Workshop #1

THE BASICS OF D3

TOPIC OVERVIEW

- HTML Basics
- Styling with CSS
- SVG Basics with HTML
- Javascript Refresher
- Using D3

HTML BASICS

- Create and modify HTML documents
- Understand HTML tags and attributes
- Create “class” and “id” attributes

Course Overview

CS 571 – Data Visualization & Exploration Instructor: Cindy Xiong Bearfield TA: Hamza Elhamdadi Summer 2024 Tue, Wed, Thu 10:00 – 11:45 am Online via Zoom Information visualization is an area of research that helps people analyze and understand data using visualization techniques. This multi-disciplinary area draws from other areas of science, including human-computer interaction, data science, psychology, and art, to develop new visualization methods and understand how (and why) they are effective.

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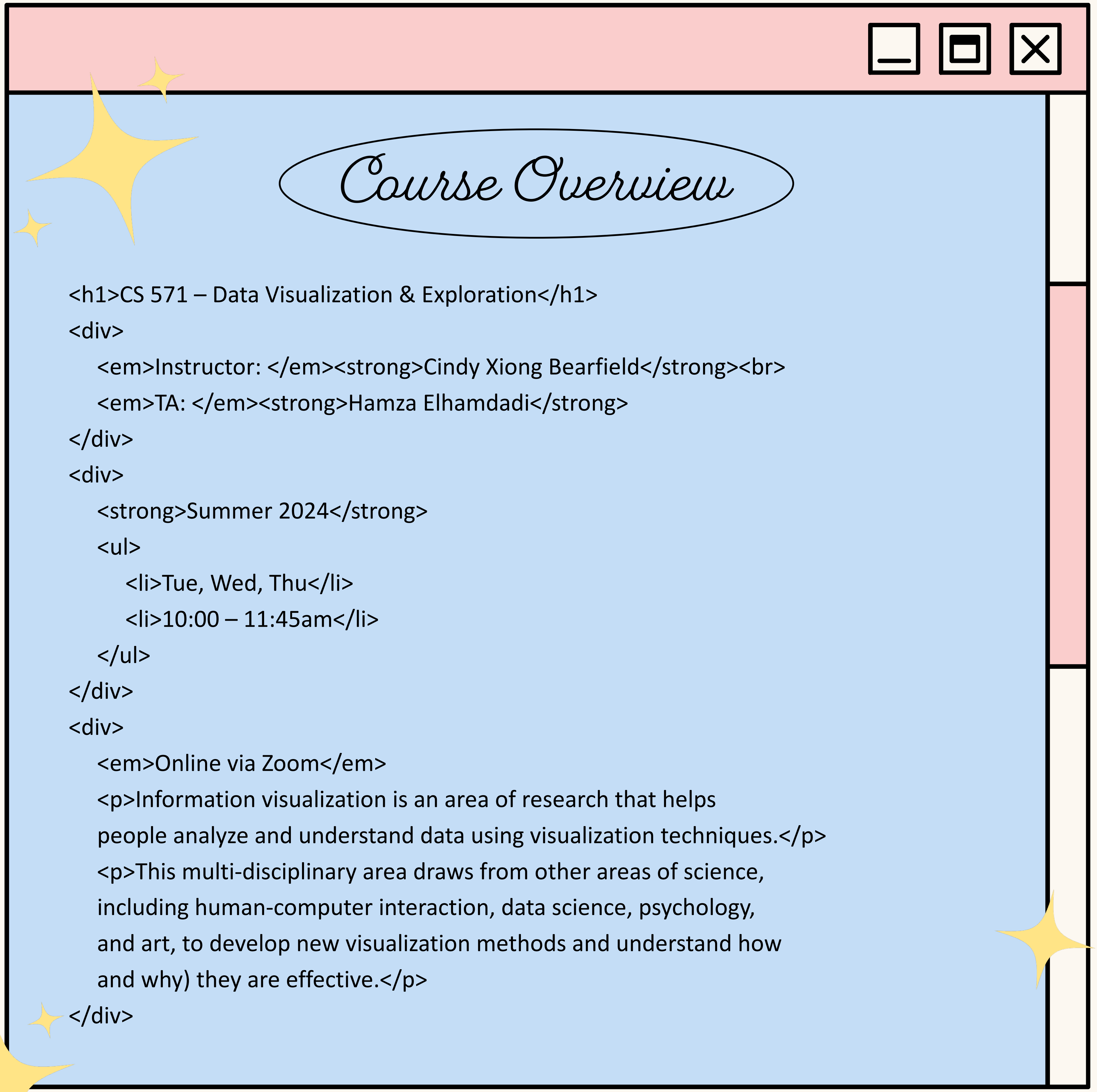

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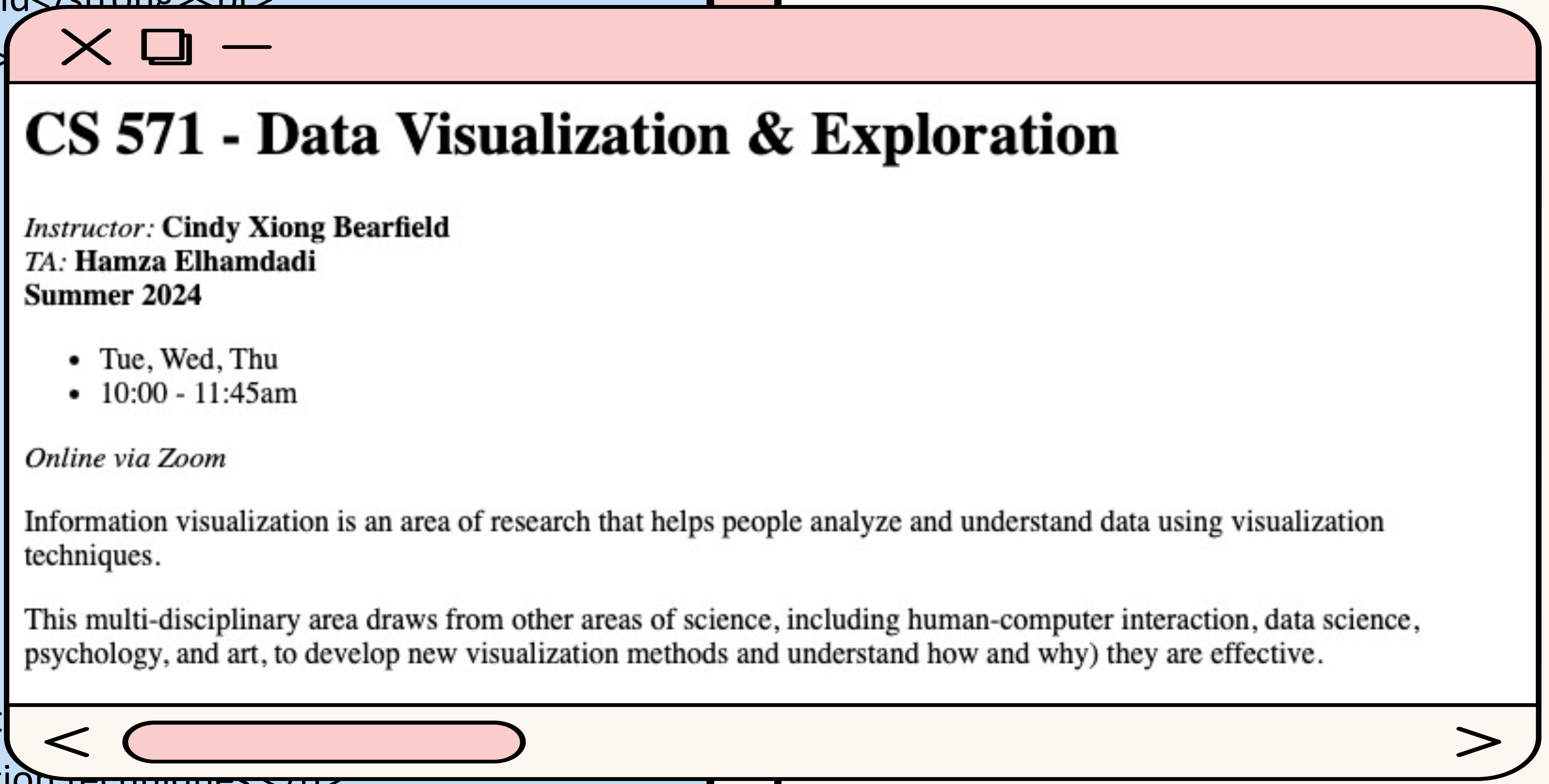

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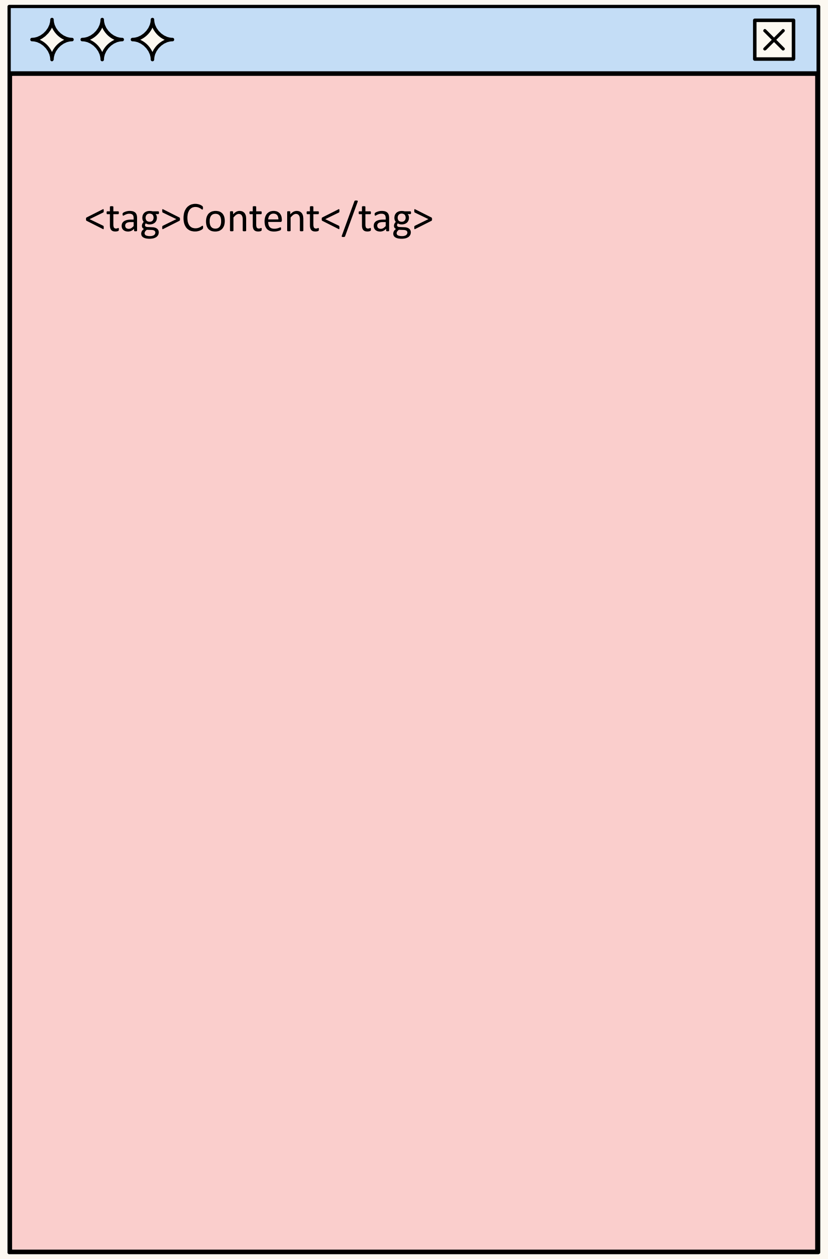

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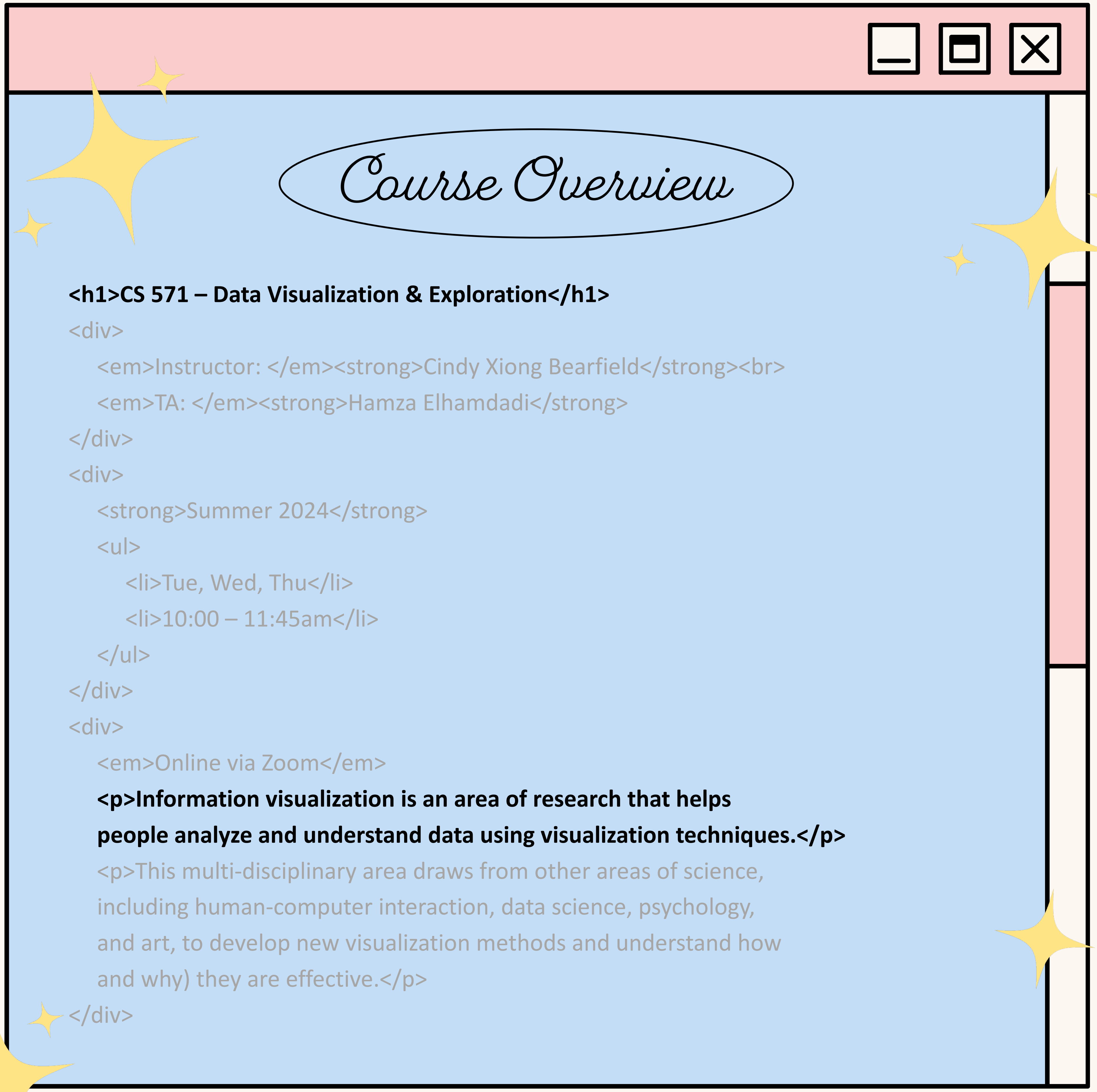

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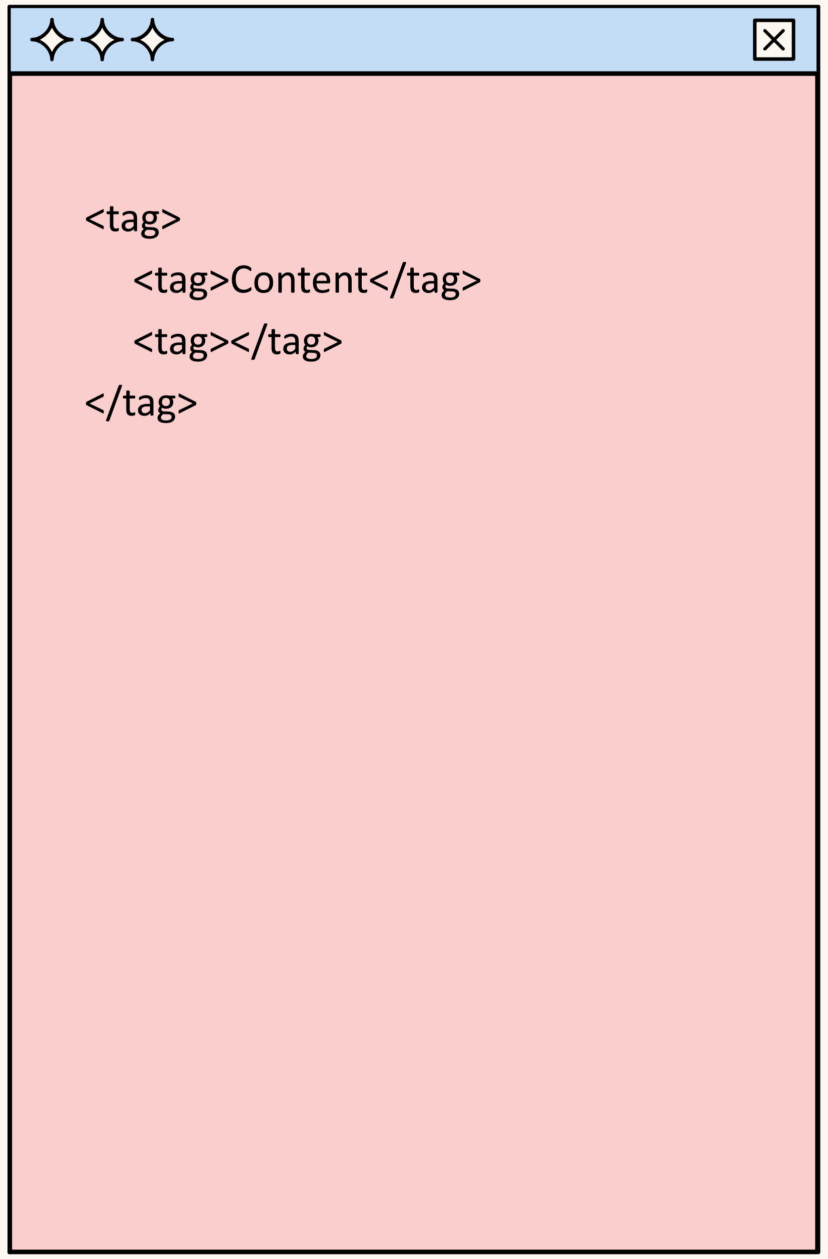

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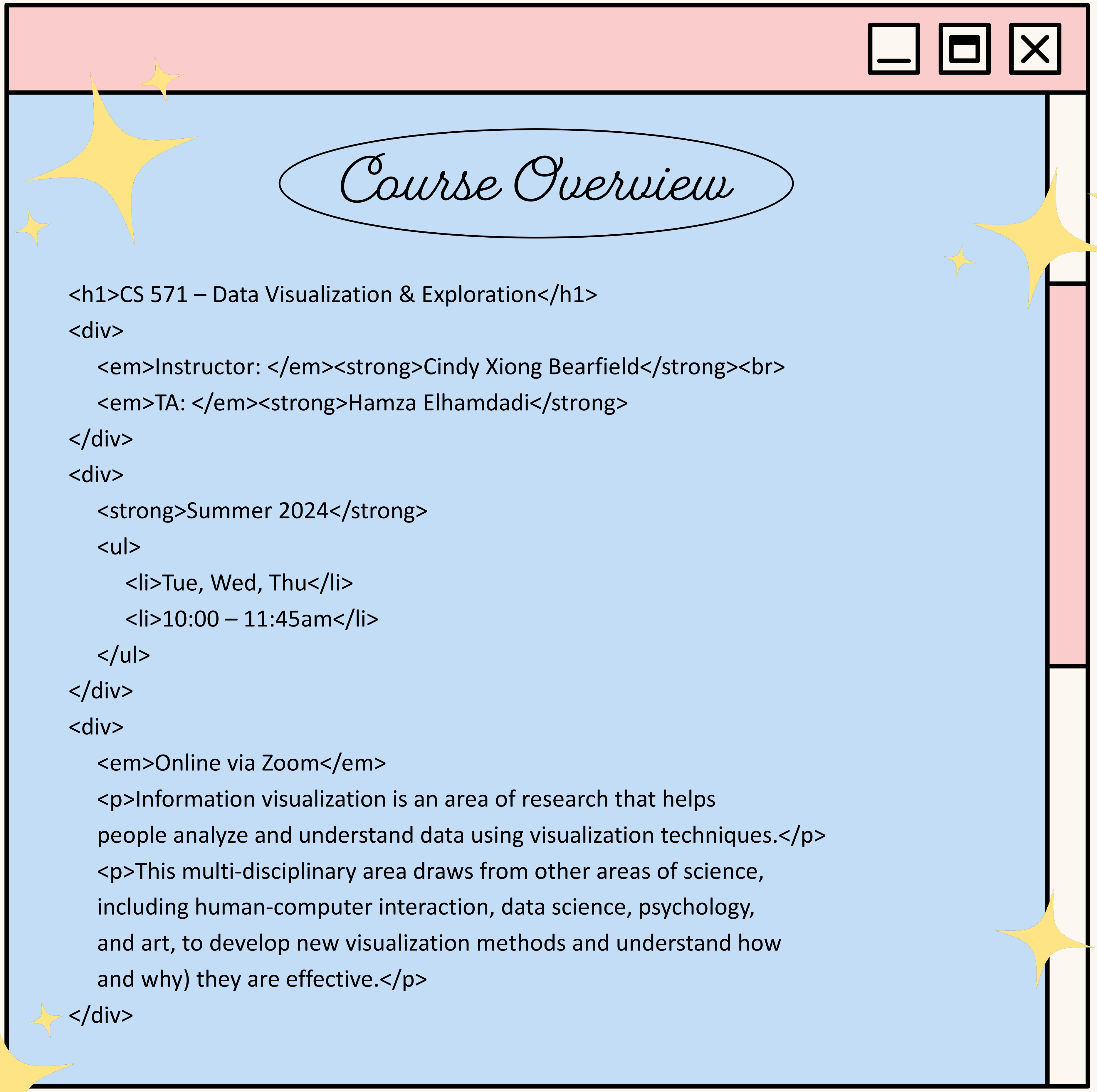

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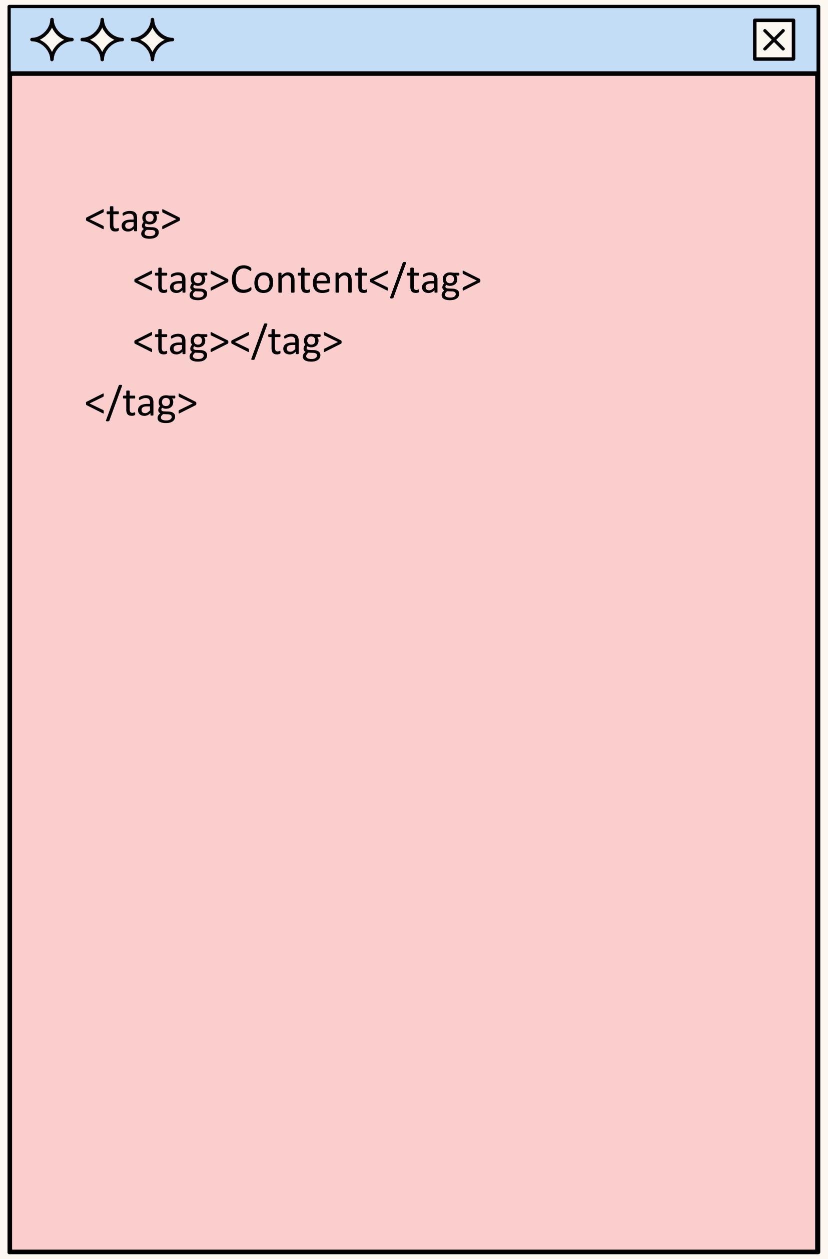

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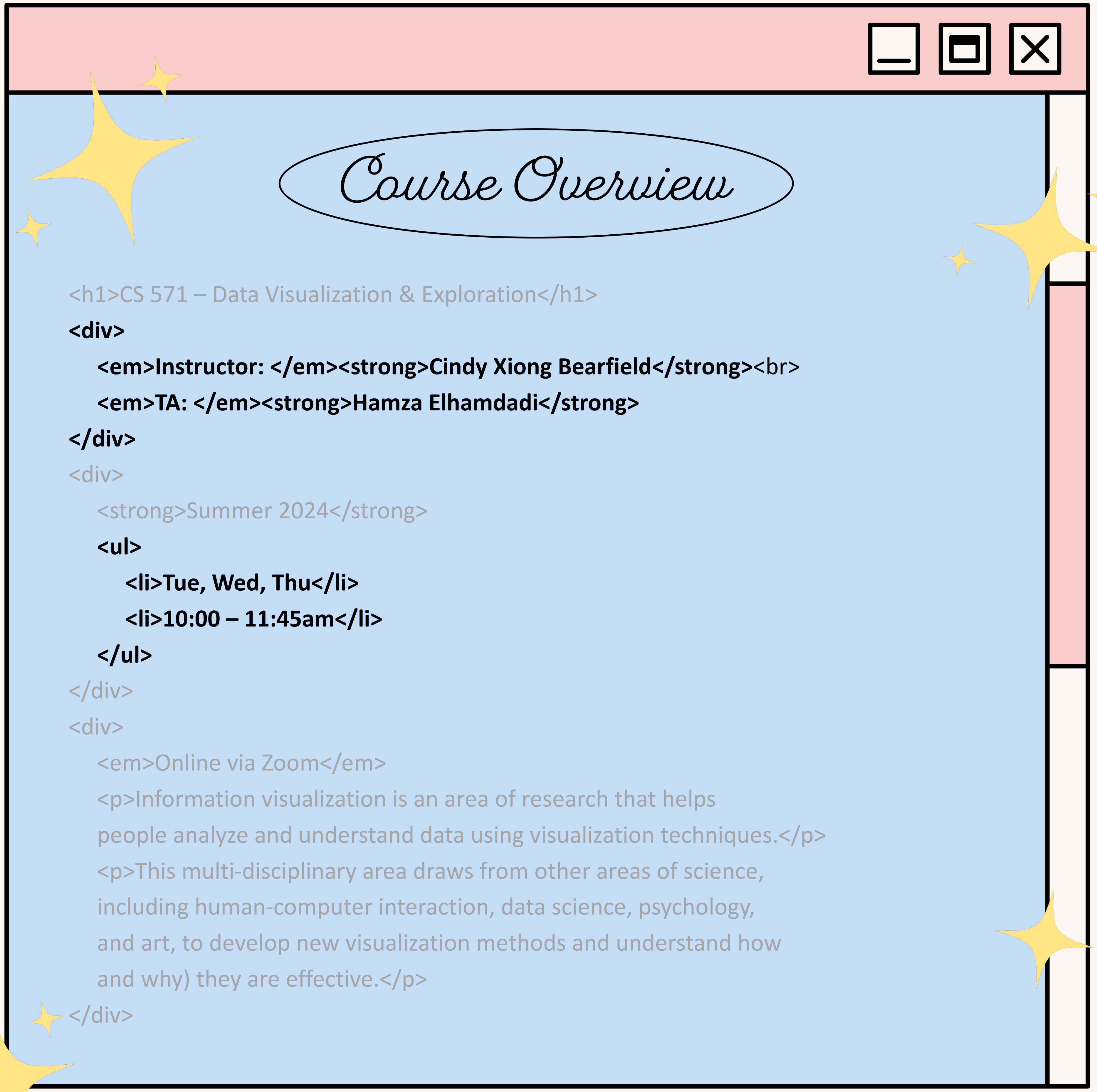

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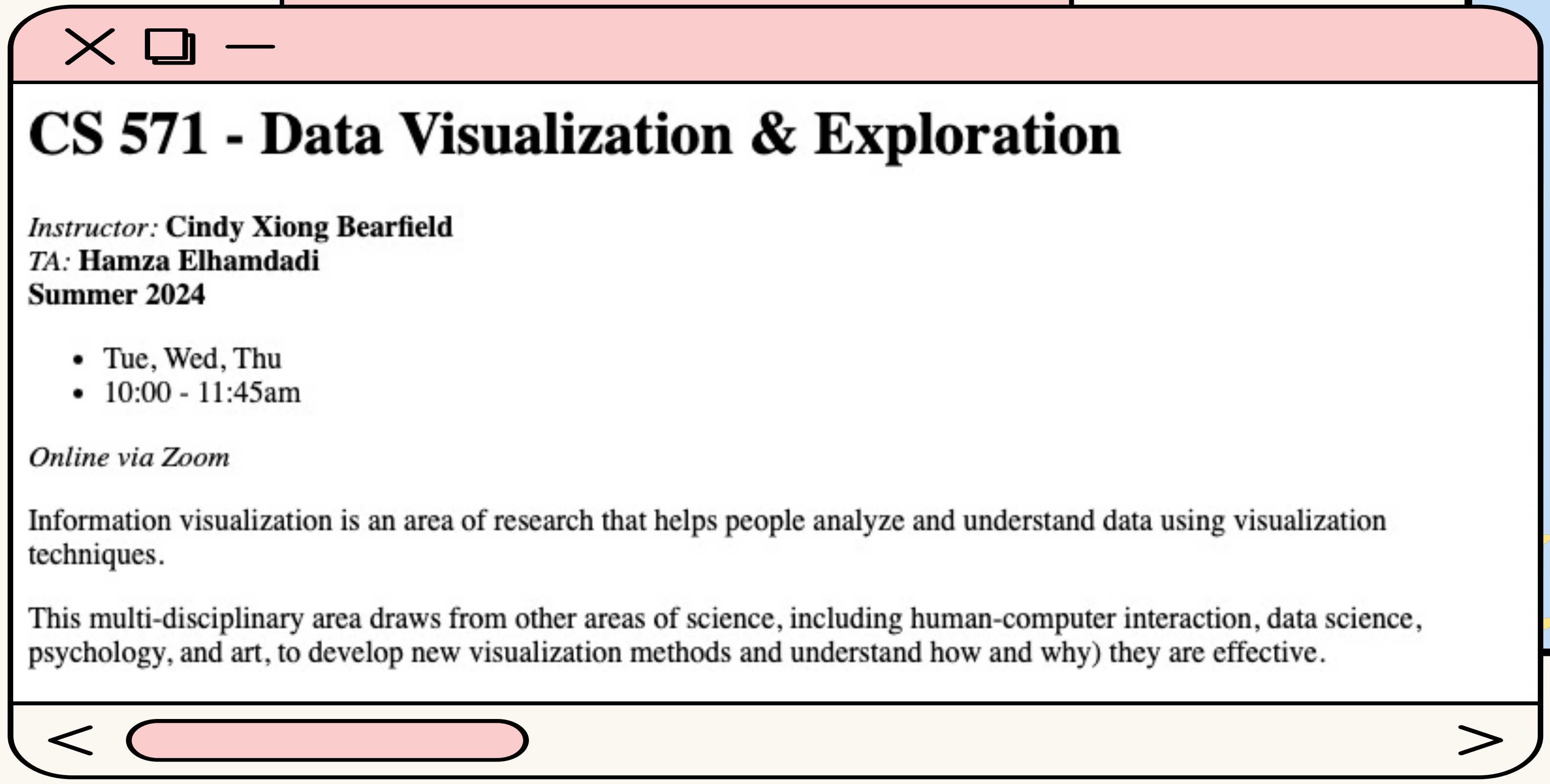

