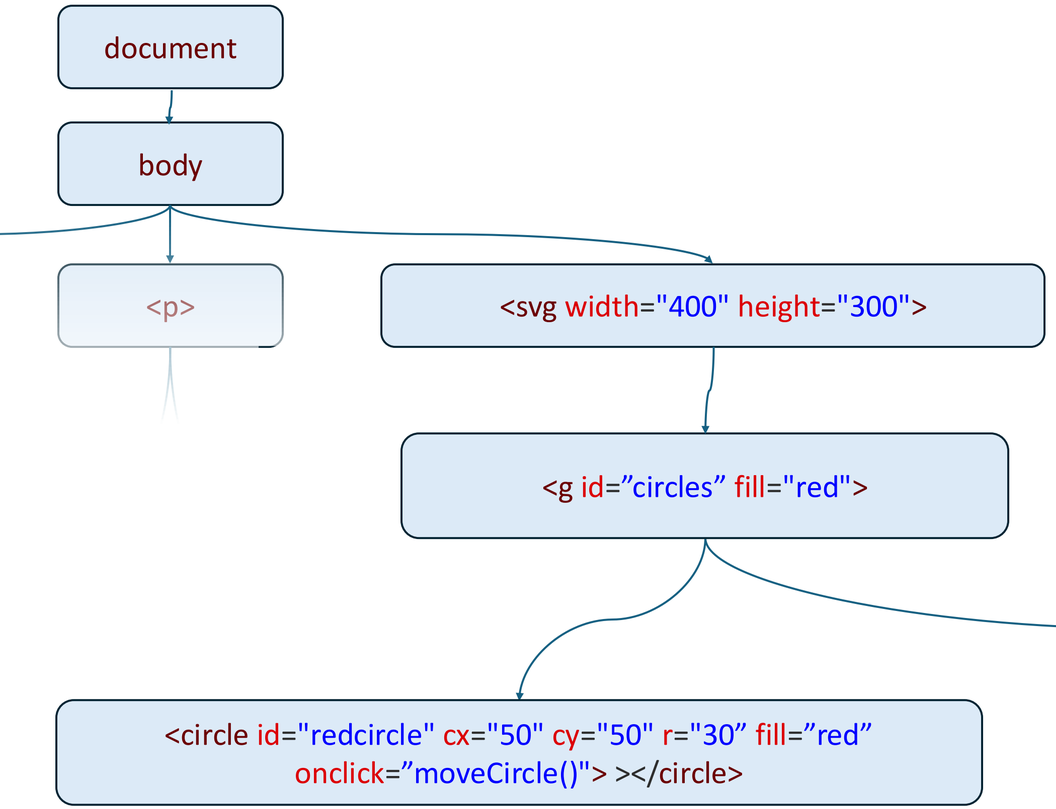
Basic idea is to warp time: as *duration* goes from start (0%) to end (100%), dynamically adjust the *interpolation fraction* using an **easing function**.



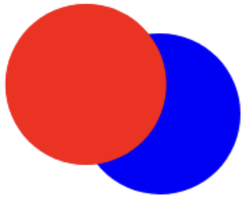


From Jeff Heer

Data Visualization



Show Hide



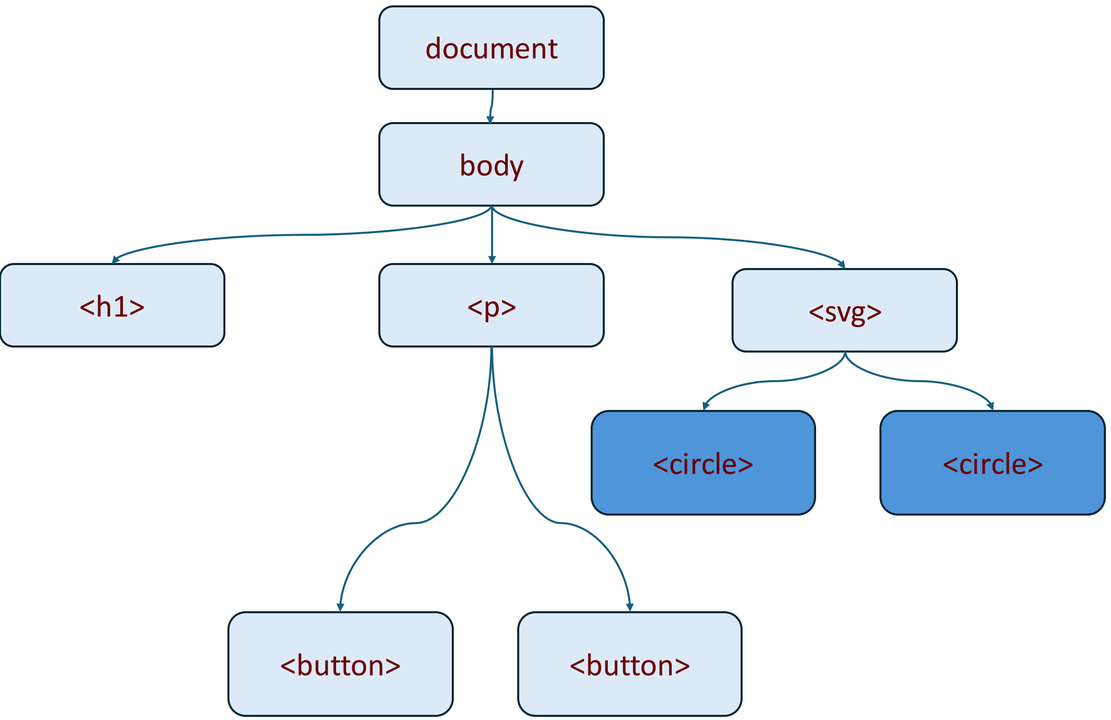
https://easings.net/

```
function moveCircle() {
    const duration = 1000;
    let i = 0;
    setInterval(() => {
        const t = Math.min(i++ / duration, 1);

        t = ease(t); //
        redcircle.setAttribute('cx', t * 150 + (1 - t) * 50);
        redcircle.setAttribute('cy', t * 90 + (1 - t) * 50);
        }, 1)
        }

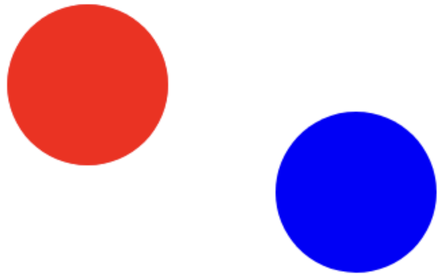
redcircle.addEventListener('click', moveCircle);
```

Selecting Elements



Data Visualization

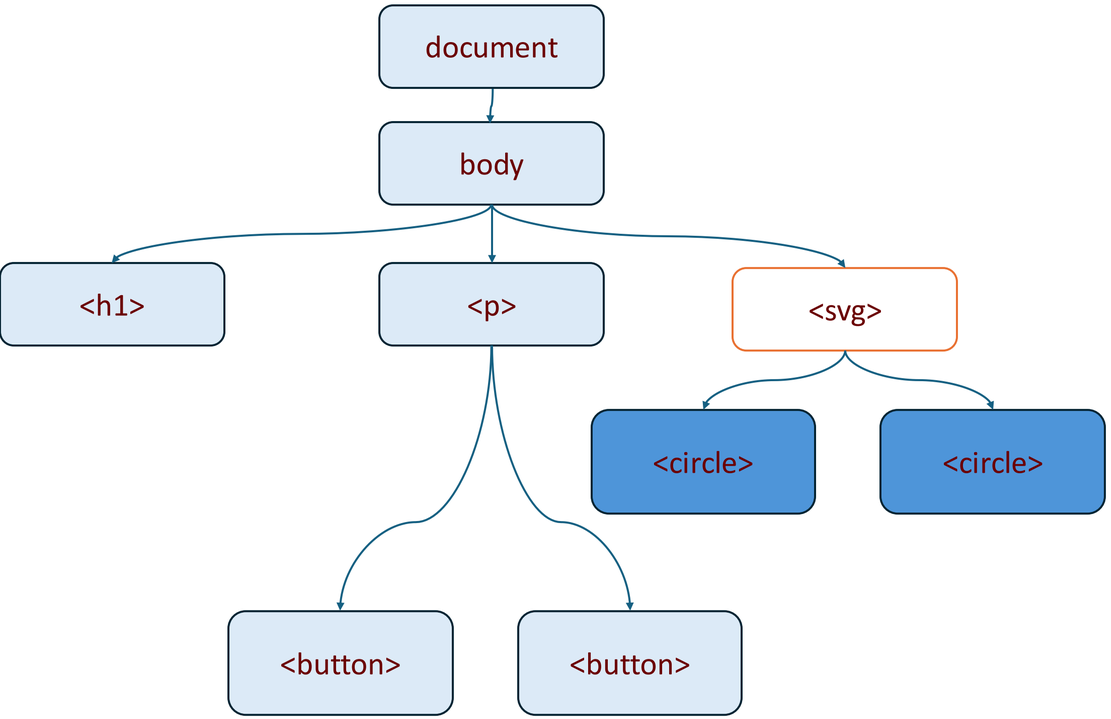
Show Hide



Inspector Console Debugger Network

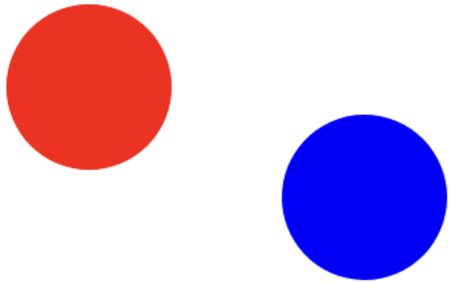
Filter Output Errors Warnings

```
document.querySelectorAll('circle')
NodeList [ circle#redcircle , circle#bluecircle ]
```



Data Visualization

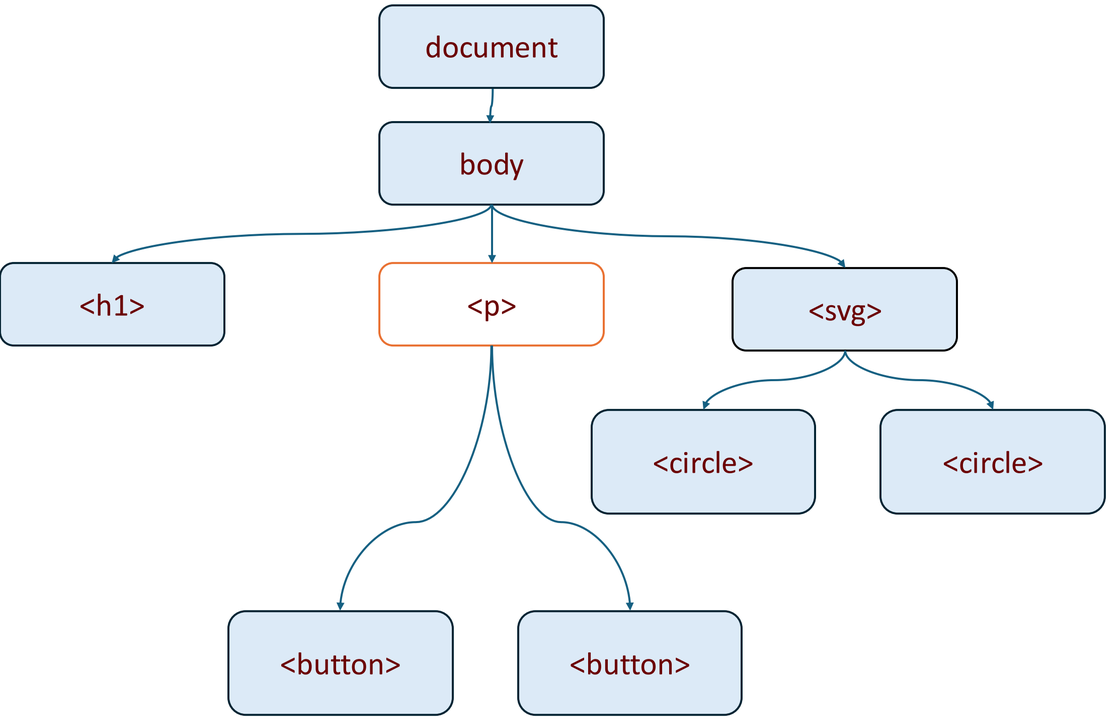
Show Hide



Inspector Console Debugger Network

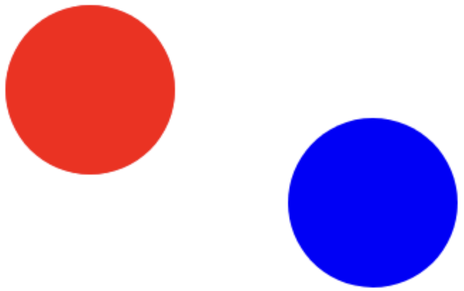
Filter Output Errors Warnings

```
>> svg.querySelectorAll('circle')
<- ▶ NodeList [ circle#redcircle , circle#bluecircle ]
```