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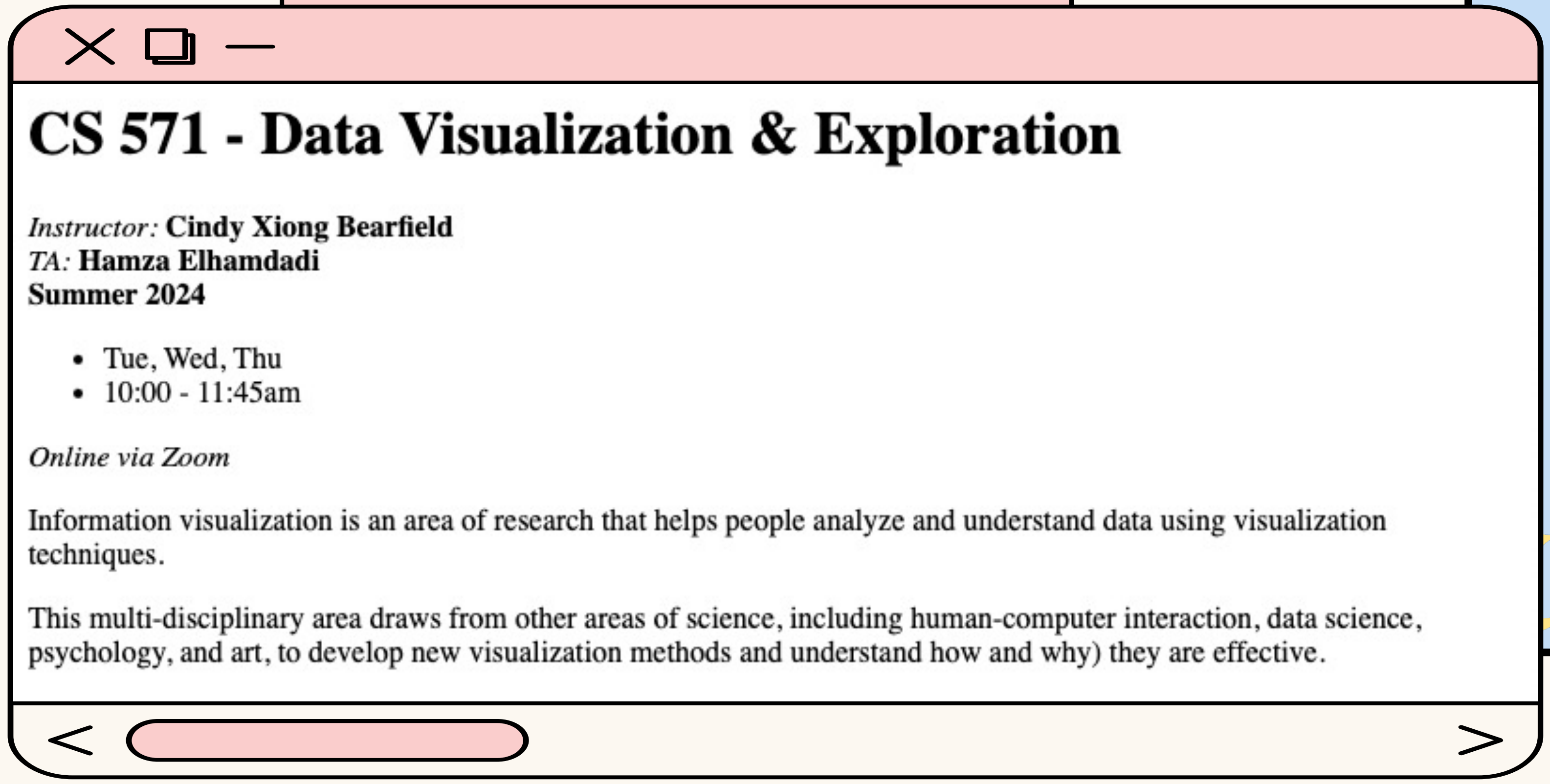

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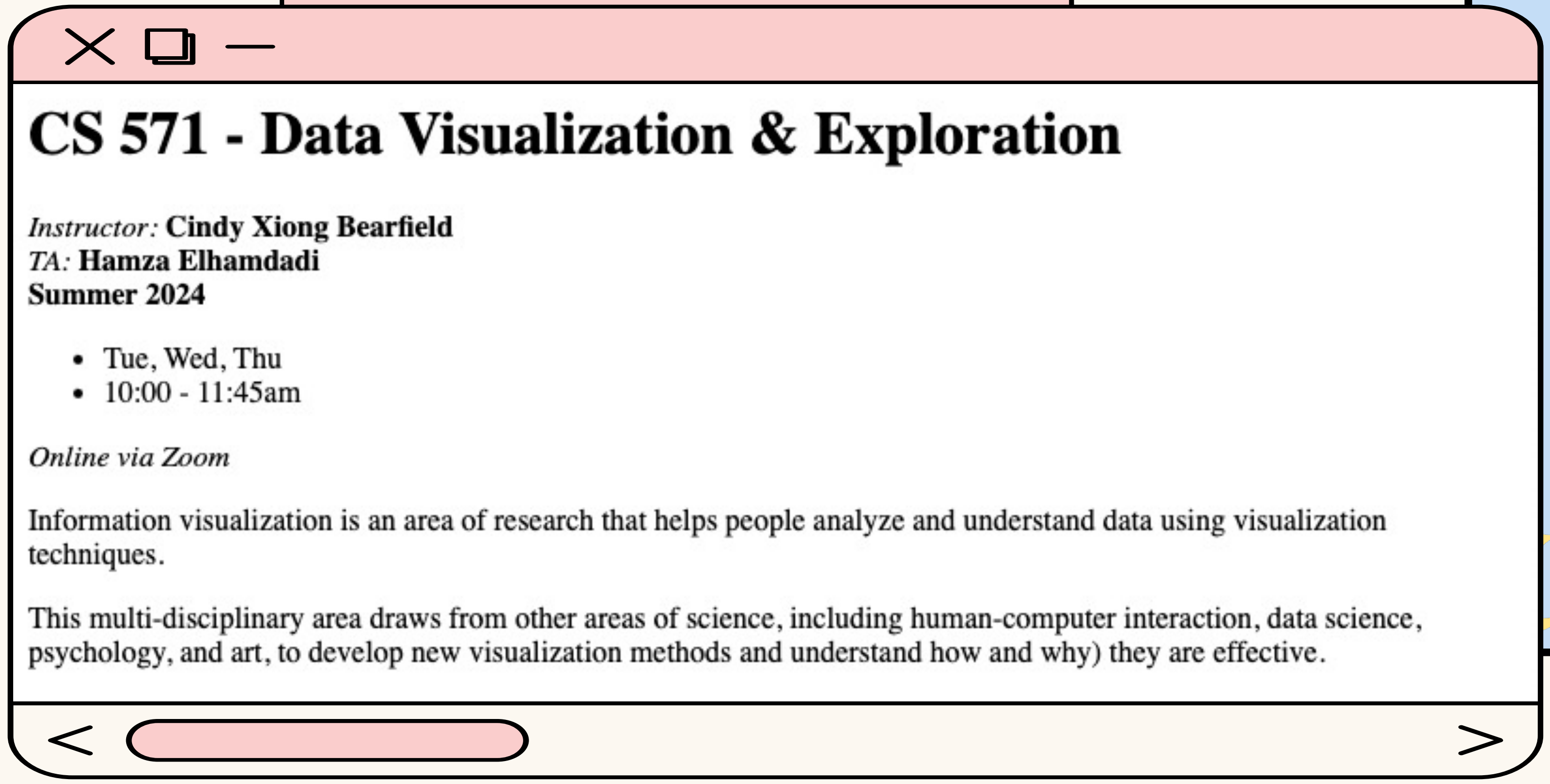

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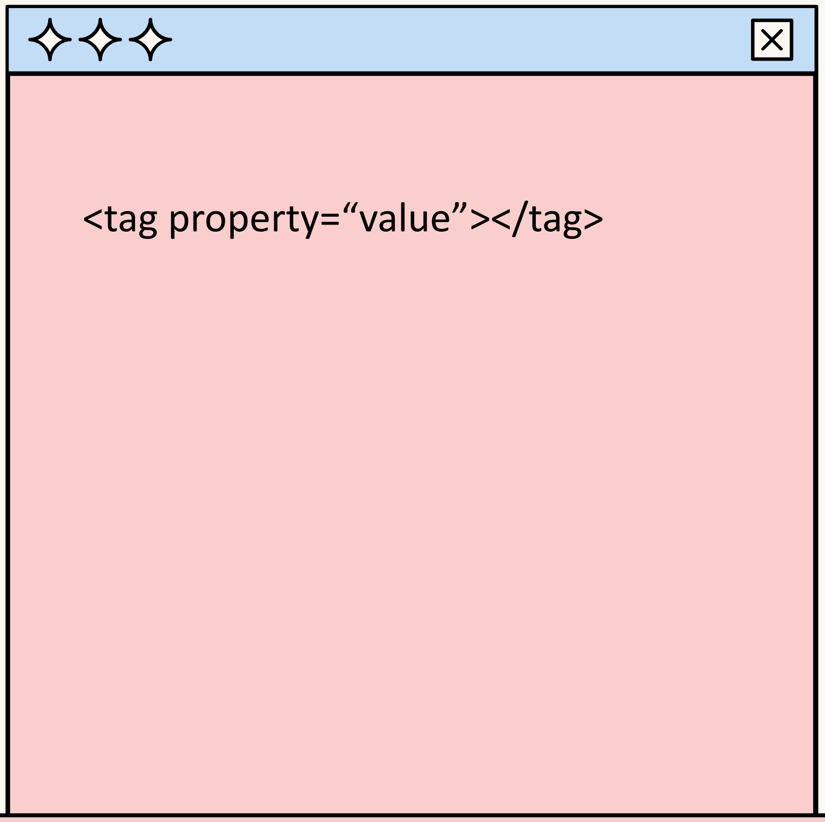

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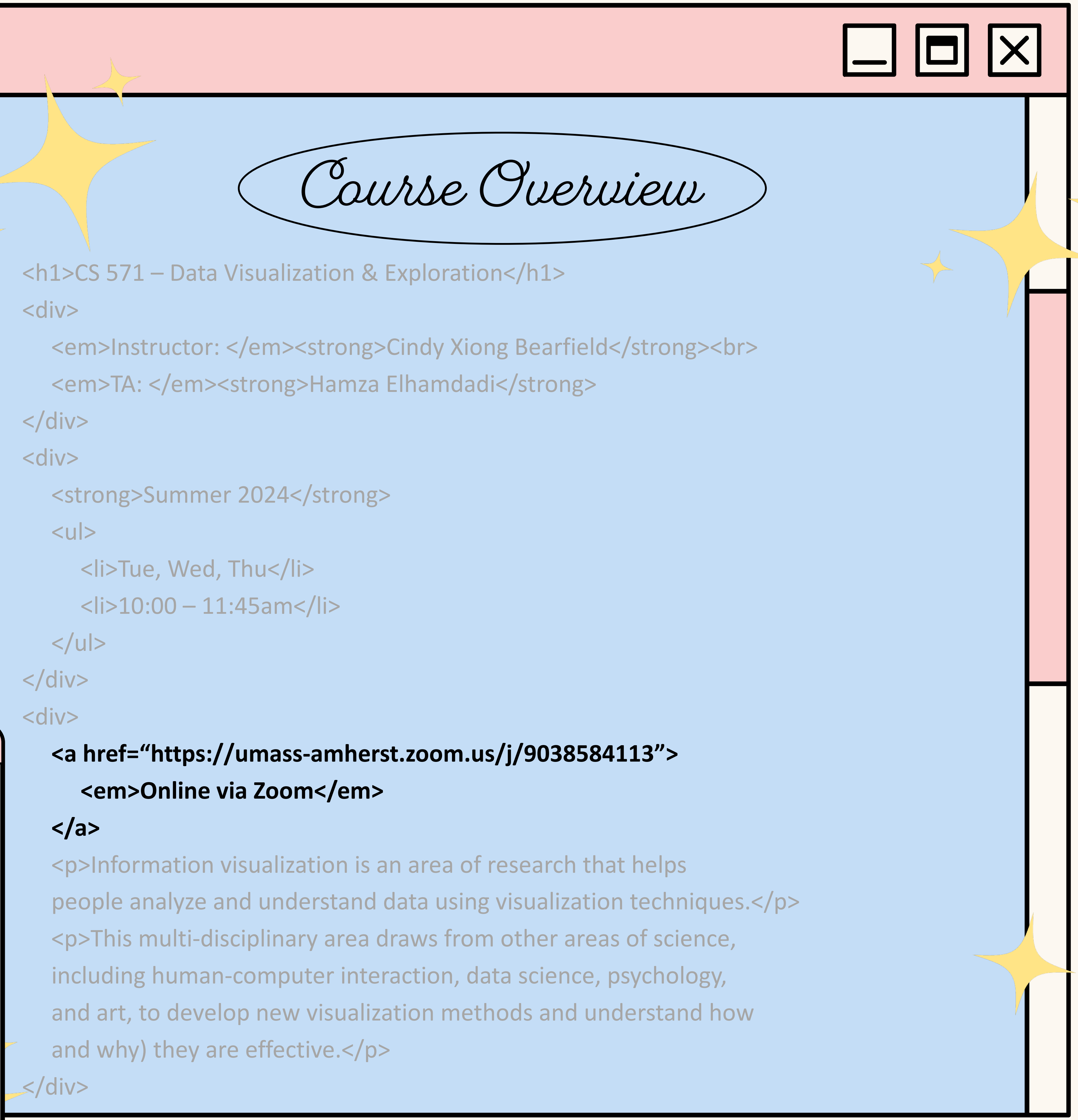

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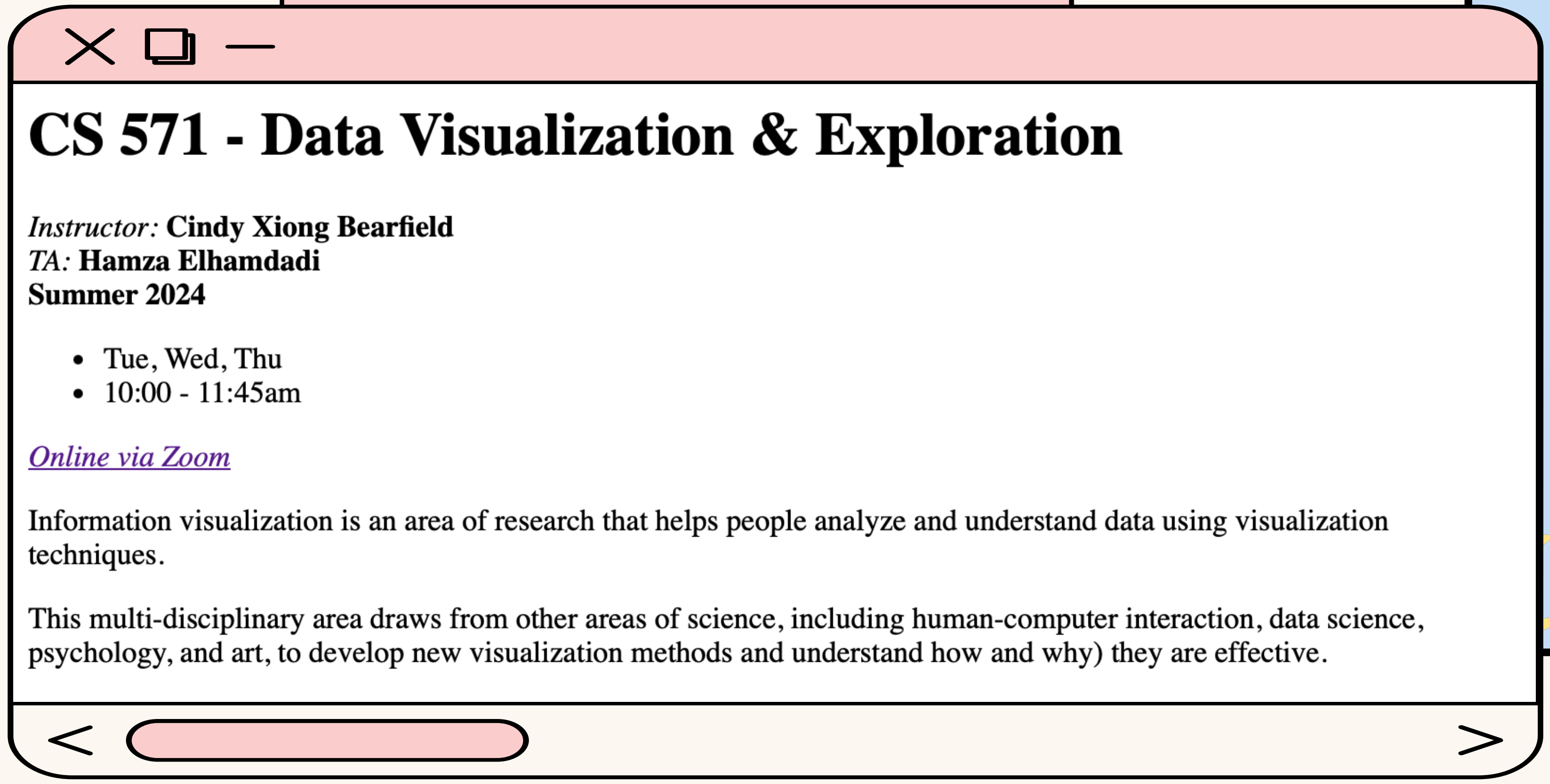

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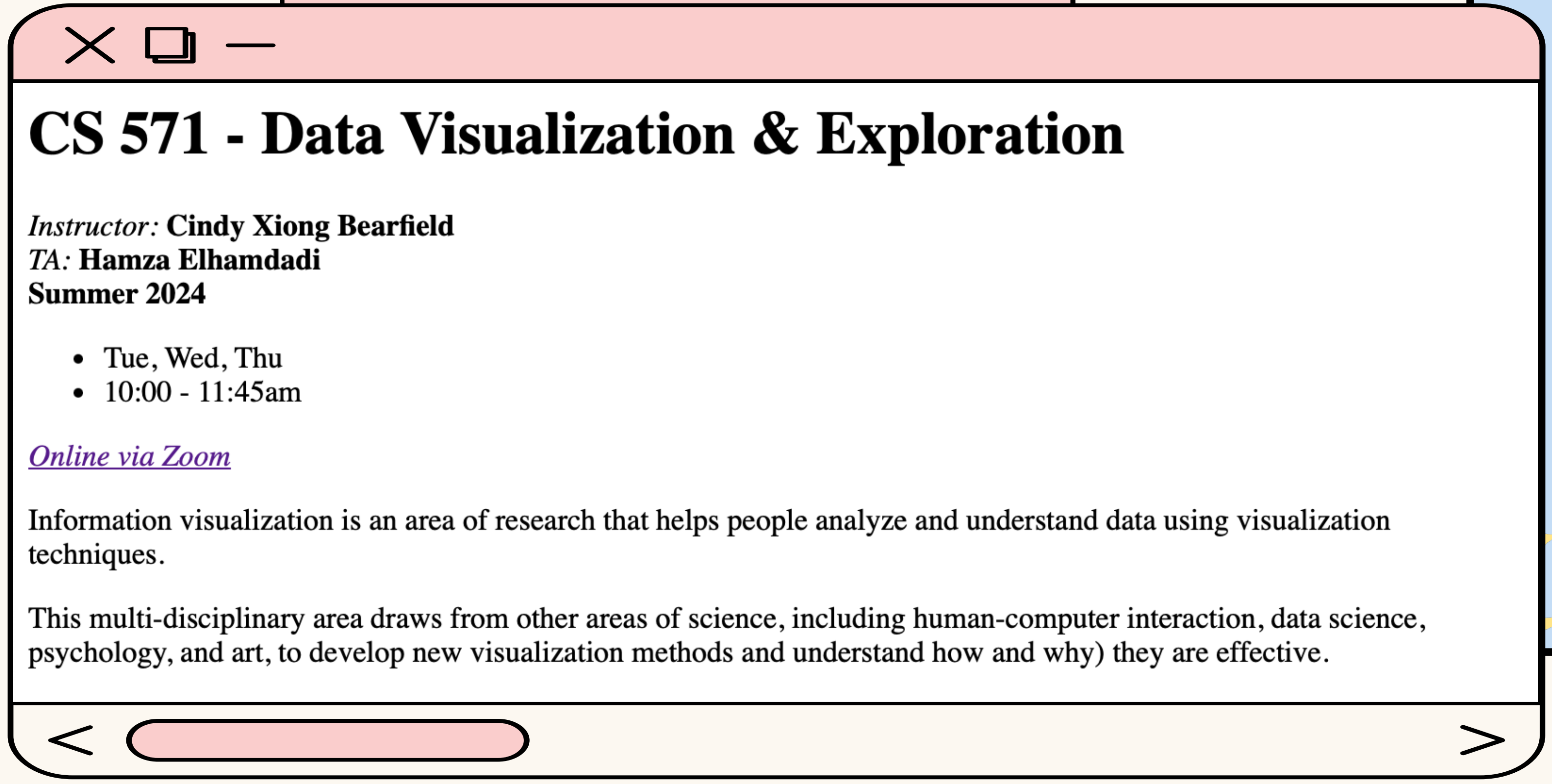

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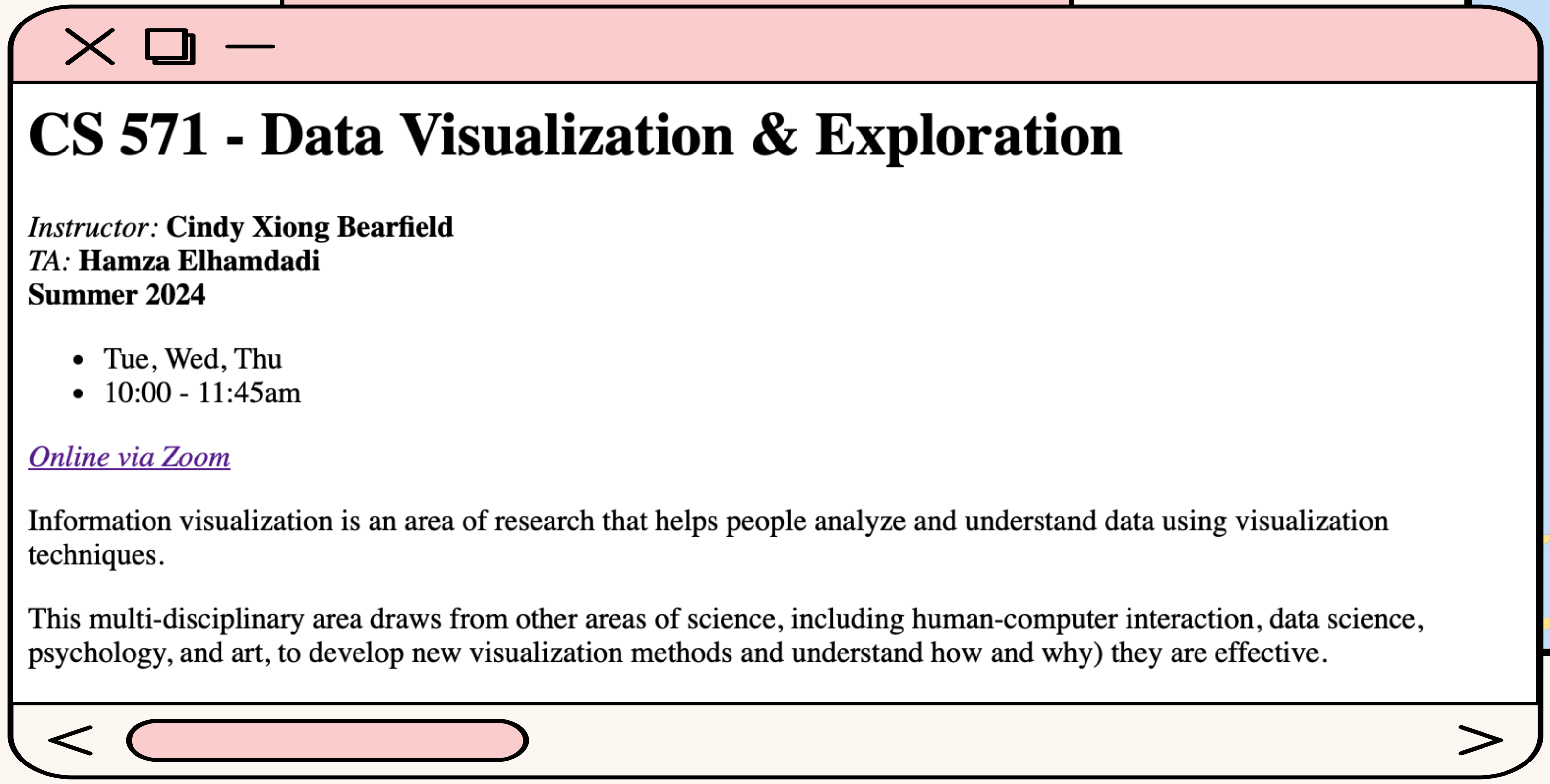

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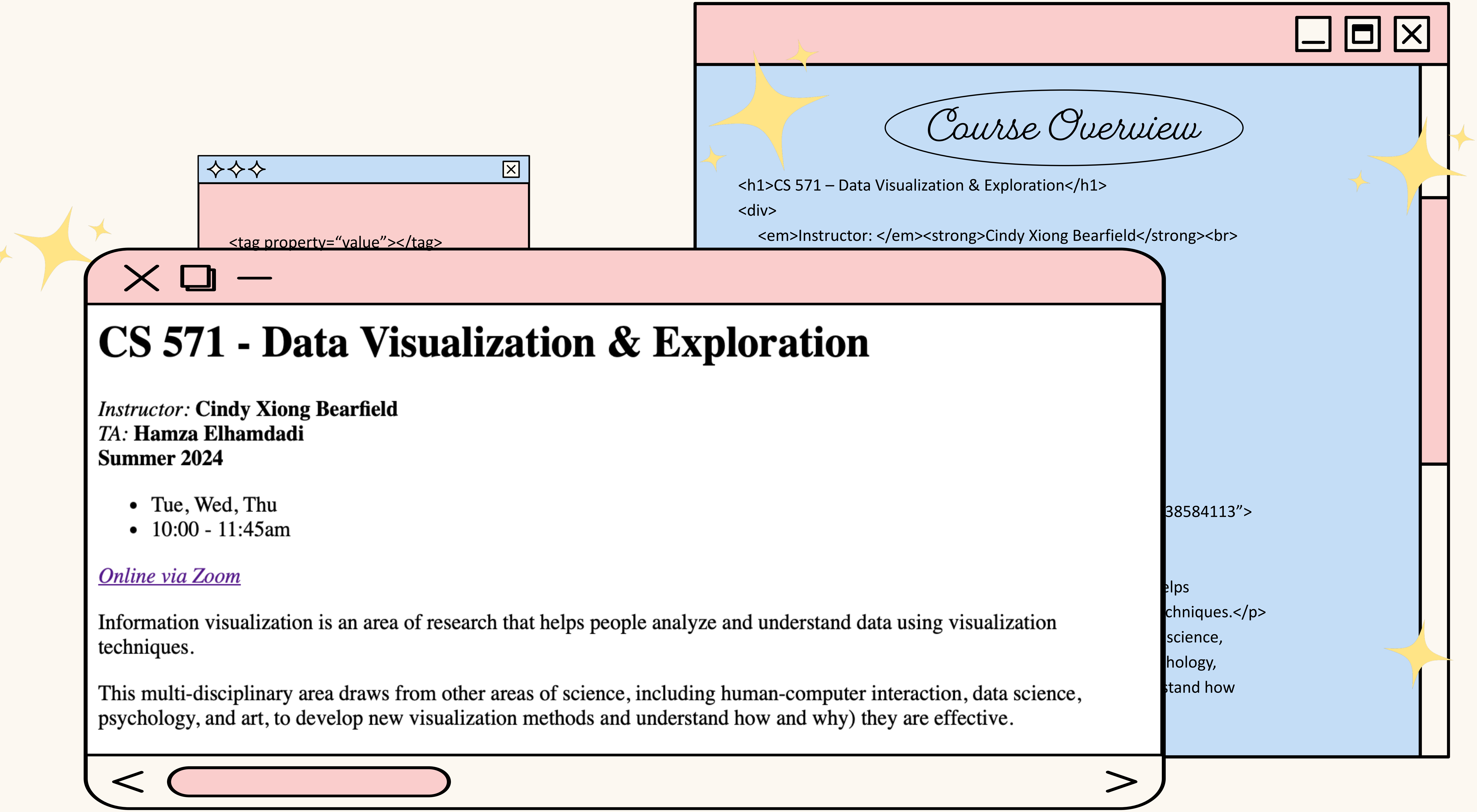

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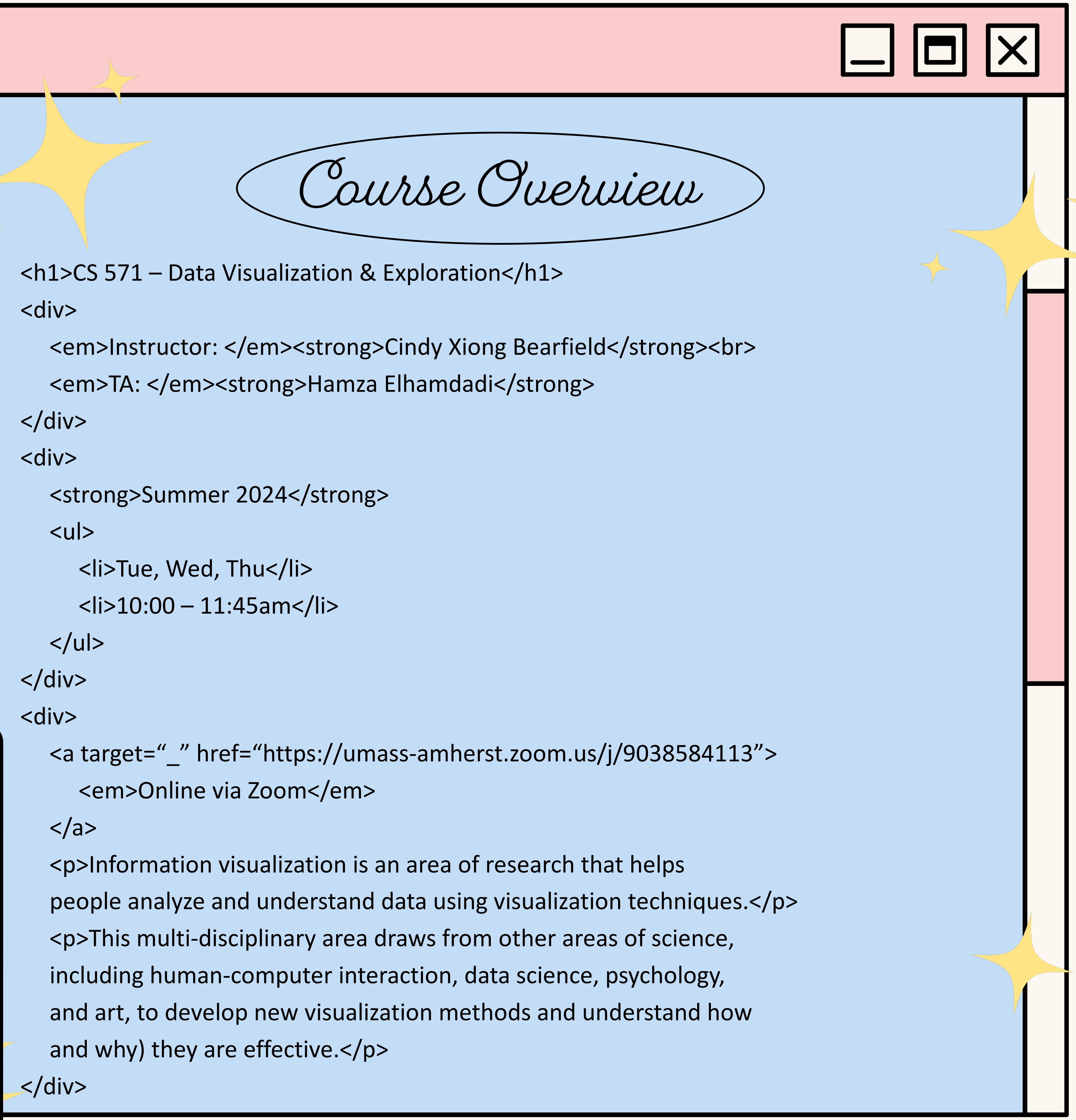

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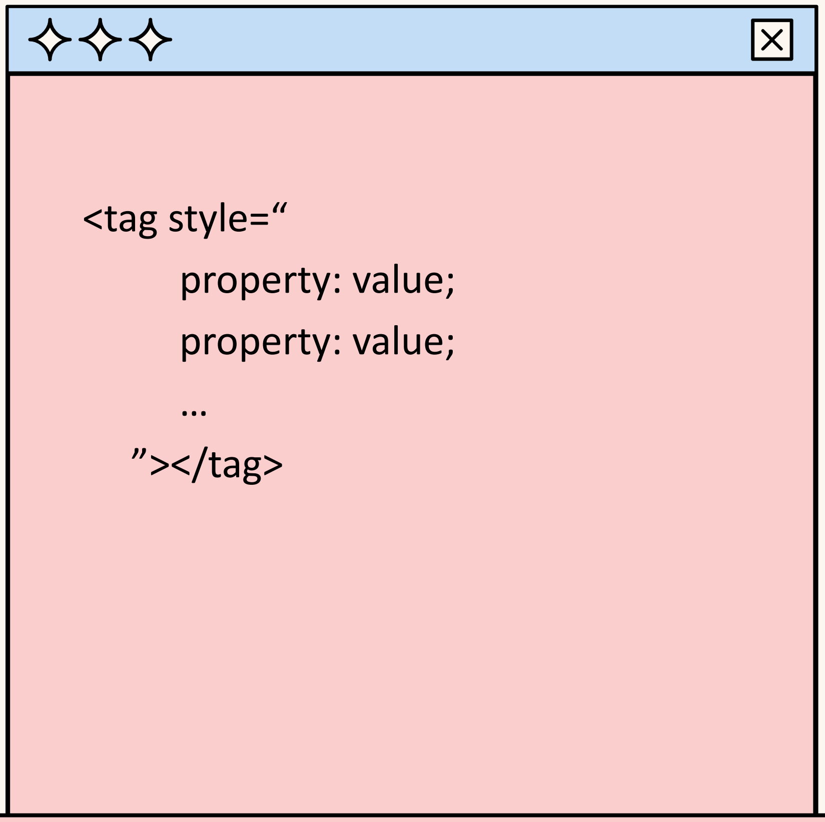

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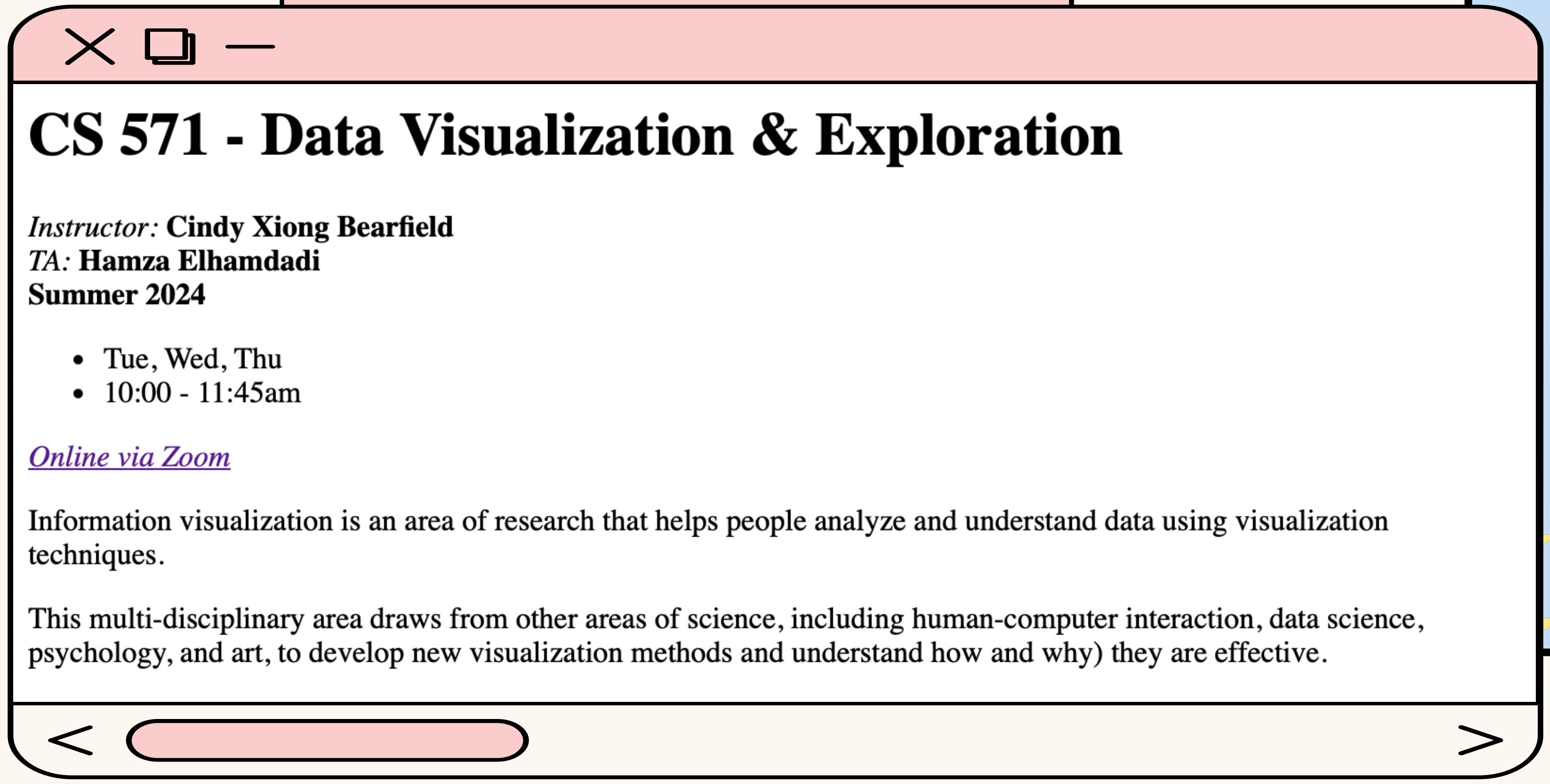

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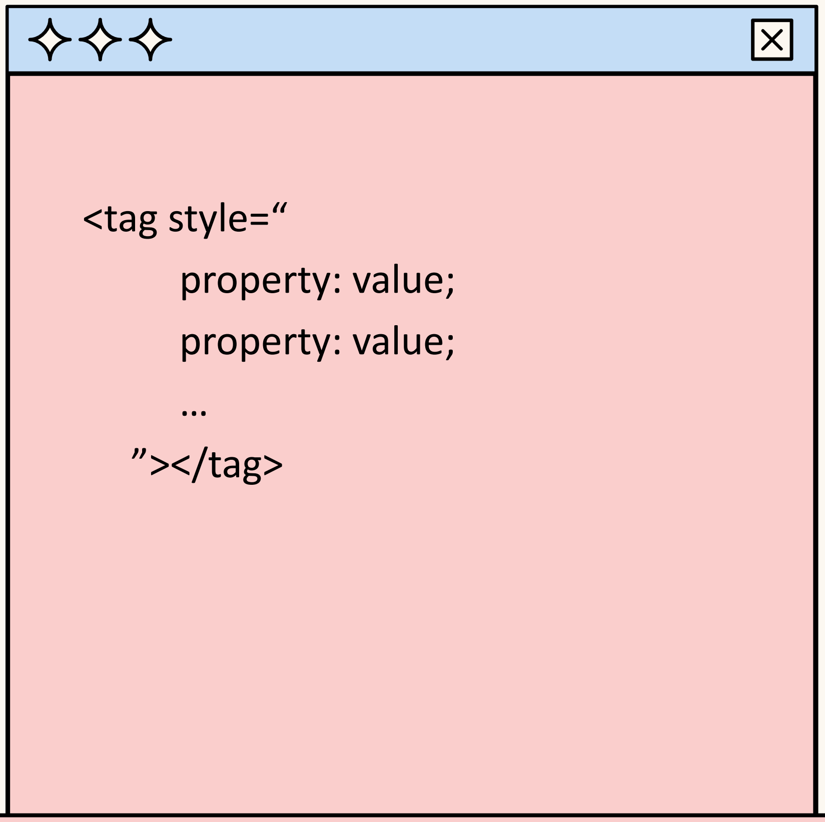

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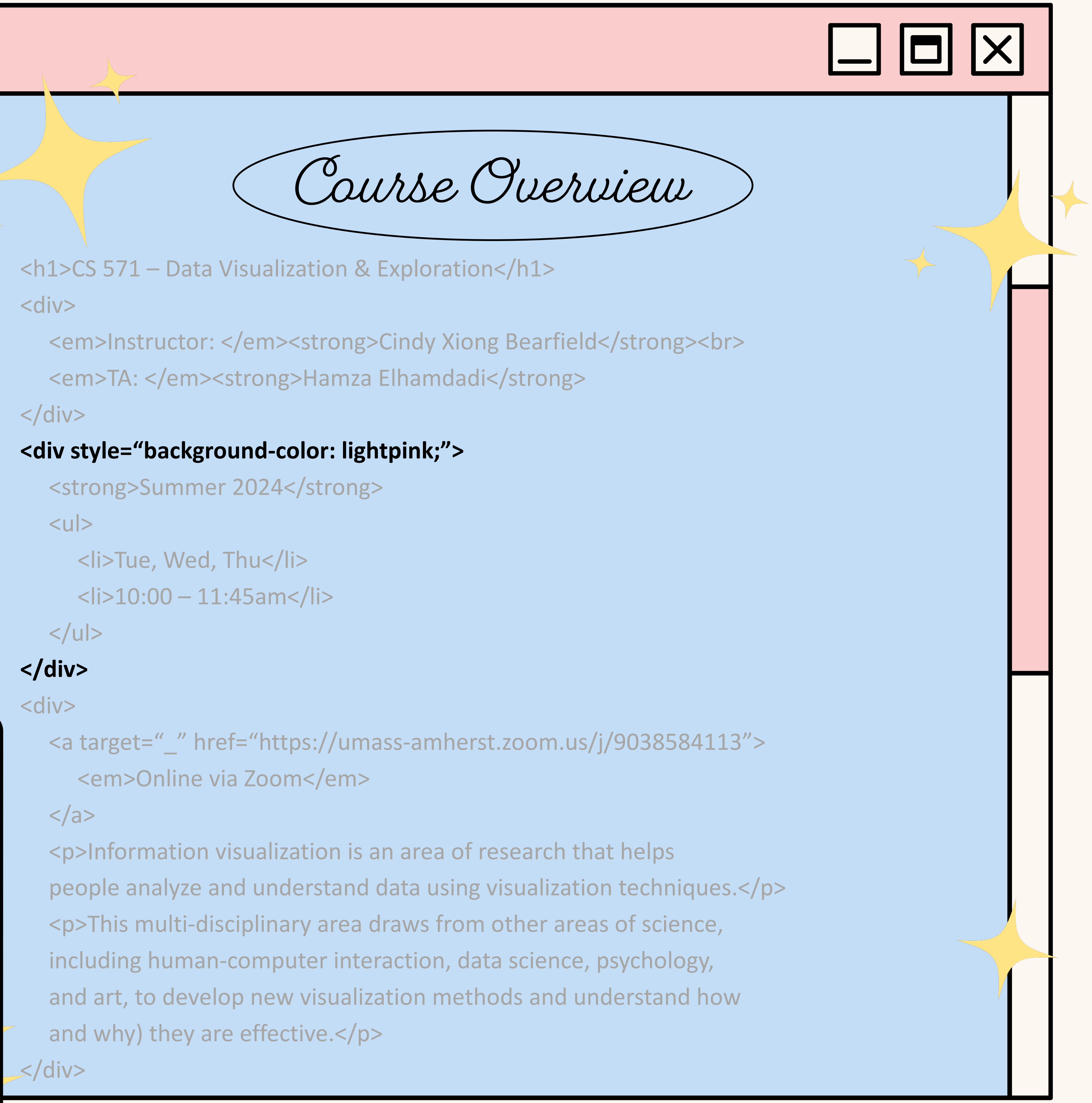

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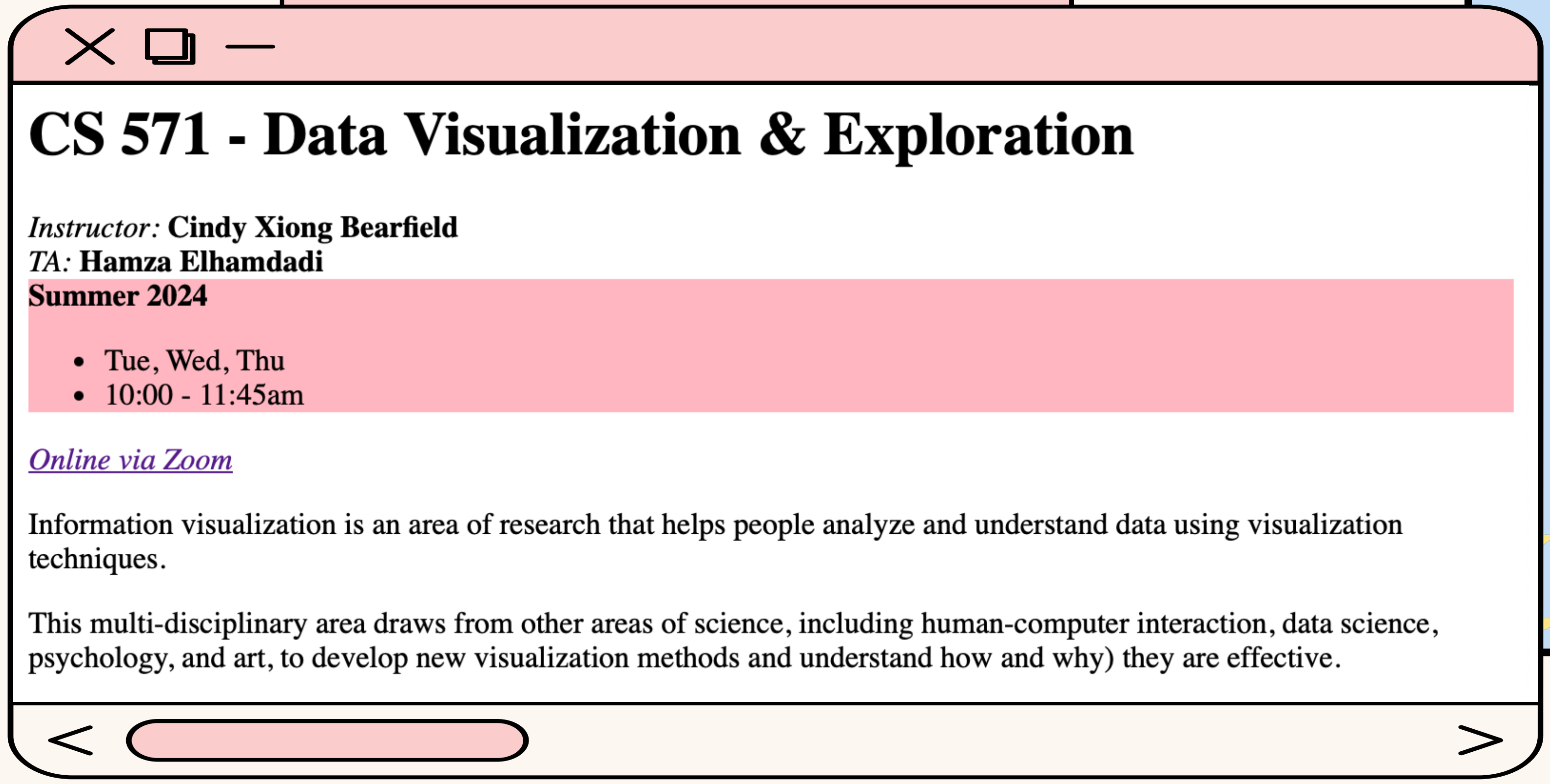

CS 571 - Data Visualization & Exploration

Instructor: **Cindy Xiong Bearfield**
TA: **Hamza Elhamdadi**
Summer 2024

- Tue, Wed, Thu
- 10:00 - 11:45am

Online via Zoom

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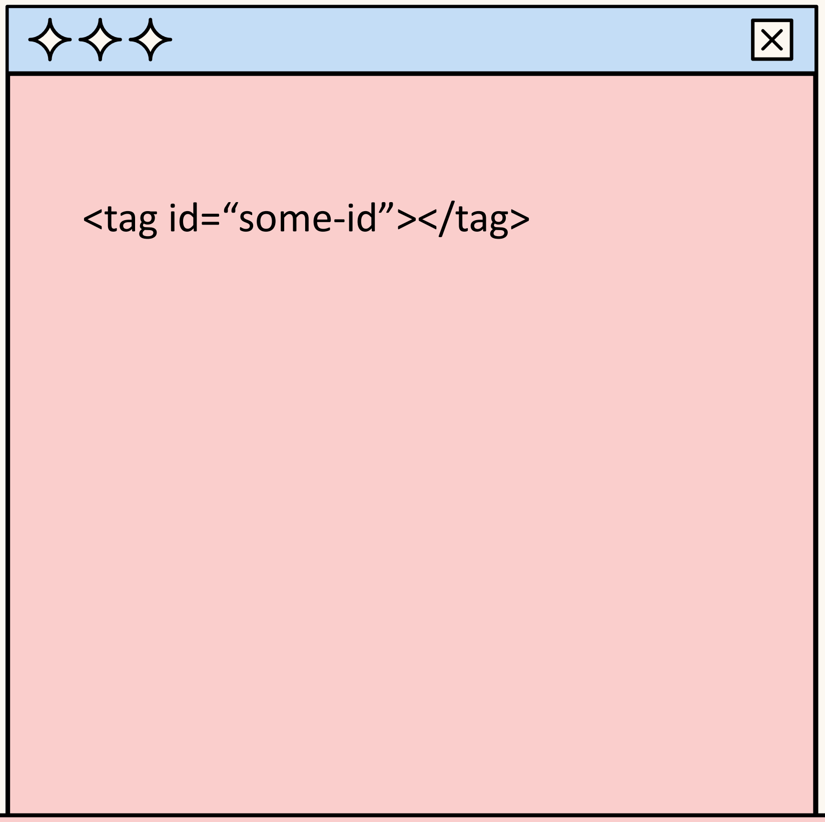
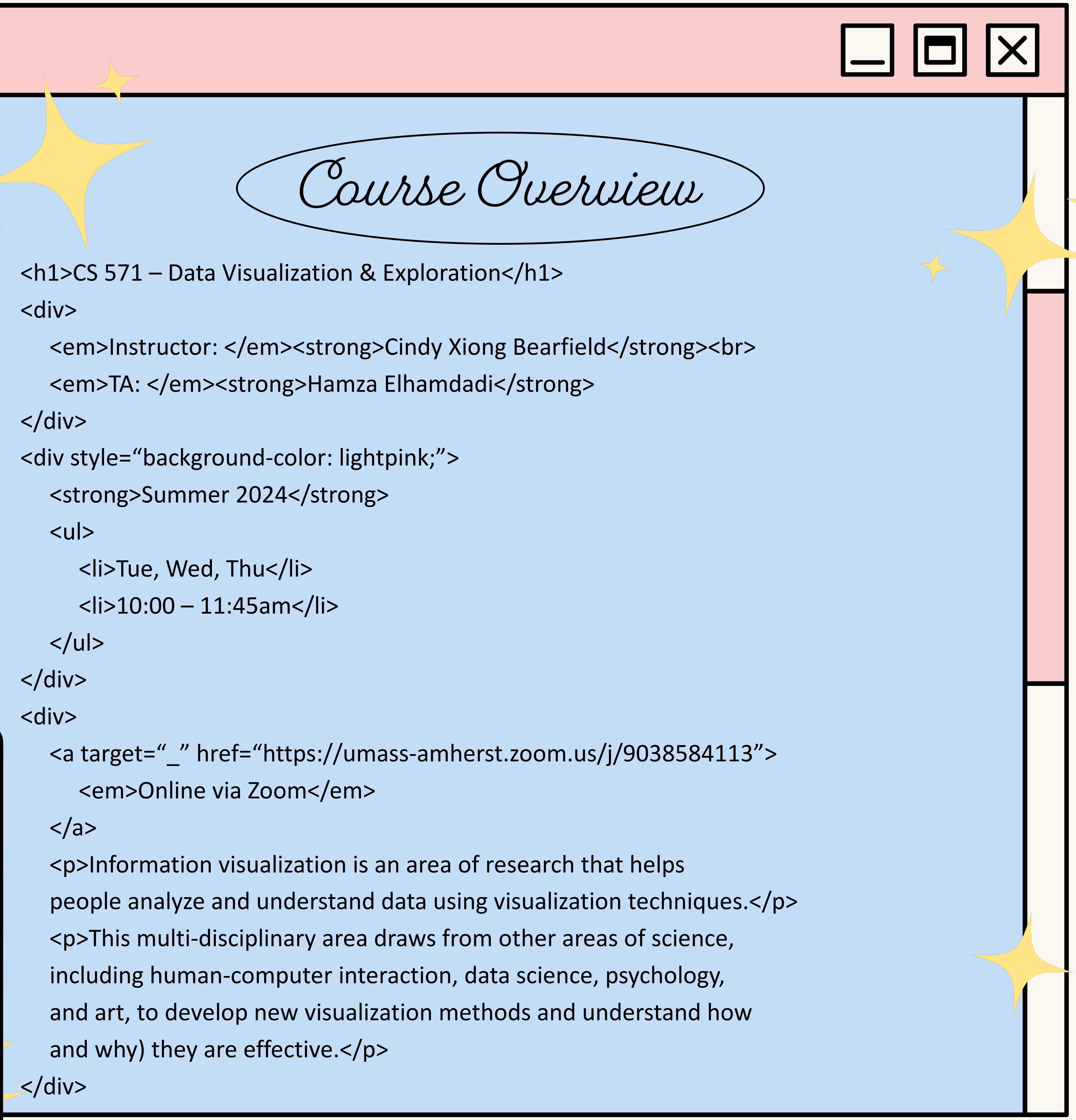


```
<tag id="some-id"></tag>
```



Course Overview

```
<h1>CS 571 – Data Visualization & Exploration</h1>
<div>
    <em>Instructor: </em><strong>Cindy Xiong Bearfield</strong><br>
    <em>TA: </em><strong>Hamza Elhamdadi</strong>
</div>
<div style="background-color: lightpink;">
    <strong>Summer 2024</strong>
    <ul>
        <li>Tue, Wed, Thu</li>
        <li>10:00 – 11:45am</li>
    </ul>
</div>
<div>
    <a target="_" href="https://umass-amherst.zoom.us/j/9038584113">
        <em>Online via Zoom</em>
    </a>
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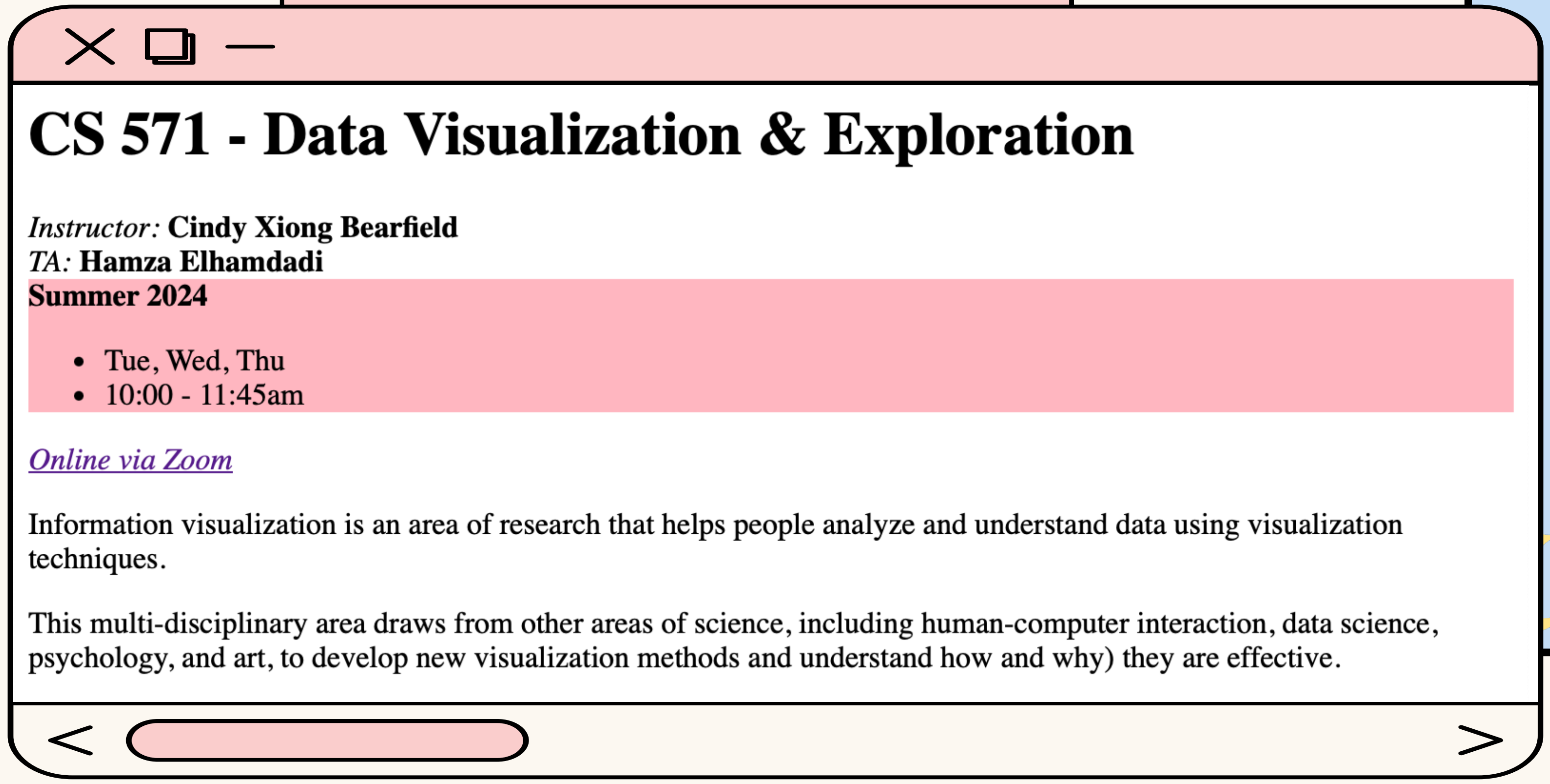
</div>
```



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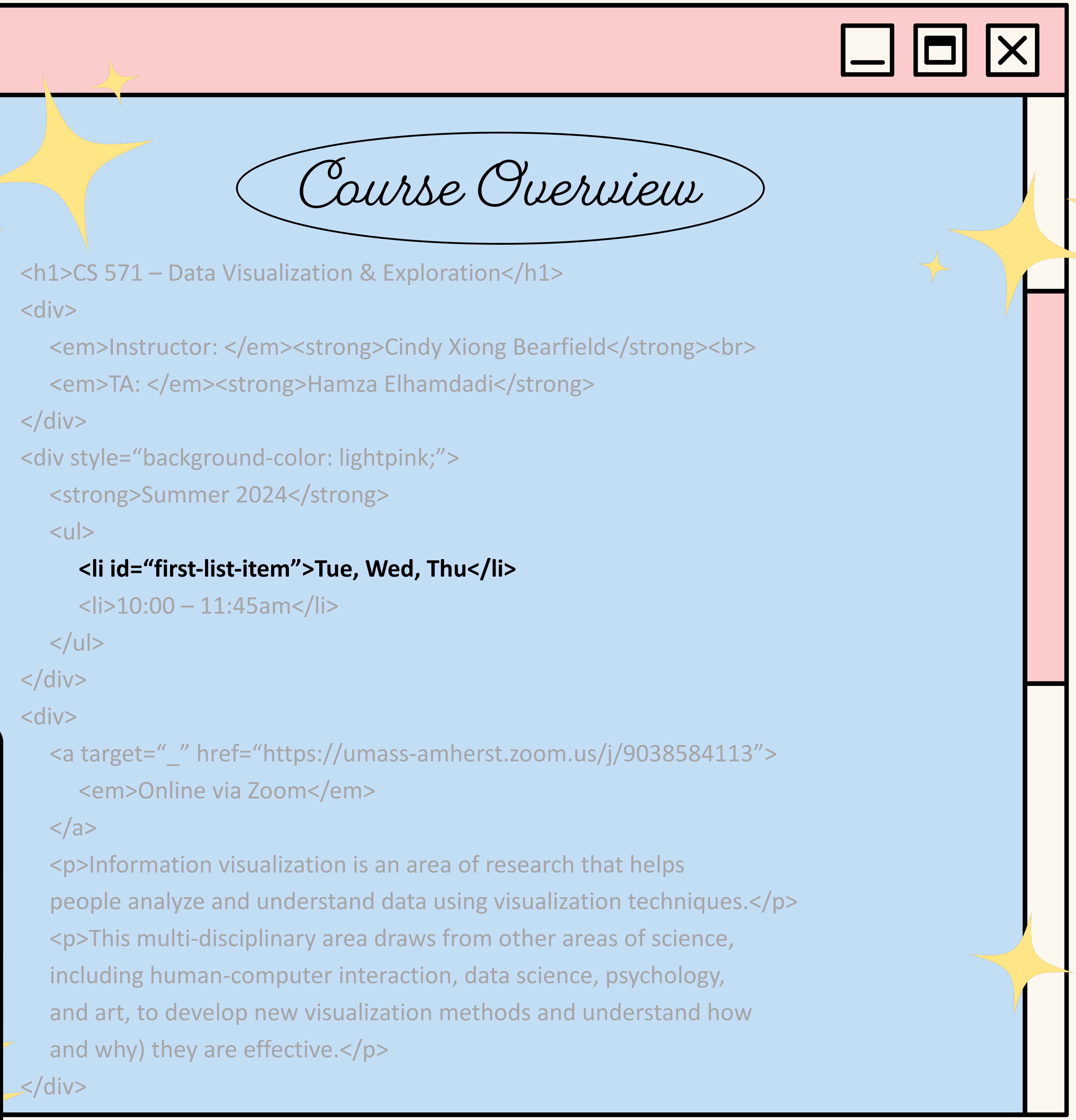
```
<tag id=“some-id”></tag>
```



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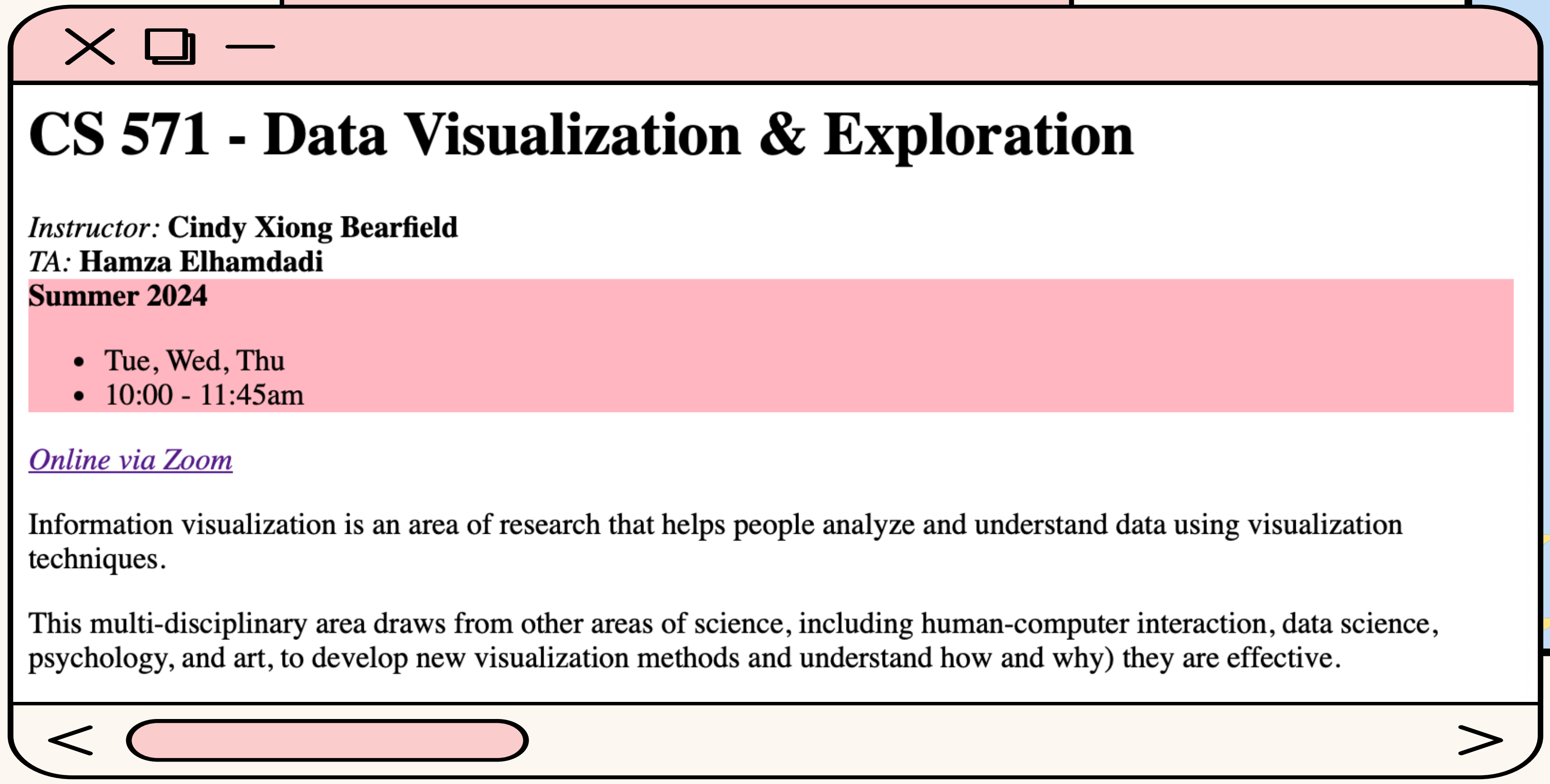

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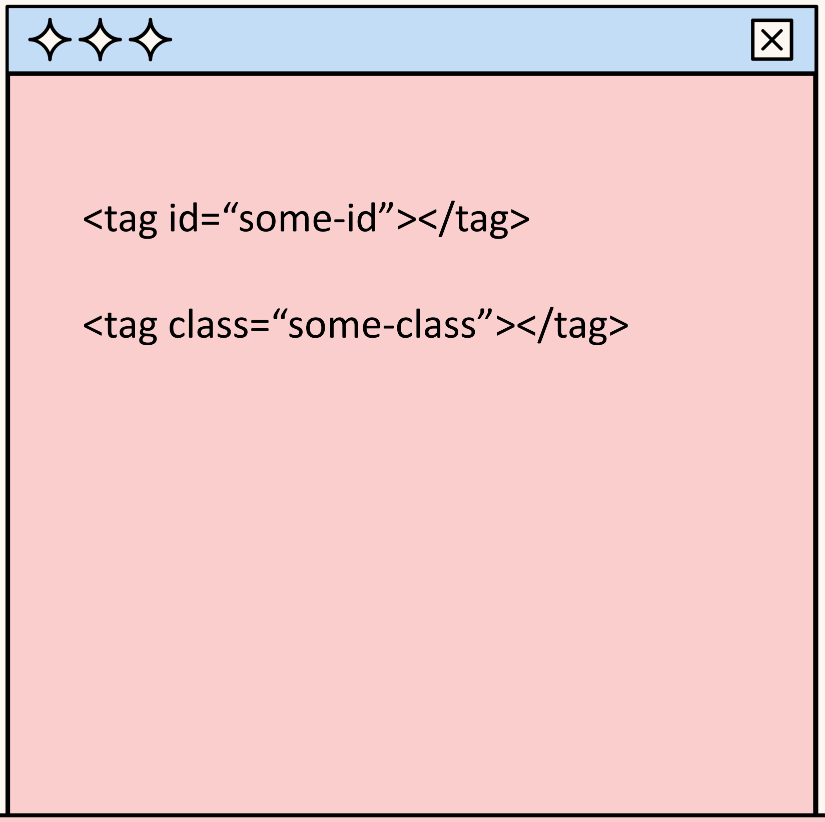
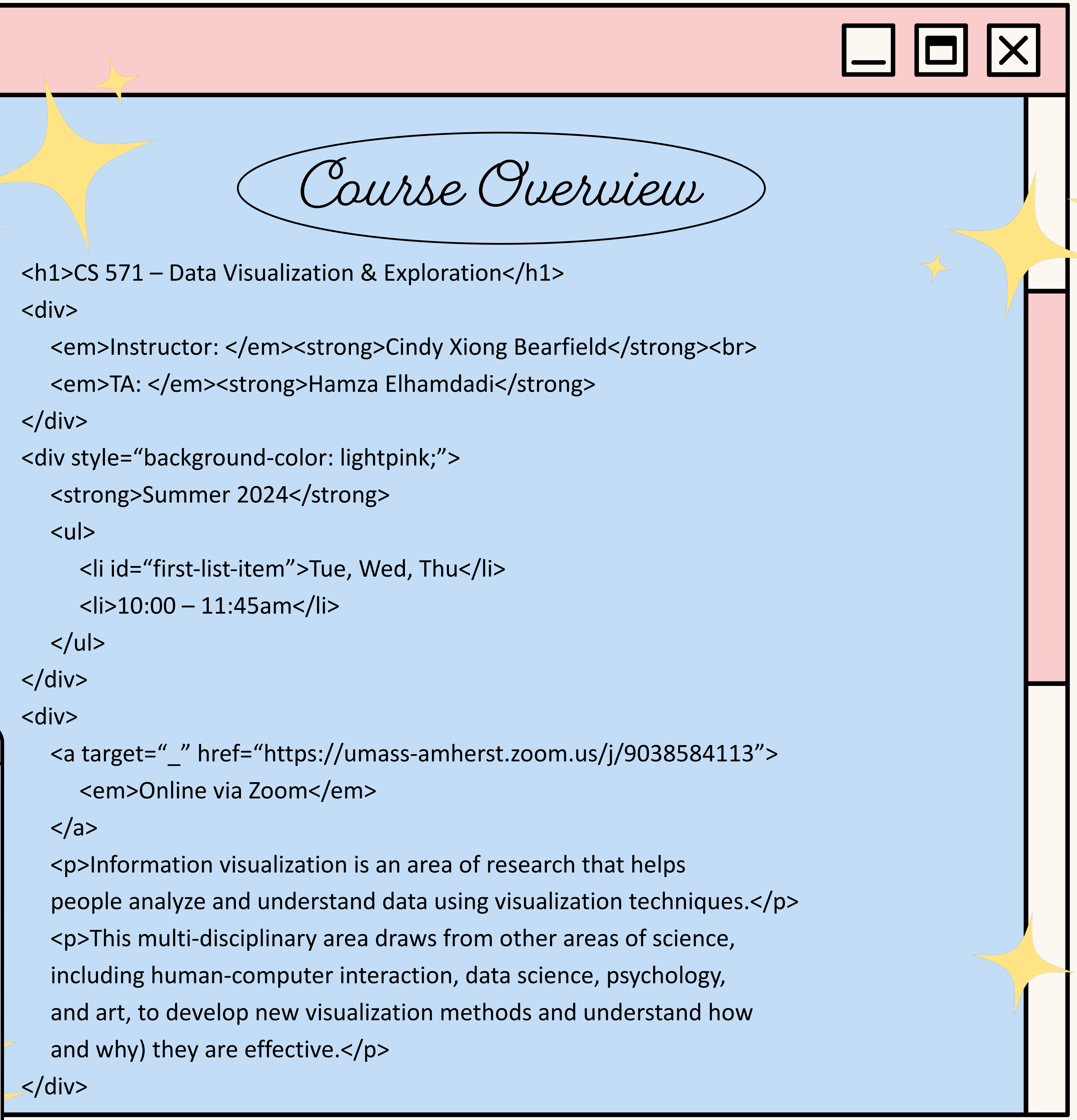


```
<tag id=“some-id”></tag>

<tag class=“some-class”></tag>
```