Data Visualization

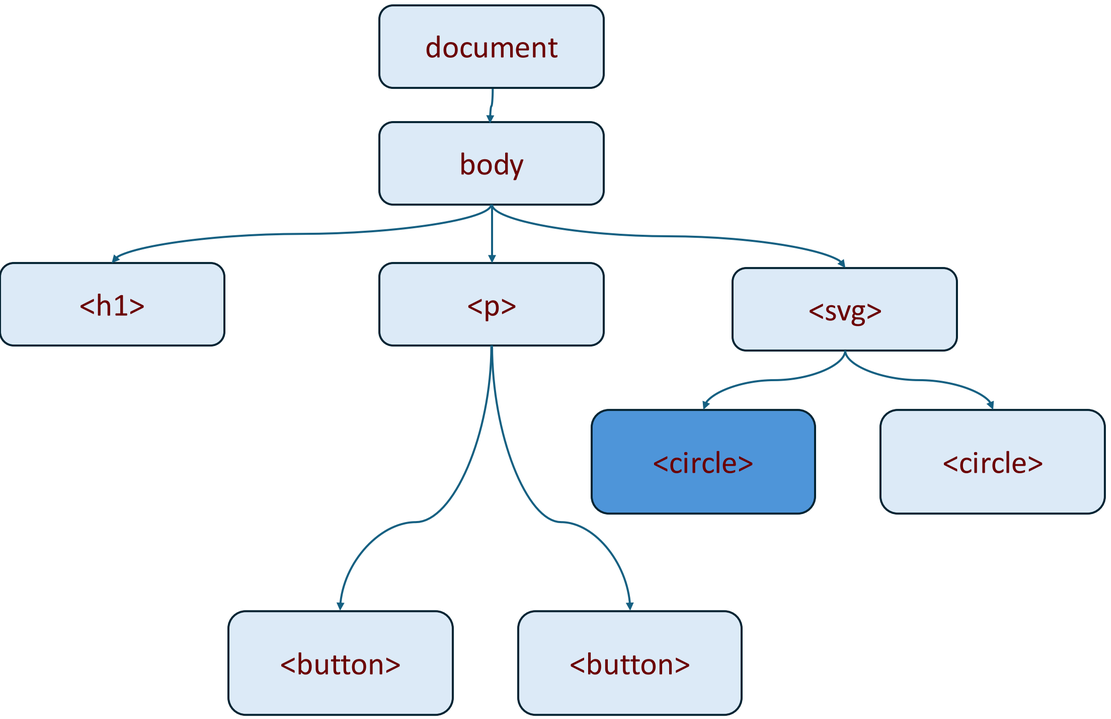
Show Hide

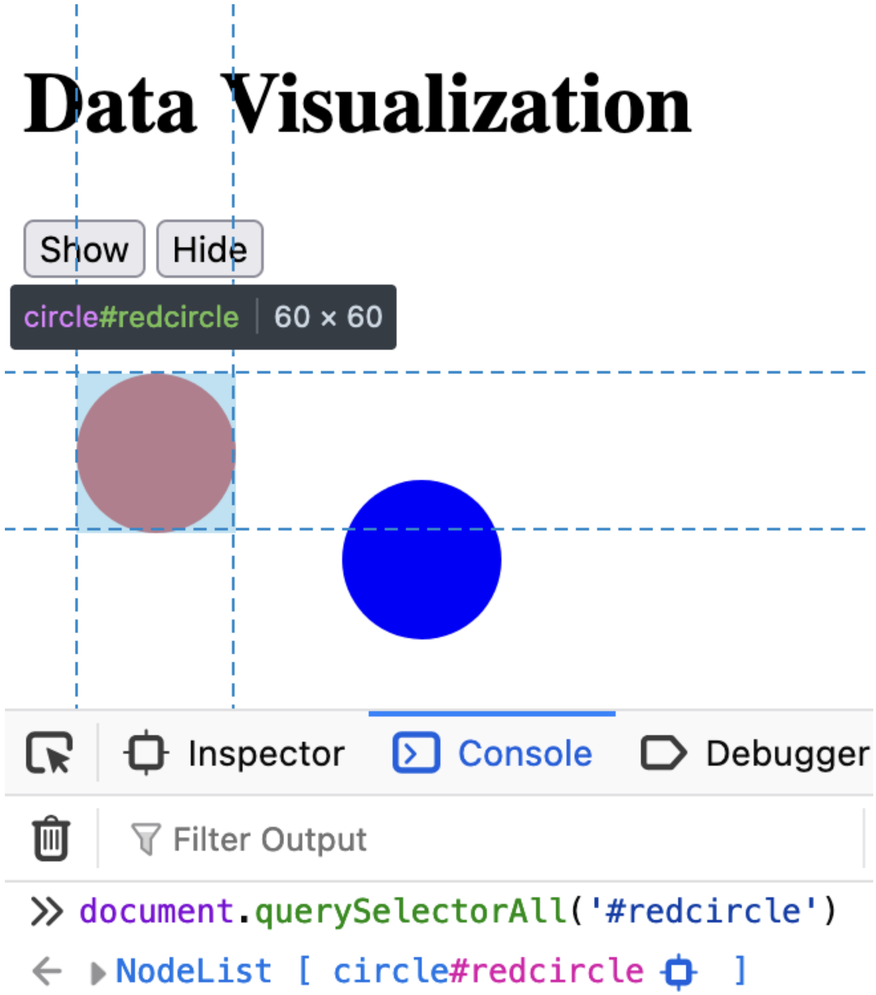


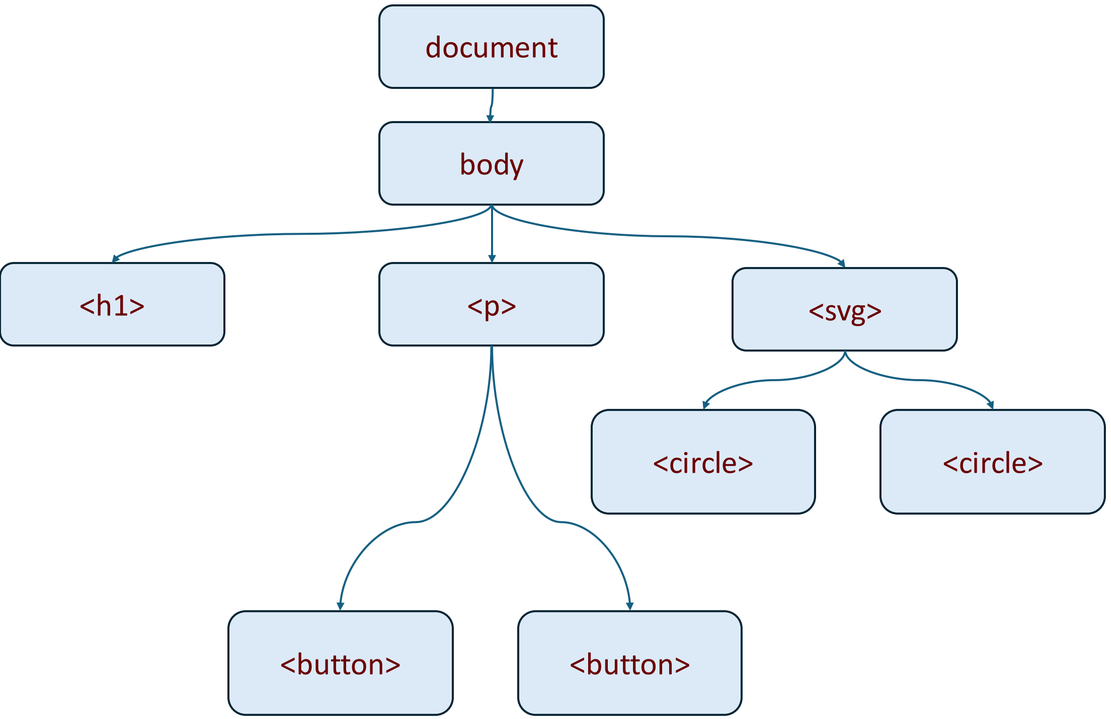
Inspector Console Debugger Network {

Filter Output Errors Warnings

```
p.querySelectorAll('circle')
NodeList []
```


document
body
<h1>
<p>
<svg>
<circle>
<circle>
<button>
<button>

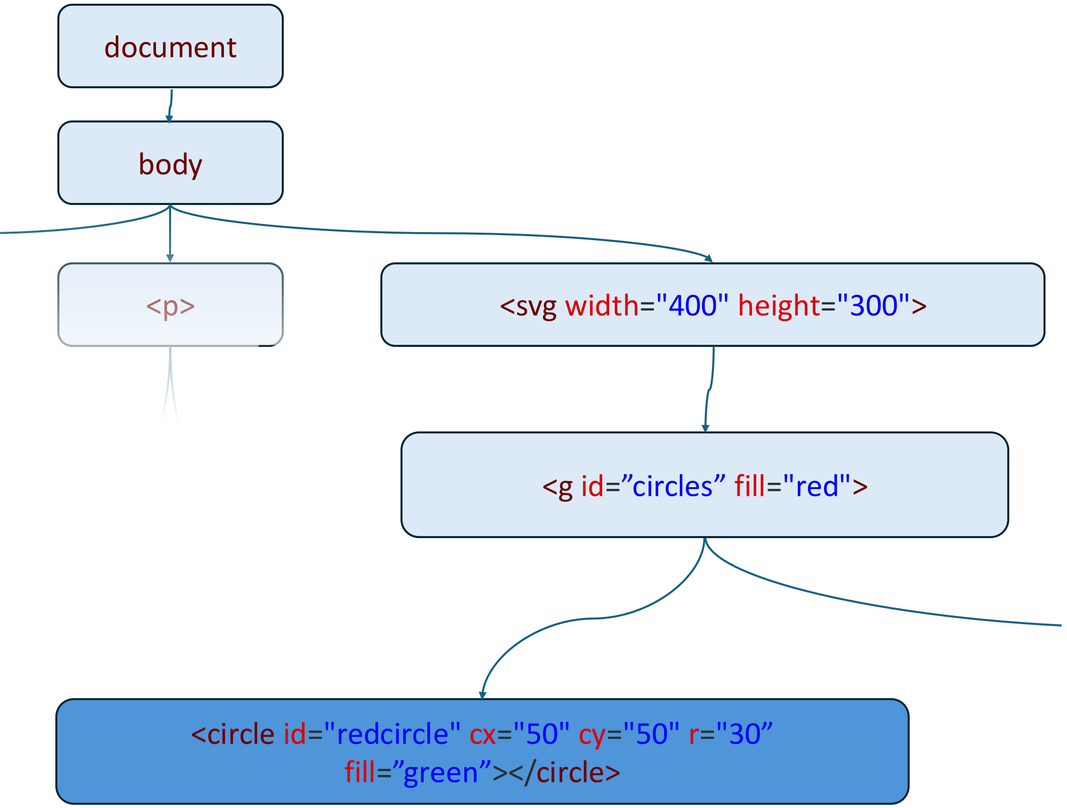

Data Visualization
Show
Hide
circle#redcircle
60 × 60
Inspector
Console
Debugger
Filter Output
document.querySelectorAll('#redcircle')
NodeList [circle#redcircle]

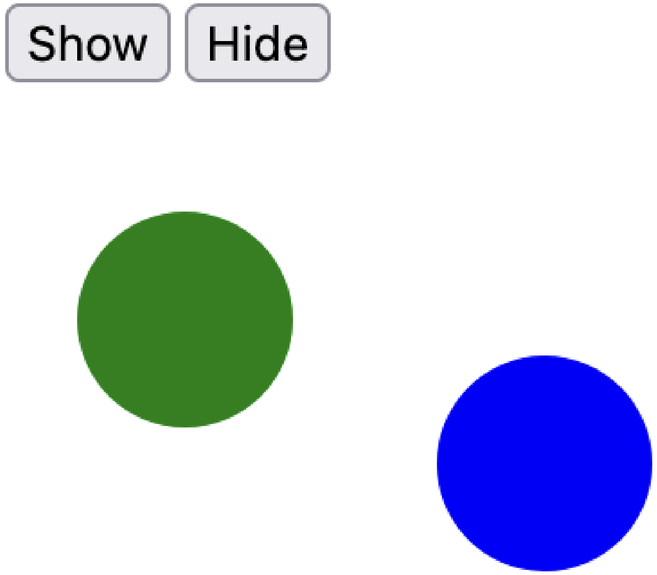


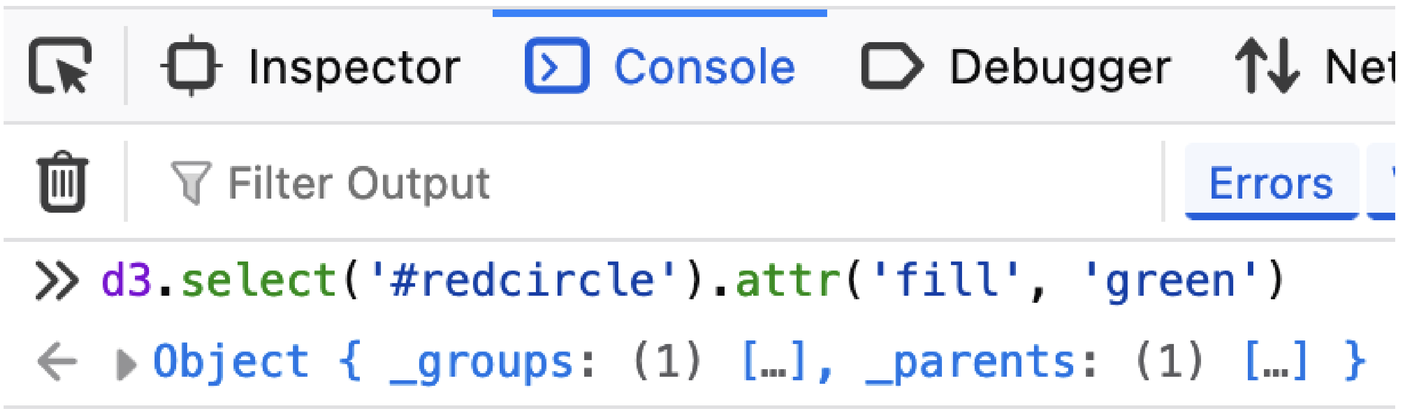

```
#foo        // <any id="foo">
foo         // <foo>
.foo        // <any class="foo">
[foo=bar]     // <any foo="bar">
foo bar     // <foo><bar></foo>
```

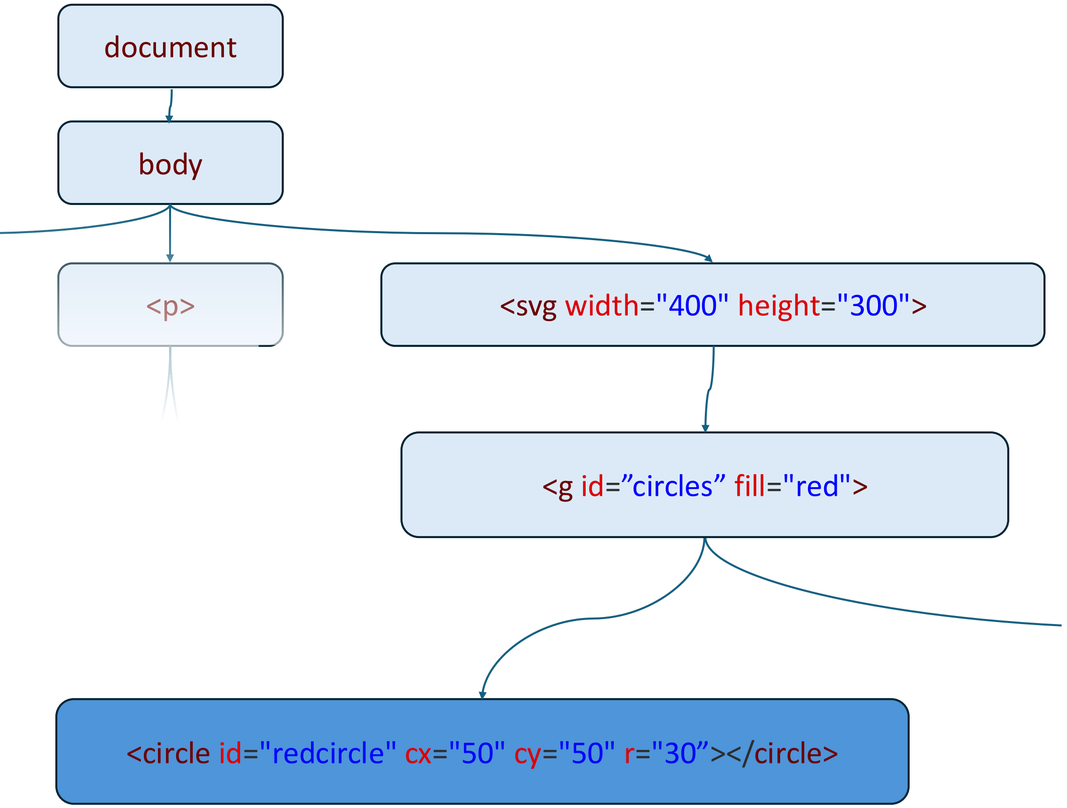
D3.js

Data Visualization



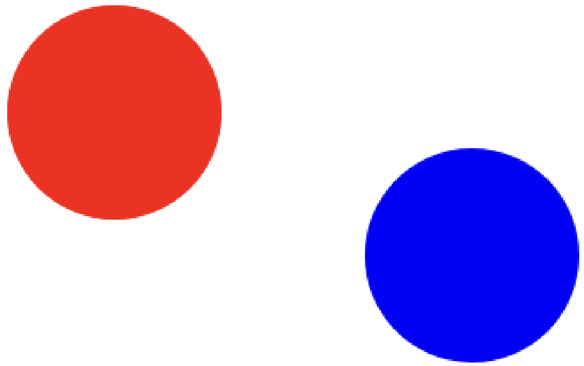


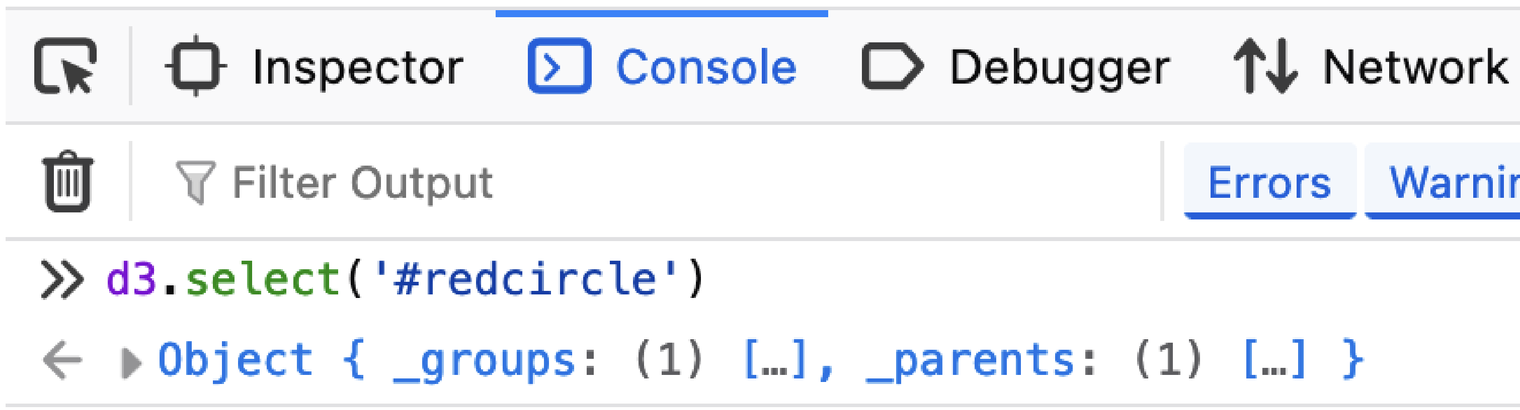


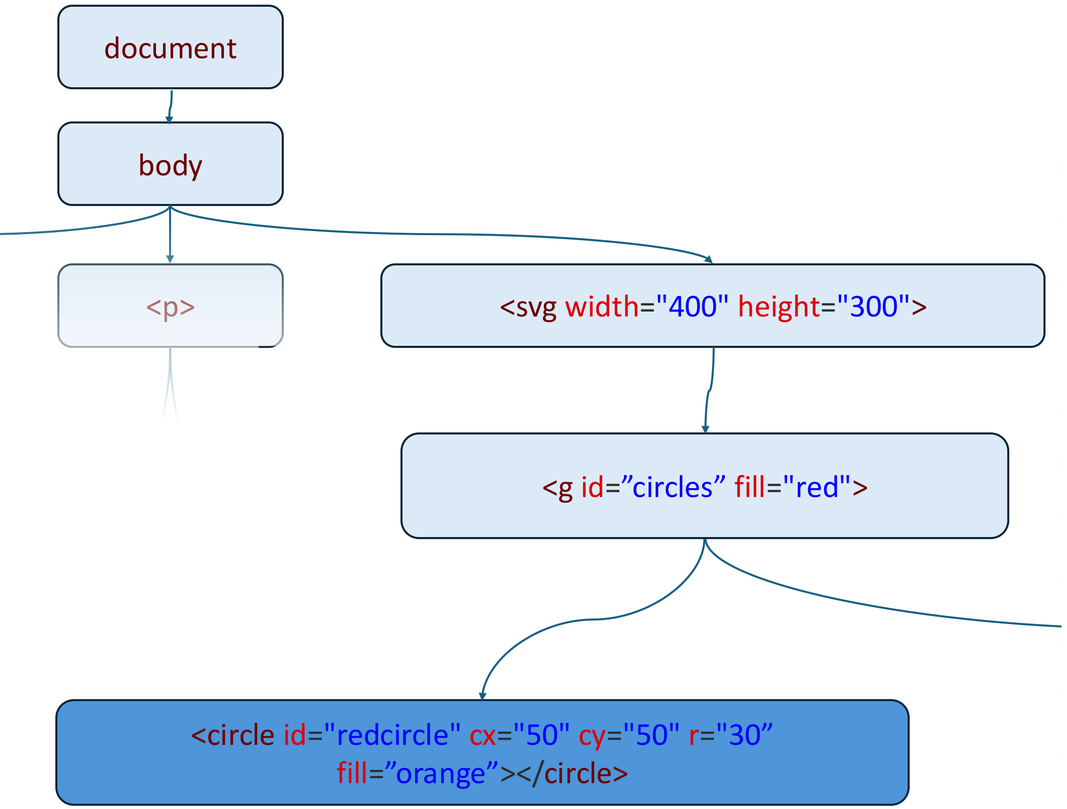


Data Visualization

Show Hide

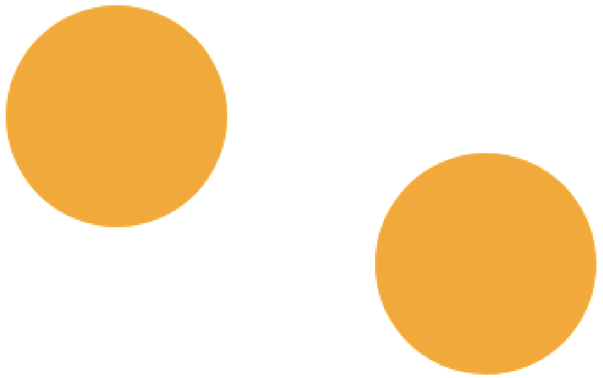


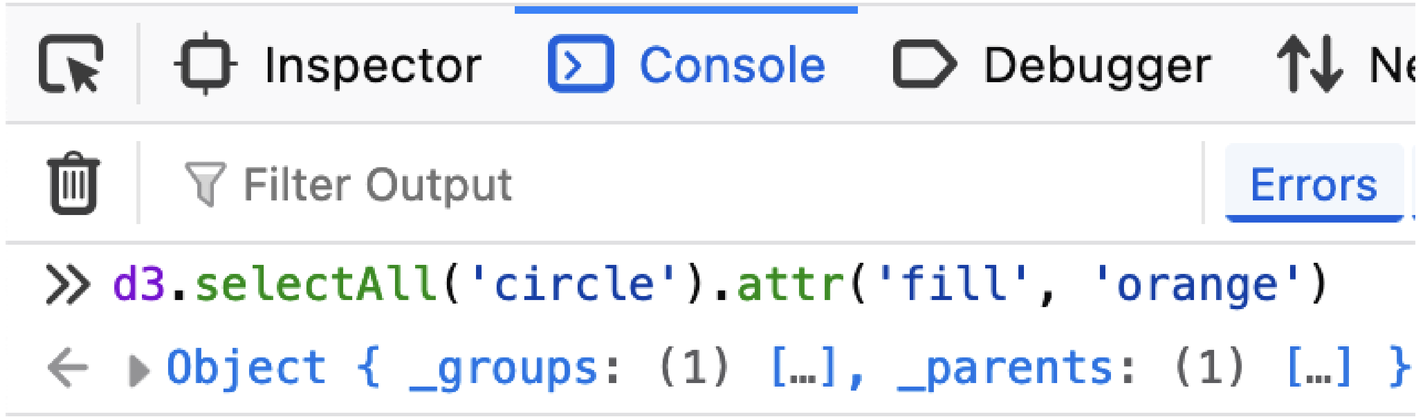


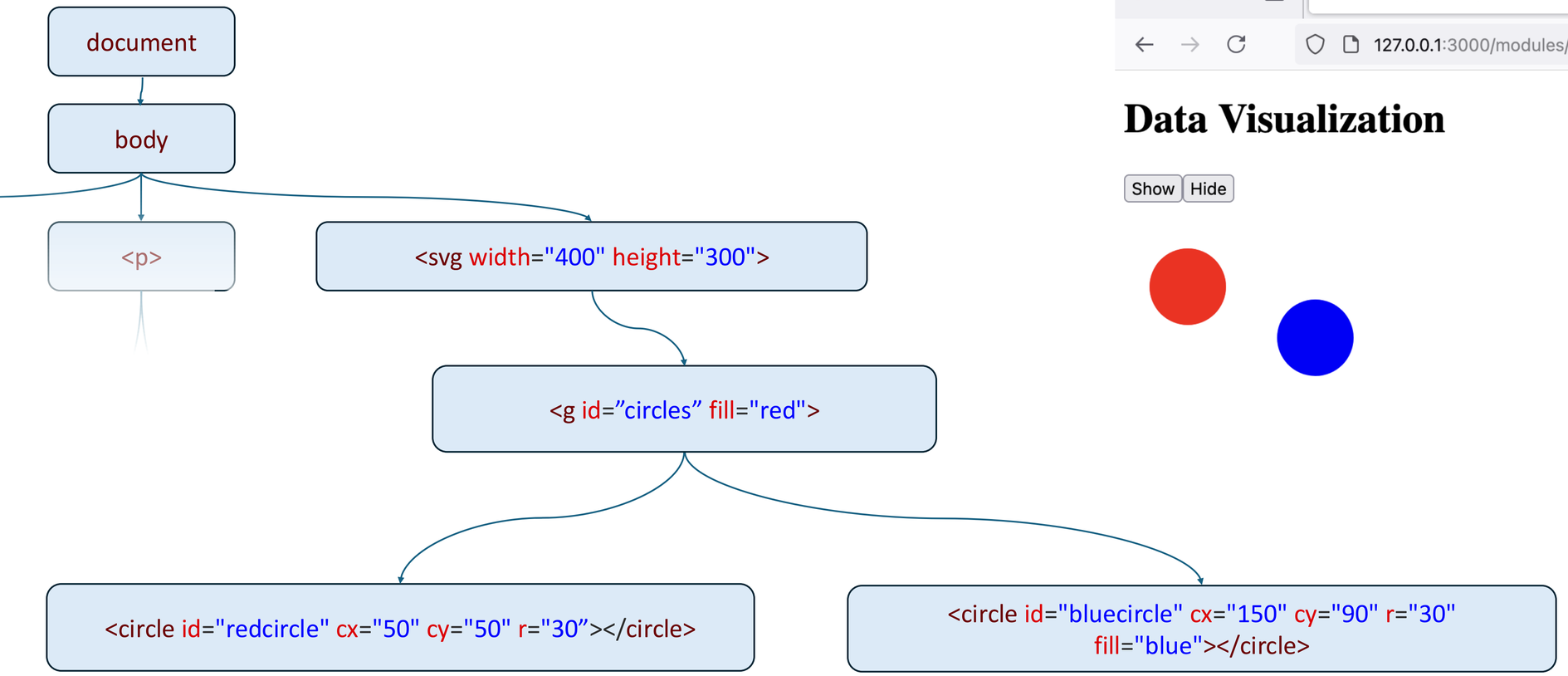


Data Visualization

Show Hide



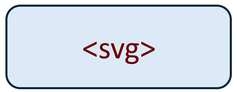



document
body
<p>
<svg width="400" height="300">
<g id=”circles” fill="red">
<circle id="redcircle" cx="50" cy="50" r="30”></circle>
<circle id="bluecircle" cx="150" cy="90" r="30"
fill="blue"></circle>


127.0.0.1:3000/modules/04-Interact
127.0.0.1:3000/modules/04-Interaction-and-web/lec
Data Visualization
Show
Hide

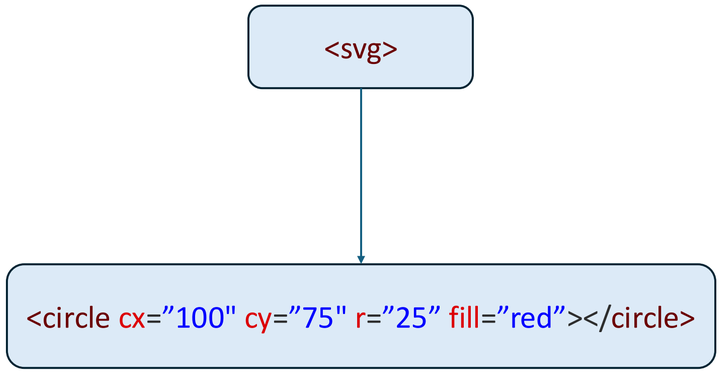
Observable and D3


2
1 + 1



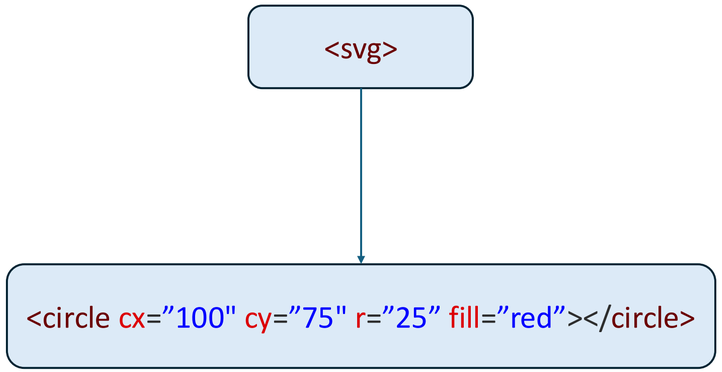

```
{
  const svg = d3.create("svg");
  return svg.node();
}
```

Creation with D3



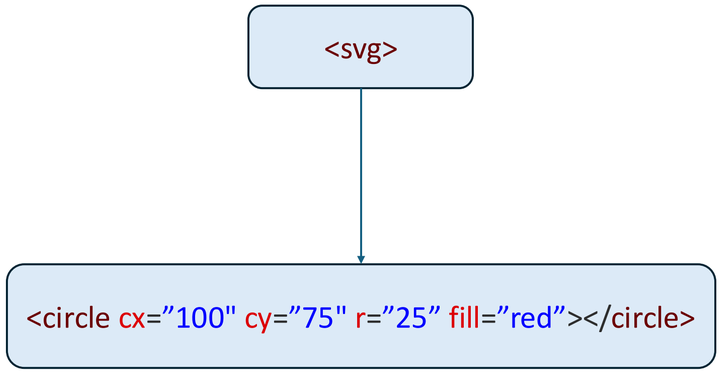
```
{
  const svg = d3.create("svg");
  const circle = svg.append('circle');
  circle.attr('cx', '100');
  circle.attr('cy', '75');
  circle.attr('r', '25');
  circle.attr('fill', 'red');
  return svg.node();
}
```

Method chaining



```
{
  const svg = d3.create("svg");
  const circle = svg.append('circle')
                    .attr('cx', '100')
                    .attr('cy', '75')
                    .attr('r', '25')
                    .attr('fill', 'red');
  return svg.node();
}
```

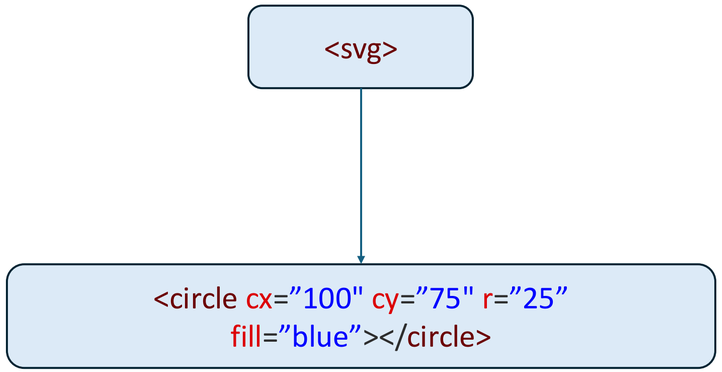
Interaction with D3



```
{
  const svg = d3.create("svg");
  const circle = svg.append('circle')
                    .attr('cx', '100')
                    .attr('cy', '75')
                    .attr('r', '25')
                    .attr('fill', 'red');

  circle.on('click',
            () => circle.attr('fill', 'blue')
            );
  return svg.node();
}
```

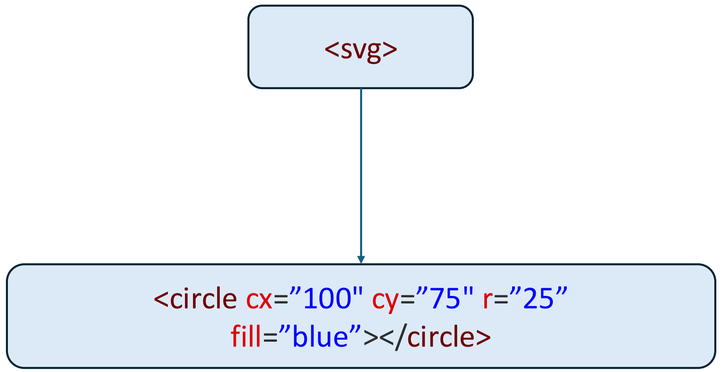
Interaction with D3



```
{
  const svg = d3.create("svg");
  const circle = svg.append('circle')
                    .attr('cx', '100')
                    .attr('cy', '75')
                    .attr('r', '25')
                    .attr('fill', 'red');

  circle.on('click',
            () => circle.attr('fill', 'blue')
            );
  return svg.node();
}
```

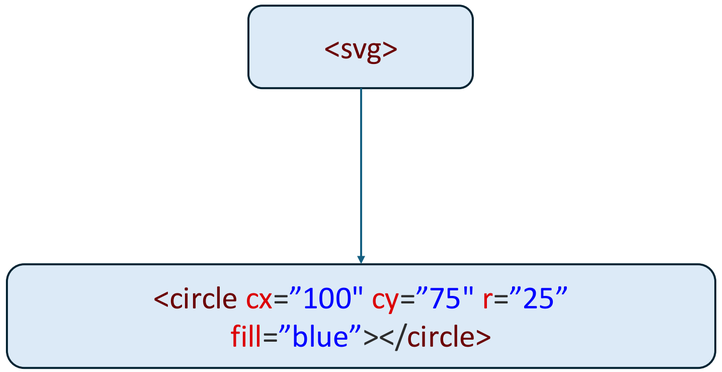
Animation with D3



```
{
  const svg = d3.create("svg");
  const circle = svg.append('circle')
                    .attr('cx', '100')
                    .attr('cy', '75')
                    .attr('r', '25')
                    .attr('fill', 'red');

  circle.on('click',
            () => circle
              .transition().duration(10000)
              .attr('fill', 'blue')
              .attr('cx', '200')
            );
  return svg.node();
}
```

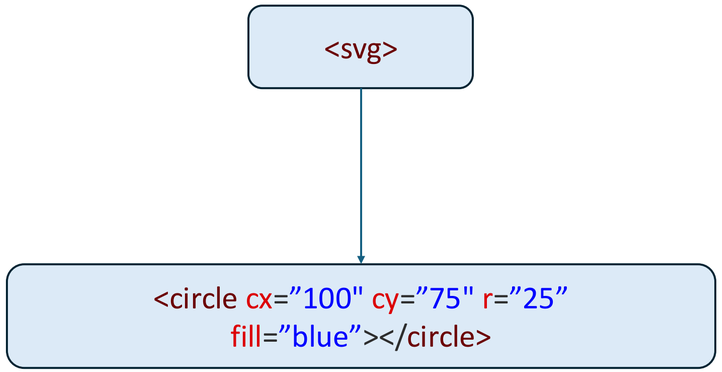
Animation with D3



```
{
  const svg = d3.create("svg");
  const circle = svg.append('circle')
                    .attr('cx', '100')
                    .attr('cy', '75')
                    .attr('r', '25')
                    .attr('fill', 'red');

  circle.on('click',
            () => circle
              .transition().duration(10000)
              .attr('fill', 'blue')
              .attr('cx', '200')
            );
  return svg.node();
}
```

Easing with D3



```
{
  const svg = d3.create("svg");
  const circle = svg.append('circle')
                    .attr('cx', '100')
                    .attr('cy', '75')
                    .attr('r', '25')
                    .attr('fill', 'red');     );

  circle.on('click',
            () => circle
              .transition().duration(2000)    )0)
              .ease(d3.easeLinear)
              .attr('fill', 'blue')
              .attr('cx', '200')
            );
  return svg.node();
}
```

Cars dataset

name	economy (mpg)	cylinders	displacement (cc)	power (hp)	weight (lb)	0-60 mph (s)
AMC Ambassador ...	13	8	360	175	3,821	11
AMC Ambassador ...	15	8	390	190	3,850	8.5
AMC Ambassador ...	17	8	304	150	3,672	11.5
AMC Concord DL 6	20.2	6	232	90	3,265	18.2
AMC Concord DL	18.1	6	258	120	3,410	15.1
AMC Concord DL	23	4	151		3,035	20.5
AMC Concord	19.4	6	232	90	3,210	17.2
AMC Concord	24.3	4	151	90	3,003	20.1
AMC Gremlin	18	6	232	100	2,789	15
AMC Gremlin	19	6	232	100	2,634	13
AMC Gremlin	20	6	232	100	2,914	16

```
Inputs.table(cars)
```

```
▶ Array(406) [Object, Object, Object, Object,
```

```
cars
```

```
▼ Object {
    name: "AMC Ambassador Brougham"
    economy (mpg): 13
    cylinders: 8
    displacement (cc): 360
    power (hp): 175
    weight (lb): 3821
    0-60 mph (s): 11
    year: 73
  }
```

```
cars[0]
```

```
{
  const width = 640;
  const height = 400;
  const margin = {top: 20, right: 30, bottom: 30, left: 40};

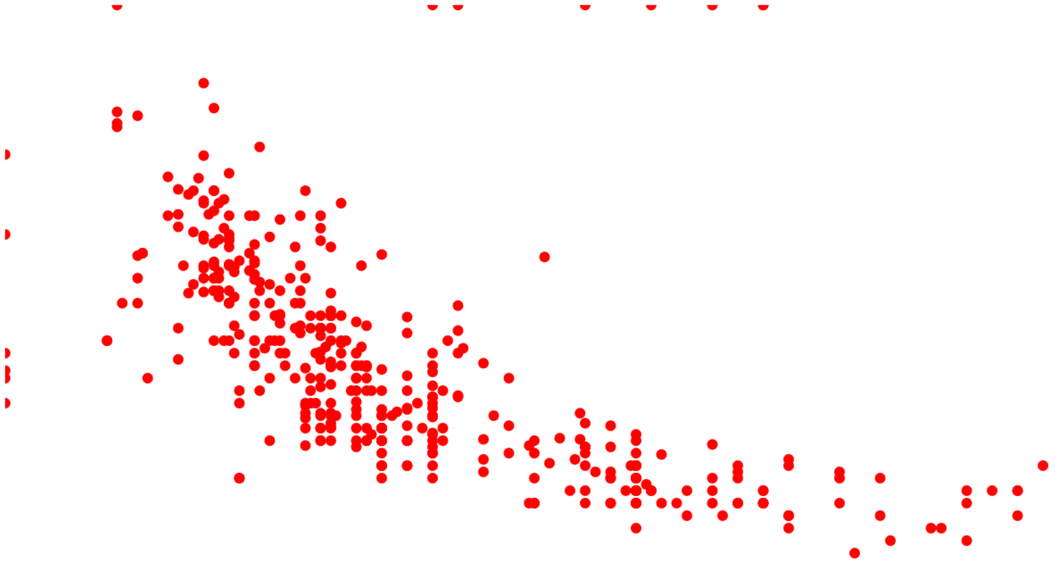
  const svg = d3.create("svg")
      .attr("width", width)
      .attr("height", height);

  const x = d3.scaleLinear()
      .domain([40, 240])
      .range([margin.left, width - margin.right]);

  const y = d3.scaleLinear()
      .domain([0, 50])
      .range([height - margin.bottom, margin.top]);

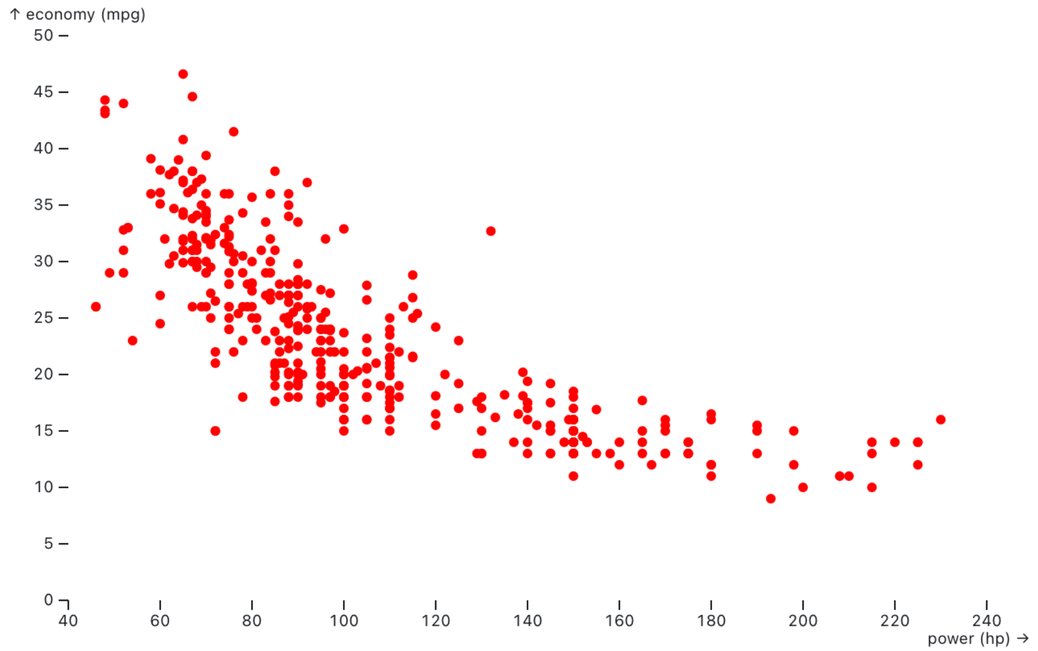
  svg.selectAll('circle')
      .data(cars)
      .enter().append('circle')
      .attr("fill", "red")
      .attr("cx", (d) => x(d["power (hp)"]))
      .attr("cy", (d) => y(d["economy (mpg)"]))
      .attr("r", 3)

  return svg.node();
}
```



```d3
{
  const width = 640;
  const height = 400;
  const margin = {top: 20, right: 30, bottom: 30, left: 40};

  const svg = d3.create("svg")
      .attr("width", width)
      .attr("height", height);

  const x = d3.scaleLinear()
      .domain([40, 240])
      .range([margin.left, width - margin.right]);

  const y = d3.scaleLinear()
      .domain([0, 50])
      .range([height - margin.bottom, margin.top]);

  svg.selectAll('circle')
      .data(cars)
      .enter().append('circle')
      .attr("fill", "red")
      .attr("cx", (d) => x(d["power (hp)"]))
      .attr("cy", (d) => y(d["economy (mpg)"]))
      .attr("r", 3)

  return svg.node();
}
```

```plot
{}  Plot.plot({
      width: 640,
      height: 400,
      marginTop: 20, marginRight: 30, marginBottom: 30, marginLeft: 40,

      x: {domain: [40, 240]},
      y: {domain: [0, 50]},
      marks: [
        Plot.dot(cars, {x: "power (hp)",
                        y: "economy (mpg)",
                        r: 3,
                        fill: 'red'
                       }),
      ]
    })
```



Creating a plot

```
{
  const width = 640;
  const height = 400;
  const margin = {top: 20, right: 30, bottom: 30, left: 40};

  const svg = d3.create("svg")
      .attr("width", width)
      .attr("height", height);
```

<svg width=”640" height=”400” >

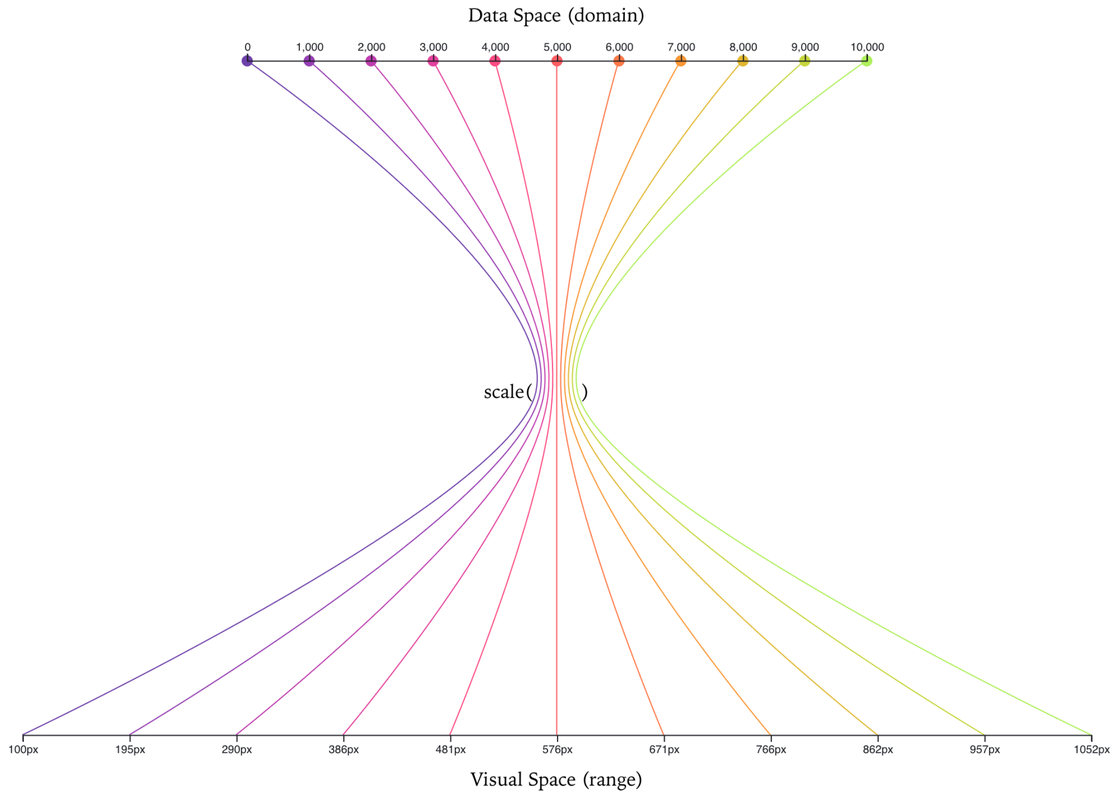
```
Plot.plot({
  width: 640,
  height: 400,
  marginTop: 20, marginRight: 30, marginBottom: 30, marginLeft: 40,
```

Creating scales

```
const x = d3.scaleLinear()
    .domain([40, 240])
    .range([margin.left, width - margin.right]);

const y = d3.scaleLinear()
    .domain([0, 50])
    .range([height - margin.bottom, margin.top]);
```