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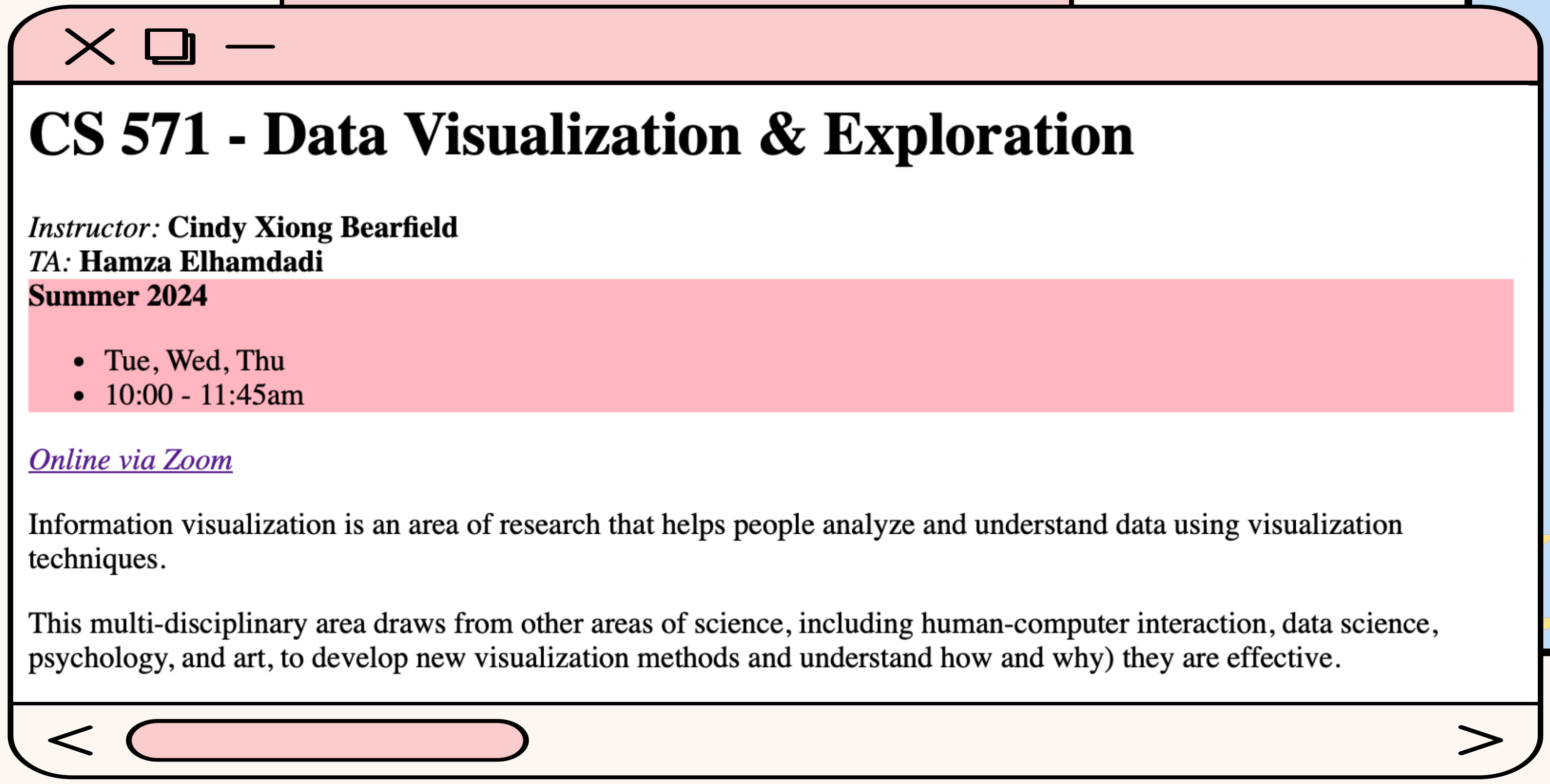

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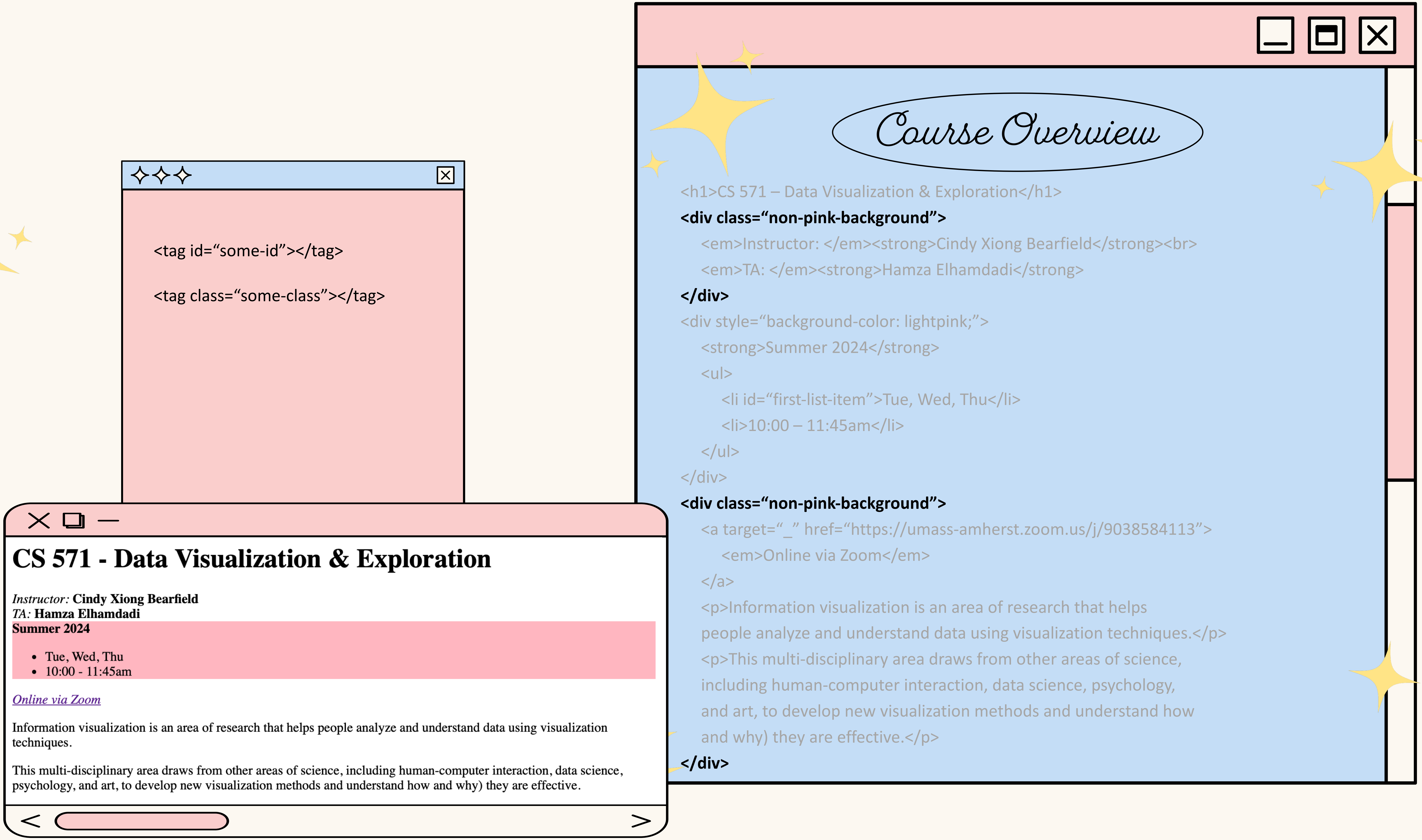

```
<tag id=“some-id”></tag>

<tag class=“some-class”></tag>
```

```
<h1>CS 571 – Data Visualization & Exploration</h1>
<div class=“non-pink-background”>
   <em>Instructor: </em><strong>Cindy Xiong Bearfield</strong><br>
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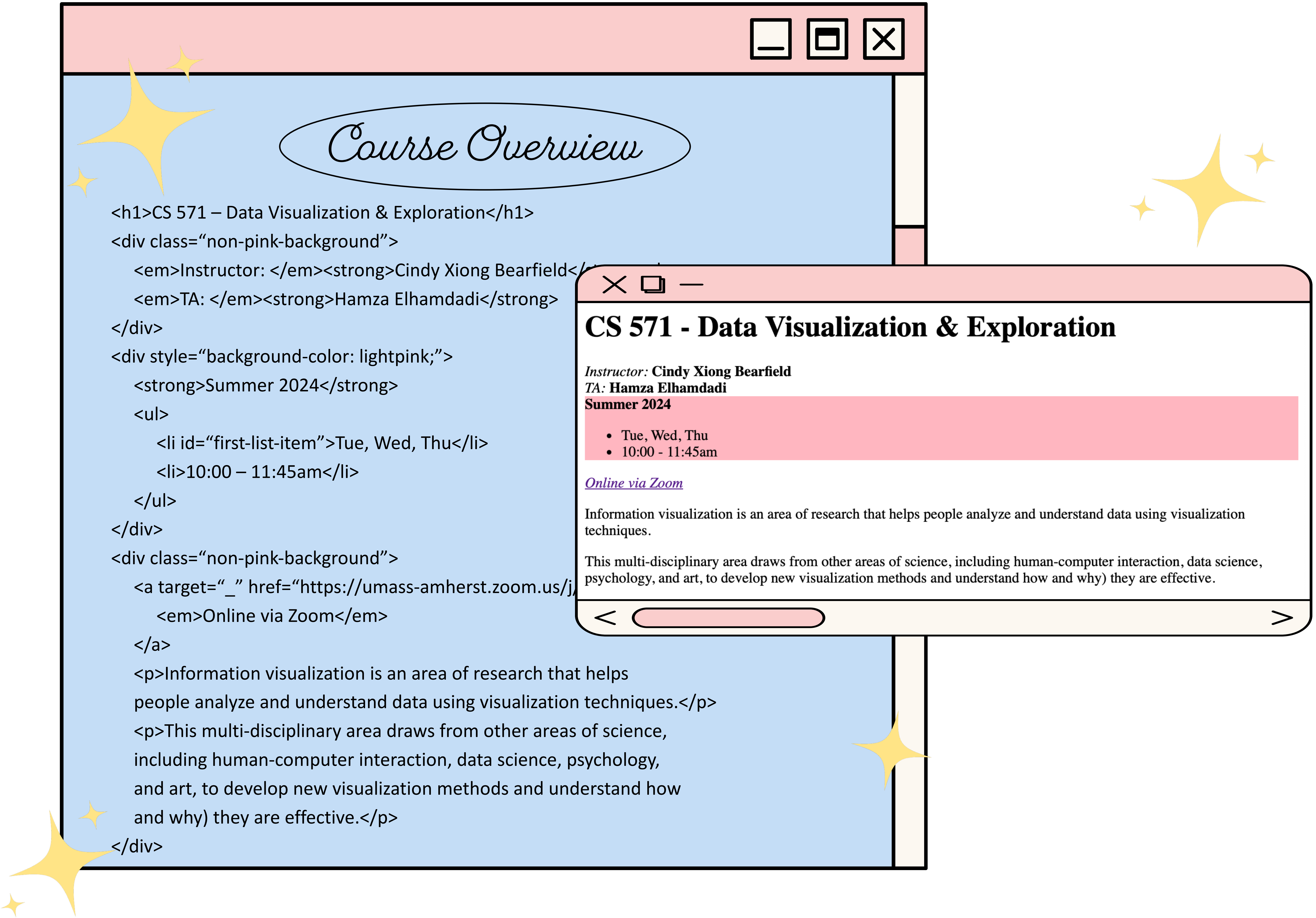
STYLING WITH CSS

- Define CSS rules for HTML tags
- Create and link external CSS files
- Use CSS rules to style classed objects



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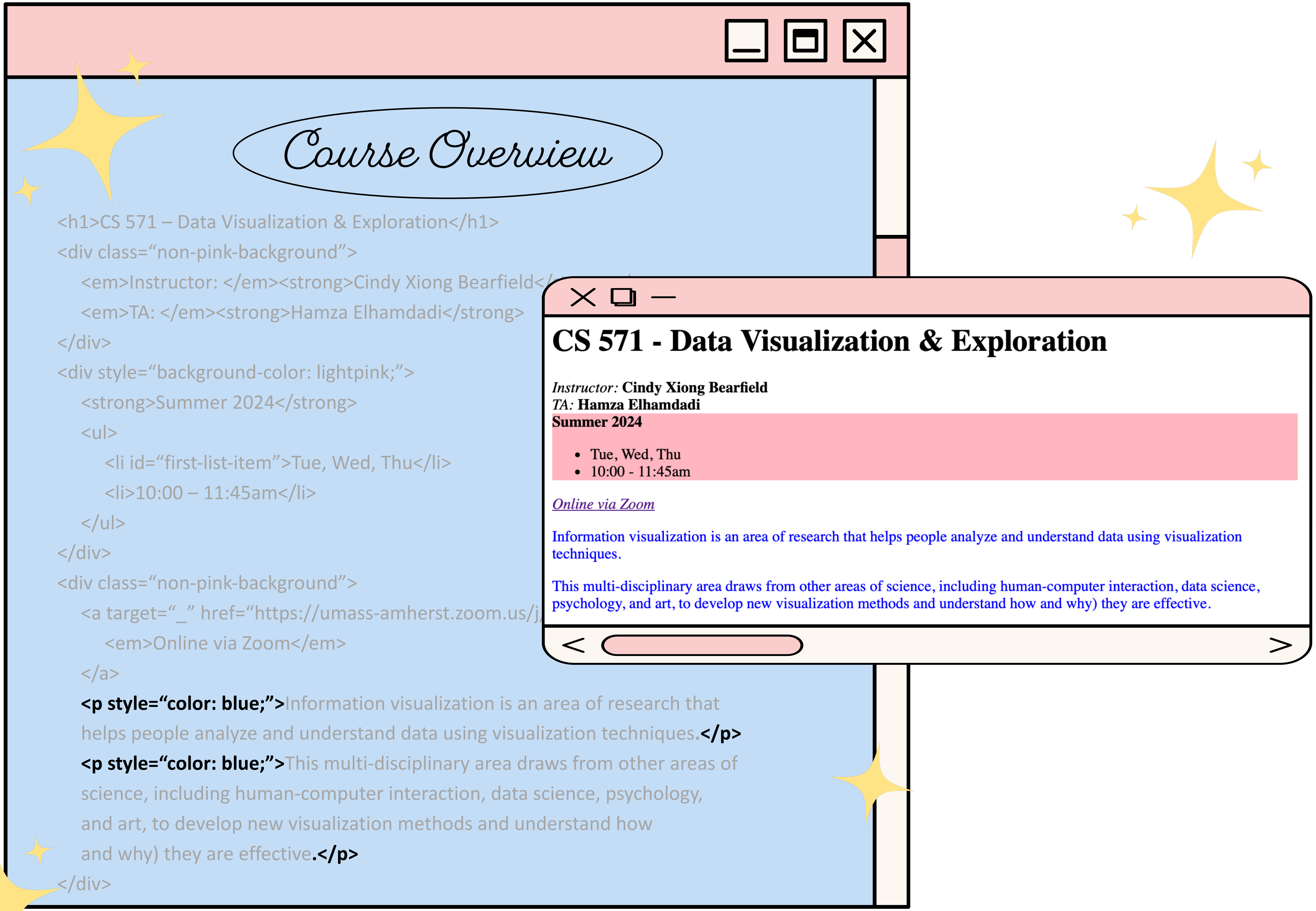

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</div>
<div class="non-pink-background">
  <a target="_" href="https://umass-amherst.zoom.us/j
    <em>Online via Zoom</em>
  </a>
  <p style="color: blue;">Information visualization is an area of research that
  helps people analyze and understand data using visualization techniques.</p>
  <p style="color: blue;">This multi-disciplinary area draws from other areas of
  science, including human-computer interaction, data science, psychology,
  and art, to develop new visualization methods and understand how
  and why) they are effective.</p>
</div>
```

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CSS Selectors

```
<p style="color: blue;"></p>
```

```
<style>

    p {
        color: blue;
    }

</style>
```

CSS Selectors

```
<p style=“color: blue;”></p>
```

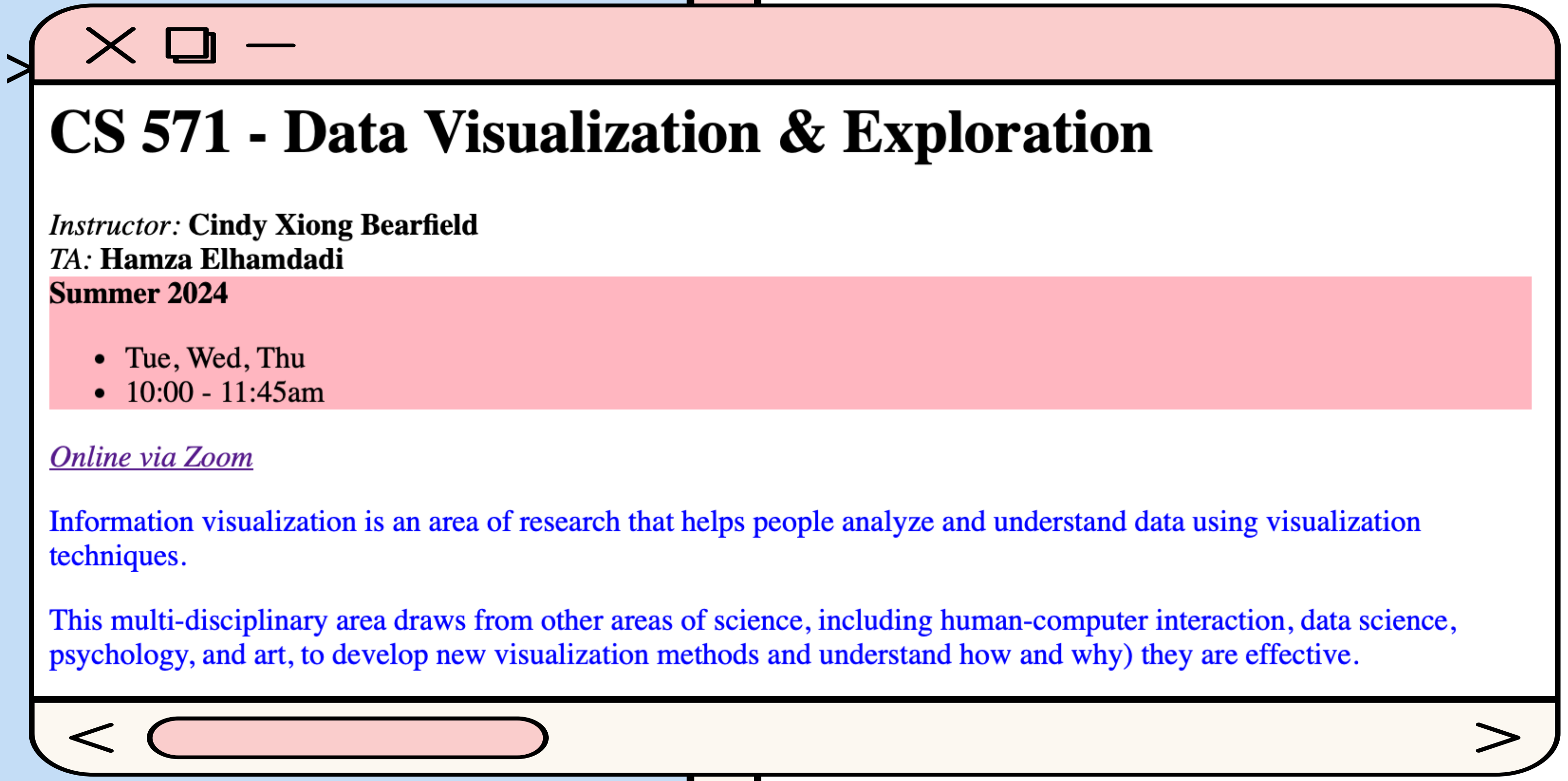
CSS Selectors

```
<p style="color: blue;">
```

```
<style>

    p {
        color: blue;
    }

</style>
```



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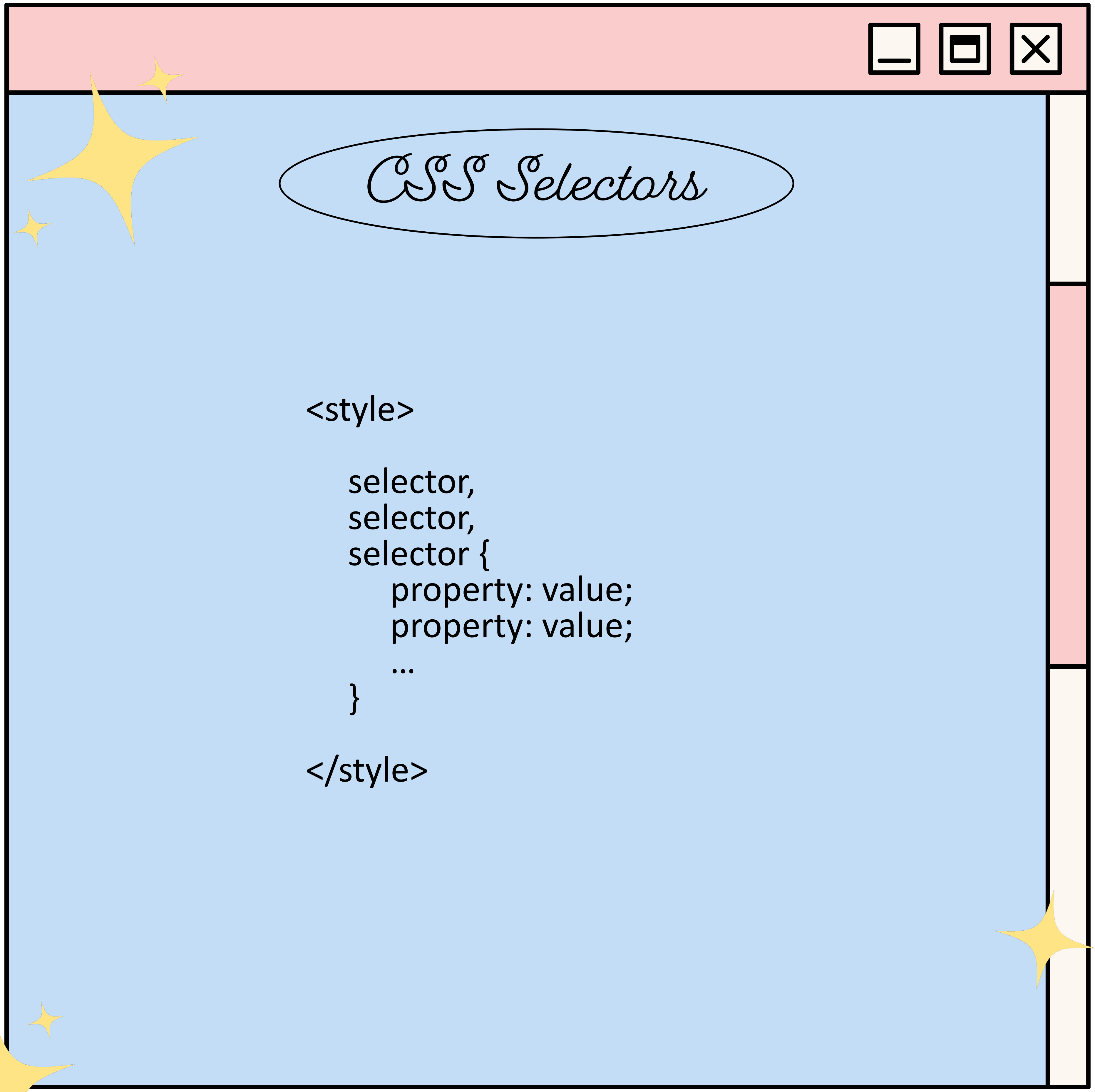
CSS Selectors

```
<style>

    selector {
        property: value;
        property: value;
        ...
    }

</style>
```



CSS Selectors

```
<style>

    selector,
    selector,
    selector {
        property: value;
        property: value;
        …
    }

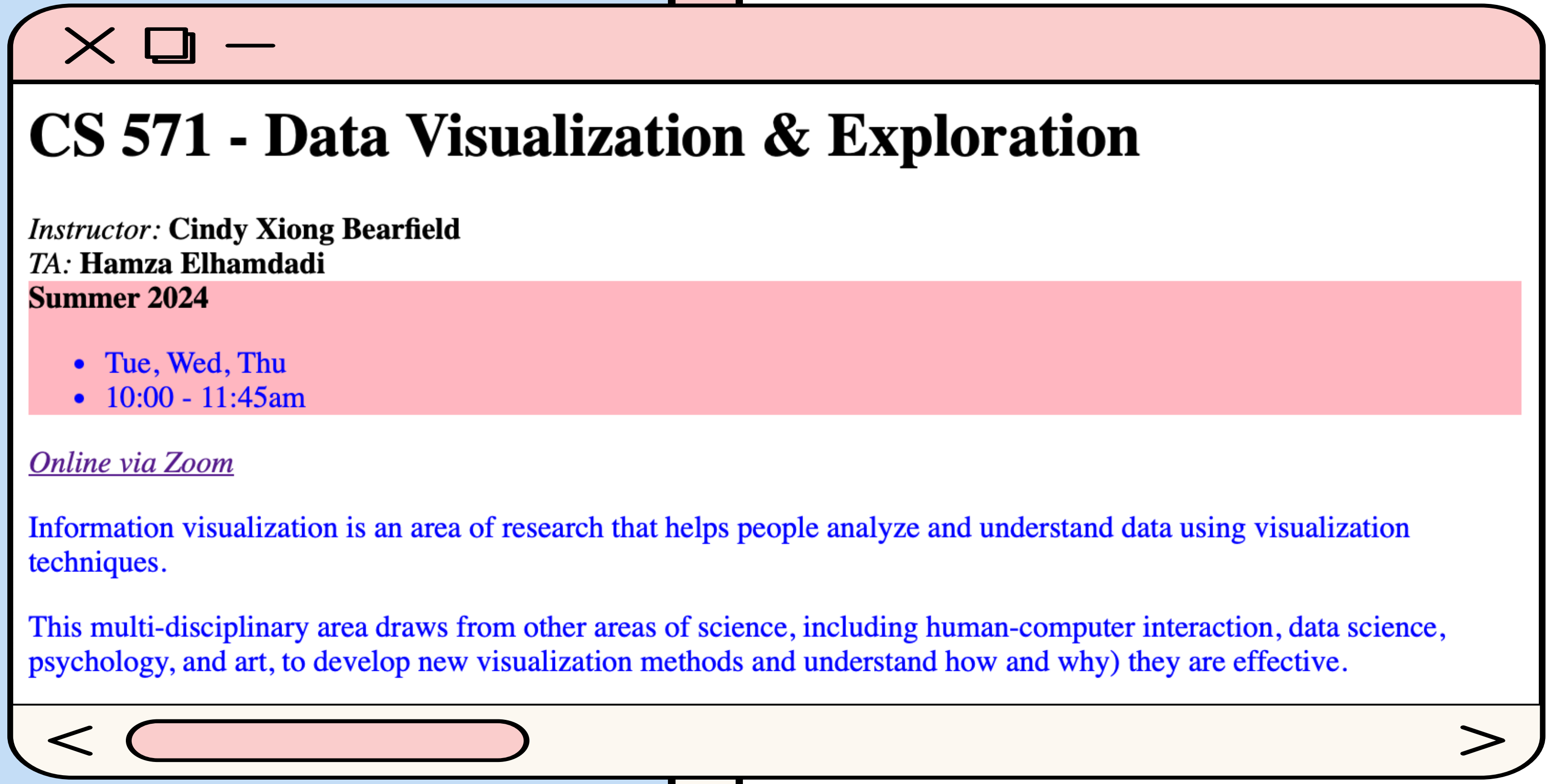
</style>
```

CSS Selectors

```
<style>

    p, li {
        color: blue;
    }

</style>
```



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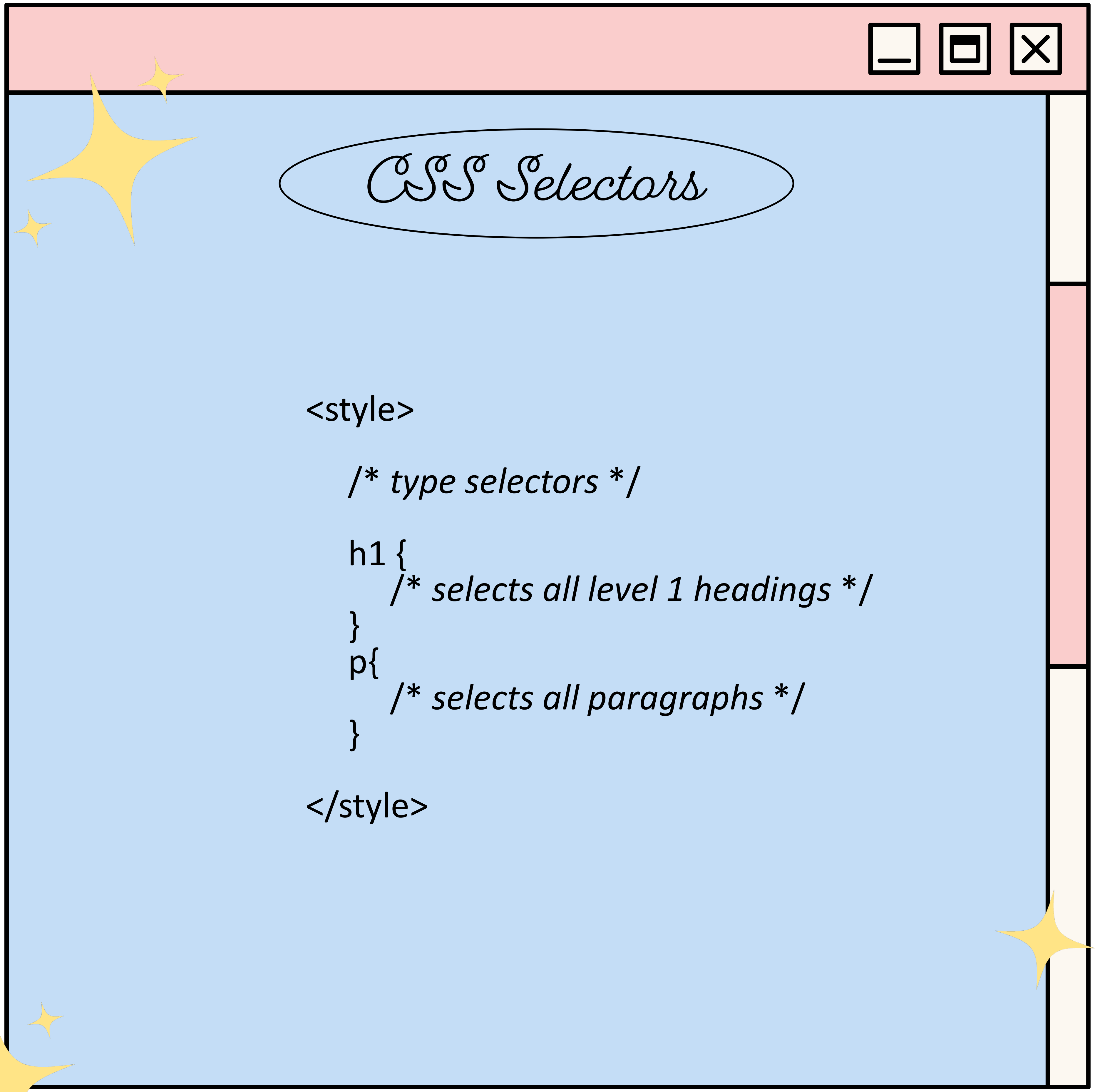