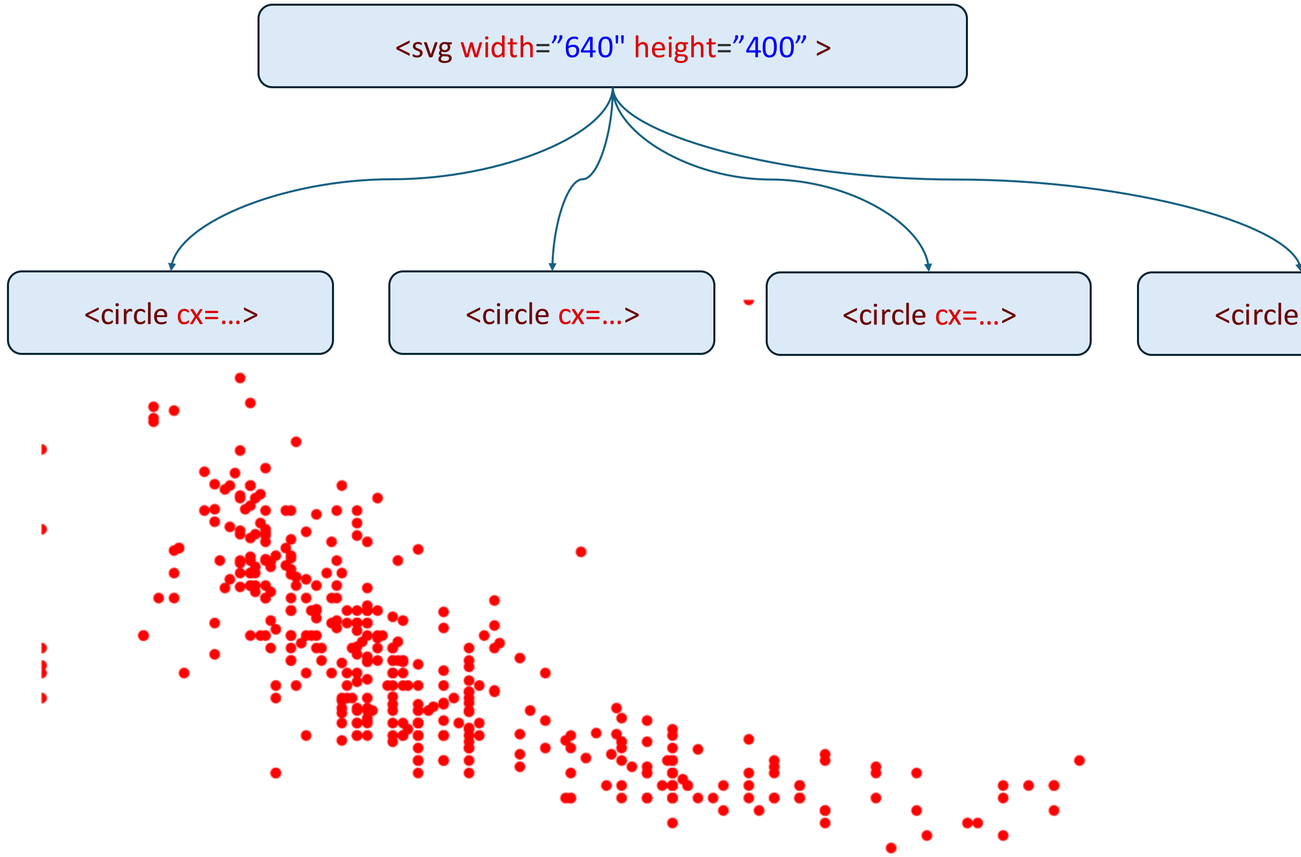
```
x: {domain: [40, 240]},
y: {domain: [0, 50]},
marks: [
```

Transition



Creating a layer

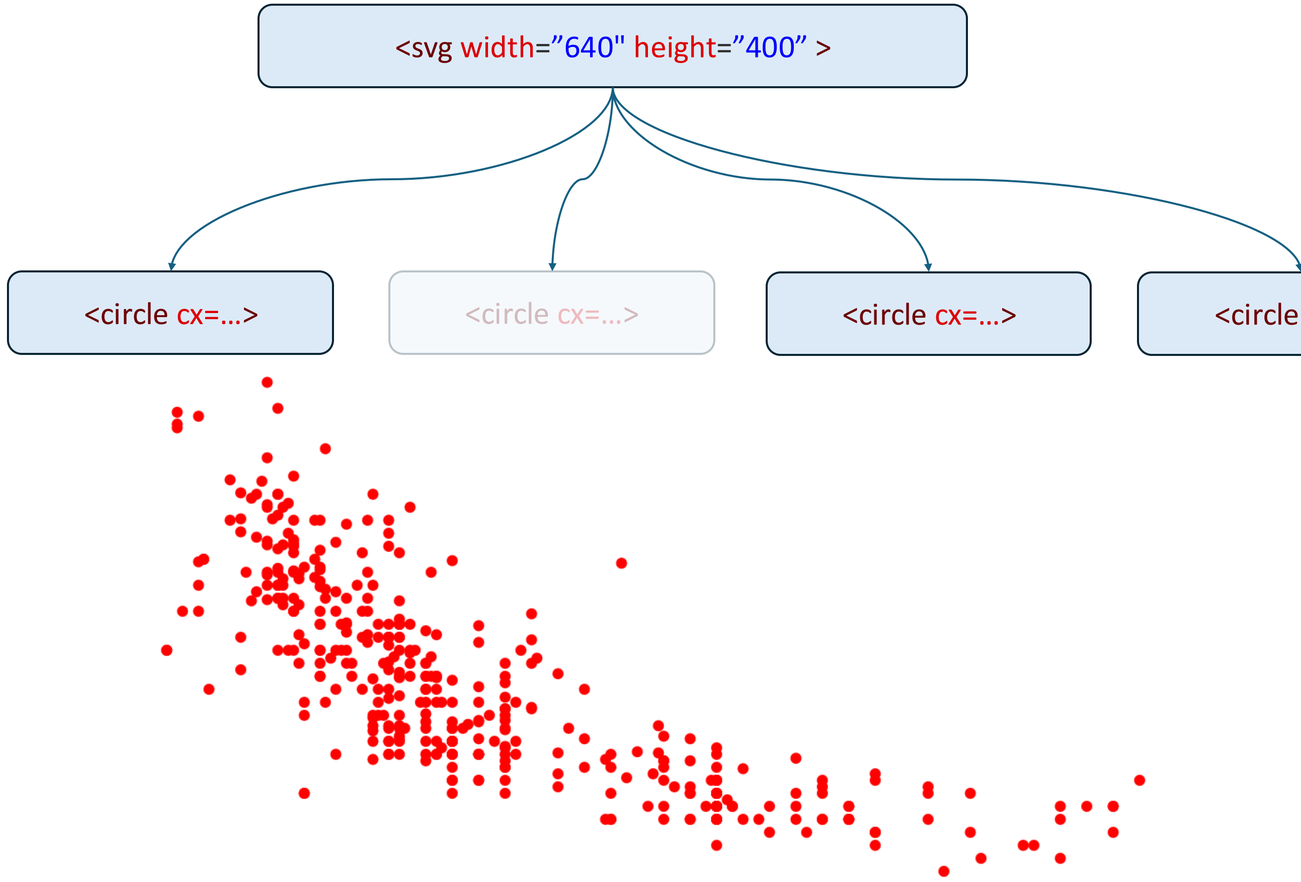
```
svg.selectAll('circle')
    .data(cars)
    .enter().append('circle')
    .filter((d) => d["power (hp)"] > 0 && d["economy (mpg)"] > 0)
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```




```
  marks: [
    Plot.dot(cars, {x: "power (hp)",
                    y: "economy (mpg)",
                    r: 3,
                    fill: 'red'
                   }),
  ]
```

Applying a transform (filtering)

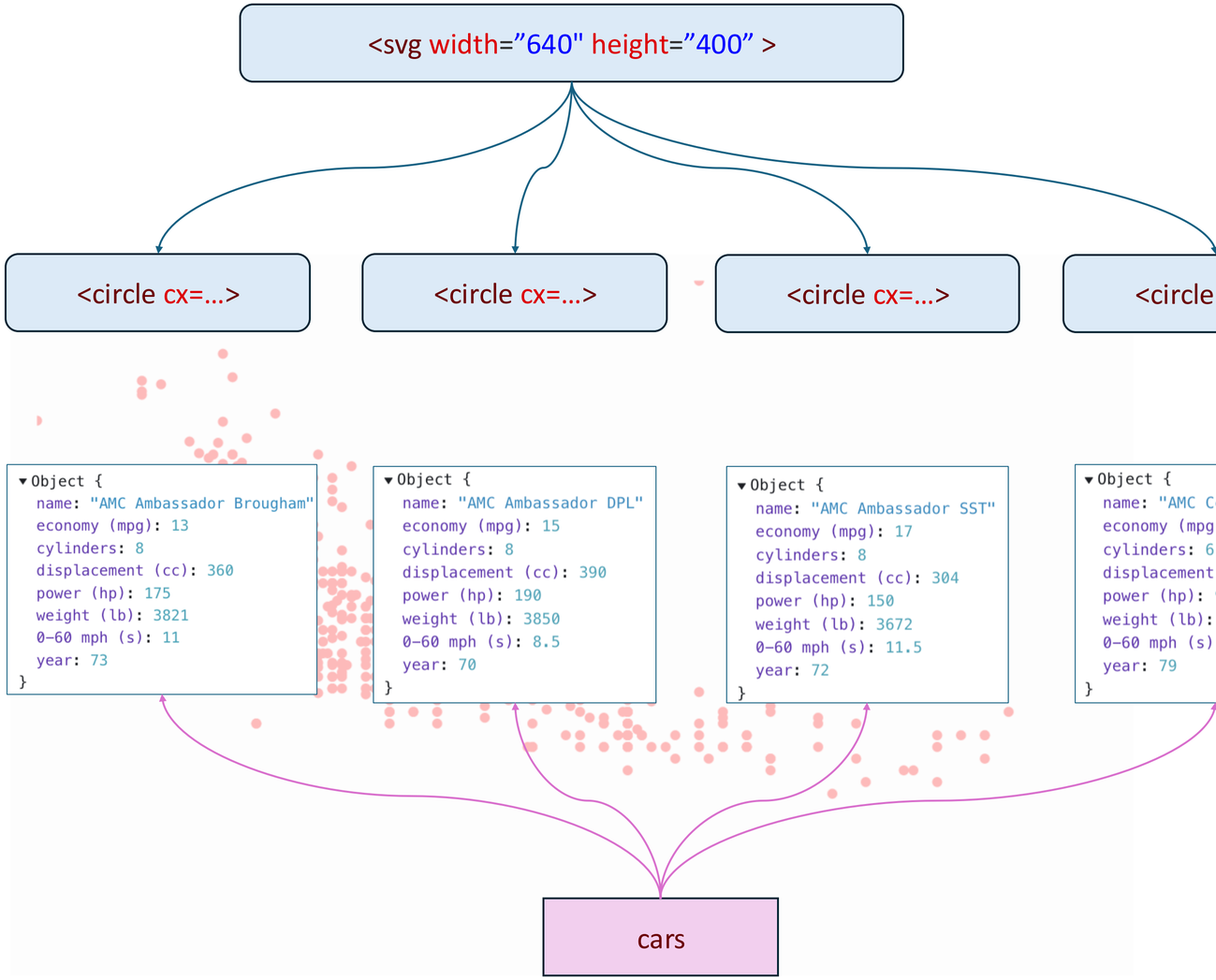
```
svg.selectAll('circle')
    .data(cars)
    .enter().append('circle')
    .filter((d) => d["power (hp)"] > 0 && d["economy (mpg)"] > 0)
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```



Aesthetic mappings

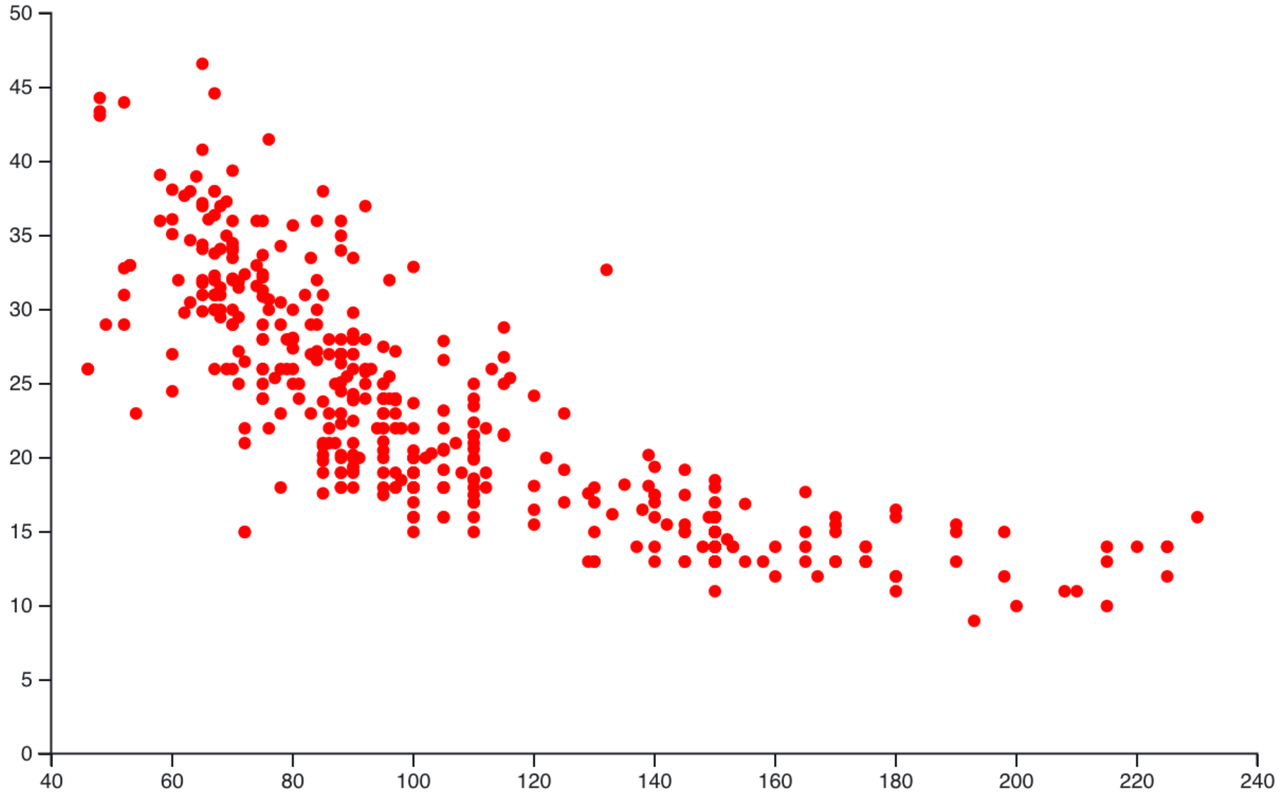
```
svg.selectAll('circle')
    .data(cars)
    .enter().append('circle')
    .filter((d) => d["power (hp)"] > 0 && d["economy (mpg)"] > 0)
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

```
  marks: [
    Plot.dot(cars, {x: "power (hp)",
                    y: "economy (mpg)",
                    r: 3,
                    fill: 'red'
                   }),
  ]
```



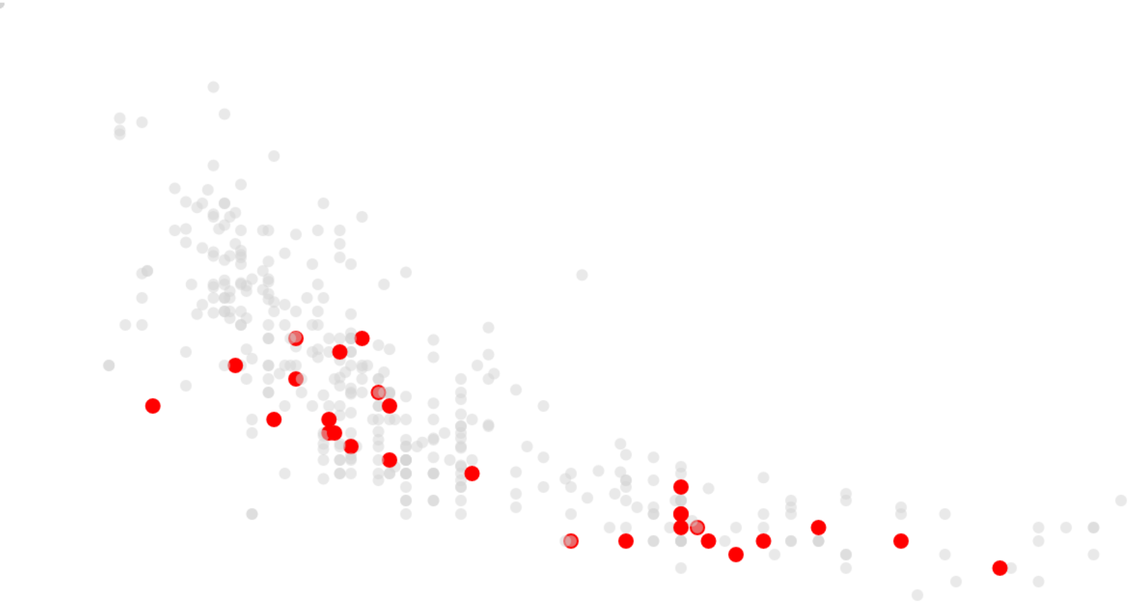
Creating axes

```
svg.append("g")
    .attr("transform", `translate(0,${height - margin.bottom})`)
    .call(d3.axisBottom(x));

svg.append("g")
    .attr("transform", `translate(${margin.left},0)`)
    .call(d3.axisLeft(y));
```

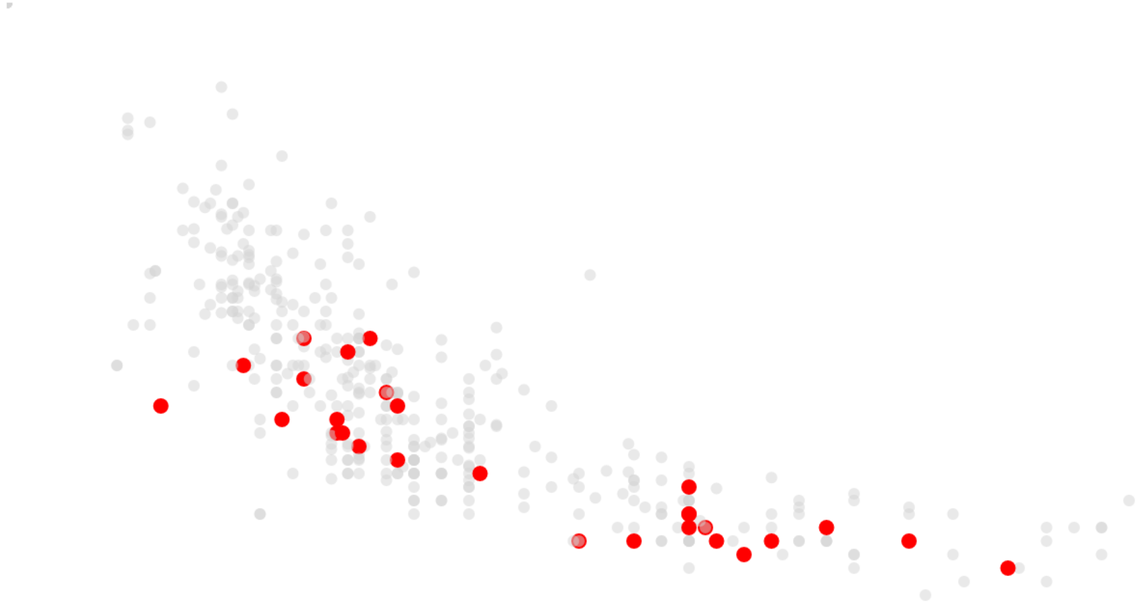


Interaction with D3

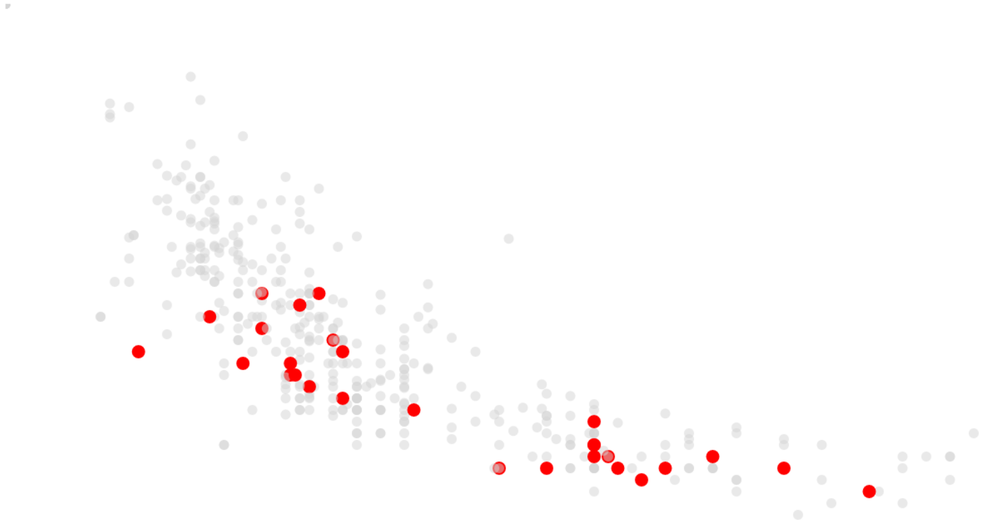
```
function onclick(event, datum) {
    svg.selectAll('circle')
      .attr('opacity', 0.5)
      .attr('fill', 'lightgrey')
      .attr('r', 3)
      .filter((d) => d.year == datum.year)
      .attr('fill', 'red')
      .attr('opacity', 1.)
      .attr('r', 4);
}
```



```
function onclick(event, datum) {
    svg.selectAll('circle')
      .attr('opacity', 0.5)
      .attr('fill', 'lightgrey')
      .attr('r', 3)
      .filter((d) => d.year == datum.year)
      .attr('fill', 'red')
      .attr('opacity', 1.)
      .attr('r', 4);
}
```

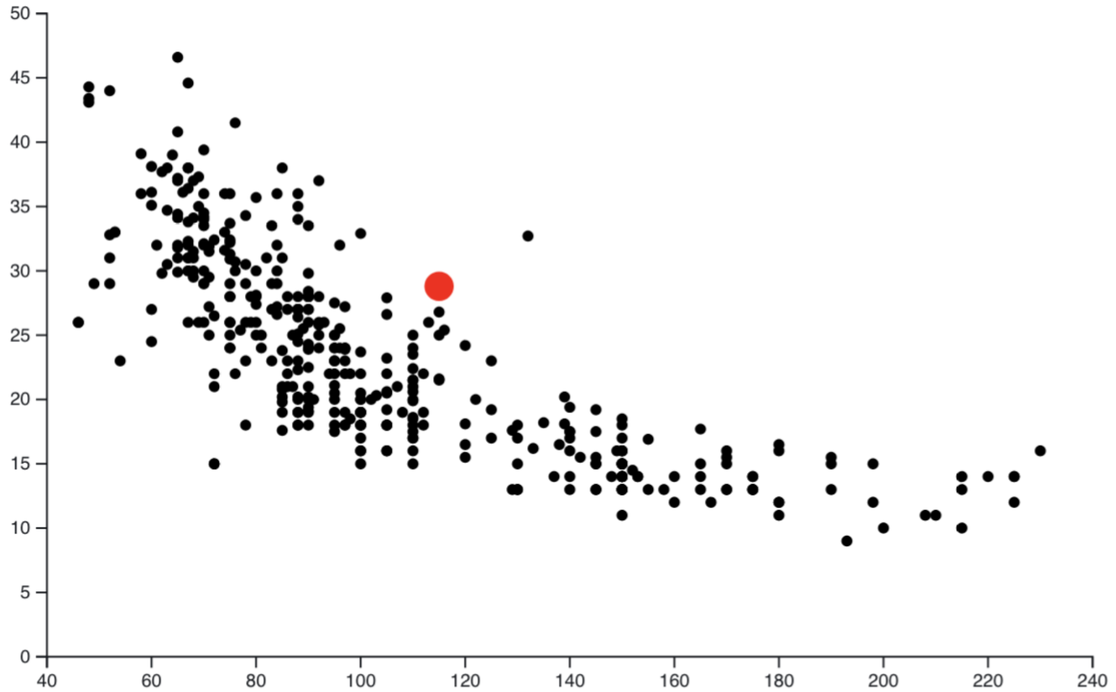


```
svg.selectAll('circle')
    .data(cars)
    .join('circle')
    .filter((d) => d["power (hp)"] > 0 && d["economy (mpg)"] > 0)
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
    .on('click', onclick)
```



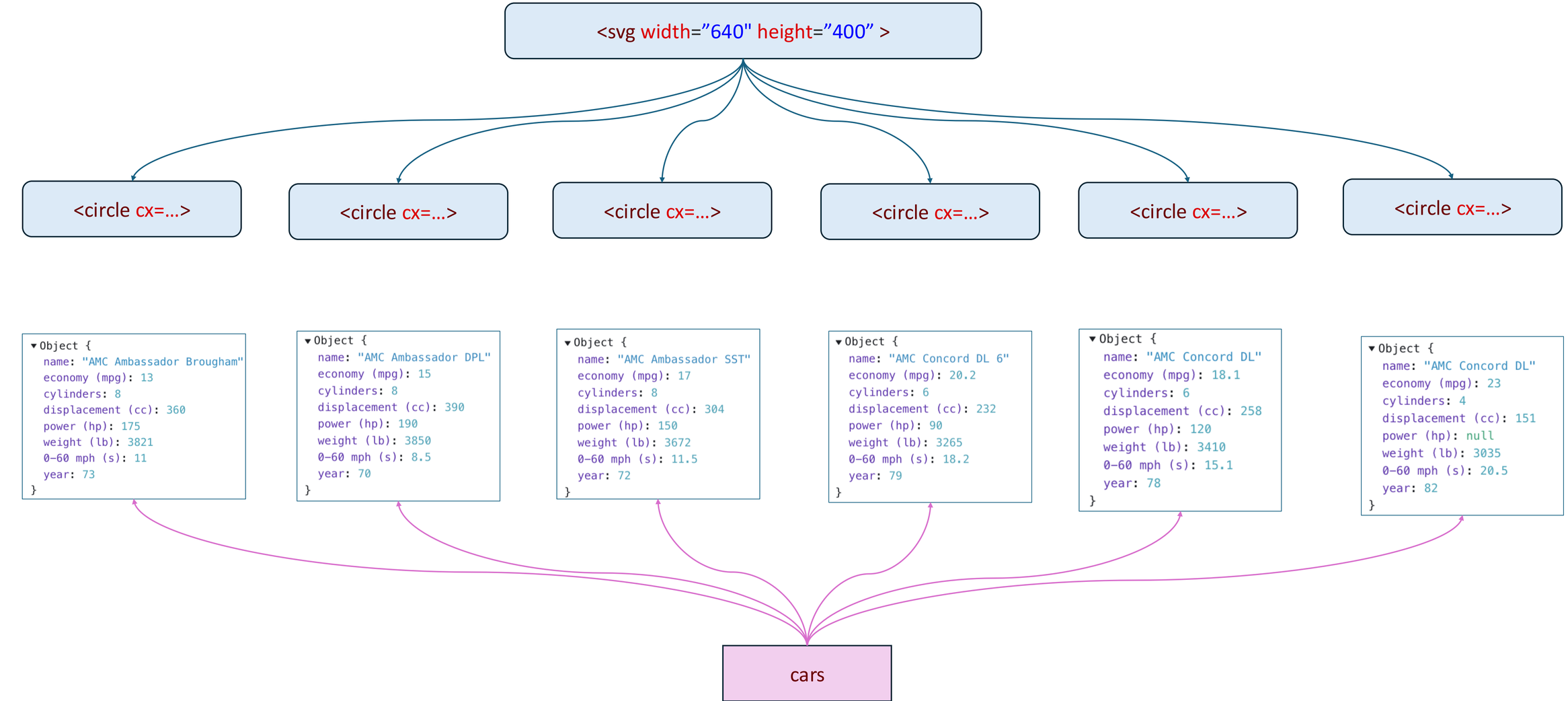
```
function onclick(event, datum) {
  svg.selectAll('circle')
    .transition().duration(500)
    .attr('opacity', 0.5)
    .attr('fill', 'lightgrey')
    .attr('r', 3)
    .filter((d) => d.year == datum.year)
    .attr('fill', 'red')
    .attr('opacity', 1.)
    .attr('r', 4);
}
```

```
svg.selectAll('circle')
    .data(cars)
    .enter().append('circle')
    .filter((d) => d["power (hp)"] > 0 && d["economy (mpg)"] > 0)
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
    .on('mouseover', (event, datum) => d3.select(event.target).attr('fill', 'red').attr('r', 8))
    .on('mouseout', (event, datum) => d3.select(event.target).attr('fill', 'black').attr('r', 3))
```



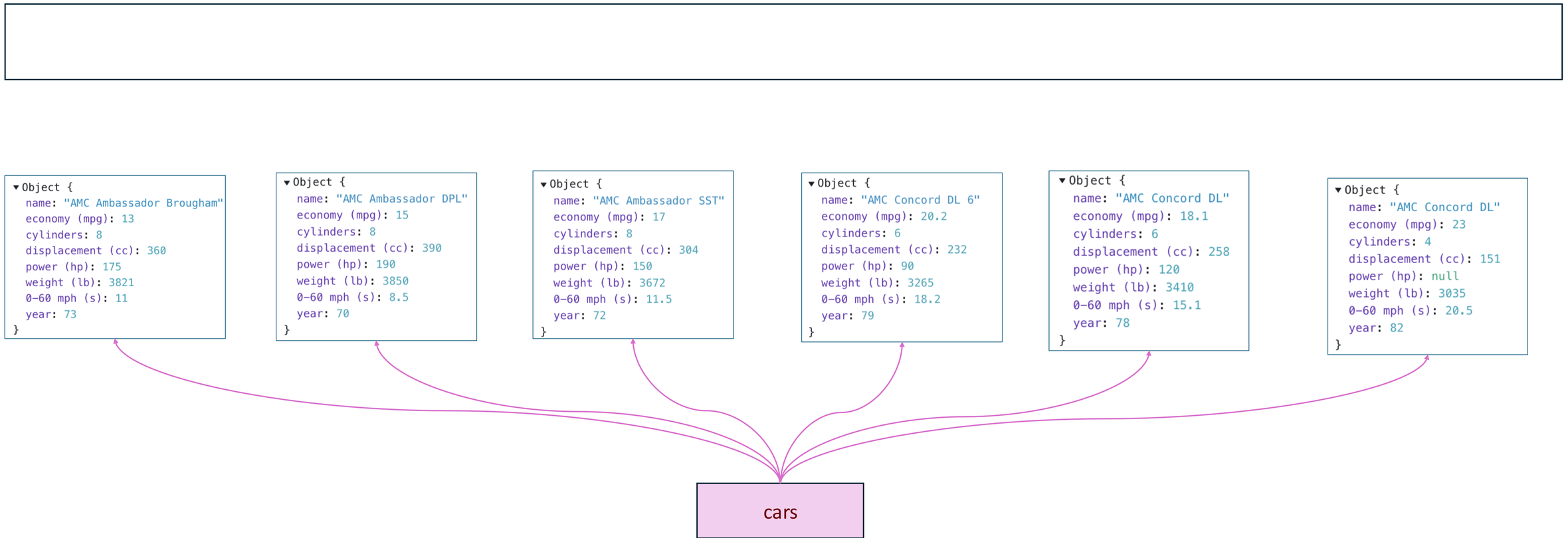
D3 Joins

```
svg.selectAll('circle')
    .data(cars)
    .enter().append('circle')
    .filter((d) => d["power (hp)"] > 0 && d["economy (mpg)"] > 0)
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

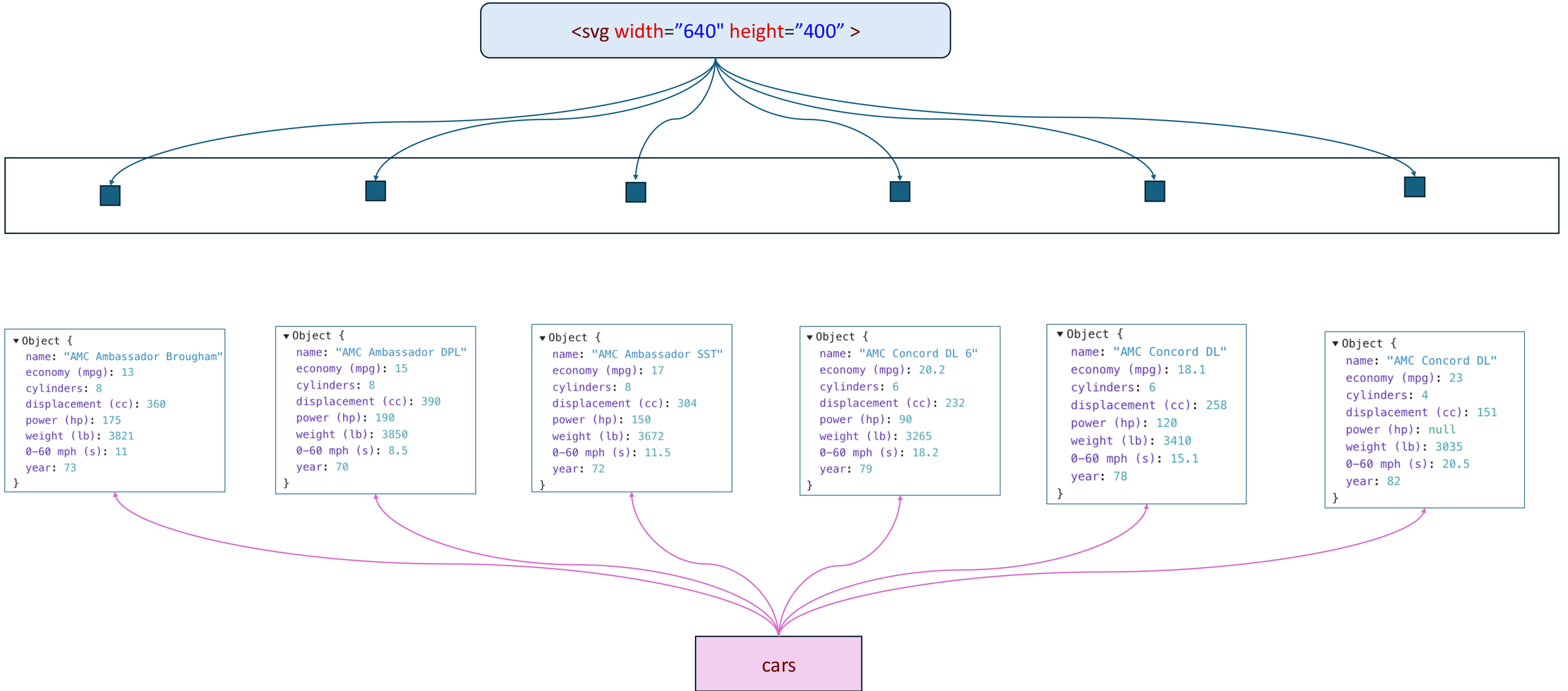


```
svg.selectAll('circle')
```

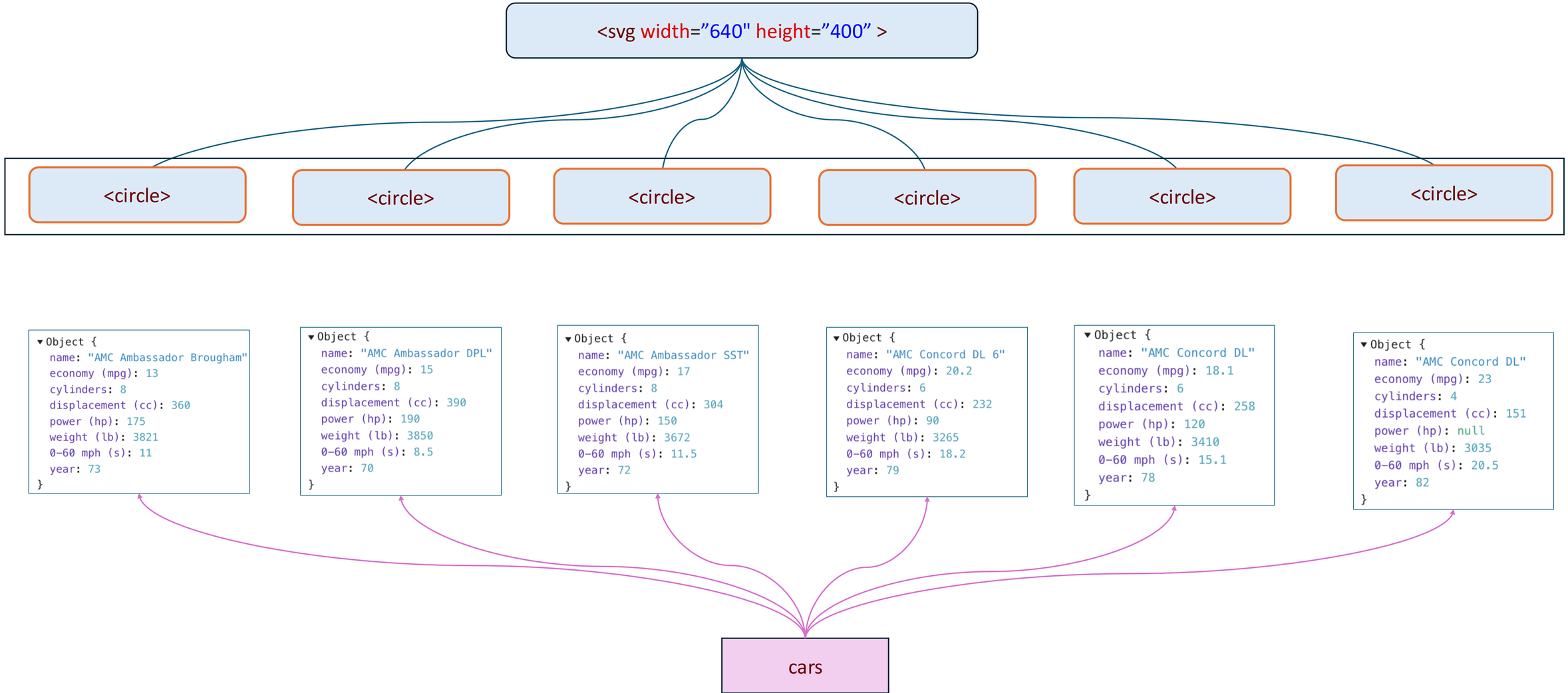
<svg width=”640" height=”400” >



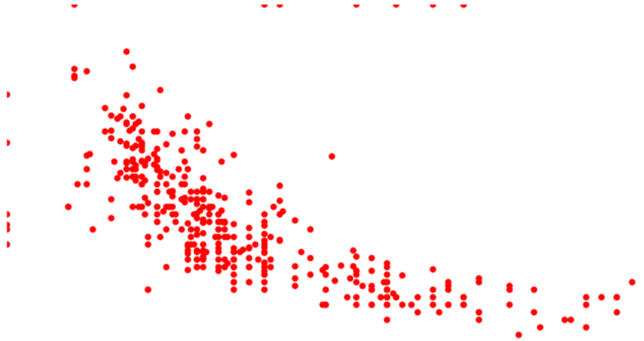
```
svg.selectAll('circle')
    .data(cars).enter()
```

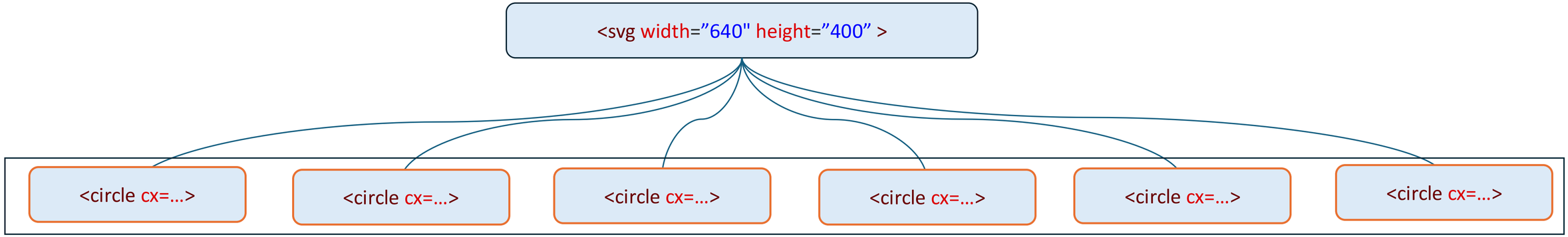


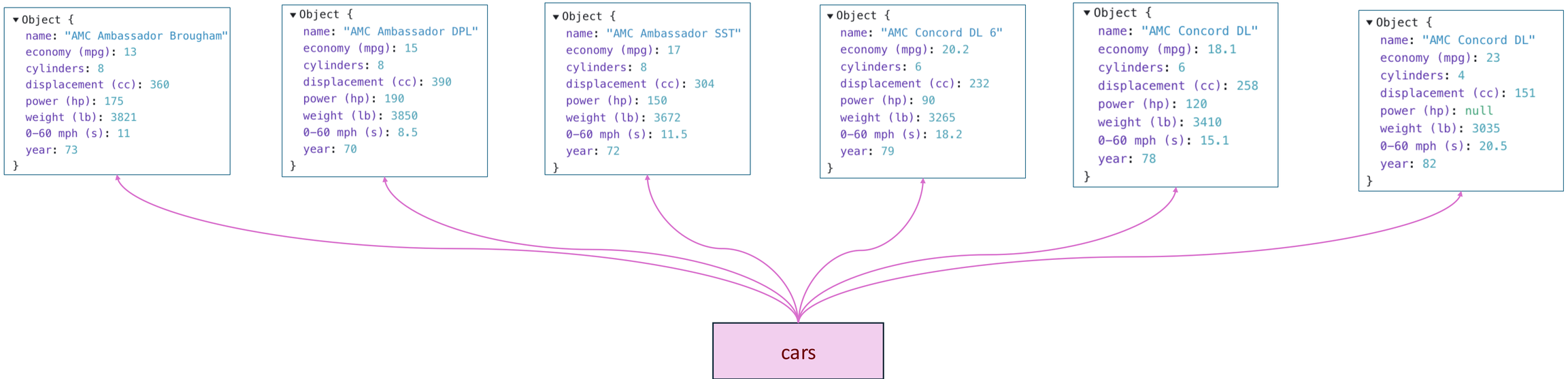
```
svg.selectAll('circle')
    .data(cars).enter()
    .append('circle')
```