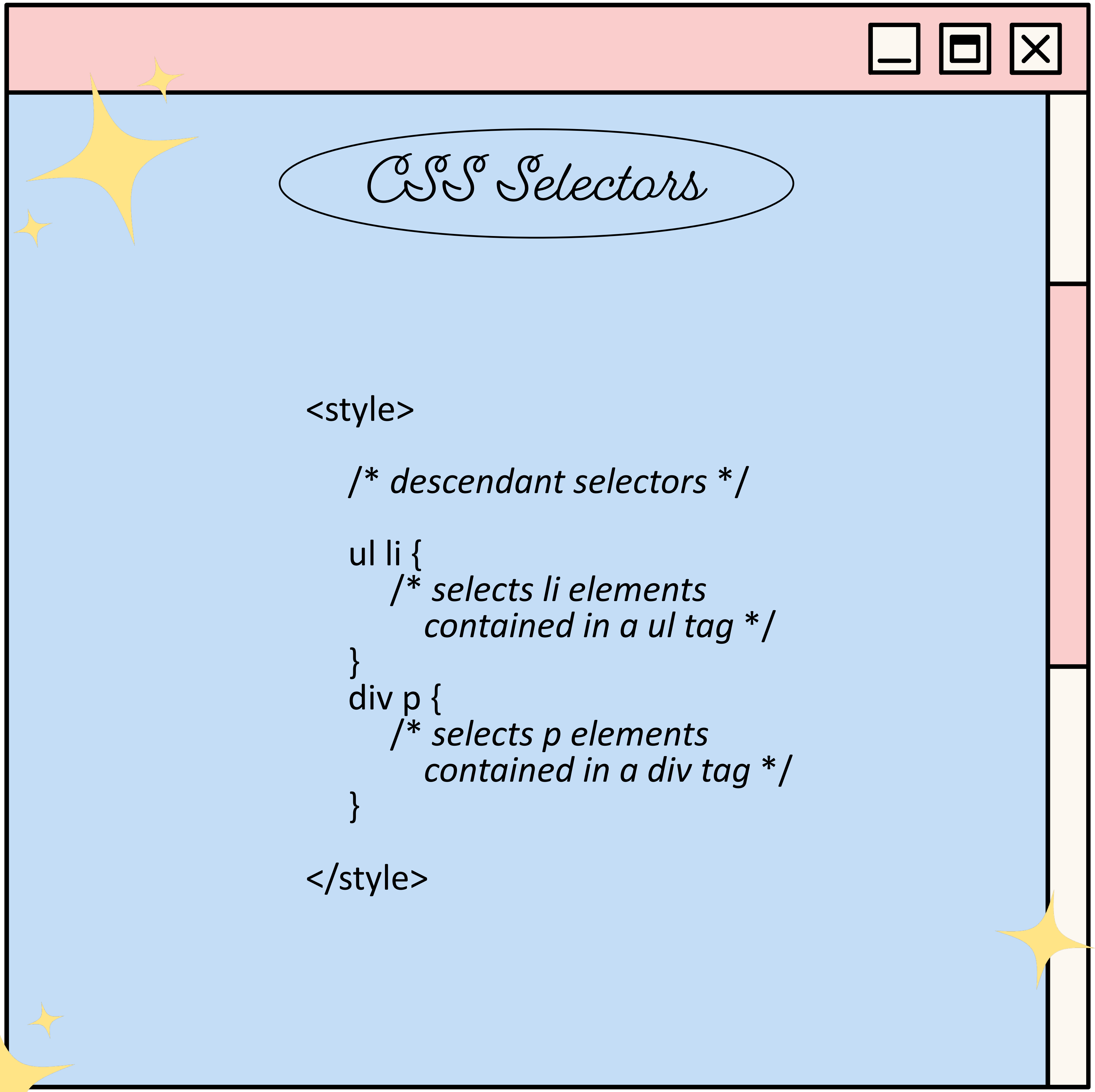
CSS Selectors

```
<style>

    /* type selectors */

    h1 {
        /* selects all level 1 headings */
    }
    p{
        /* selects all paragraphs */
    }

</style>
```



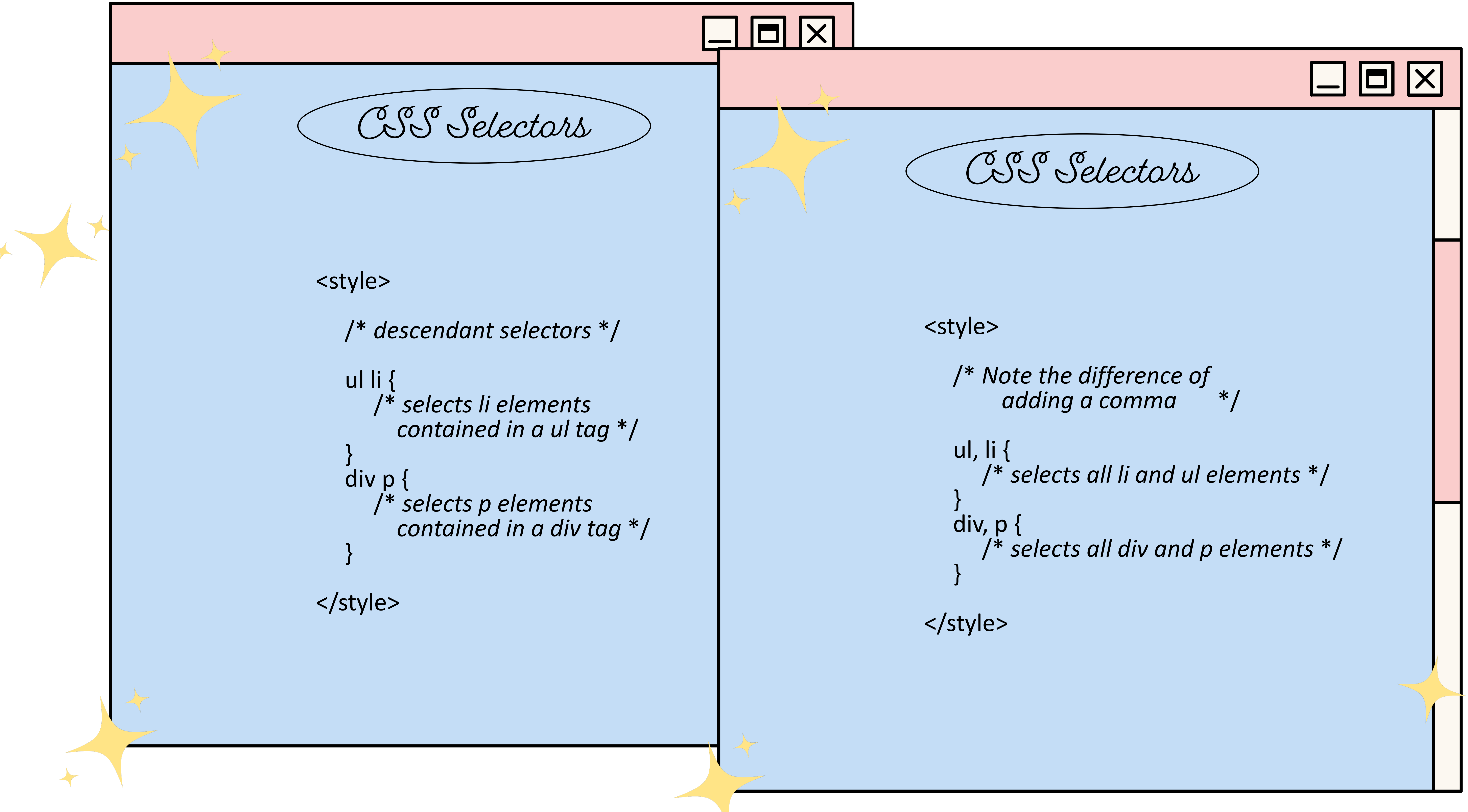
CSS Selectors

```
<style>

    /* descendant selectors */

    ul li {
        /* selects li elements
           contained in a ul tag */
    }
    div p {
        /* selects p elements
           contained in a div tag */
    }

</style>
```



CSS Selectors

```
<style>

    /* descendant selectors */

    ul li {
        /* selects li elements
           contained in a ul tag */
    }
    div p {
        /* selects p elements
           contained in a div tag */
    }

</style>
```

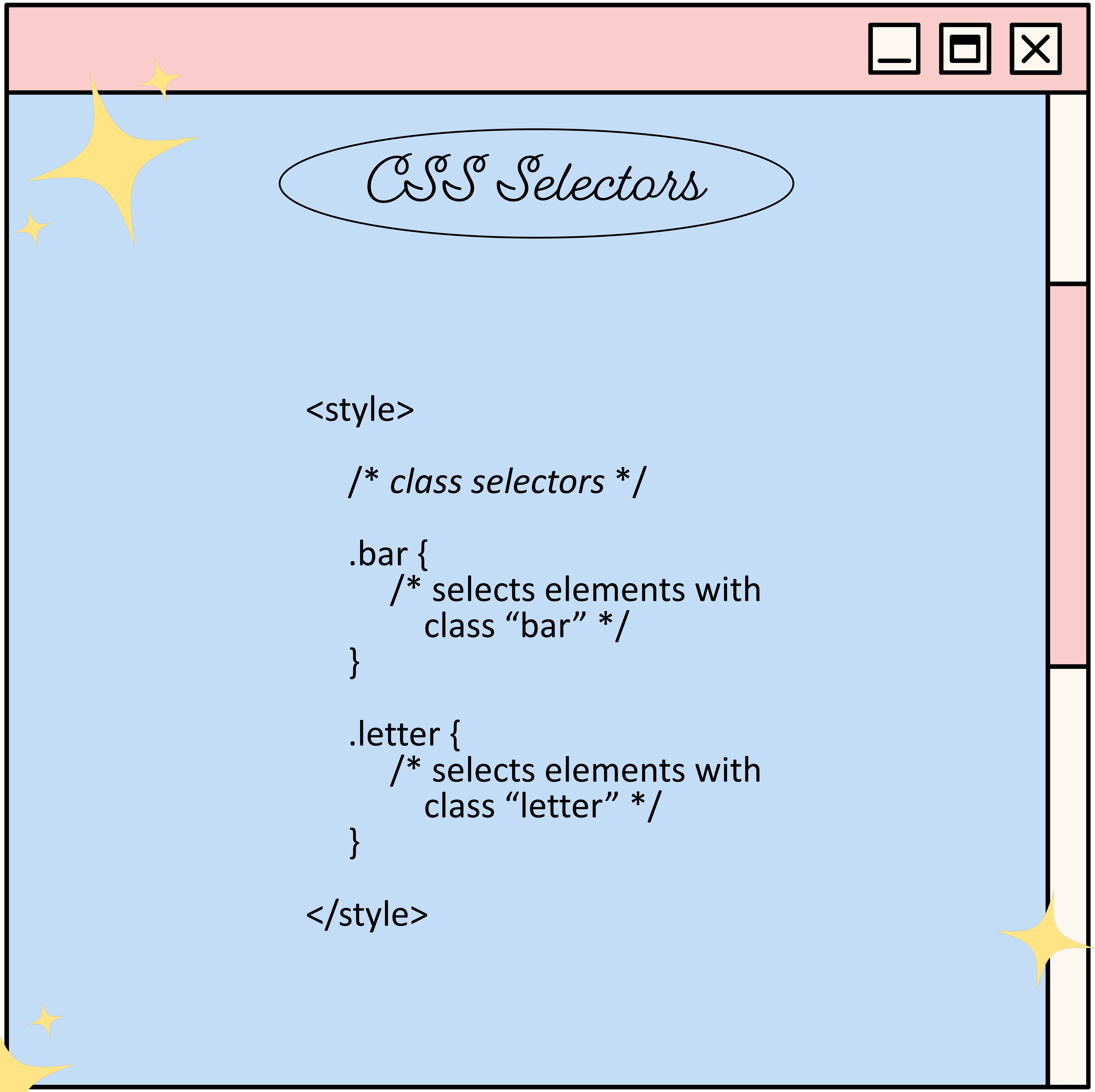
CSS Selectors

```
<style>

    /* Note the difference of
          adding a comma       */

    ul, li {
        /* selects all li and ul elements */
    }
    div, p {
        /* selects all div and p elements */
    }

</style>
```



CSS Selectors

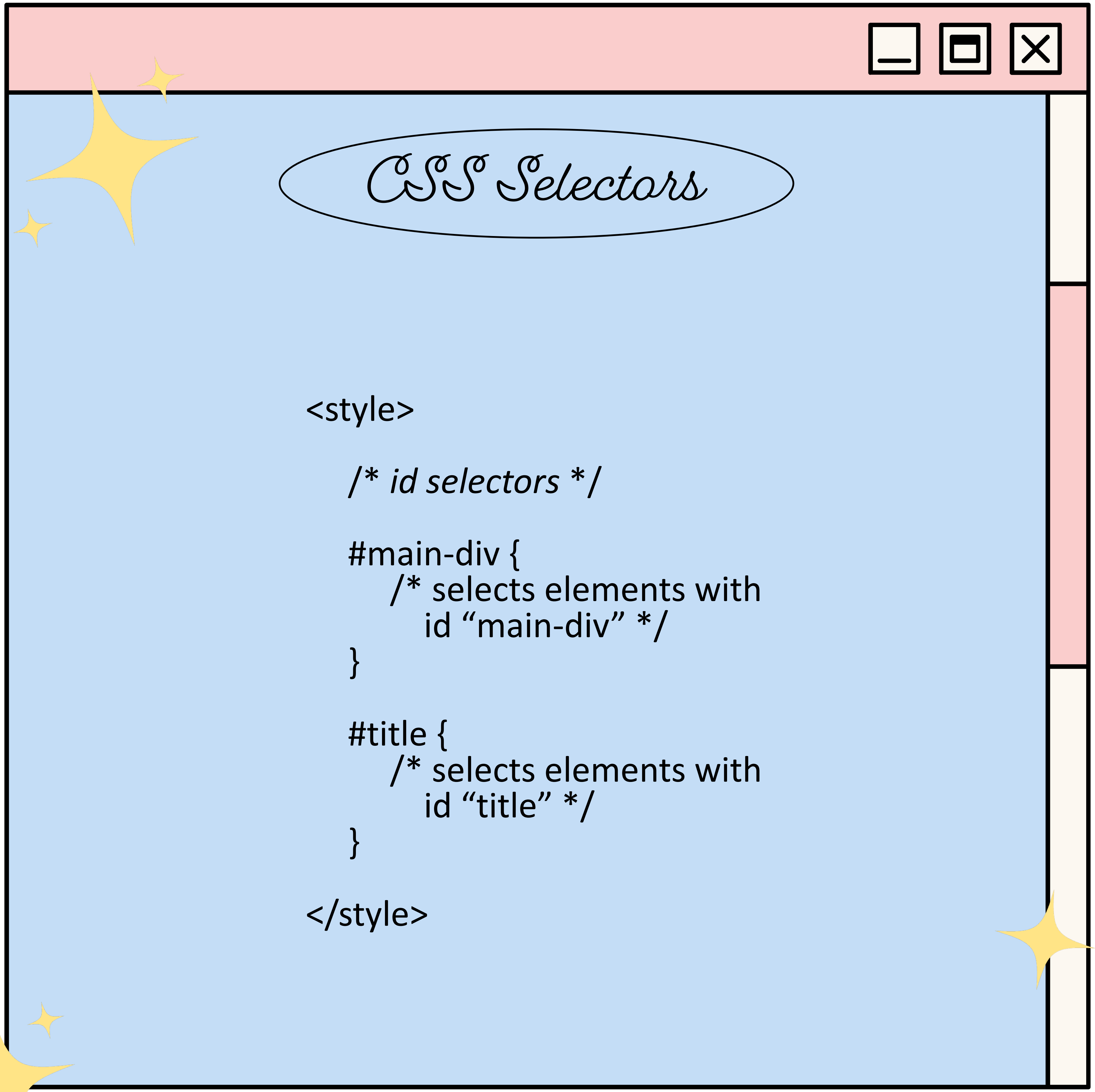
```
<style>

    /* class selectors */

    .bar {
        /* selects elements with
           class “bar” */
    }

    .letter {
        /* selects elements with
           class “letter” */
    }

</style>
```



CSS Selectors

```
<style>

    /* id selectors */

    #main-div {
        /* selects elements with
           id “main-div” */
    }

    #title {
        /* selects elements with
           id “title” */
    }

</style>
```

External CSS

```
<link rel=“stylesheet” href=“style.css”>
```

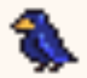
SVG BASICS WITH HTML

Understand the SVG HTML structure

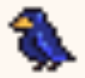
Create SVG shapes and text

Group and transform SVG objects

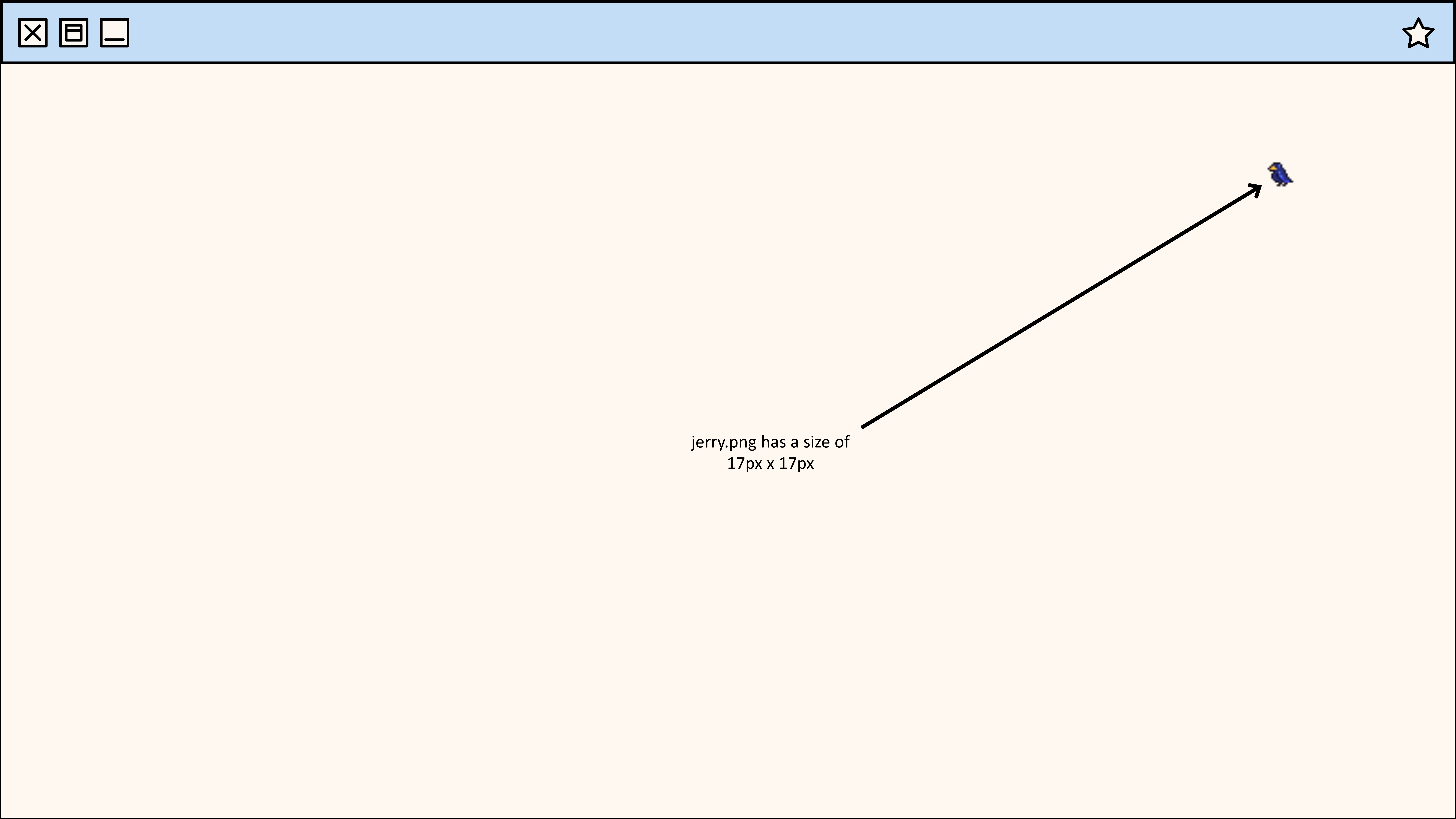
Here’s a little guy



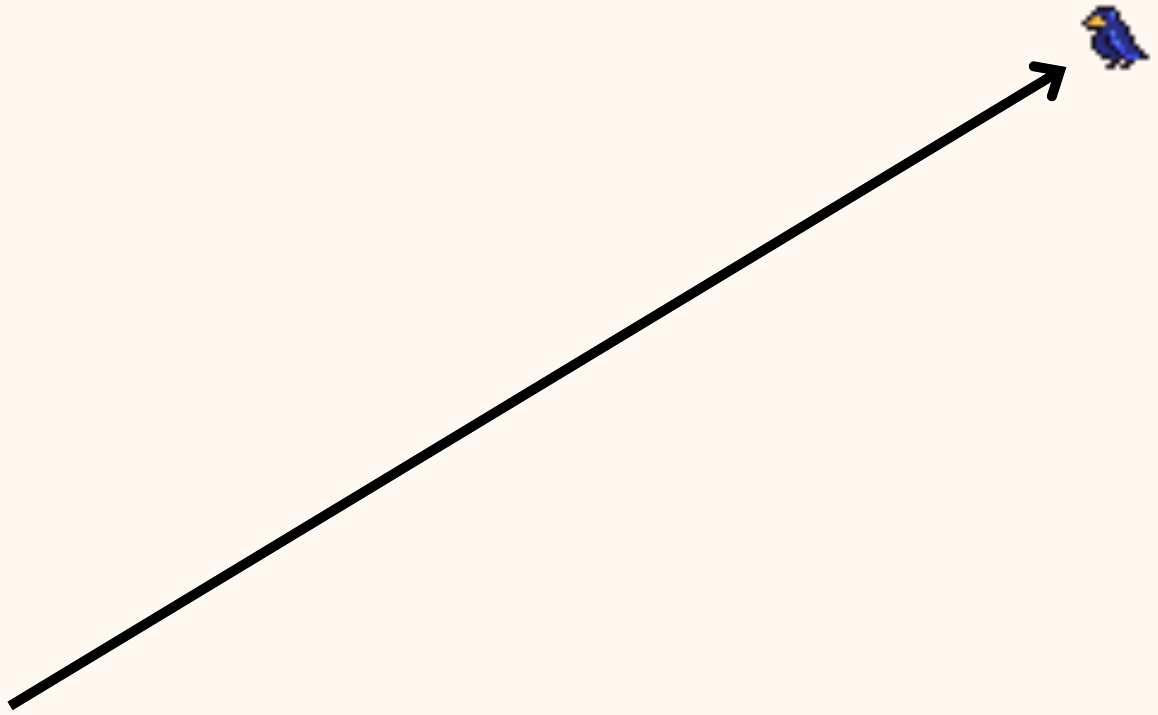
His name is Jerry



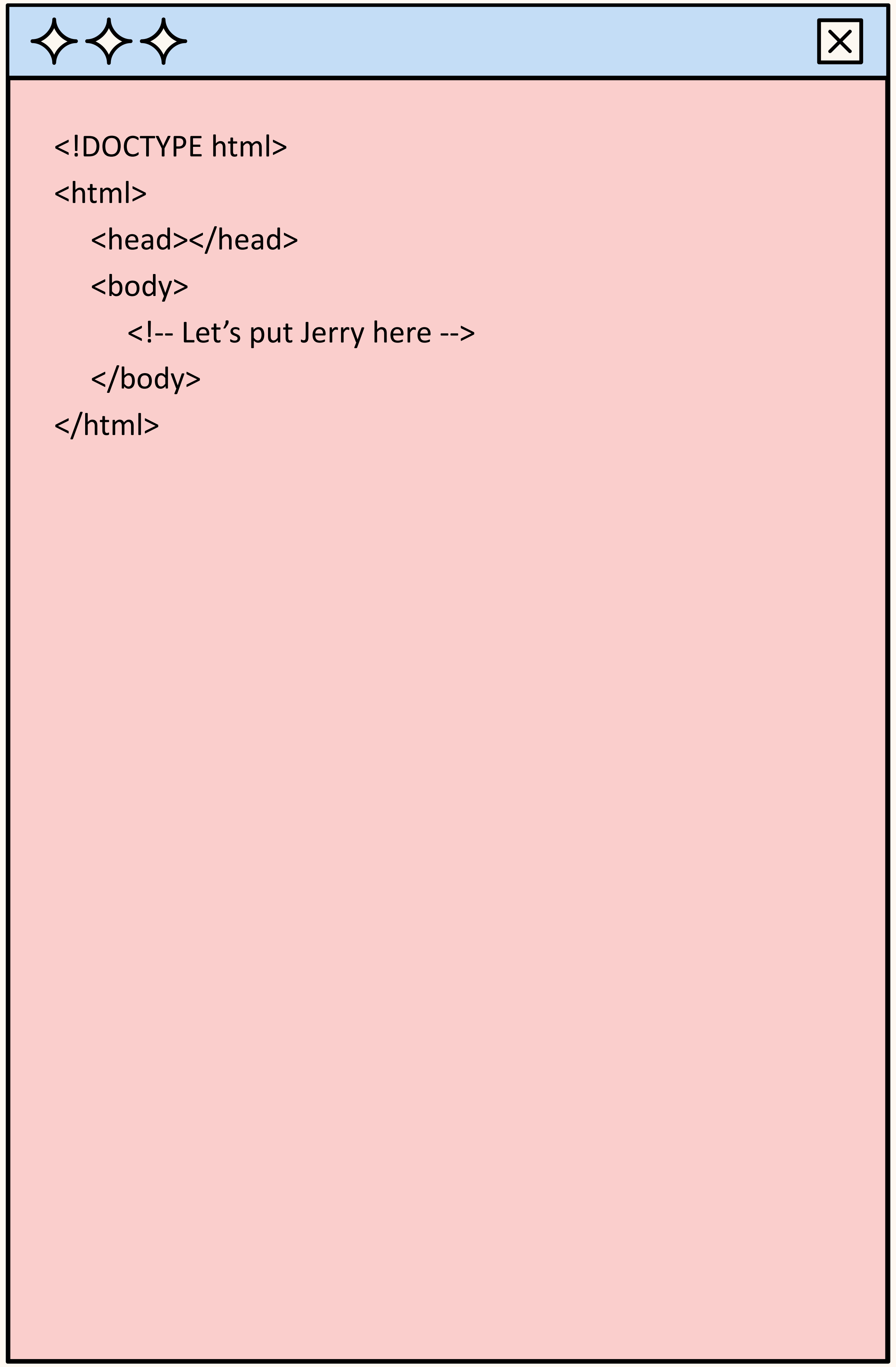
Jerry is stored
in a file called
“jerry.png”



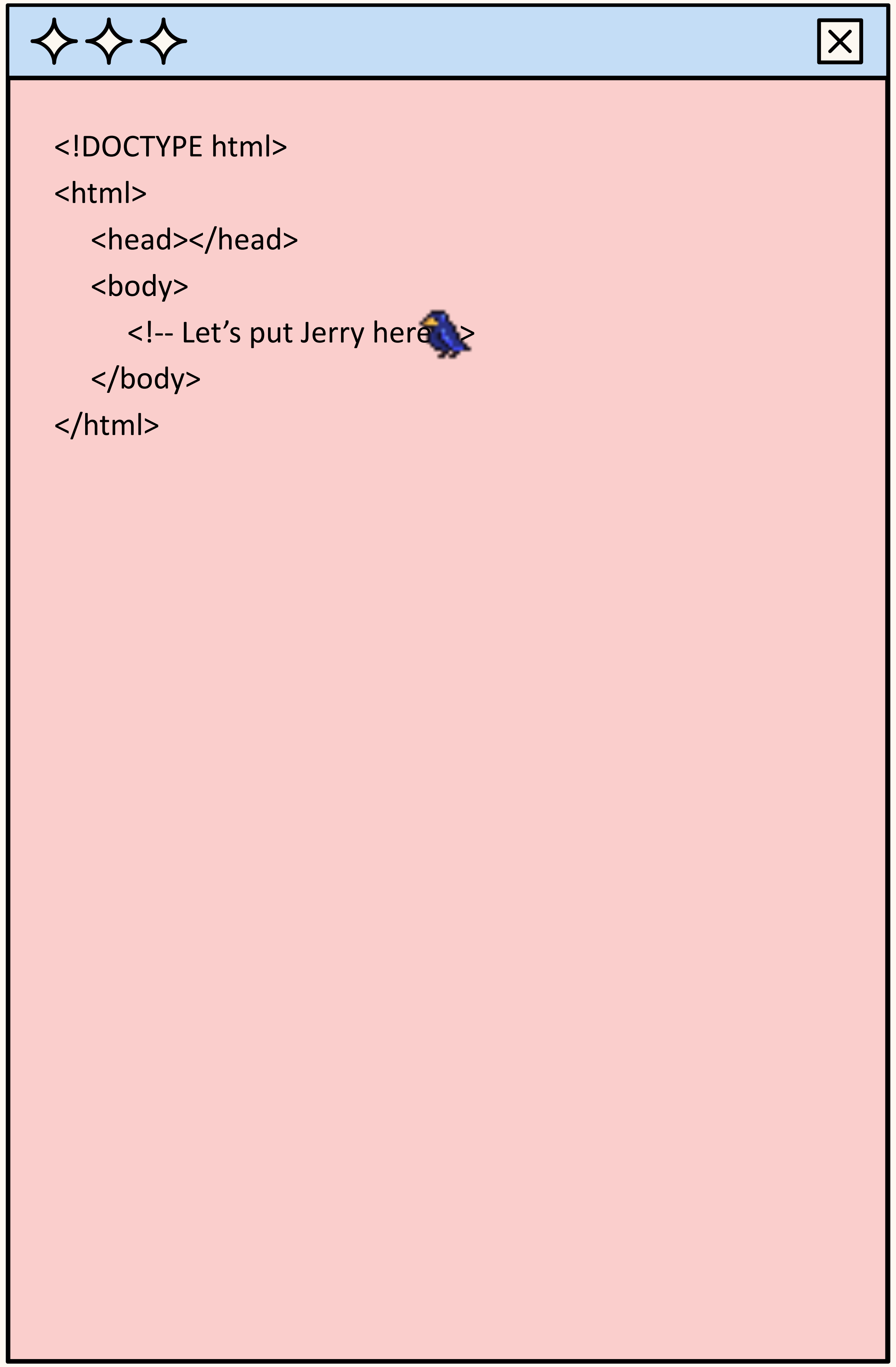
jerry.png has a size of
17px x 17px



Let’s add Jerry to a webpage!



```
<!DOCTYPE html>
<html>
    <head></head>
    <body>
        <!-- Let’s put Jerry here -->
    </body>
</html>
```