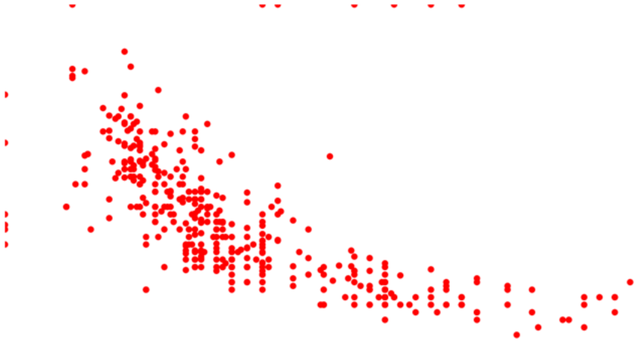
```
svg.selectAll('circle')
    .data(cars).enter()
    .append('circle')
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

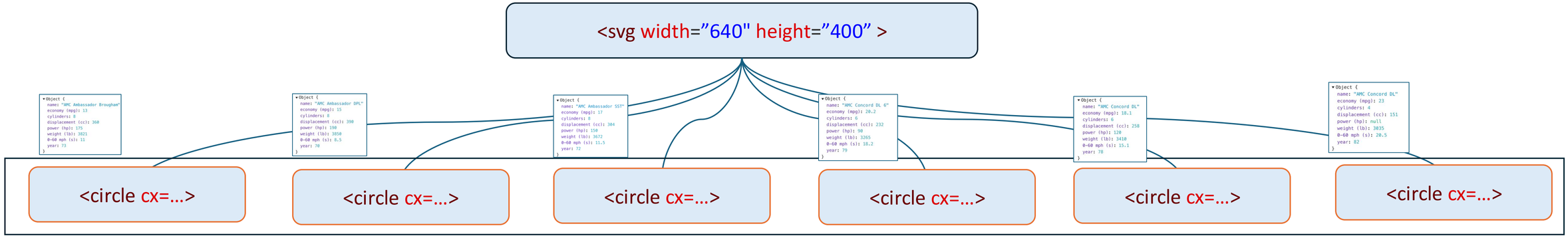


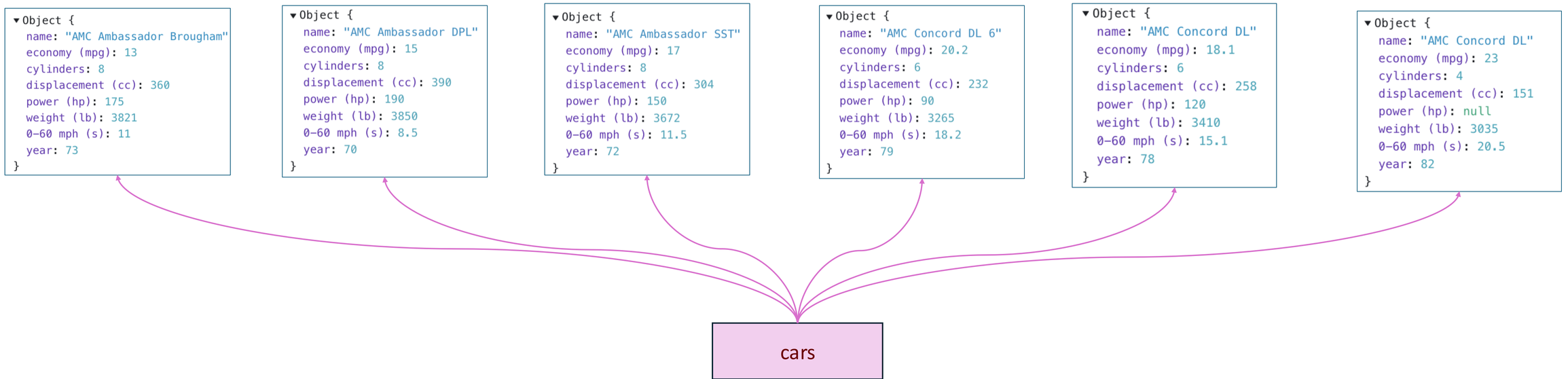




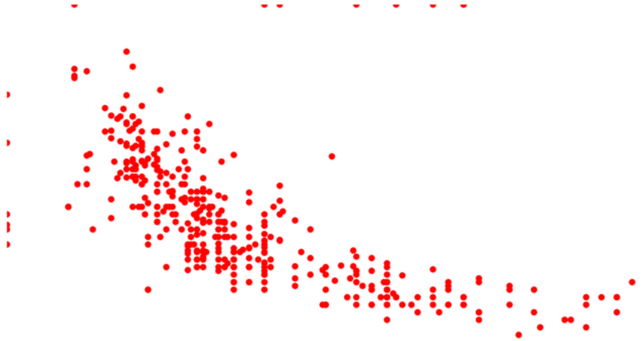
```
svg.selectAll('circle')
    .data(cars).enter()
    .append('circle')
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

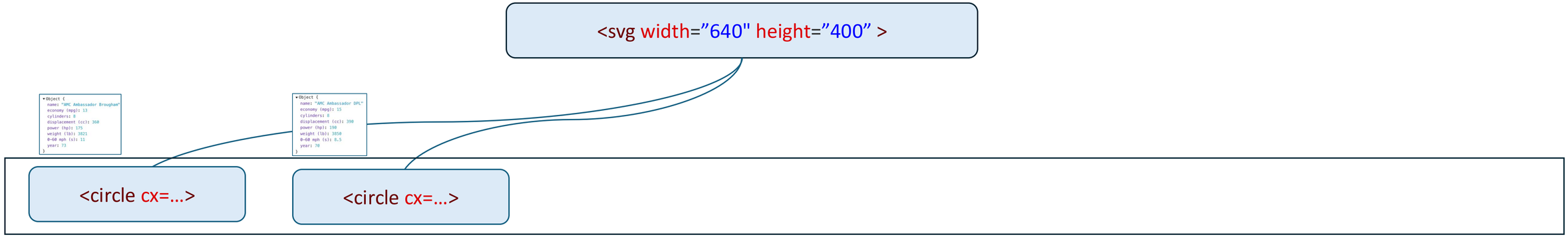


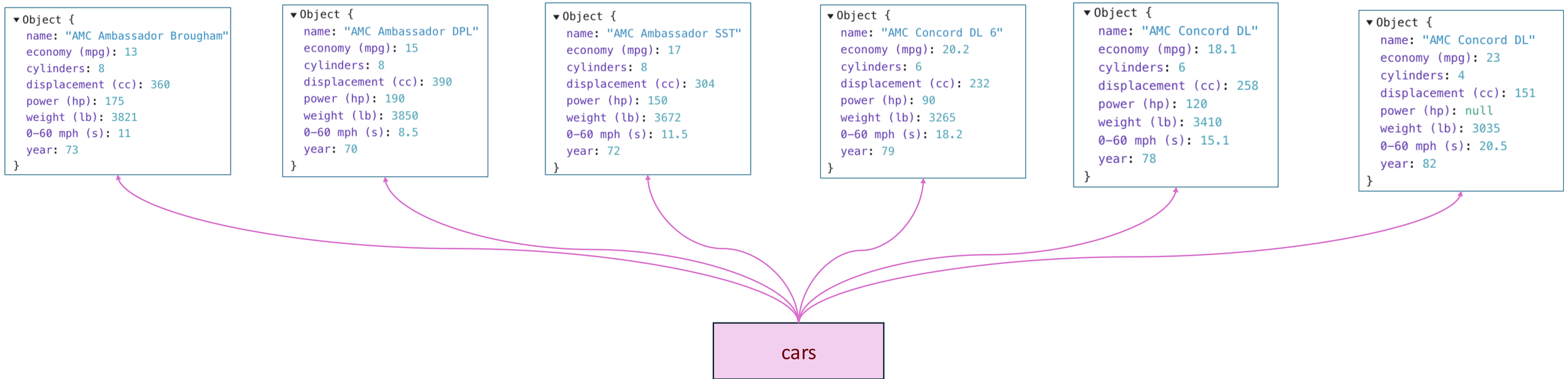




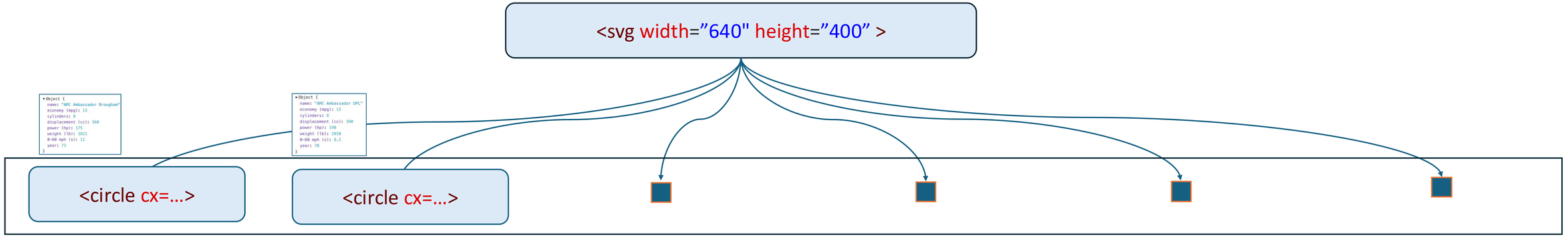
```
svg.selectAll('circle')
    .data(cars).enter()
    .append('circle')
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

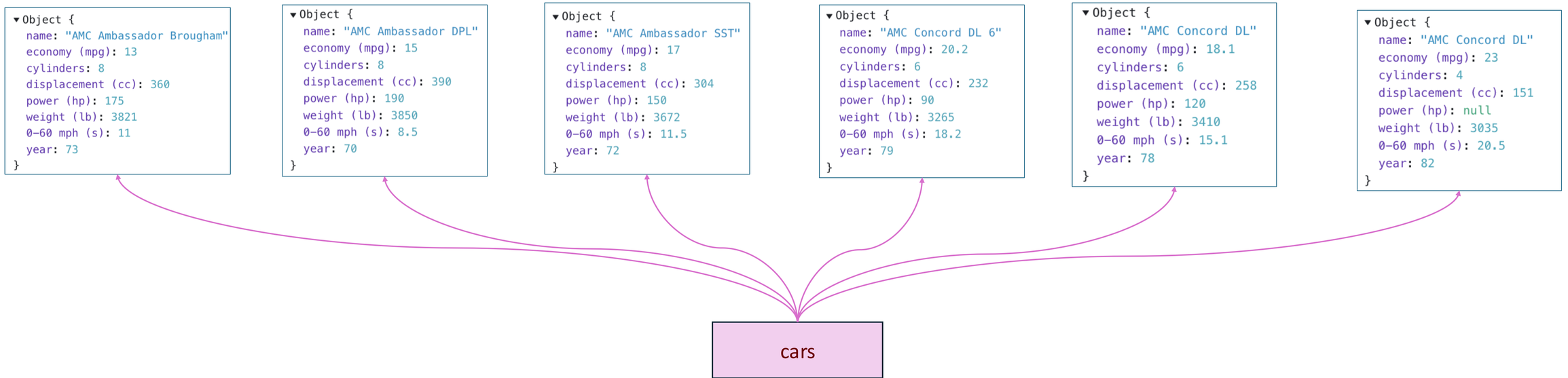






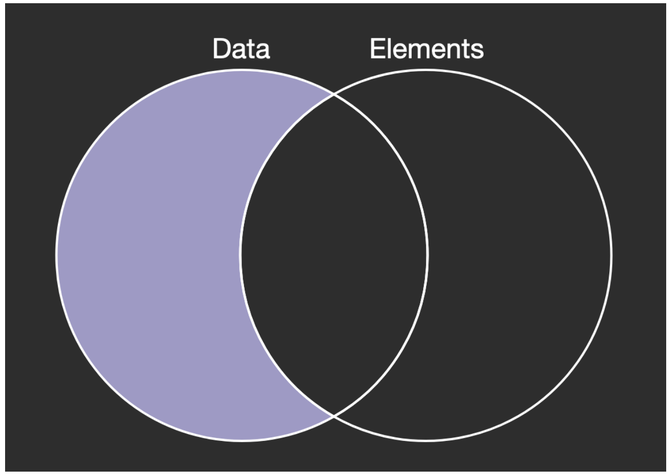
```
svg.selectAll('circle')
    .data(cars).enter()
    .append('circle')
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

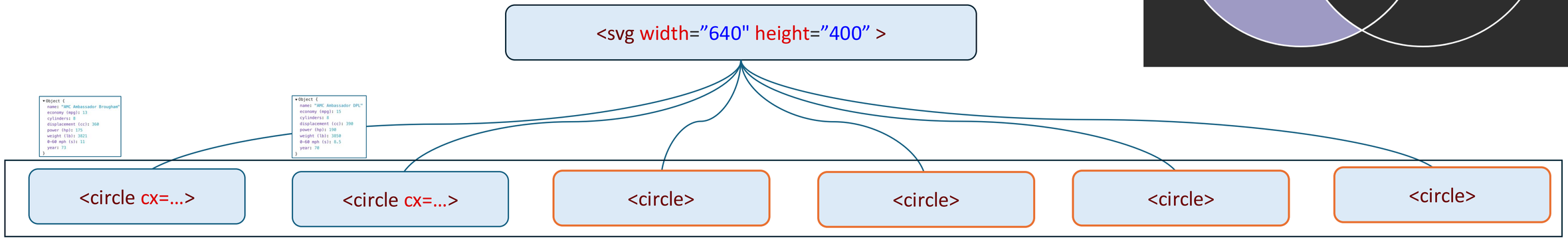


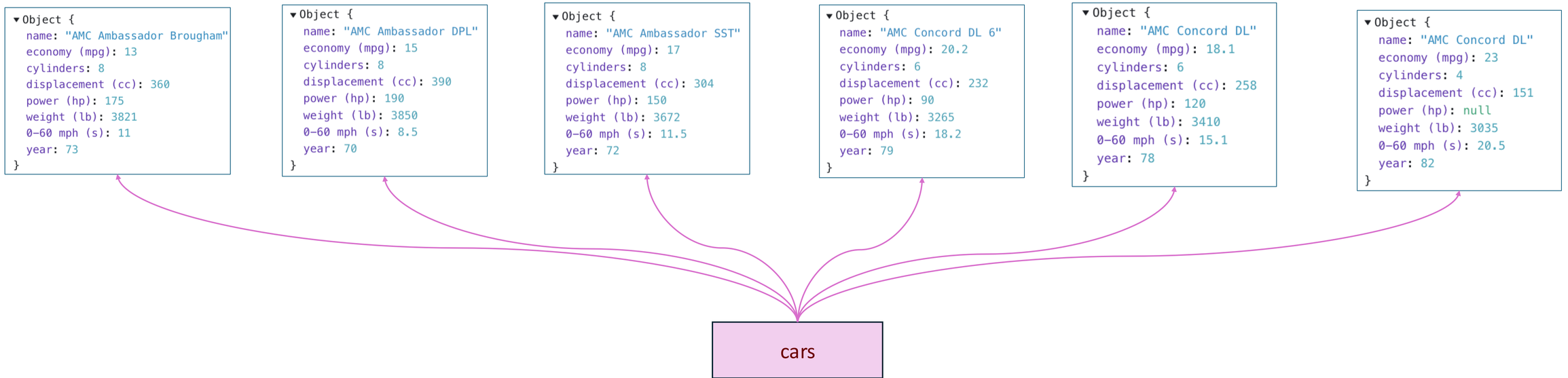


```
svg.selectAll('circle')
    .data(cars).enter()
    .append('circle')
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

Enter:

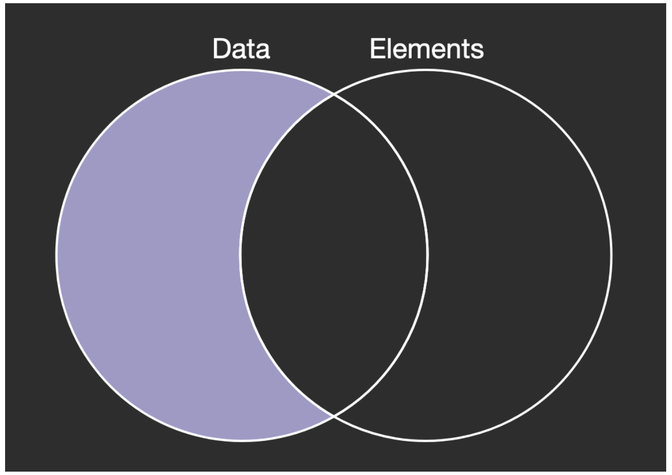


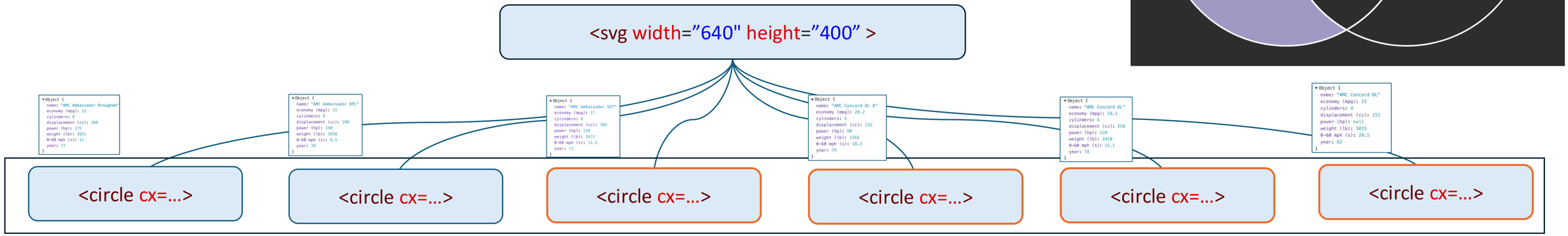


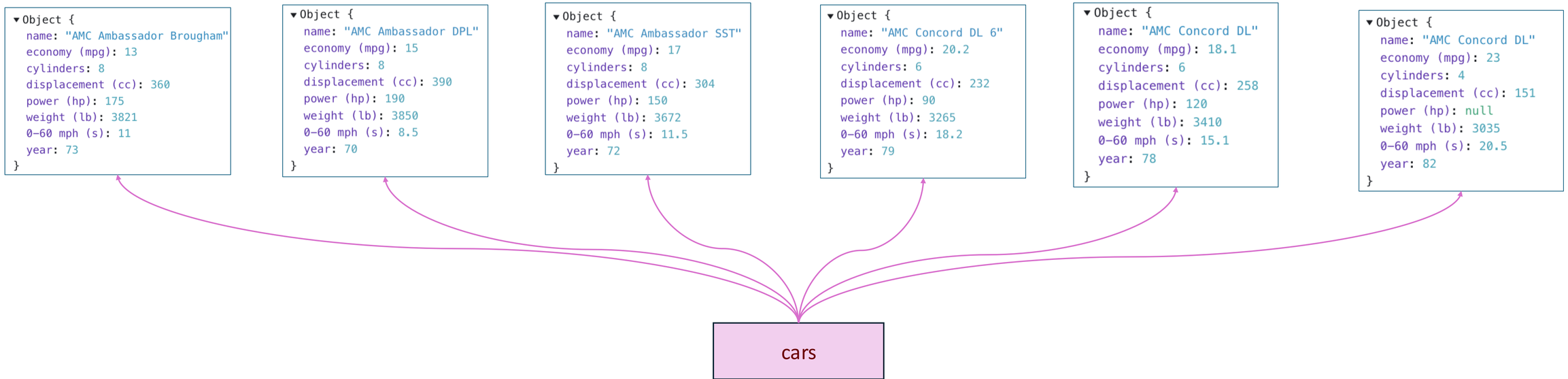


```
svg.selectAll('circle')
    .data(cars).enter()
    .append('circle')
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

Enter:

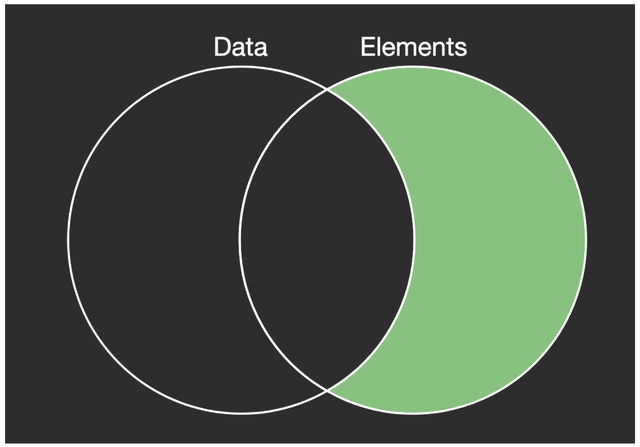


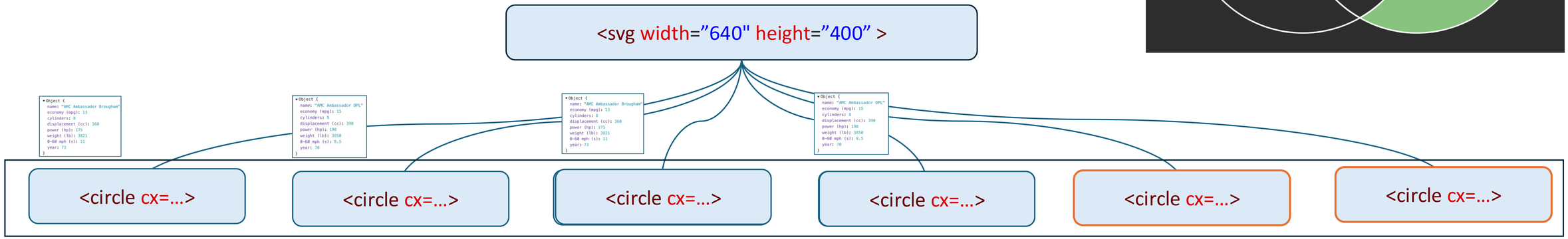


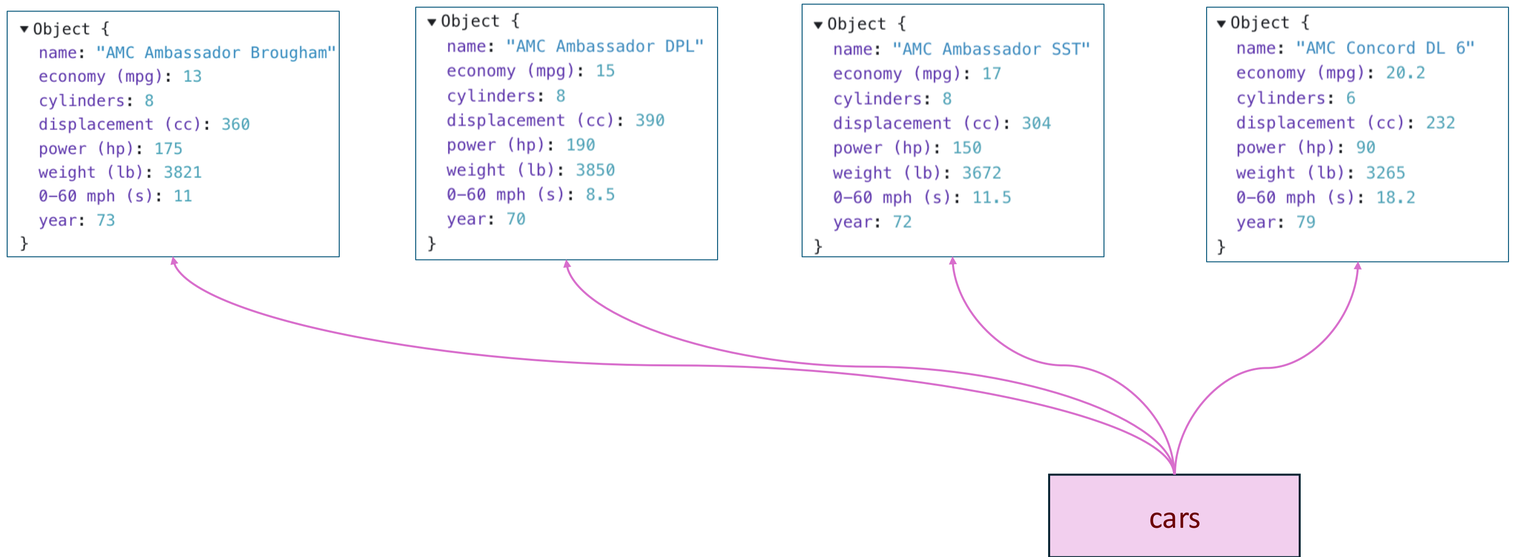


```
svg.selectAll('circle')
    .data(cars).exit()
    .remove()
```

Exit:

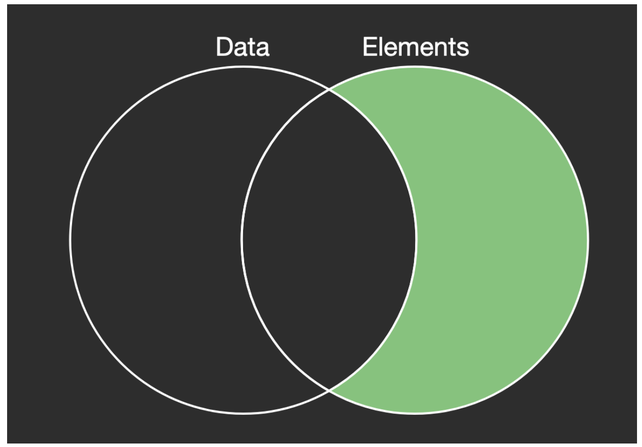


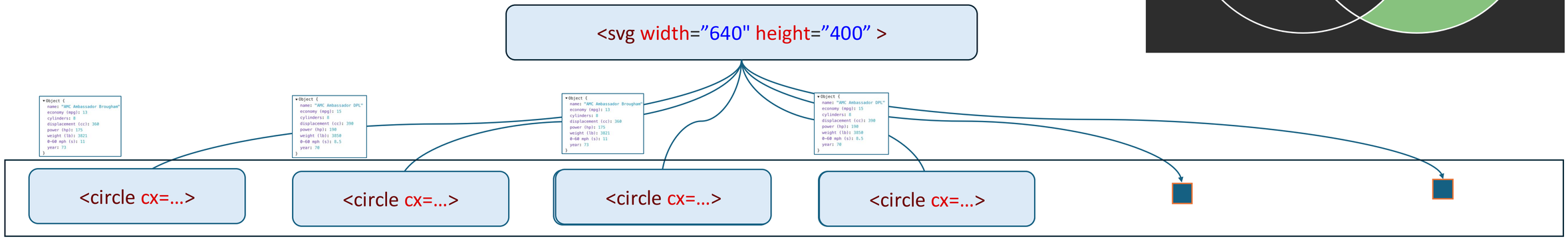


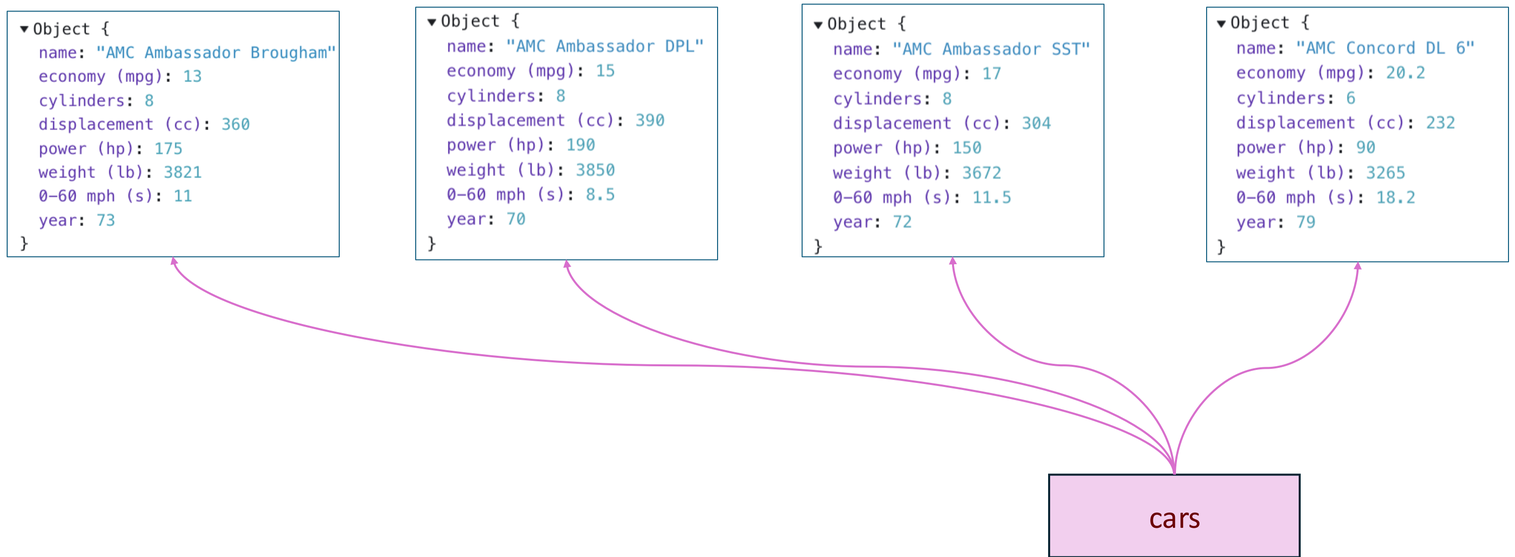


```
svg.selectAll('circle')
    .data(cars).exit()
    .remove()
```

Exit:

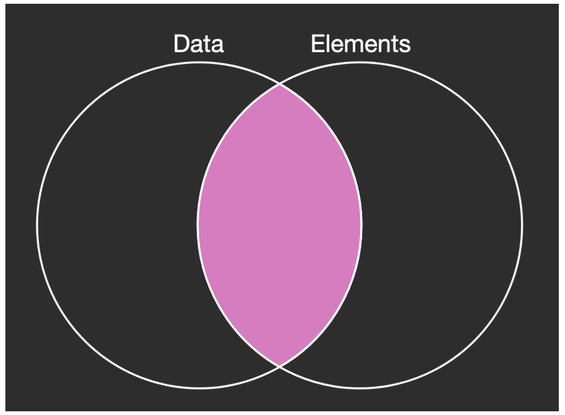


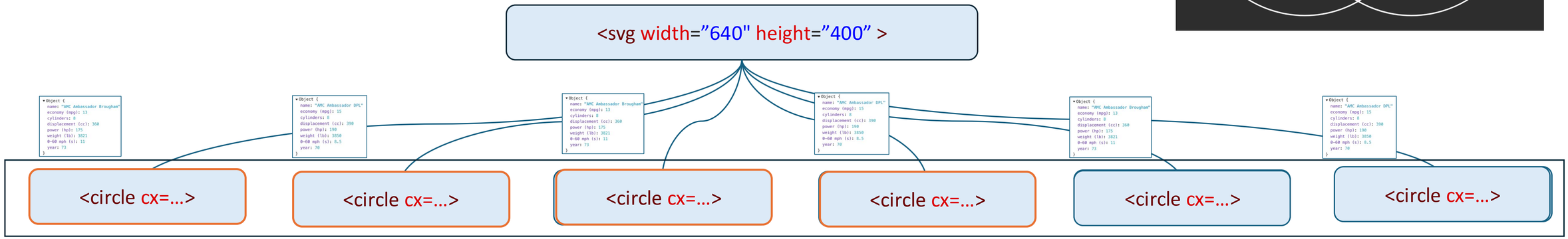


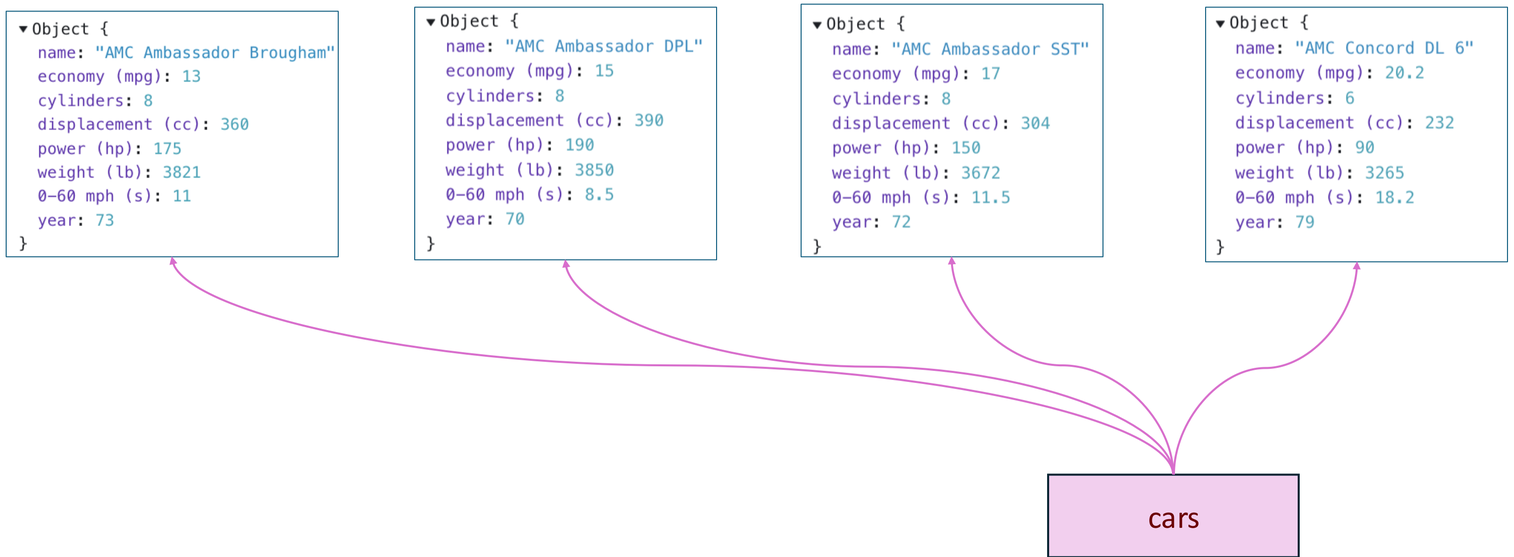


```
svg.selectAll('circle')
    .data(cars)
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```

Update:

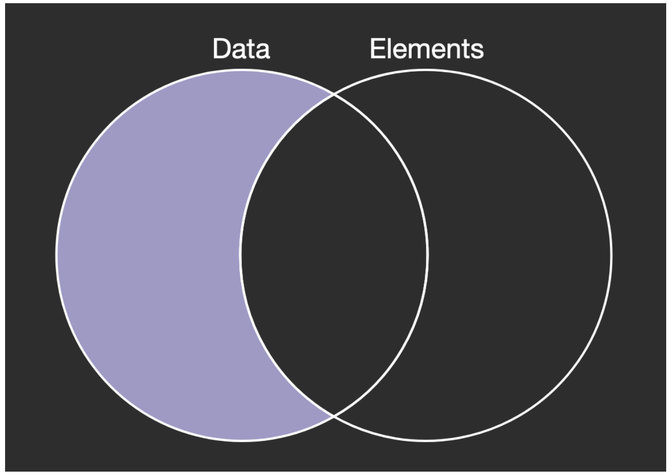


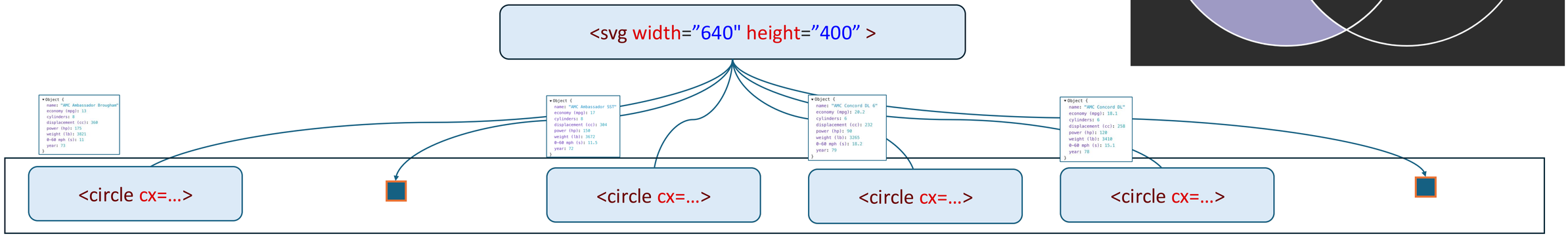


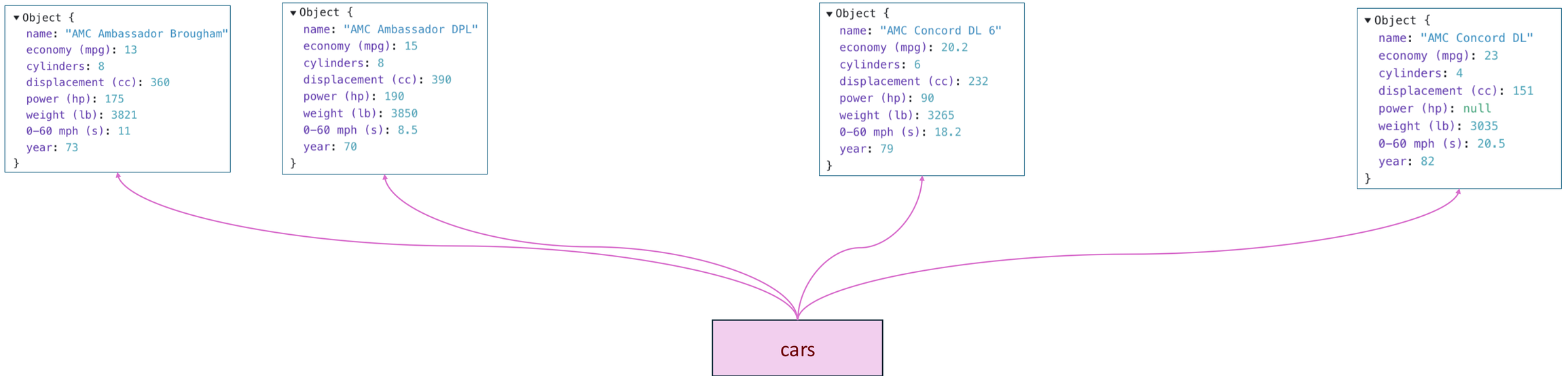


```
svg.selectAll('circle')
    .data(cars, d => d.name).enter()
    .append('circle')
    .attr("fill", "red")
```

Enter:

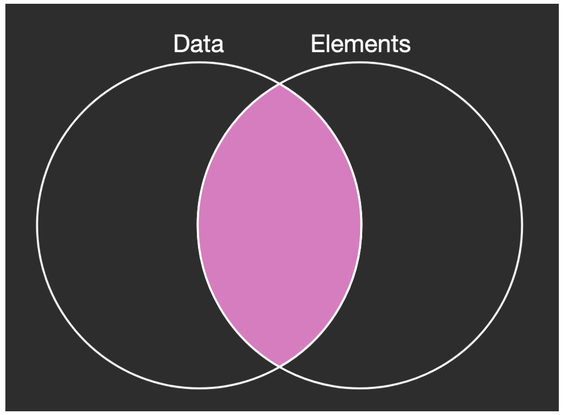


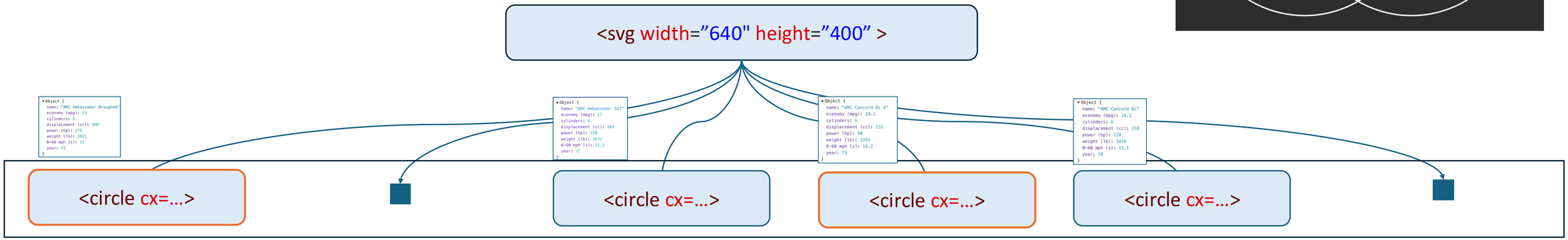


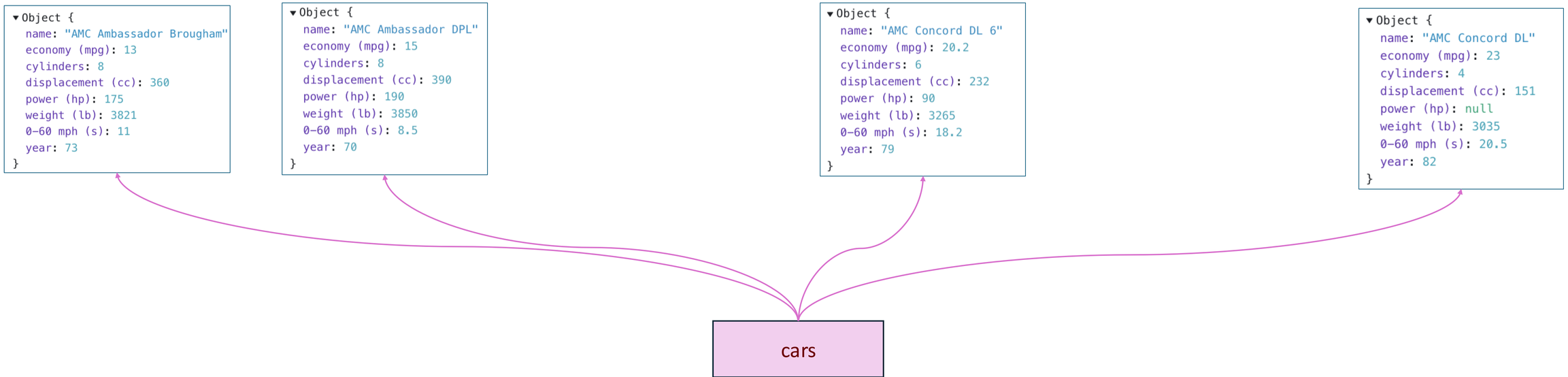