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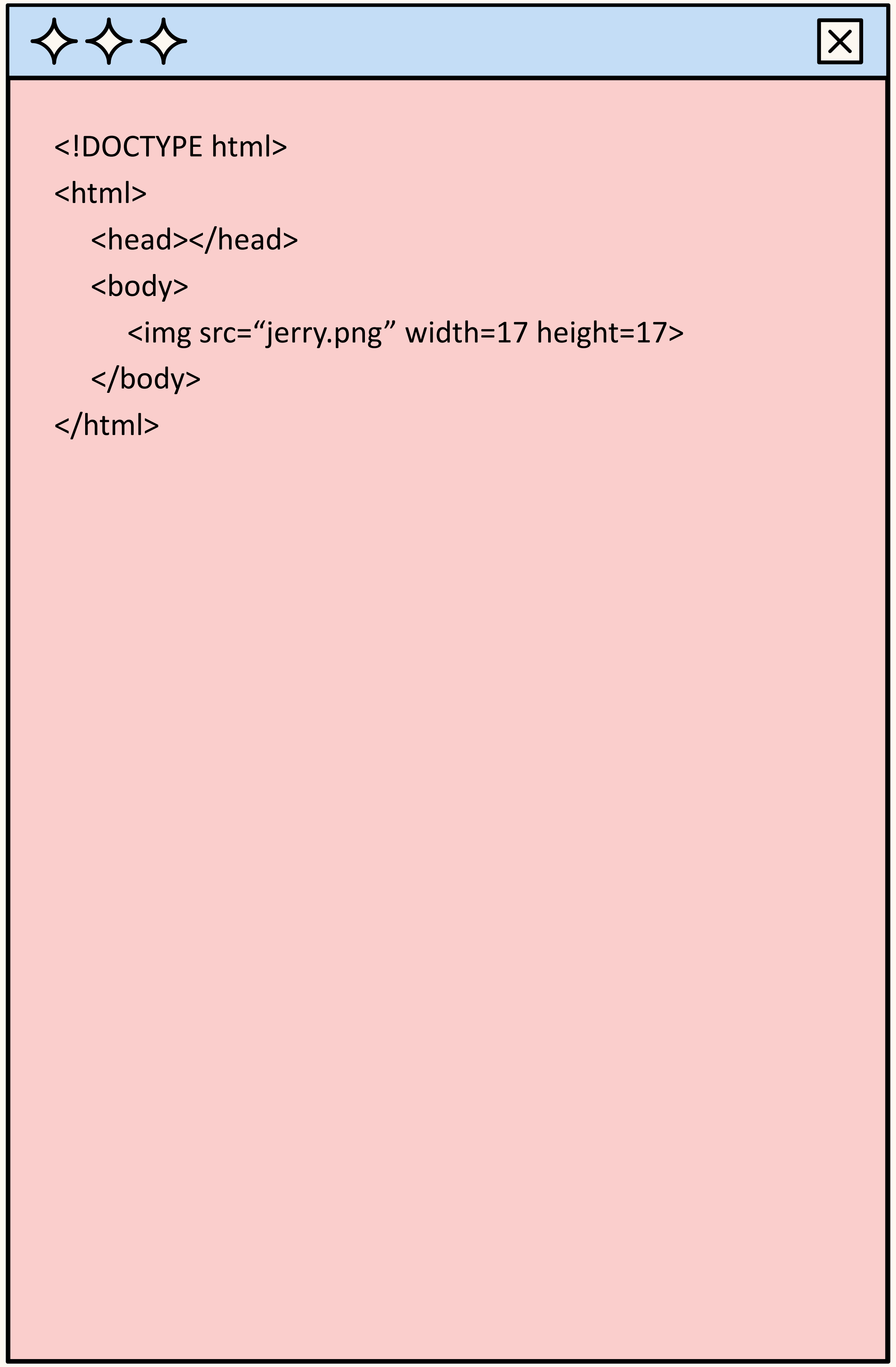
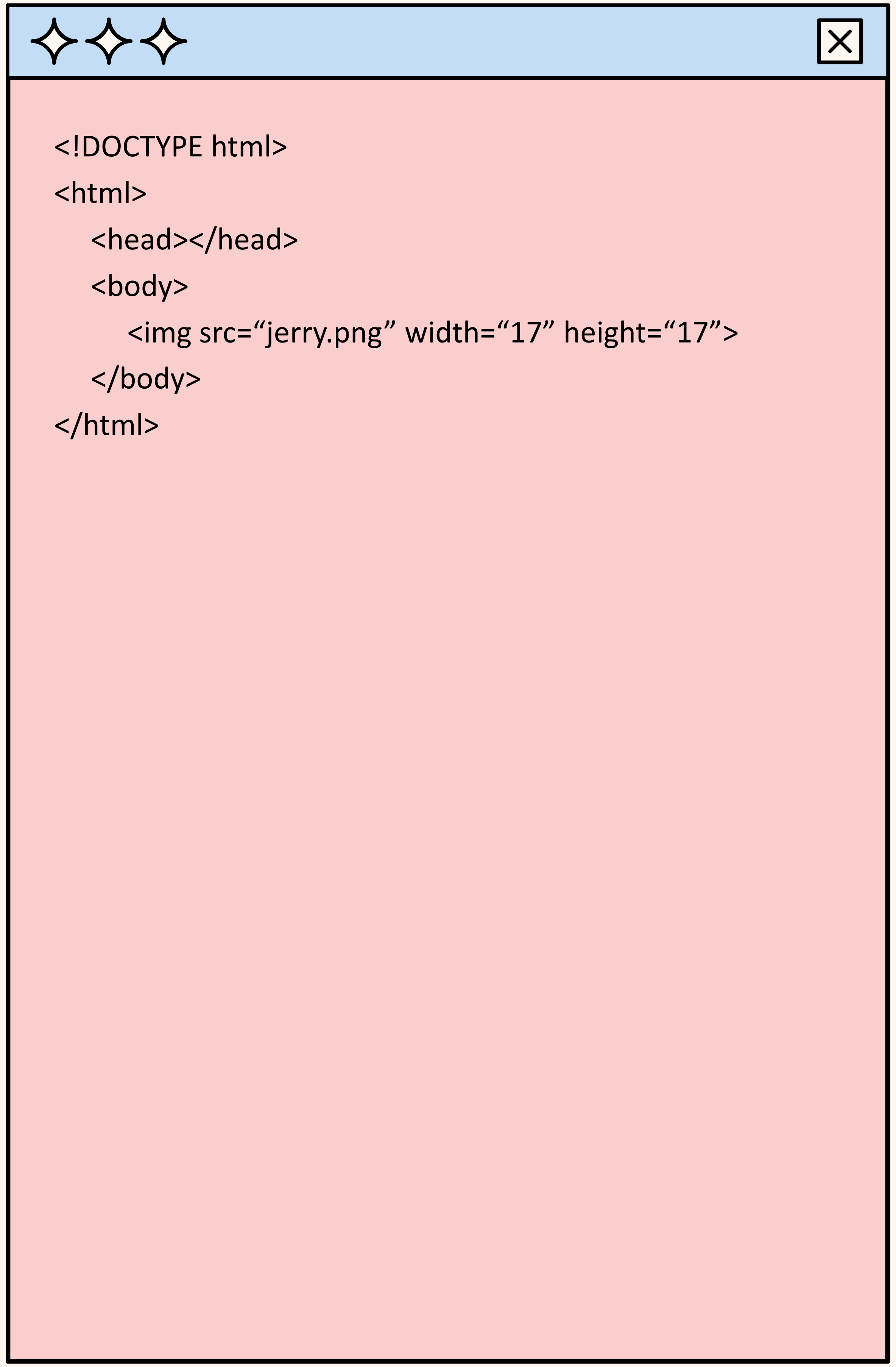
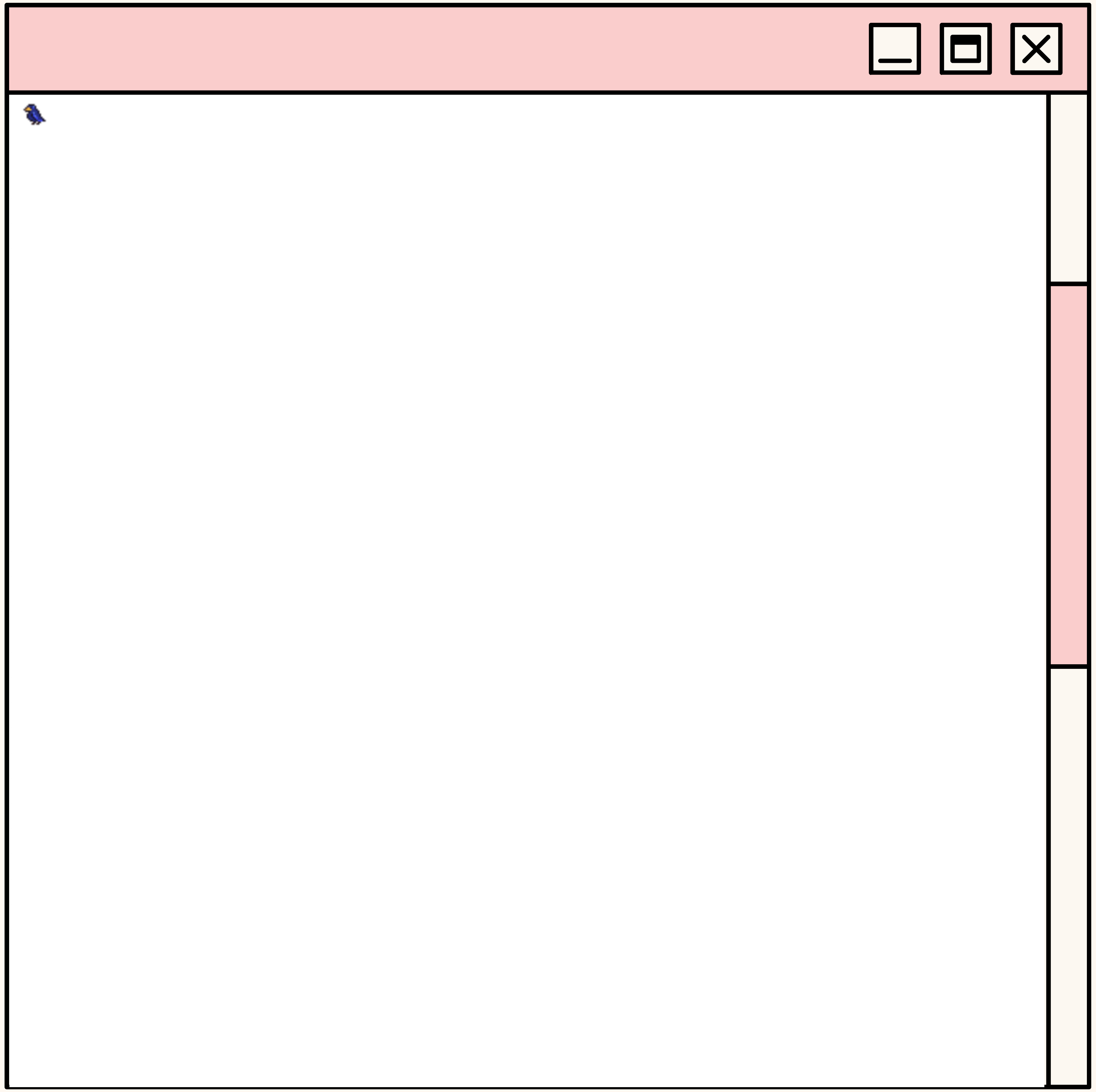
<!DOCTYPE html>
<html>
    <head></head>
    <body>
        <!-- Let’s put Jerry here >
    </body>
</html>
```

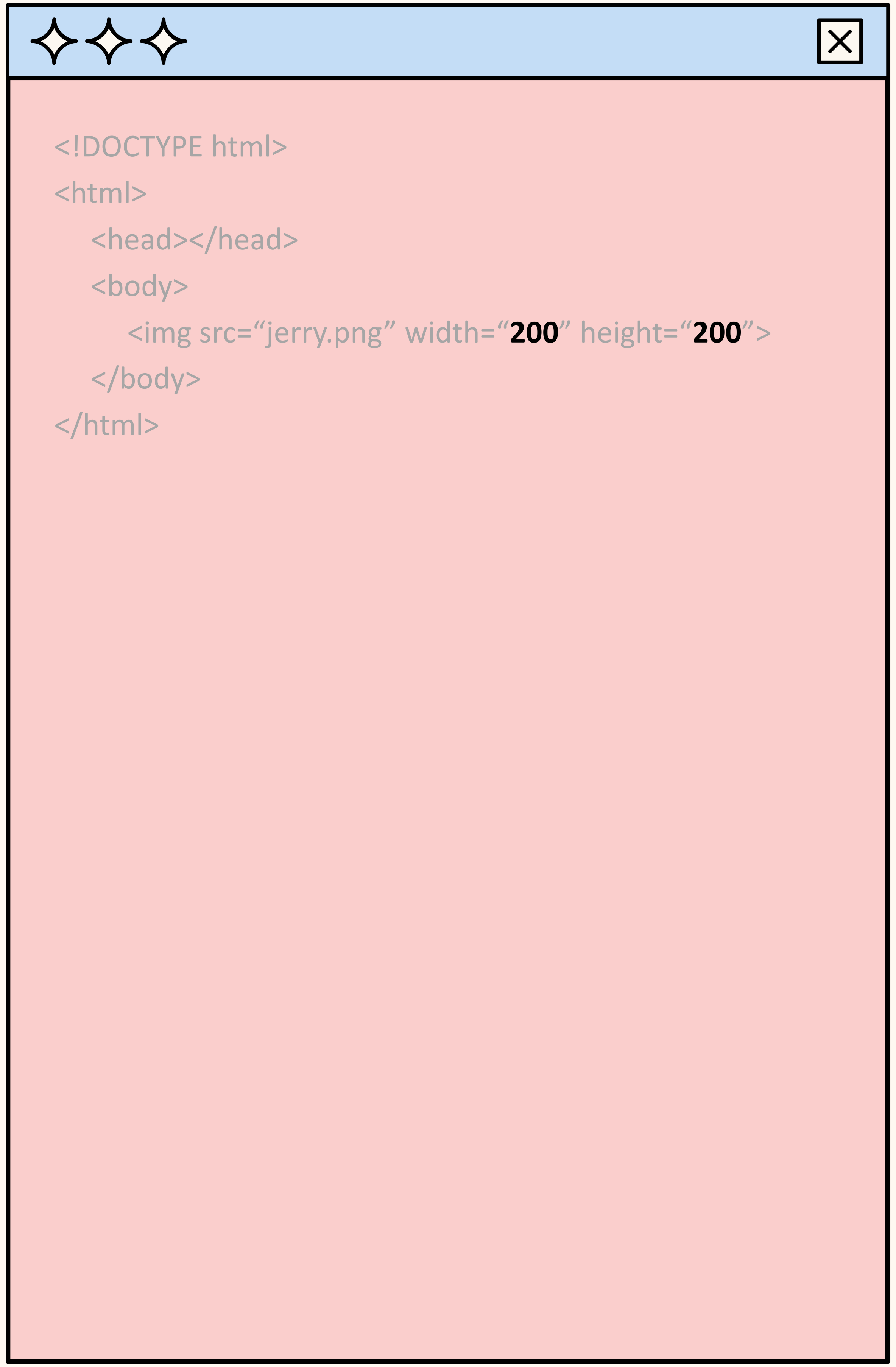


```
<!DOCTYPE html>
<html>
    <head></head>
    <body>
        <img src=“jerry.png” width=17 height=17>
    </body>
</html>
```

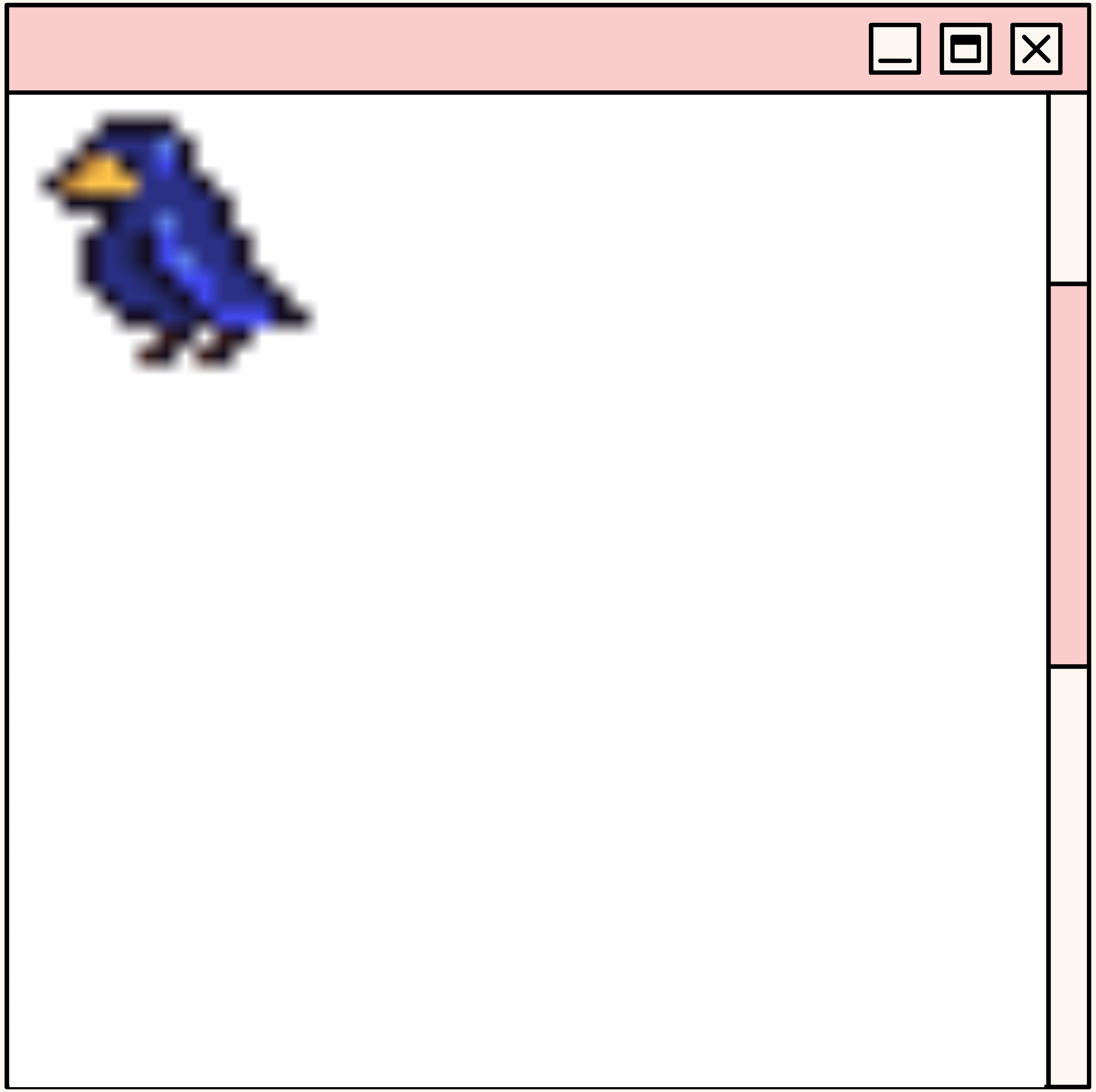


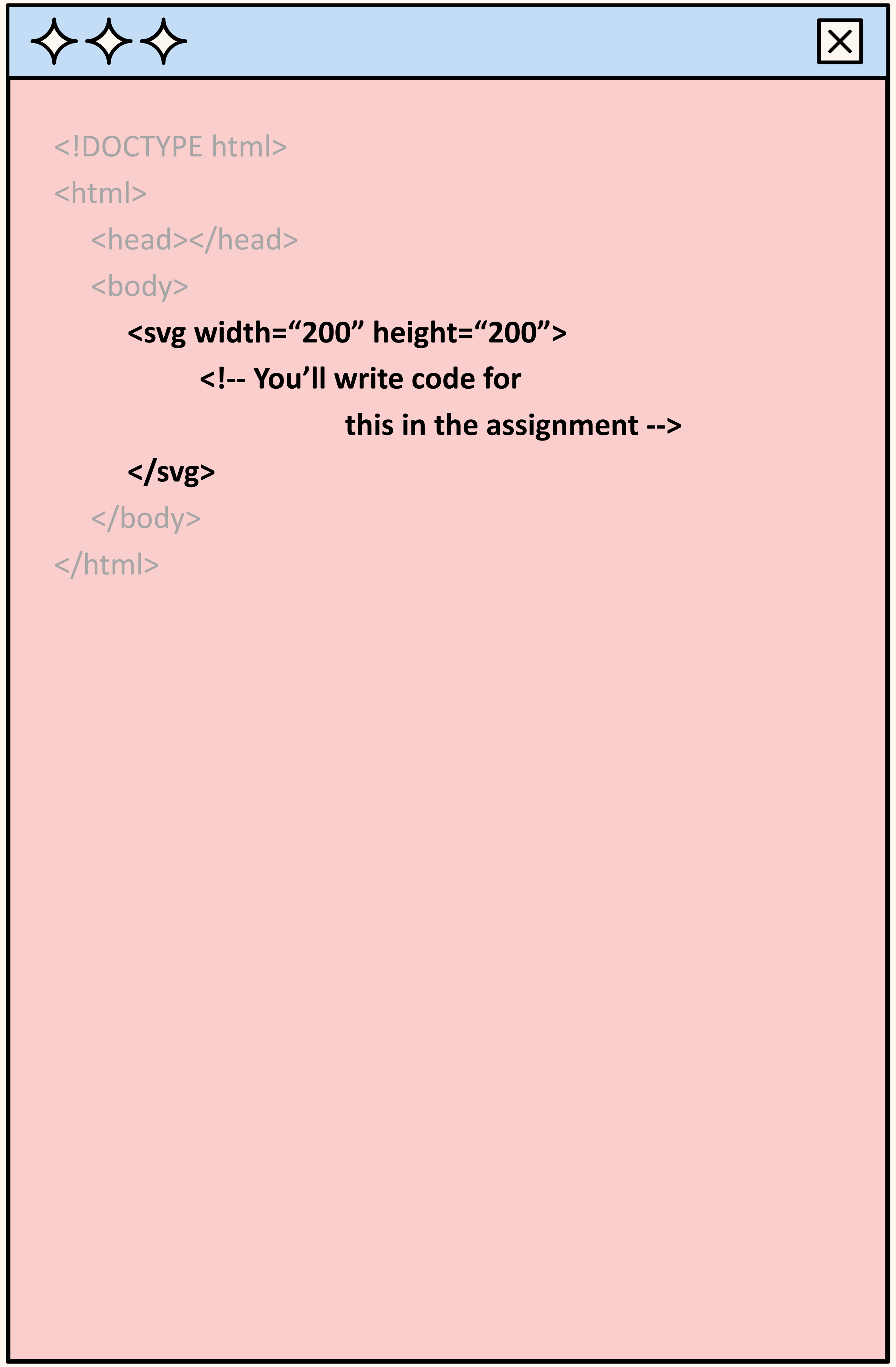
```
<!DOCTYPE html>
<html>
    <head></head>
    <body>
        <img src=“jerry.png” width=“17” height=“17”>
    </body>
</html>
```



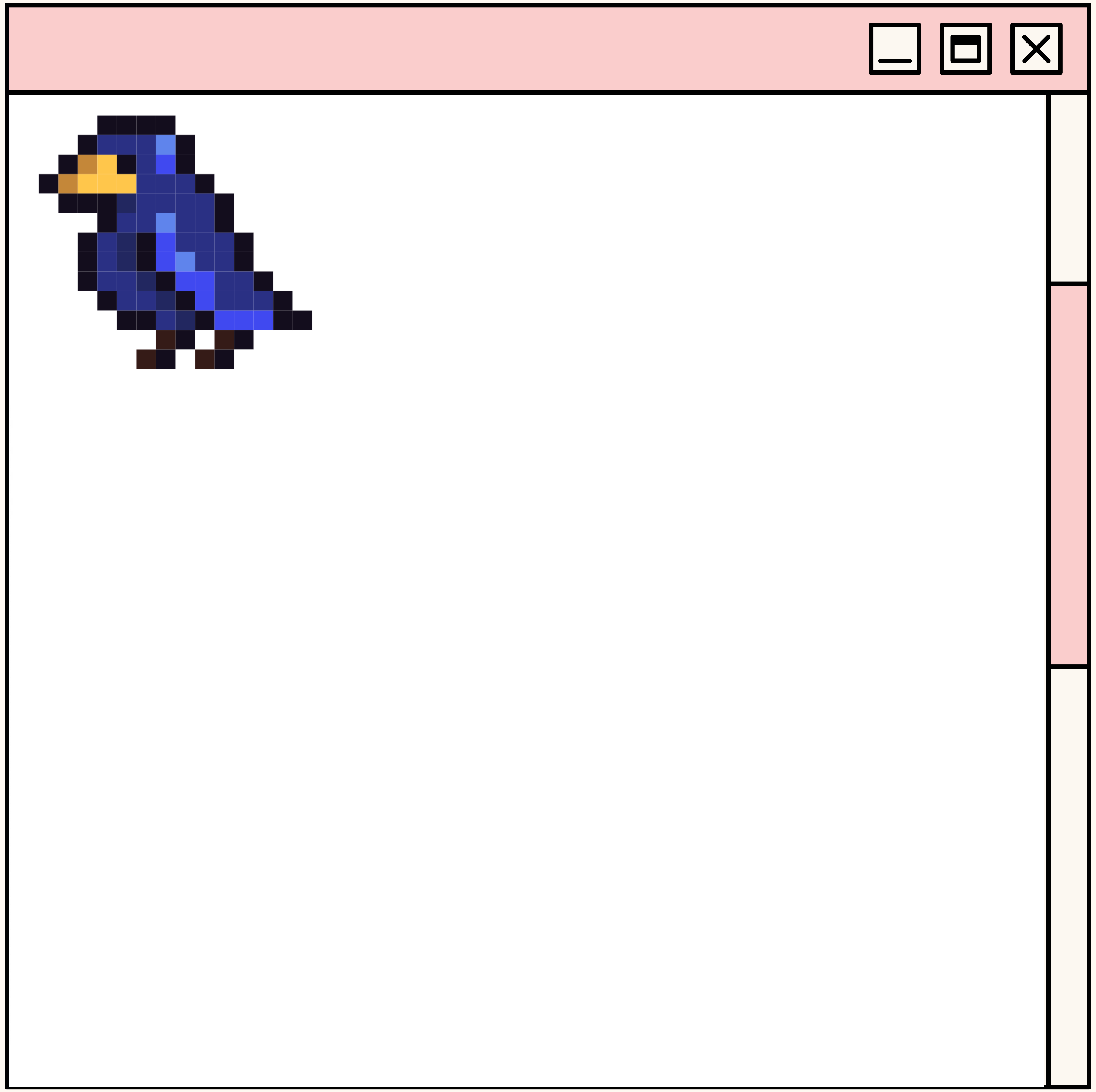


```
<!DOCTYPE html>
<html>
   <head></head>
   <body>
      <img src="jerry.png" width="200" height="200">
   </body>
</html>
```

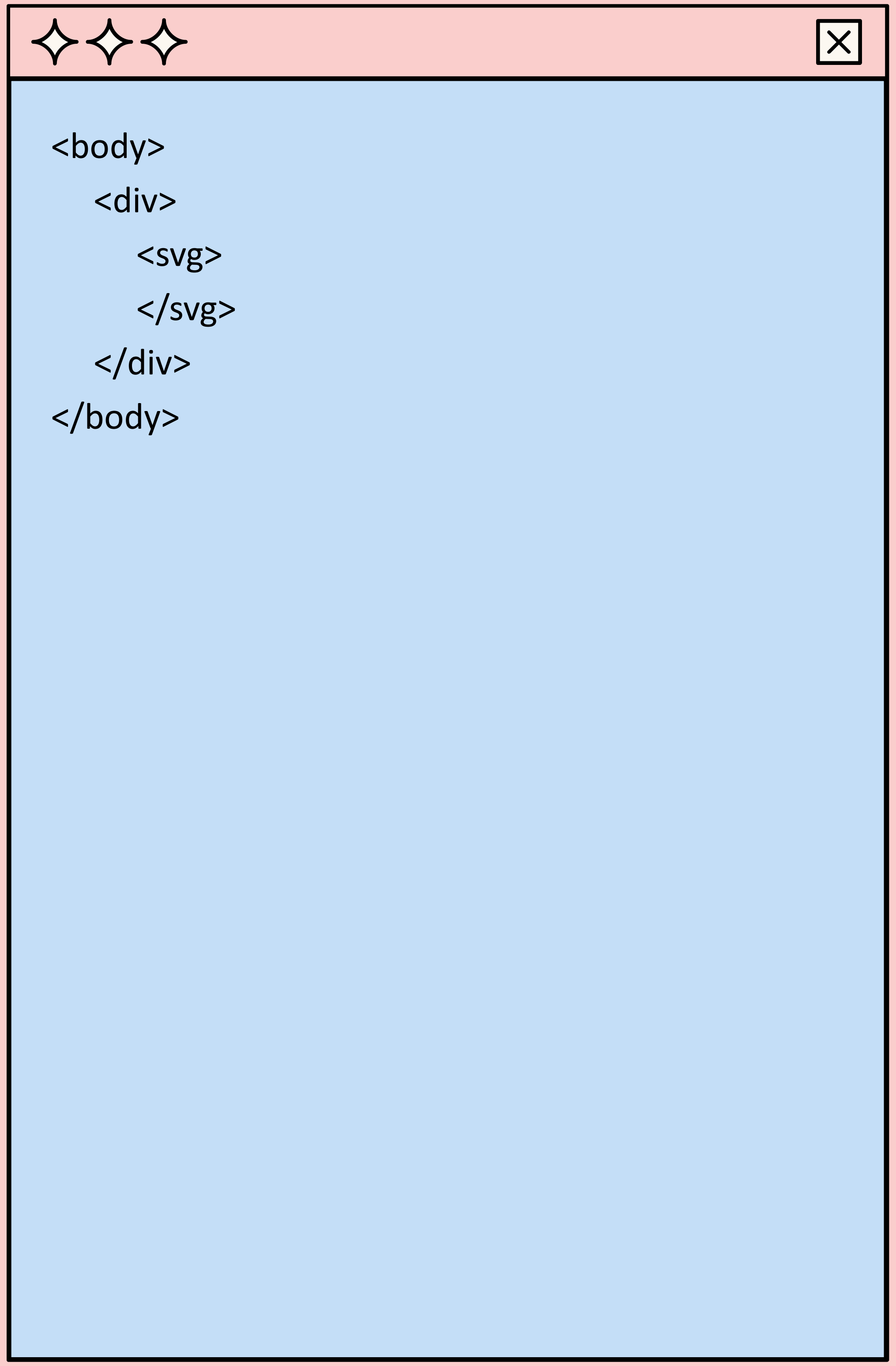




```
<!DOCTYPE html>
<html>
    <head></head>
    <body>
        <svg width="200" height="200">
            <!-- You'll write code for
                        this in the assignment -->
        </svg>
    </body>
</html>
```



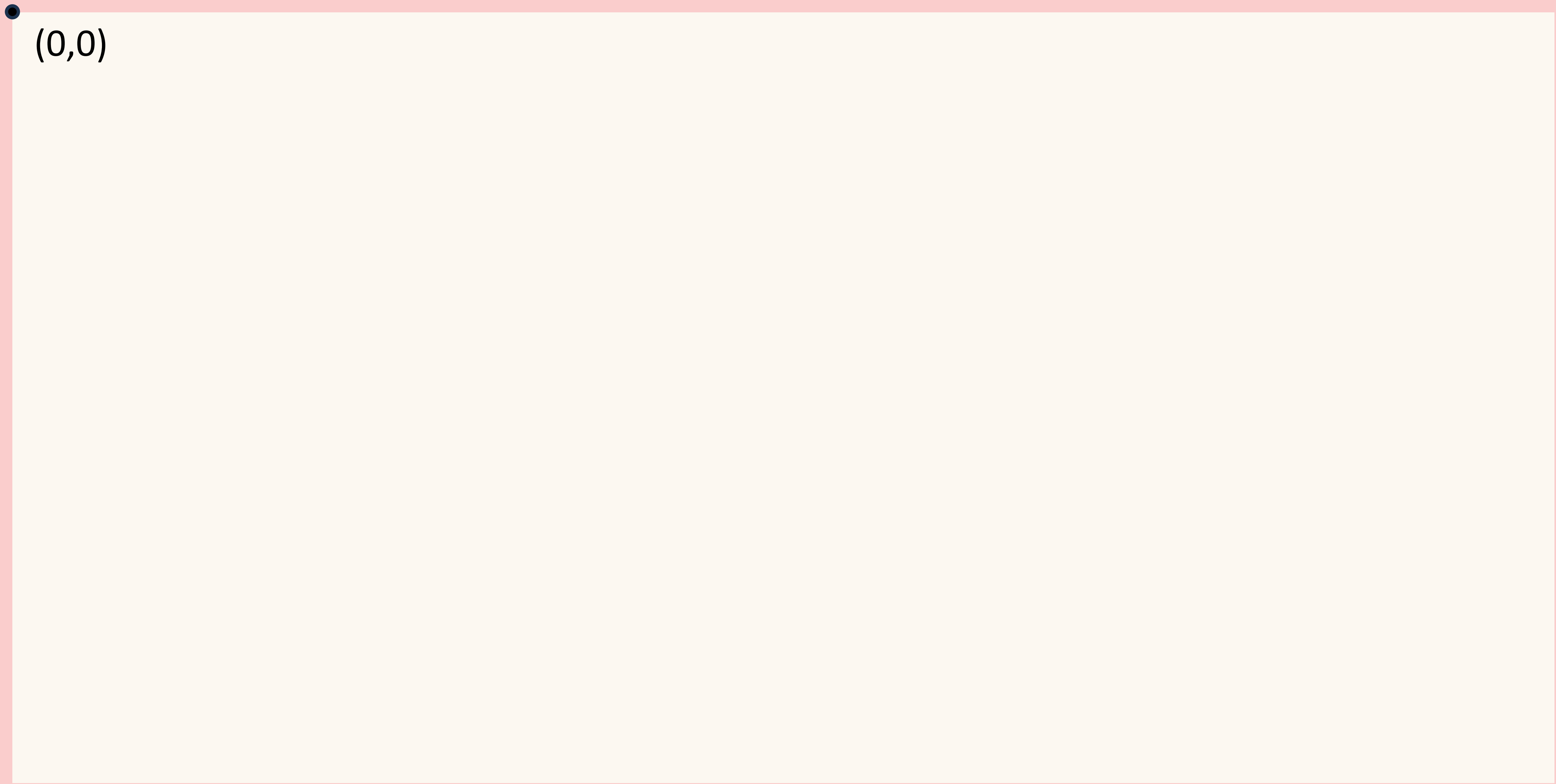
THE SVG CANVAS



```
<body>
    <div>
        <svg>
        </svg>
    </div>
</body>
```

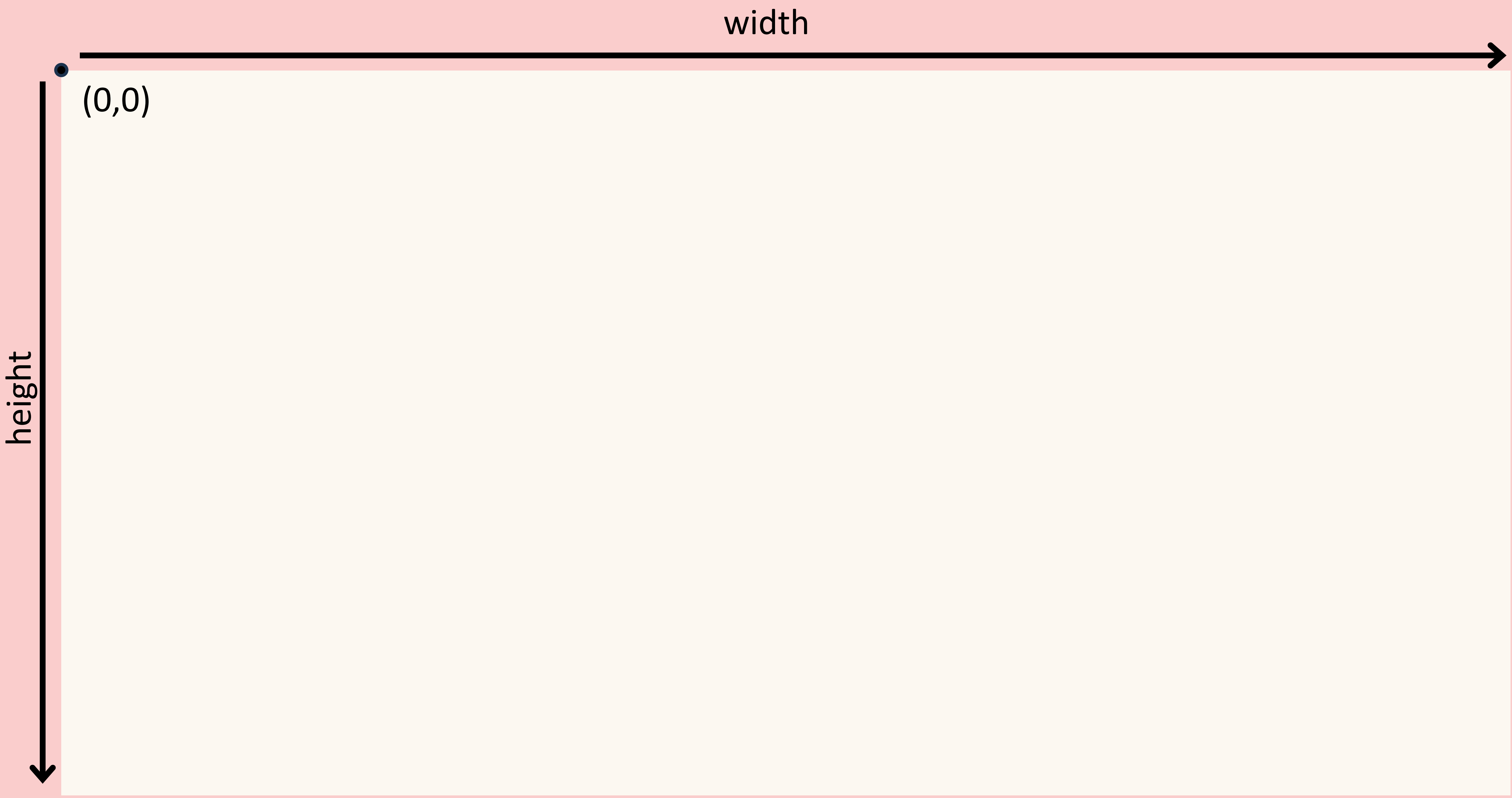
THE SVG CANVAS