```
svg.selectAll('circle')
    .data(cars, d => d.name)
    .attr("fill", "red")
```

Update:

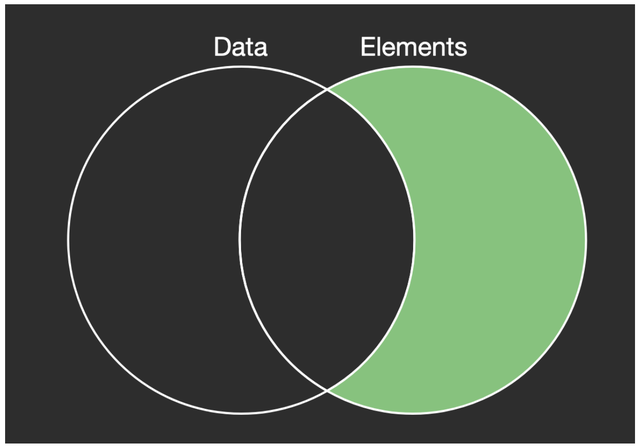


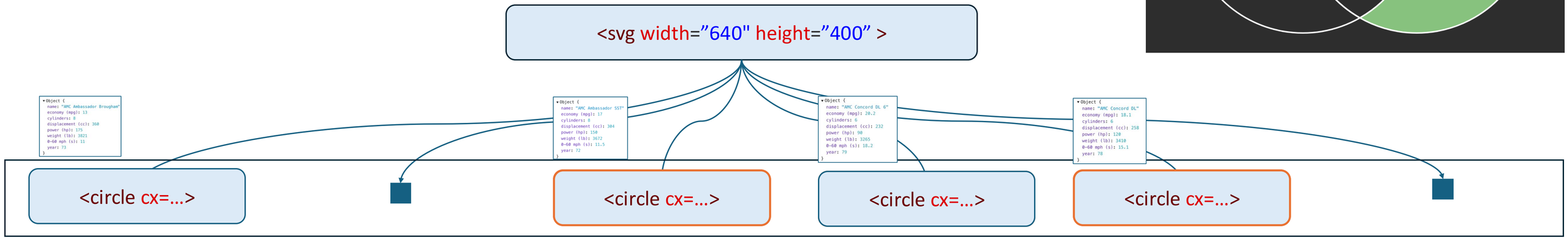


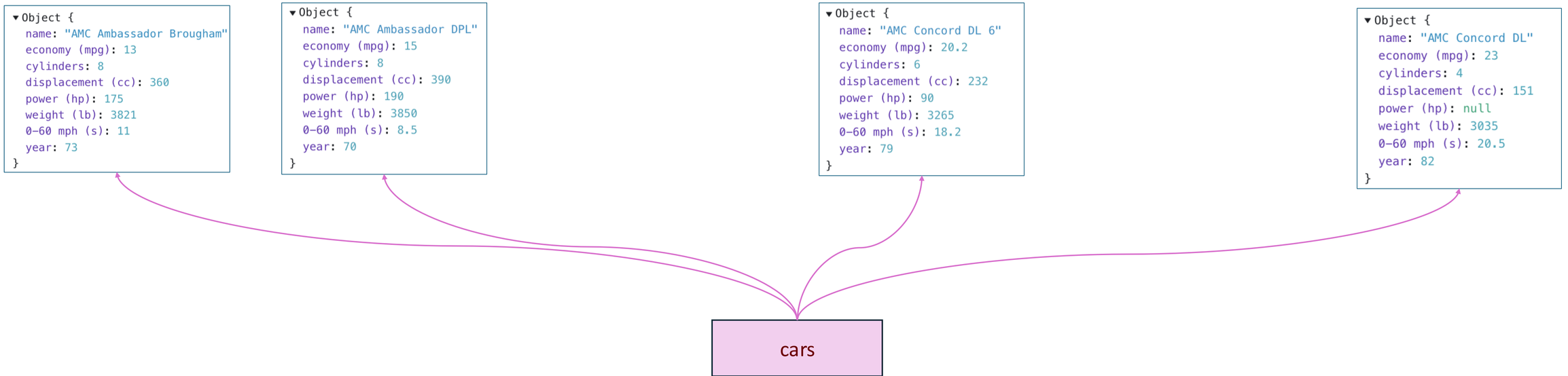


```
svg.selectAll('circle')
    .data(cars, d => d.name)
    .exit().remove()
```

Exit:

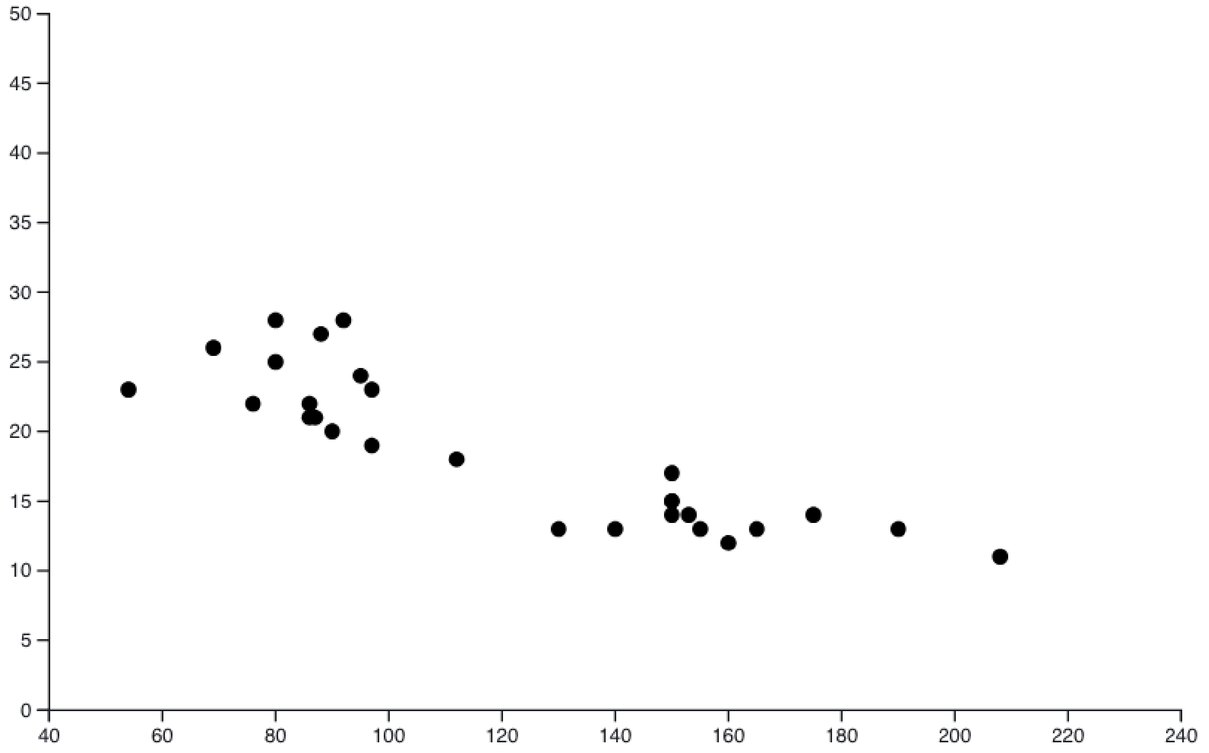






Example: Cars

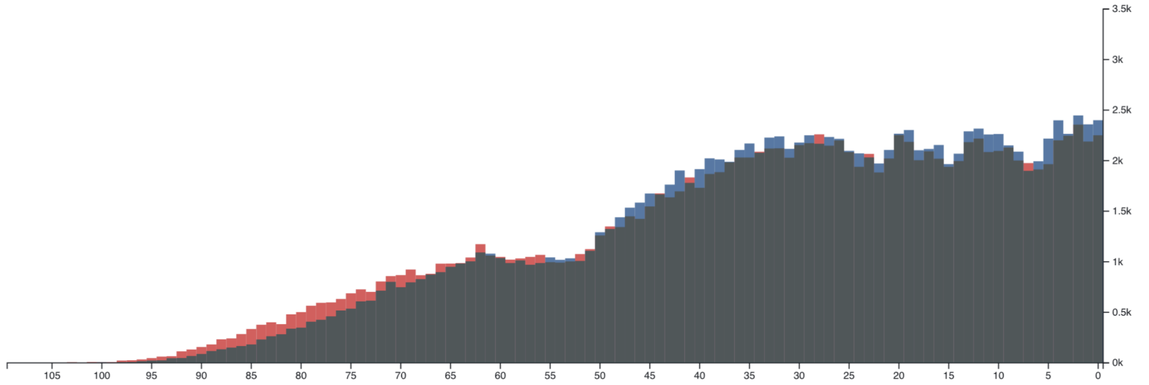
```
const svg = d3.select(chart);
const yearCars = cars.filter((d) => d.year == year);

const selection = svg.selectAll('circle')
    .data(yearCars, (d) => d.name);

// Move remaining cars
selection.transition().duration(1000)
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))

// Grow entering cars
selection.enter().append('circle')
    .filter((d) => d["power (hp)"] > 0 && d["economy (mpg)"] > 0)
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .transition().duration(1000)
    .attr("r", 4);

// Shrink and remove exiting cars
selection.exit()
  .transition().duration(1000)
  .attr("r", 0)
  .remove();
```



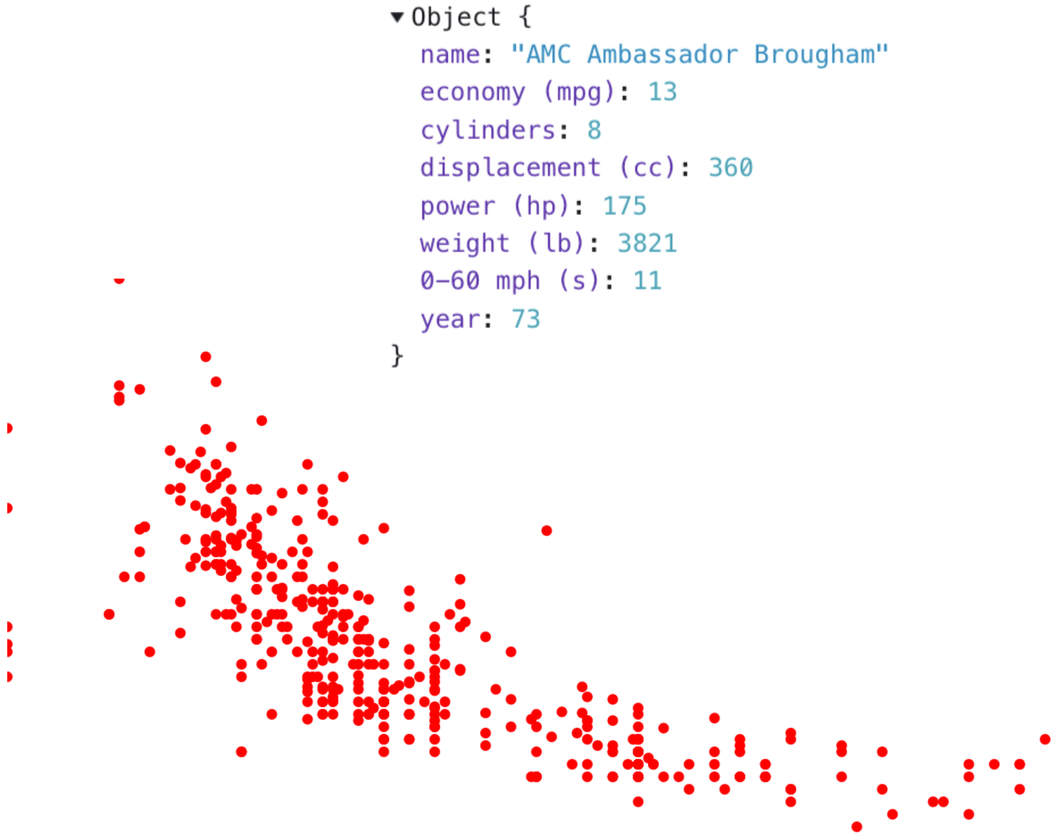
```
chart = {
  const width = 1152;
  const height = 400;
  const margin = {top: 20, right: 30, bottom: 30, left: 40};

  const x = d3.scaleBand()
      .domain(d3.reverse([...Array(110).keys()]))
      .range([margin.left, width - margin.right]);

  const y = d3.scaleLinear()
      .domain([0, 3500])
      .range([height - margin.bottom, margin.top]);

  const svg = d3.create("svg")
      .attr("width", width)
      .attr("height", height);

  svg.append("g")
      .attr("transform", `translate(0,${height - margin.bottom})`)
      .call(d3.axisBottom(x).tickValues([...Array(22).keys()].map((d) => d * 5)));

  svg.append("g")
      .attr("transform", `translate(${width - margin.right},0)`)
      .call(d3.axisRight(y).tickFormat(d => Math.round(d / 500) / 2 + 'k'));

  const colors = ["#4e79a7", "#e15759"];
  const data = population.filter((d) => d.year === icelandYear);
  svg.selectAll("rect")
      .data(data)
      .join("rect")
      .style("mix-blend-mode", "darken")
      .attr("fill", d => d.sex == 'M' ? colors[0] : colors[1])
      .attr("x", d => x(d.age))
      .attr("y", d => y(d.value))
      .attr("width", x.bandwidth())
      .attr("height", d => y(0) - y(d.value))

  return svg.node();
}
```

Year 1993

```
viewof icelandYear = Inputs.range([1841, 2019], {label: 'Year', step: 1})
```



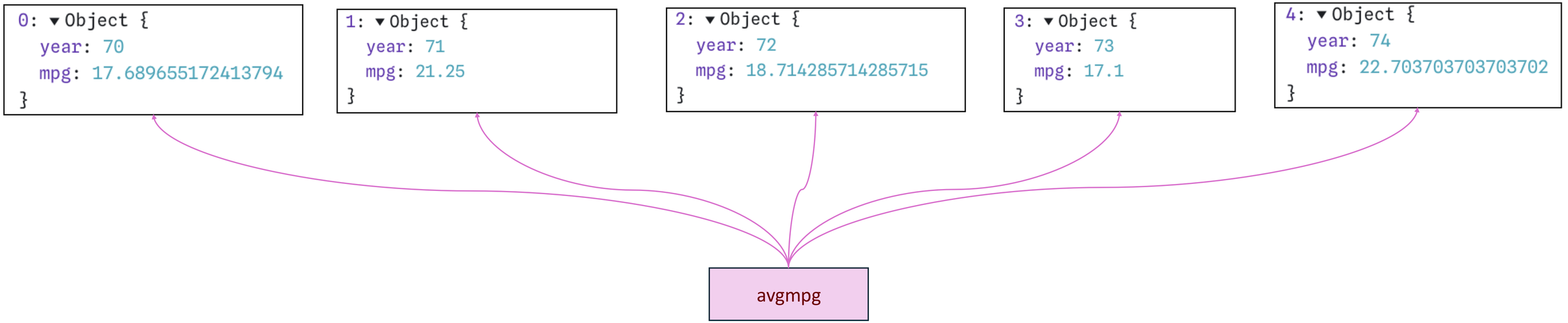
```
svg.selectAll('circle')
    .data(cars)
    .join('circle')
    .attr("fill", "red")
    .attr("cx", (d) => x(d["power (hp)"]))
    .attr("cy", (d) => y(d["economy (mpg)"]))
    .attr("r", 3)
```



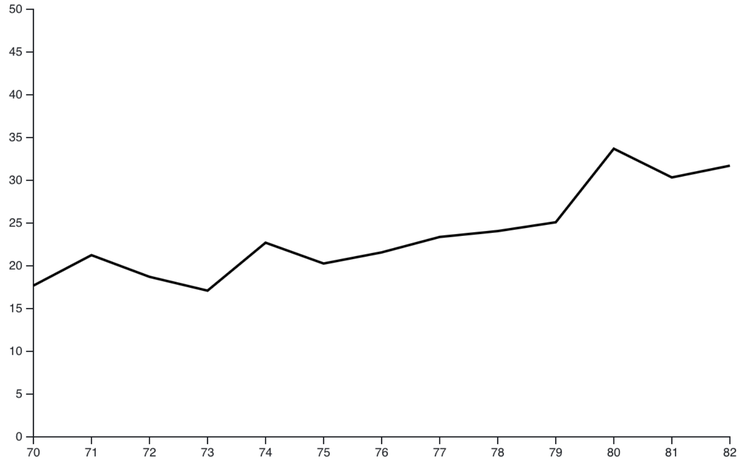

```
marks: [
  Plot.dot(cars, {x: "power (hp)",
                  y: "economy (mpg)",
                  r: 3,
                  fill: 'red'
                 }),
]
```

Line & area plots

```
avgmpg = {
  const mpgbyyear = d3.rollup(cars, v => d3.mean(v, d => d["economy (mpg)"]), d => d.year)
  return [...d3.sort(mpgbyyear)].map(d => ({year: d[0], mpg: d[1]}))
}
```



```
const line = d3.line()
  .x(d => x(d.year))
  .y(d => y(d.mpg));

svg.append('path')
  .attr("d", line(avgmpg))
  .attr("stroke-width", 2)
  .attr("stroke", "black")
  .attr("fill", "none")
```



<svg width=”640" height=”400” >

<path d=” M40,246.172L87.5,…,134.124L562.5,157.65L610,148.032 " stroke=”black" fill=”none” stroke-width=”2" >


```
▼Object {
  name: "AMC Ambassador Brougham"
  economy (mpg): 13
  cylinders: 8
  displacement (cc): 360
  power (hp): 175
  weight (lb): 3821
  0-60 mph (s): 11
  year: 73
}
```

```
▼Object {
  name: "AMC Ambassador DPL"
  economy (mpg): 15
  cylinders: 8
  displacement (cc): 390
  power (hp): 190
  weight (lb): 3850
  0-60 mph (s): 8.5
  year: 70
}
```

```
▼Object {
  name: "AMC Ambassador SST"
  economy (mpg): 17
  cylinders: 8
  displacement (cc): 304
  power (hp): 150
  weight (lb): 3672
  0-60 mph (s): 11.5
  year: 72
}
```

```
▼Object {
  name: "AMC Concord DL 6"
  economy (mpg): 20.2
  cylinders: 6
  displacement (cc): 232
  power (hp): 90
  weight (lb): 3265
  0-60 mph (s): 18.2
  year: 79
}
```

```
▼Object {
  name: "AMC Concord DL"
  economy (mpg): 18.1
  cylinders: 6
  displacement (cc): 258
  power (hp): 120
  weight (lb): 3410
  0-60 mph (s): 15.1
  year: 78
}
```

```
▼Object {
  name: "AMC Concord DL"
  economy (mpg): 23
  cylinders: 4
  displacement (cc): 151
  power (hp): null
  weight (lb): 3035
  0-60 mph (s): 20.5
  year: 82
}
```


cars