```
<body>
    <div>
        <svg>
        </svg>
    </div>
</body>
```

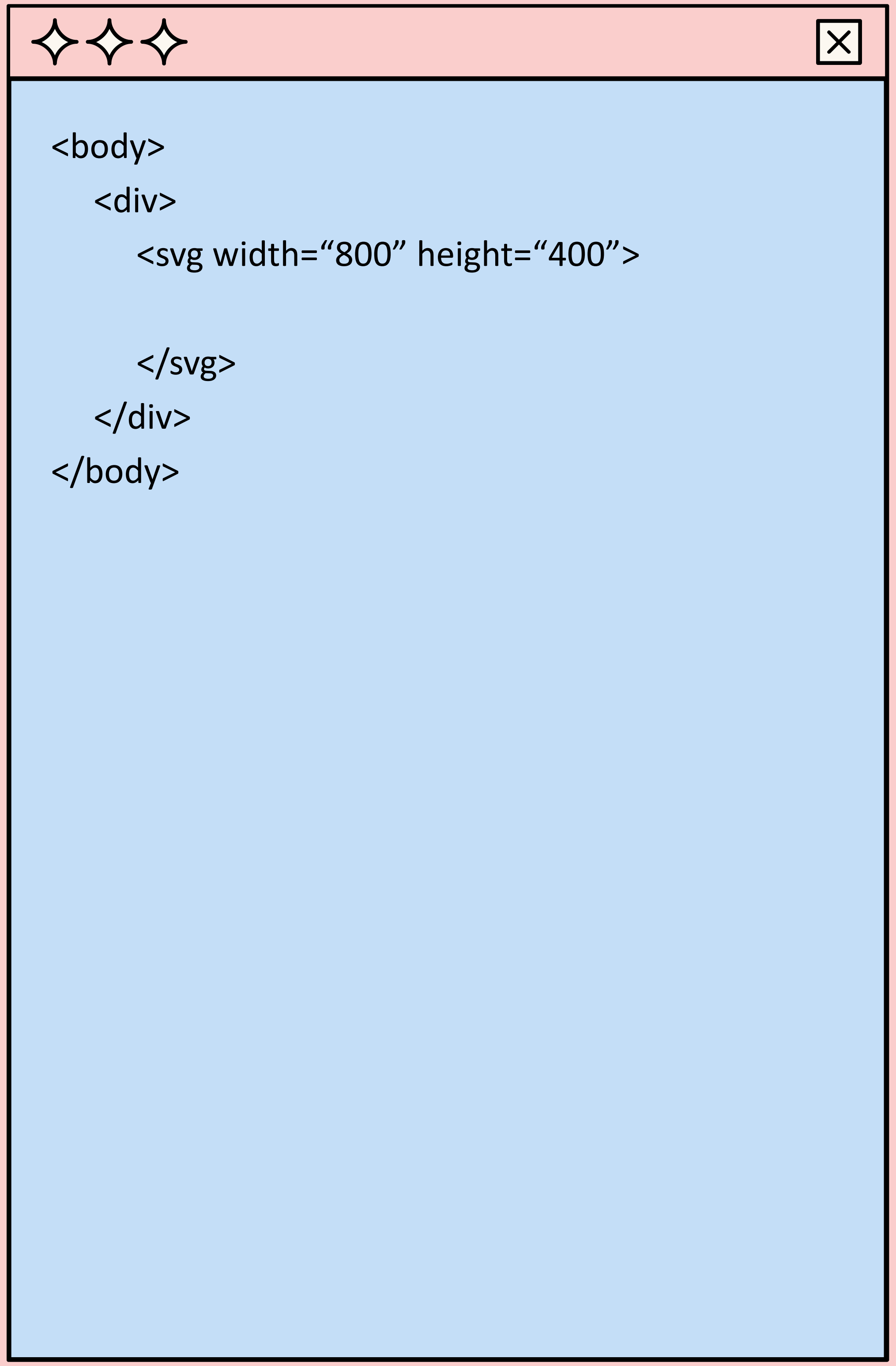


THE SVG CANVAS

```
<body>
    <div>
        <svg width=“800” height=“400”>
        </svg>
    </div>
</body>
```


width
height
(0,0)

THE SVG CANVAS - SHAPES



```
<body>
  <div>
    <svg width="800" height="400">

    </svg>
  </div>
</body>
```

THE SVG CANVAS - SHAPES

```
<body>
    <div>
        <svg width=“800” height=“400”>

        </svg>
    </div>
</body>
```

Rectangle

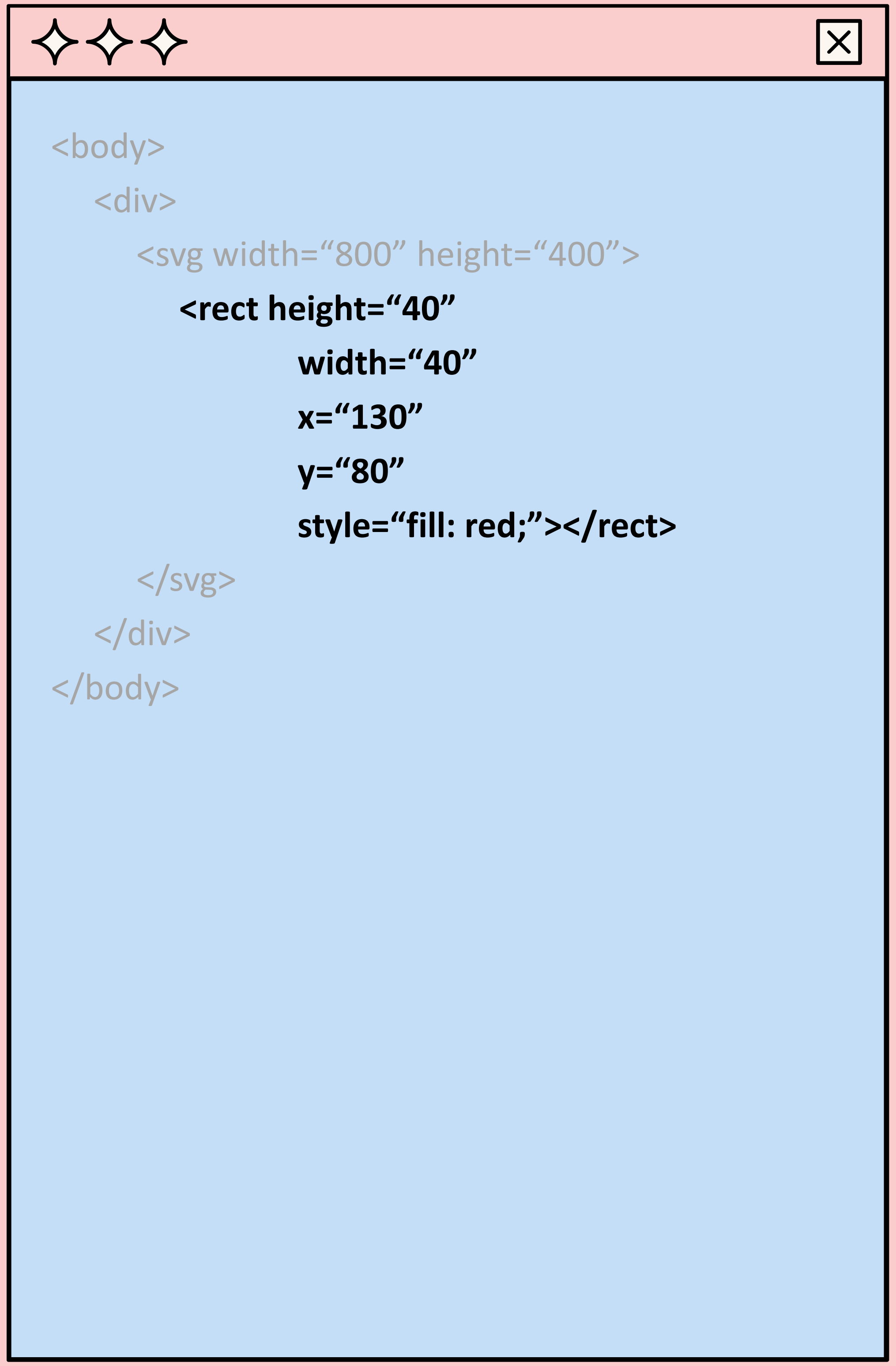
Circle

Ellipse

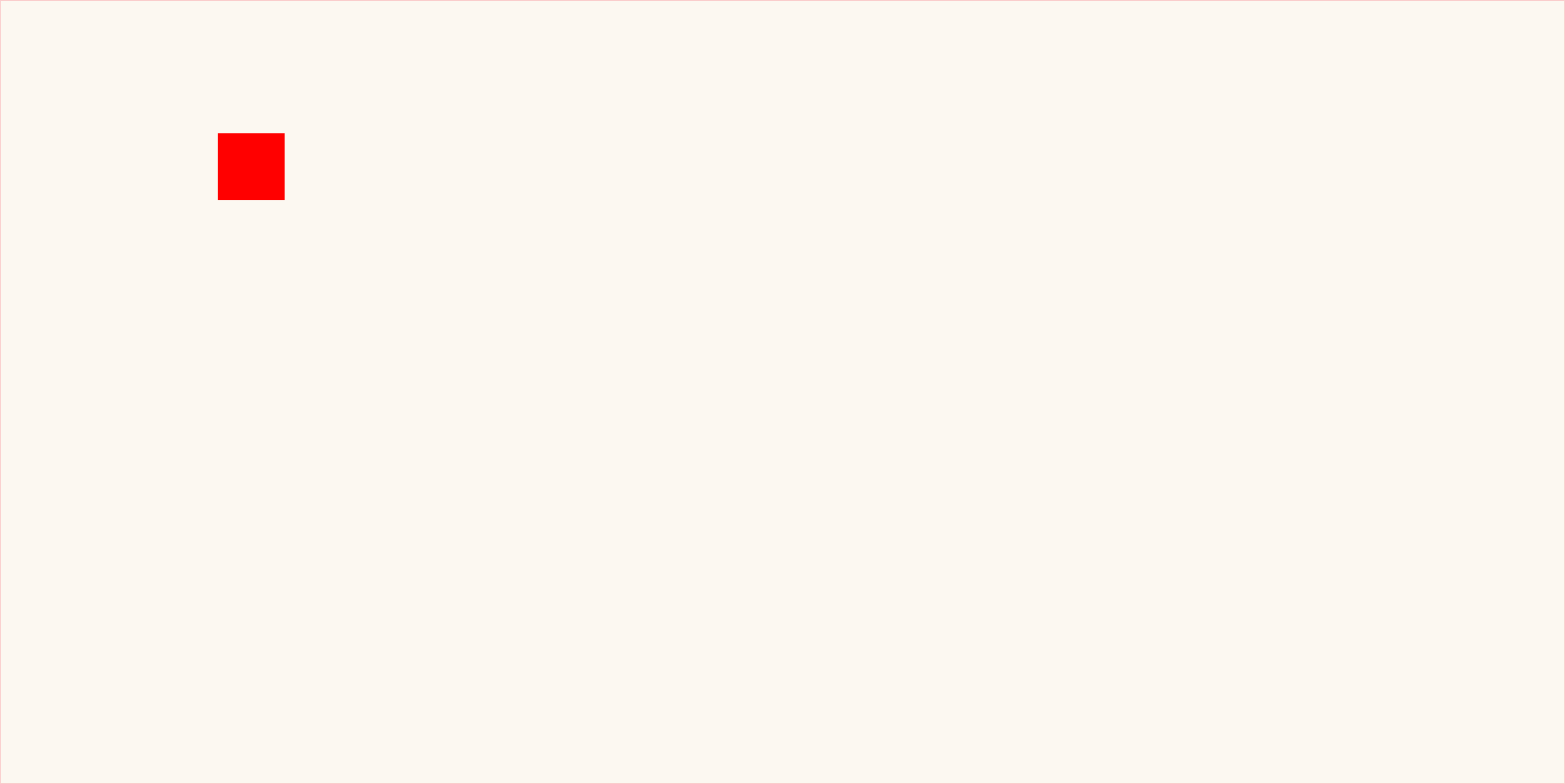
Line

Path

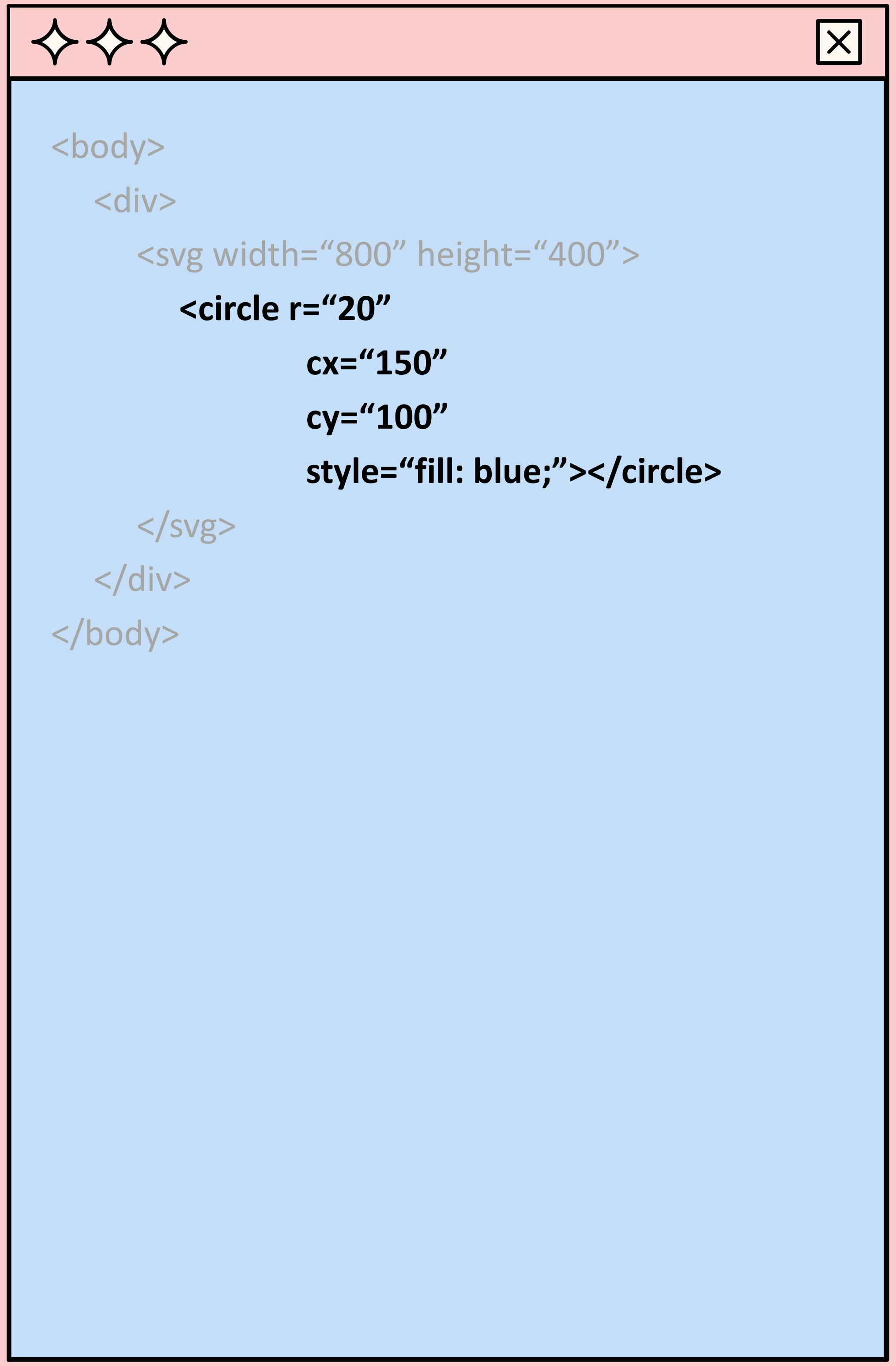
THE SVG CANVAS - RECTANGLE



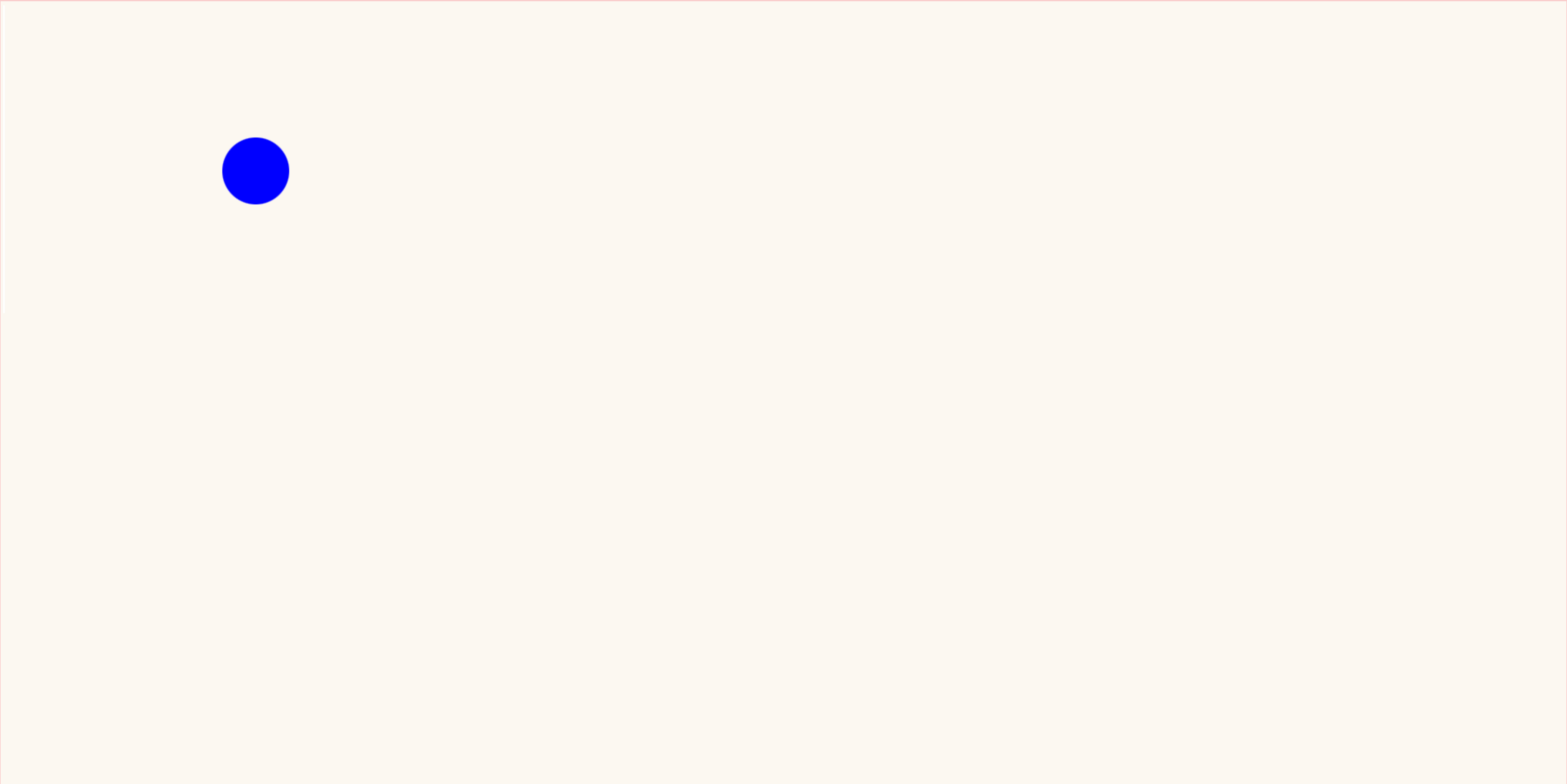
```
<body>
   <div>
      <svg width="800" height="400">
         <rect height="40"
                  width="40"
                  x="130"
                  y="80"
                  style="fill: red;"></rect>
      </svg>
   </div>
</body>
```



THE SVG CANVAS - CIRCLE

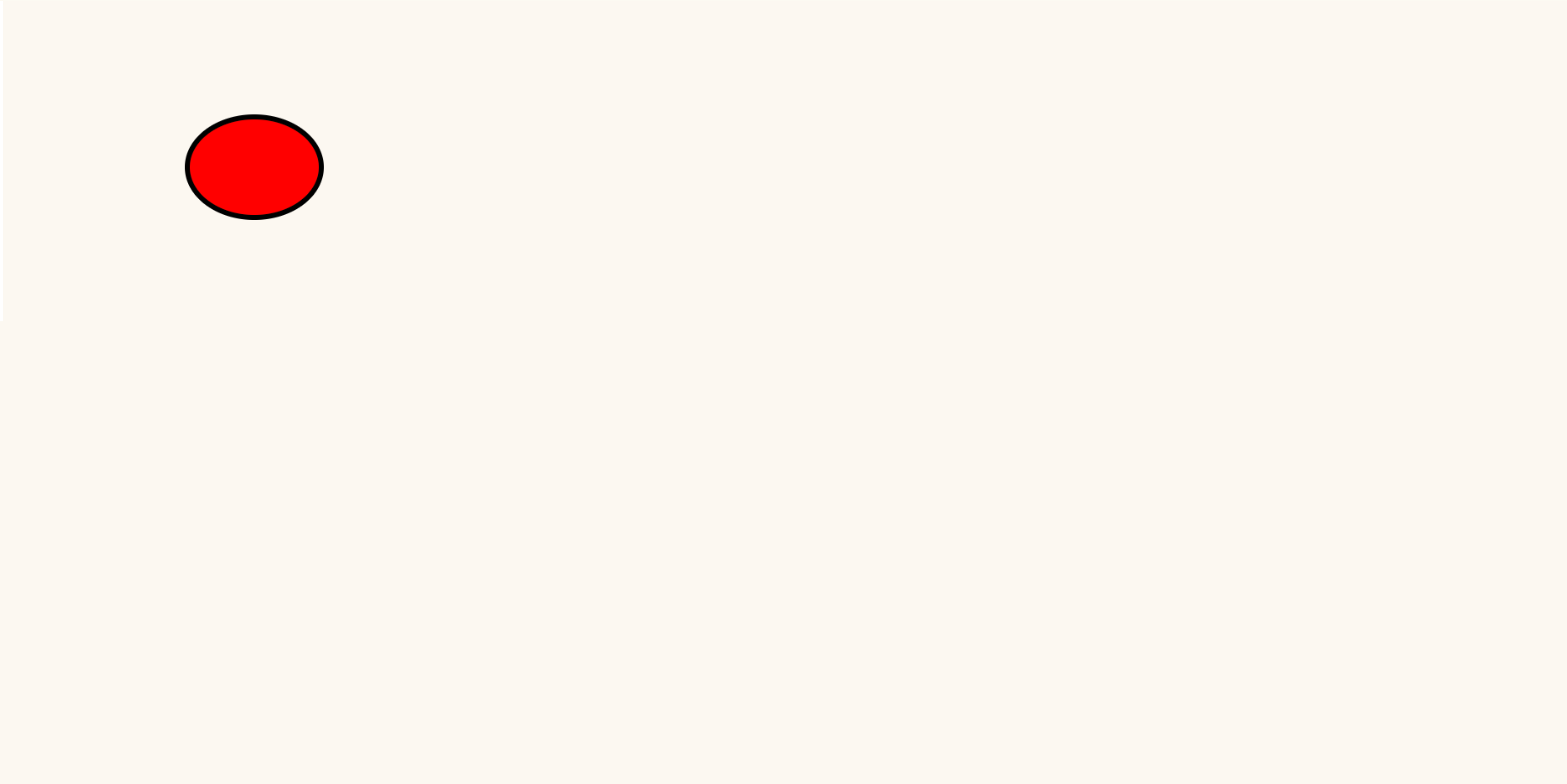


```
<body>
  <div>
    <svg width="800" height="400">
      <circle r="20"
              cx="150"
              cy="100"
              style="fill: blue;"></circle>
    </svg>
  </div>
</body>
```



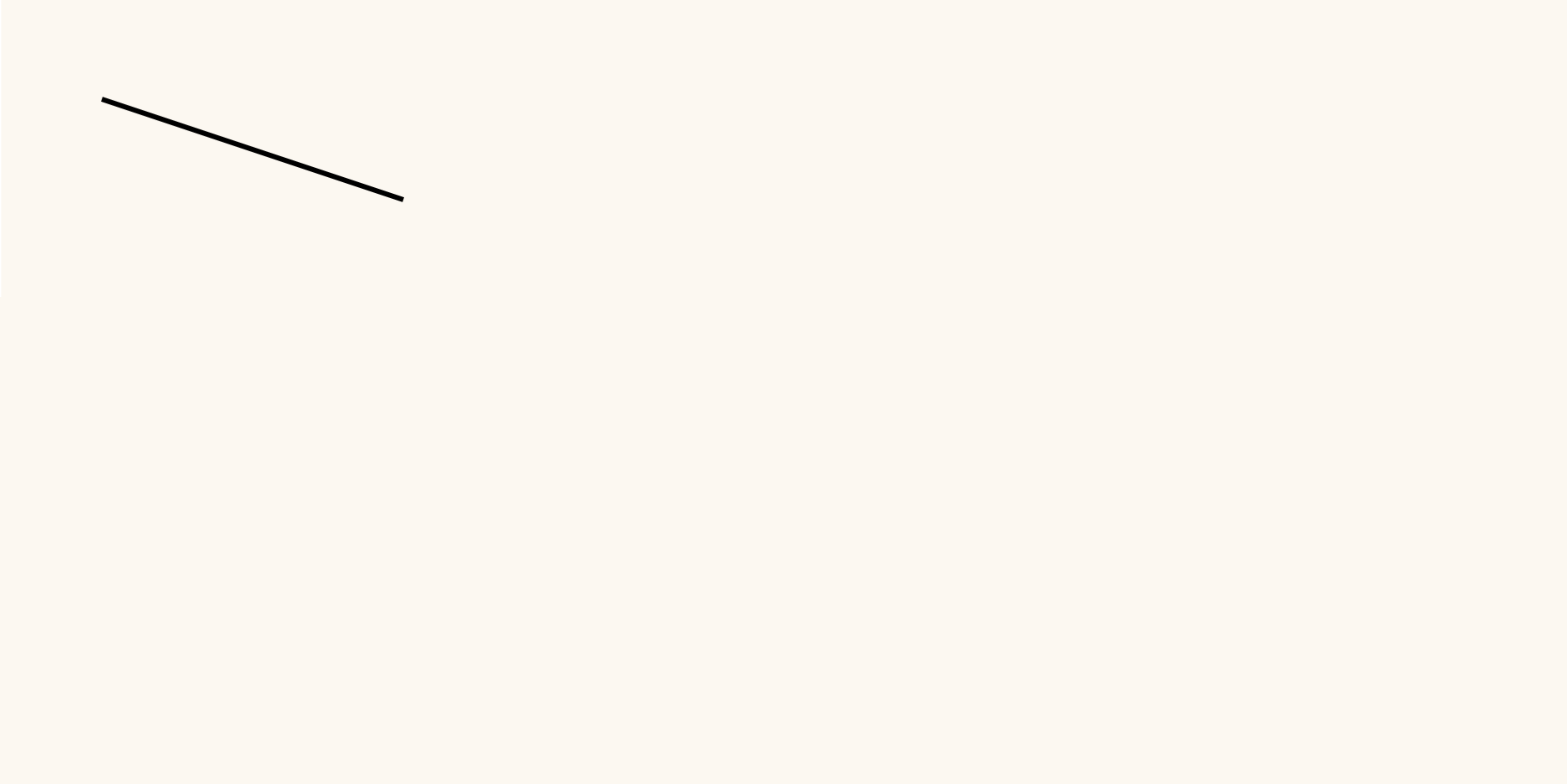
THE SVG CANVAS - ELLIPSE

```
<body>
    <div>
        <svg width=“800” height=“400”>
            <ellipse rx=“40”
                         ry=“30”
                         cx=“150”
                         cy=“100”
                         style=“
                                fill: red;
                                stroke: black;
                                stroke-width: 3px;
                         ” ></ellipse>
        </svg>
    </div>
</body>
```



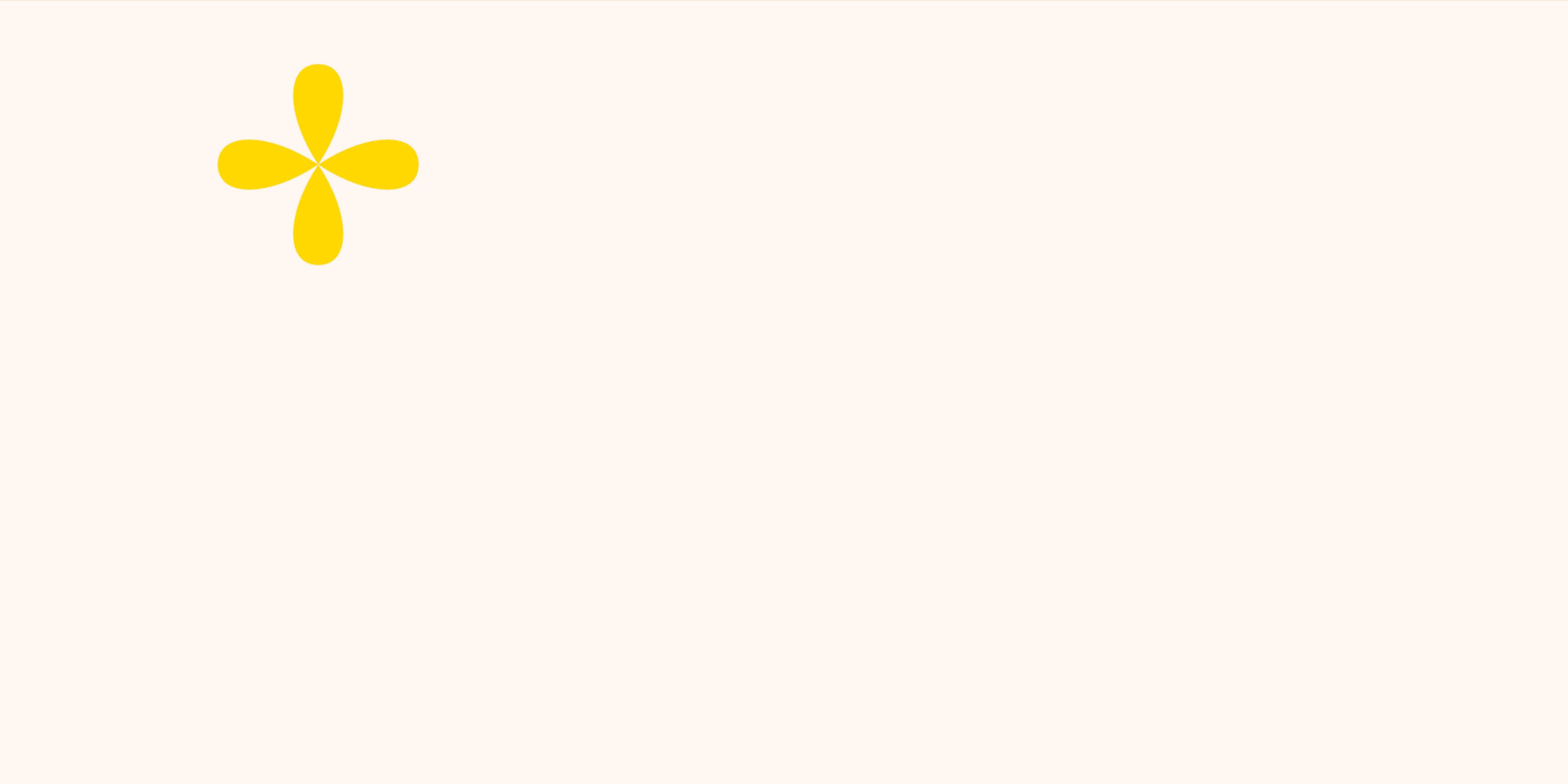
THE SVG CANVAS - LINE

```
<body>
  <div>
    <svg width=“800” height=“400”>
      <line x1=“60”
            y1=“60”
            x2=“240”
            y2=“120”
            style=“
                 stroke: black;
                 stroke-width: 3px;
             ” ></line>
    </svg>
  </div>
</body>
```



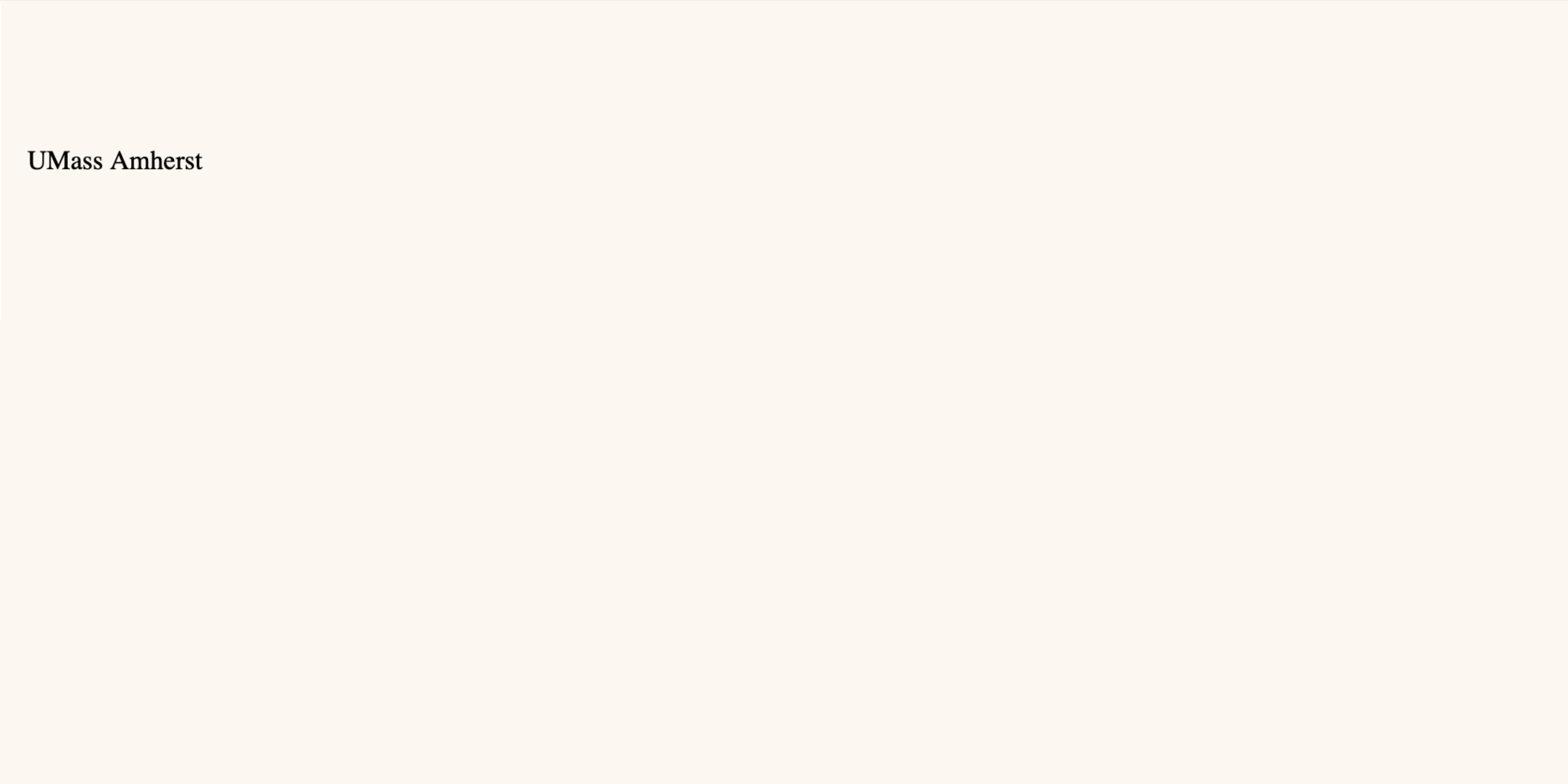
THE SVG CANVAS - PATH

```
<body>
    <div>
        <svg width=“800” height=“400”>
            <path
                d=“M190,100 m0,-60
                    c20,0 20,30 0,60
                    c30,-20 60,-20 60,0
                    c0,20 -30,20 -60,0
                    c20,30 20,60 0,60
                    c-20,0 -20,-30 0,-60
                    c-30,20 -60,20 -60,0
                    c0,-20 30,-20 60,0
                    c-20,-30 -20,-60 0,-60z”
                style=“
                     fill: gold;
                     stroke: none;
                 ” ></path>
        </svg>
    </div>
</body>
```



THE SVG CANVAS - TEXT

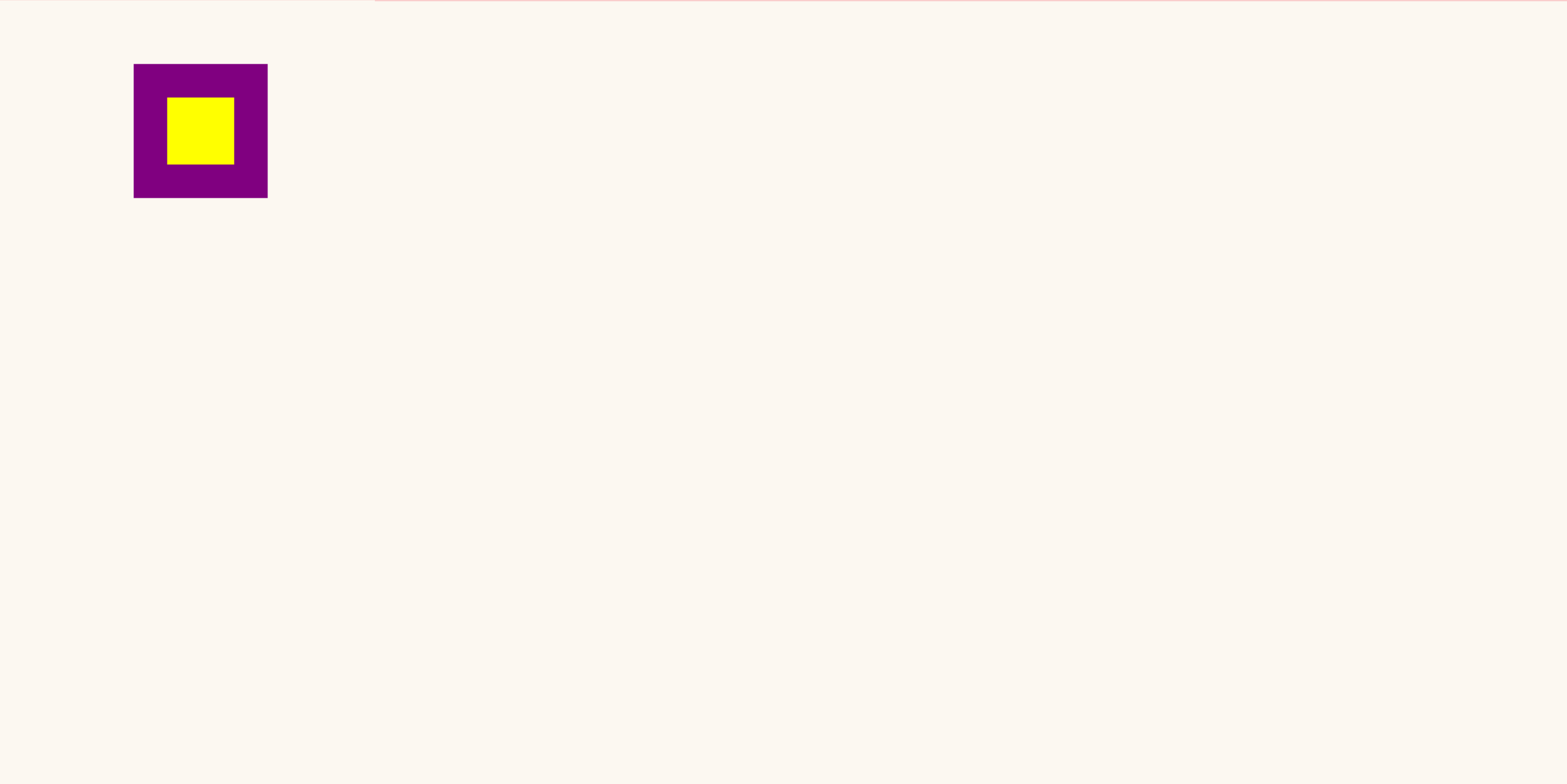
```
<body>
    <div>
        <svg width=“800” height=“400”>
            <text x=“120”
                        y=“100”
                        style=“text-anchor: end;>
                                UMass Amherst
            </text>
        </svg>
    </div>
</body>
```



UMass Amherst

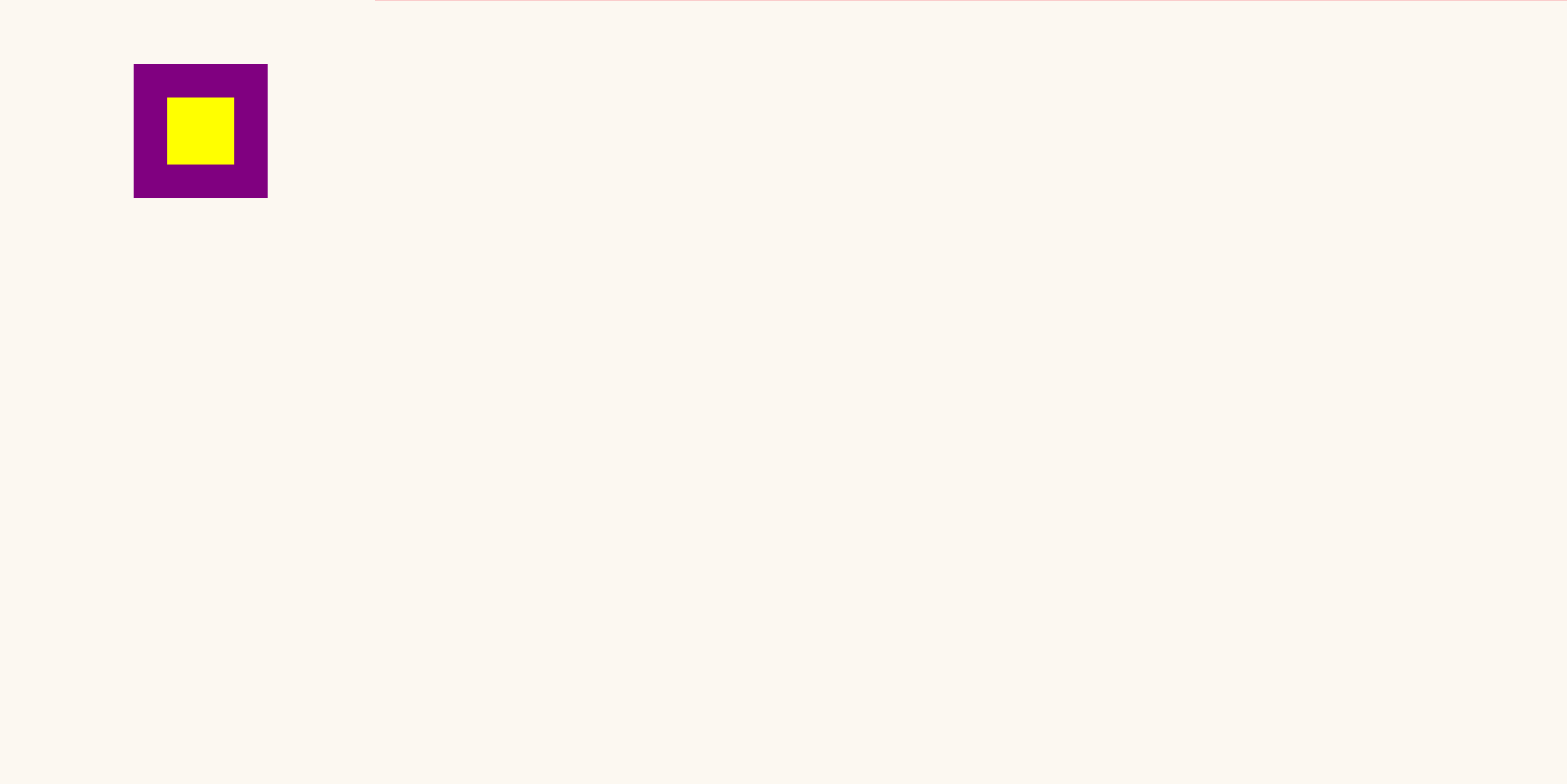
THE SVG CANVAS - ORDERING

```
<body>
    <div>
        <svg width=“800” height=“400”>
            <rect x=“80” y=“40”
                    width=“80” height=“80”
                    style=“fill: purple;” ></rect>
            <rect x=“100” y=“60”
                    width=“40” height=“40”
                    style=“fill: yellow;” ></rect>
        </svg>
    </div>
</body>
```

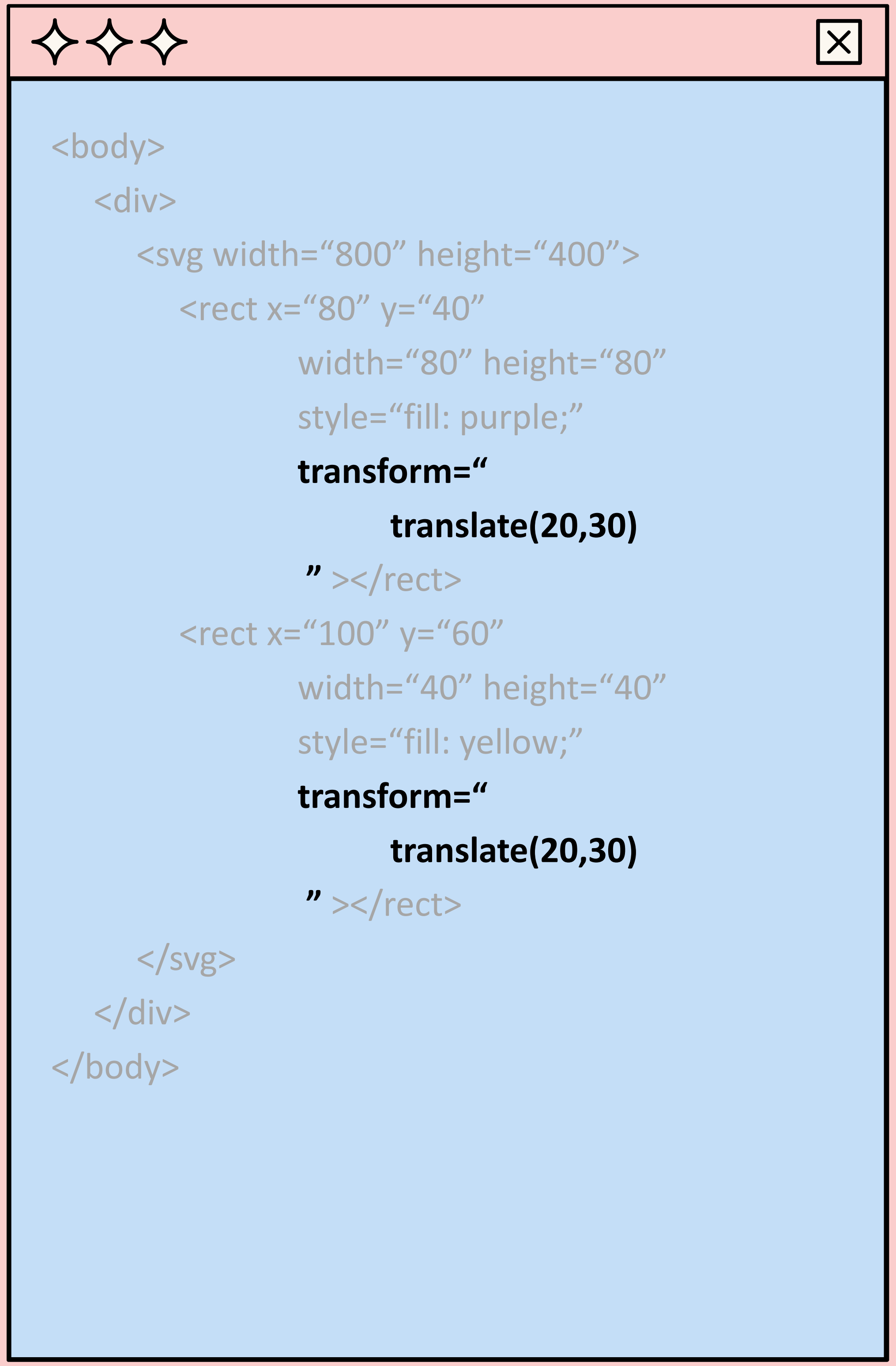


THE SVG CANVAS - TRANSFORM

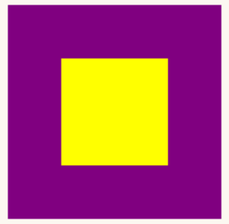
```
<body>
    <div>
        <svg width=“800” height=“400”>
            <rect x=“80” y=“40”
                        width=“80” height=“80”
                        style=“fill: purple;”
                        transform=“” ></rect>
            <rect x=“100” y=“60”
                        width=“40” height=“40”
                        style=“fill: yellow;”
                        transform=“” ></rect>
        </svg>
    </div>
</body>
```



THE SVG CANVAS - TRANSFORM



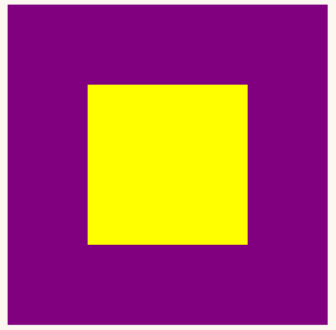
```
<body>
   <div>
      <svg width=“800” height=“400”>
         <rect x=“80” y=“40”
                 width=“80” height=“80”
                 style=“fill: purple;”
                 transform=“
                       translate(20,30)
                 ” ></rect>
         <rect x=“100” y=“60”
                 width=“40” height=“40”
                 style=“fill: yellow;”
                 transform=“
                       translate(20,30)
                 ” ></rect>
      </svg>
   </div>
</body>
```



translate(<tx>, [<ty>])

THE SVG CANVAS - TRANSFORM

```
<body>
   <div>
      <svg width="800" height="400">
         <rect x="80" y="40"
                  width="80" height="80"
                  style="fill: purple;"
                  transform="
                        translate(20,30)
                        scale(1.5,1.5)
                  " ></rect>
         <rect x="100" y="60"
                  width="40" height="40"
                  style="fill: yellow;"
                  transform="
                        translate(20,30)
                        scale(1.5,1.5)
                  " ></rect>
      </svg>
   </div>
</body>
```

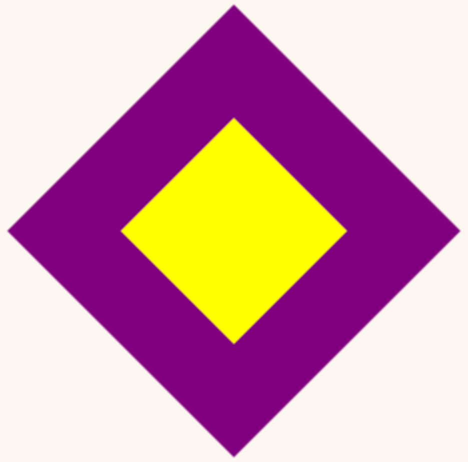


translate(<tx>, [<ty>])

scale(<sx>, [<sy>])

THE SVG CANVAS - TRANSFORM

```
<body>
    <div>
        <svg width=“800” height=“400”>
            <rect x=“80” y=“40”
                        width=“80” height=“80”
                        style=“fill: purple;”
                        transform=“
                                 translate(20,30)
                                 scale(1.5,1.5)
                                 rotate(45,120,80)
                         ” ></rect>
            <rect x=“100” y=“60”
                        width=“40” height=“40”
                        style=“fill: yellow;”
                        transform=“
                                 translate(20,30)
                                 scale(1.5,1.5)
                                 rotate(45,120,80)
                         ” ></rect>
        </svg>
    </div>
</body>
```

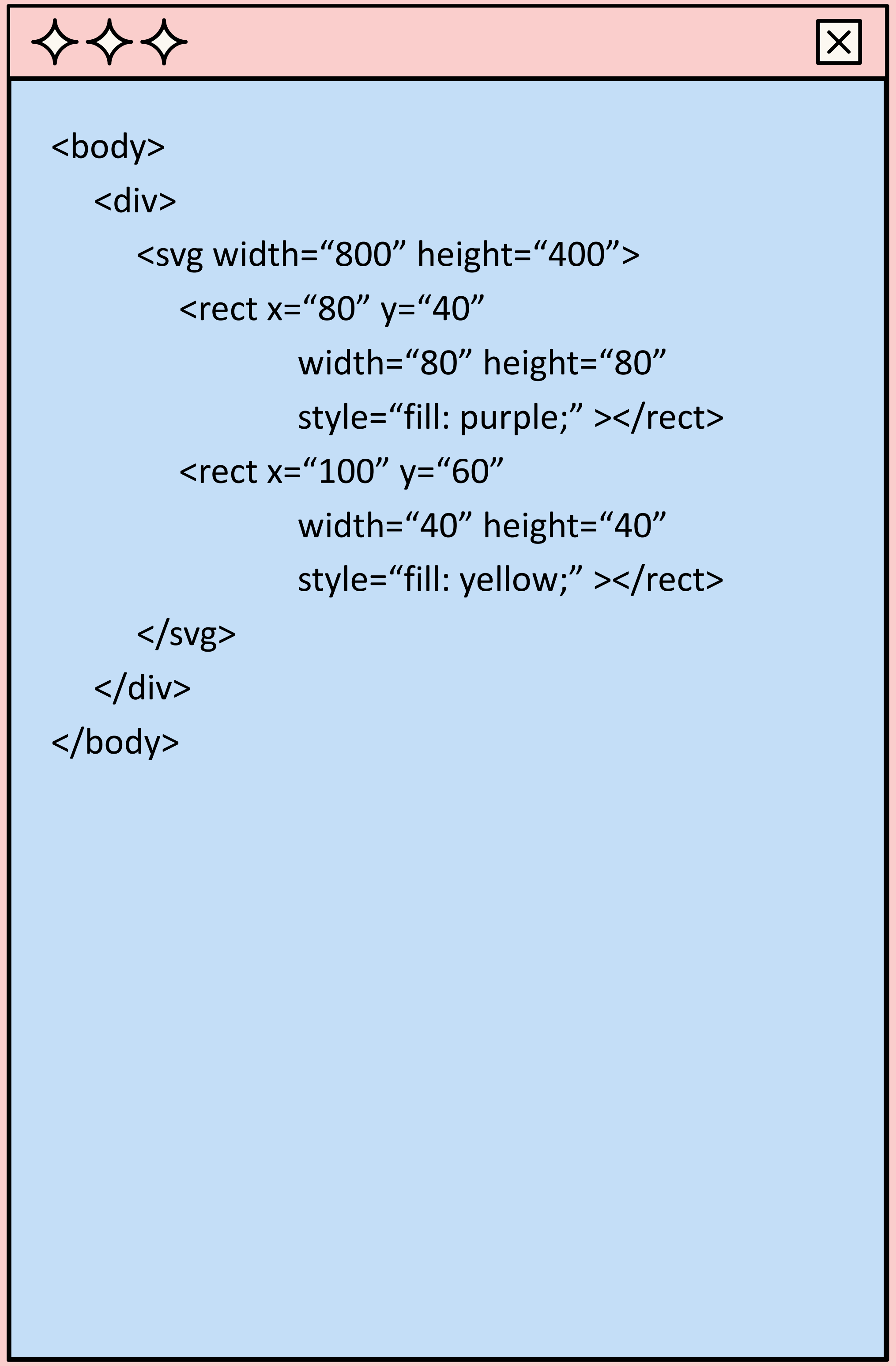


translate(<tx>, [<ty>])

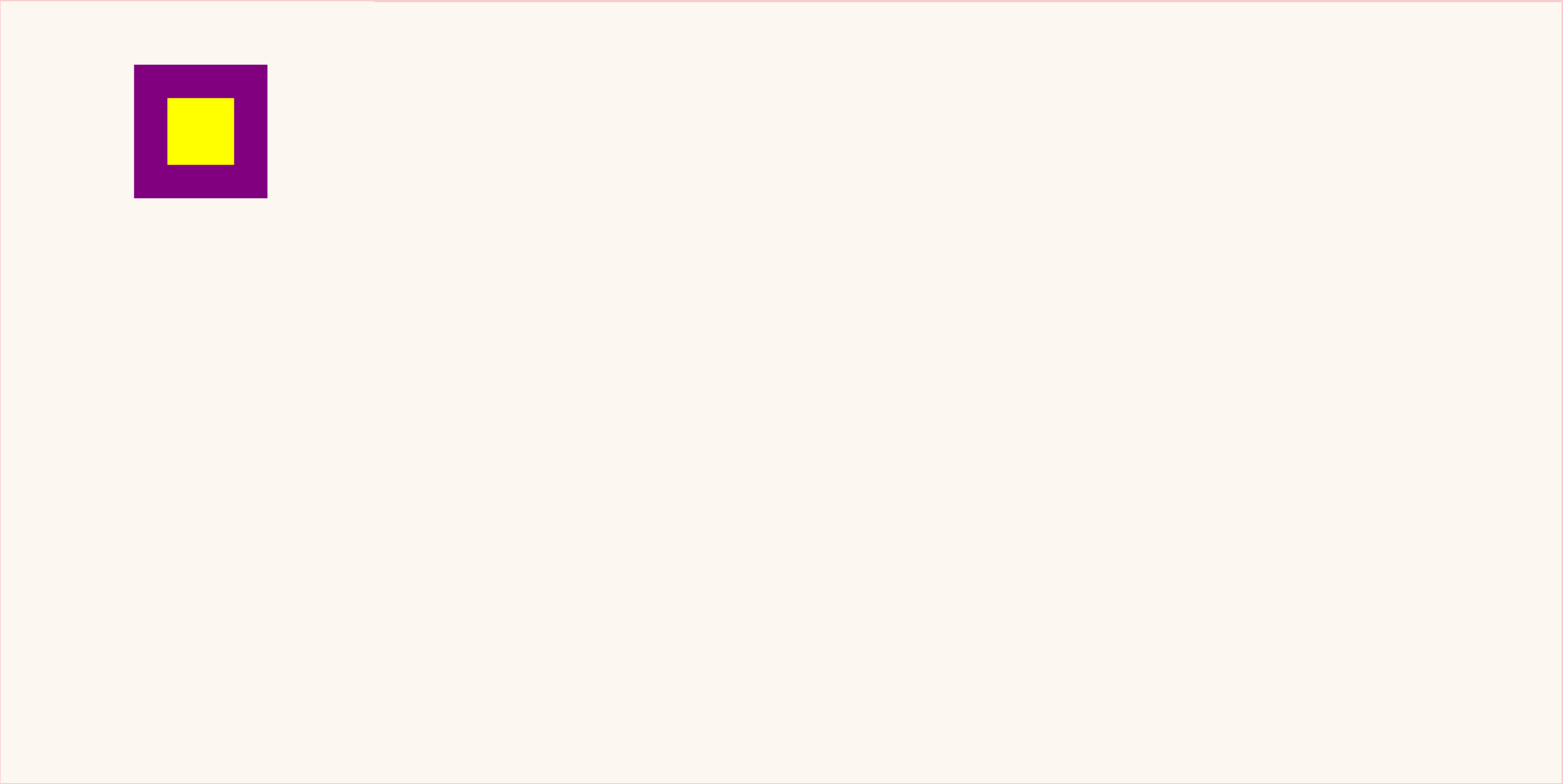
scale(<sx>, [<sy>])

rotate(<rotate-angle>, [<cx>, <cy>])

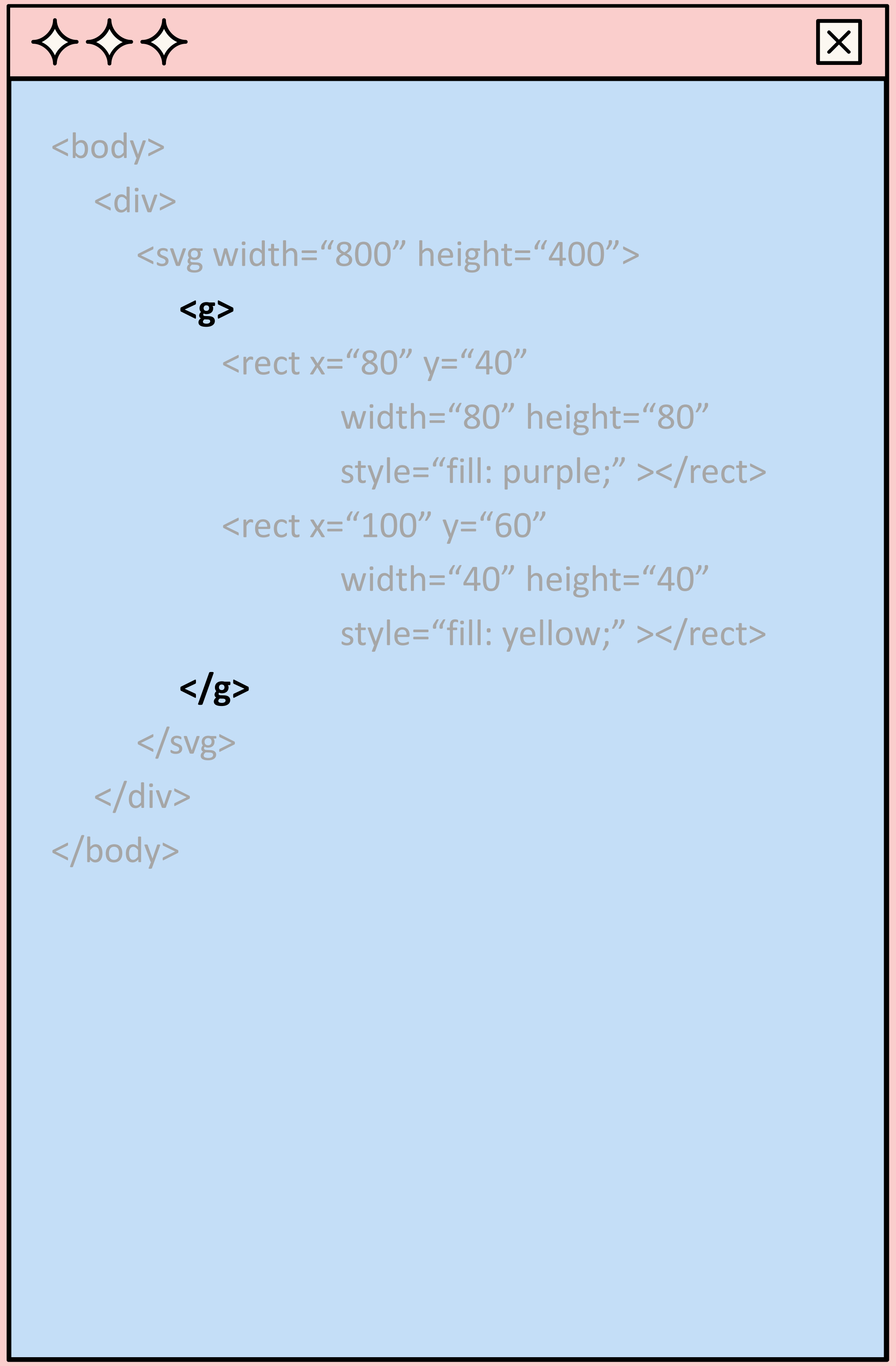
THE SVG CANVAS - ???



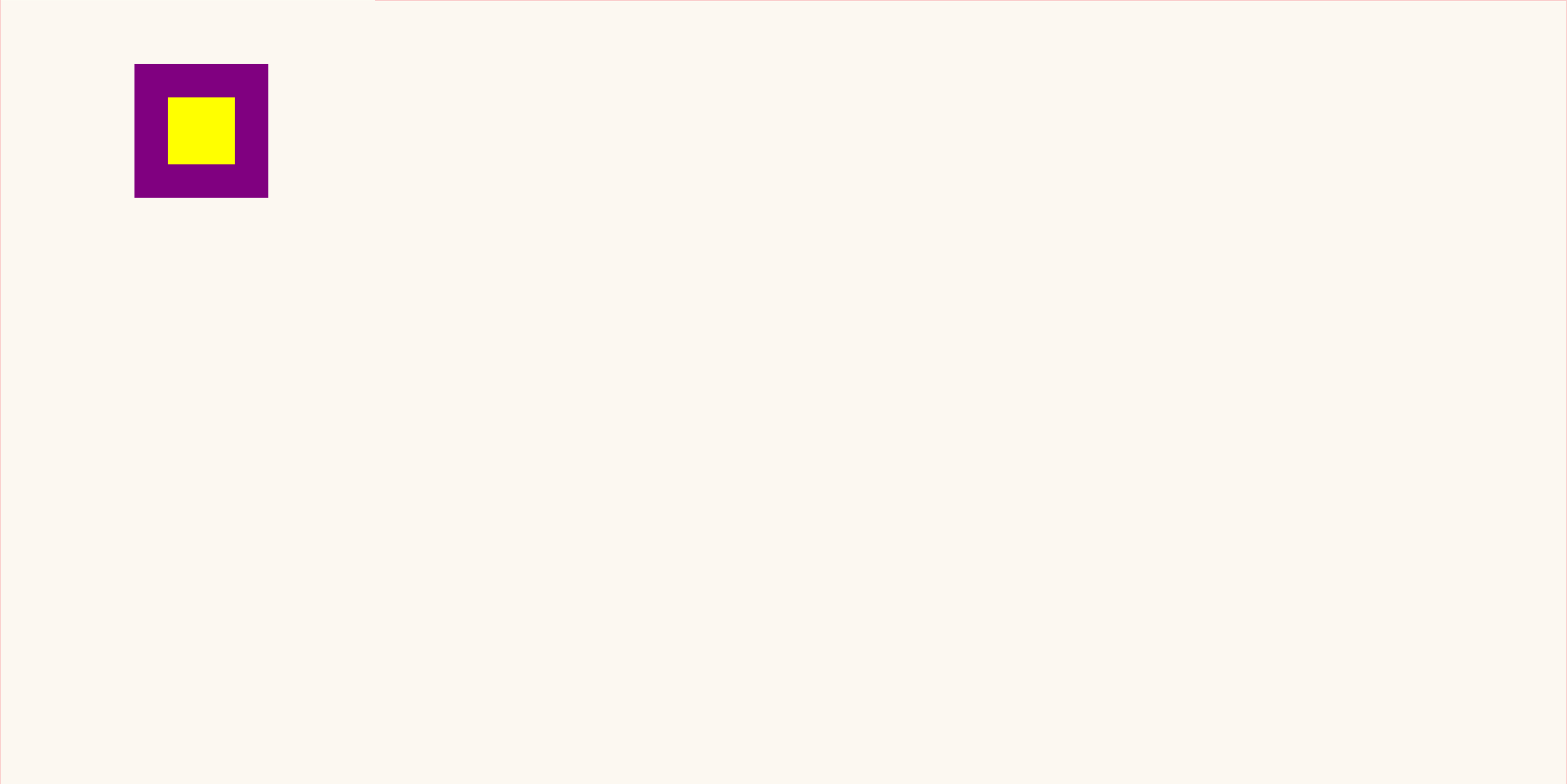
```
<body>
    <div>
        <svg width="800" height="400">
            <rect x="80" y="40"
                        width="80" height="80"
                        style="fill: purple;" ></rect>
            <rect x="100" y="60"
                        width="40" height="40"
                        style="fill: yellow;" ></rect>
        </svg>
    </div>
</body>
```



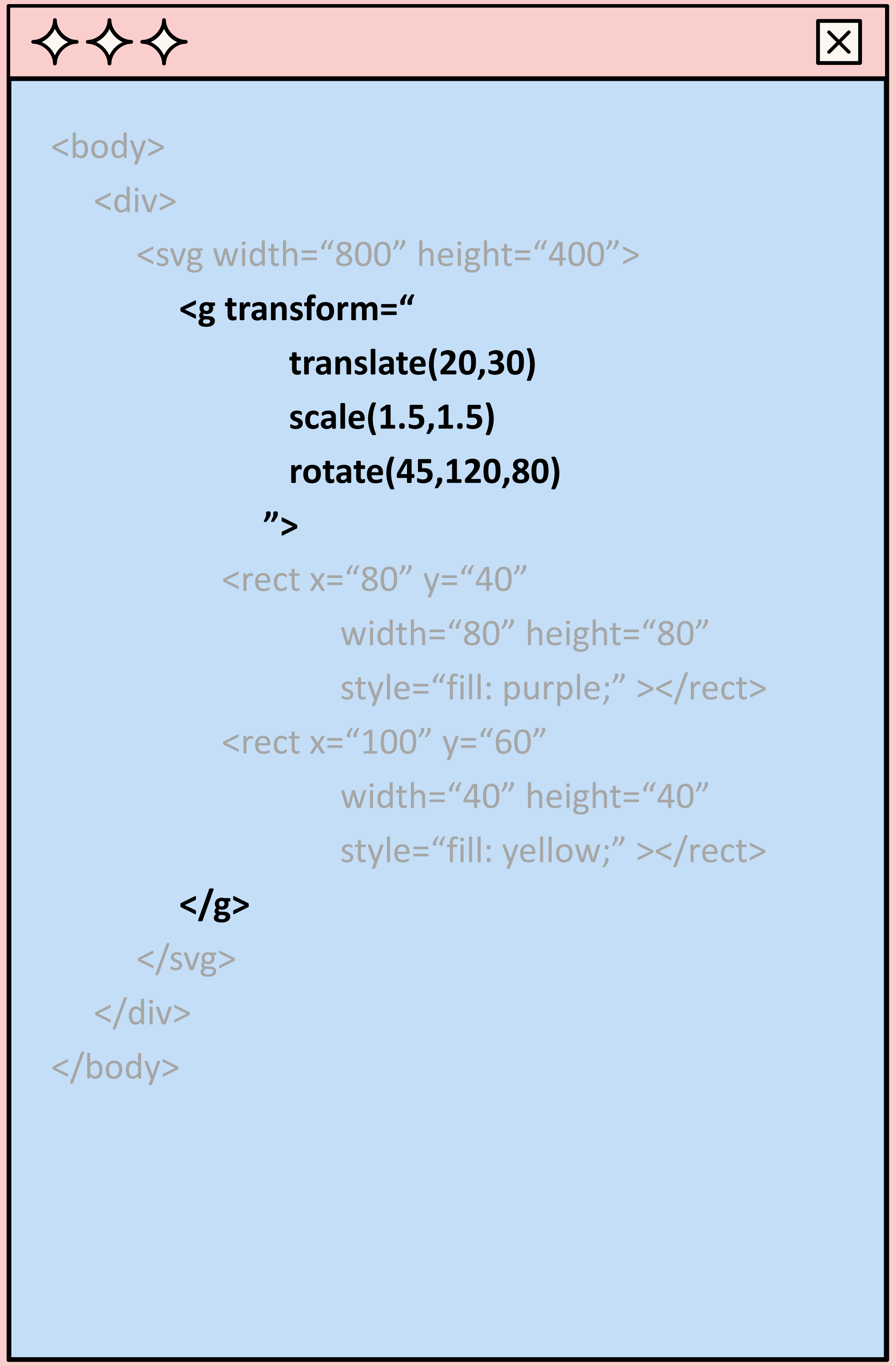
THE SVG CANVAS - GROUPING



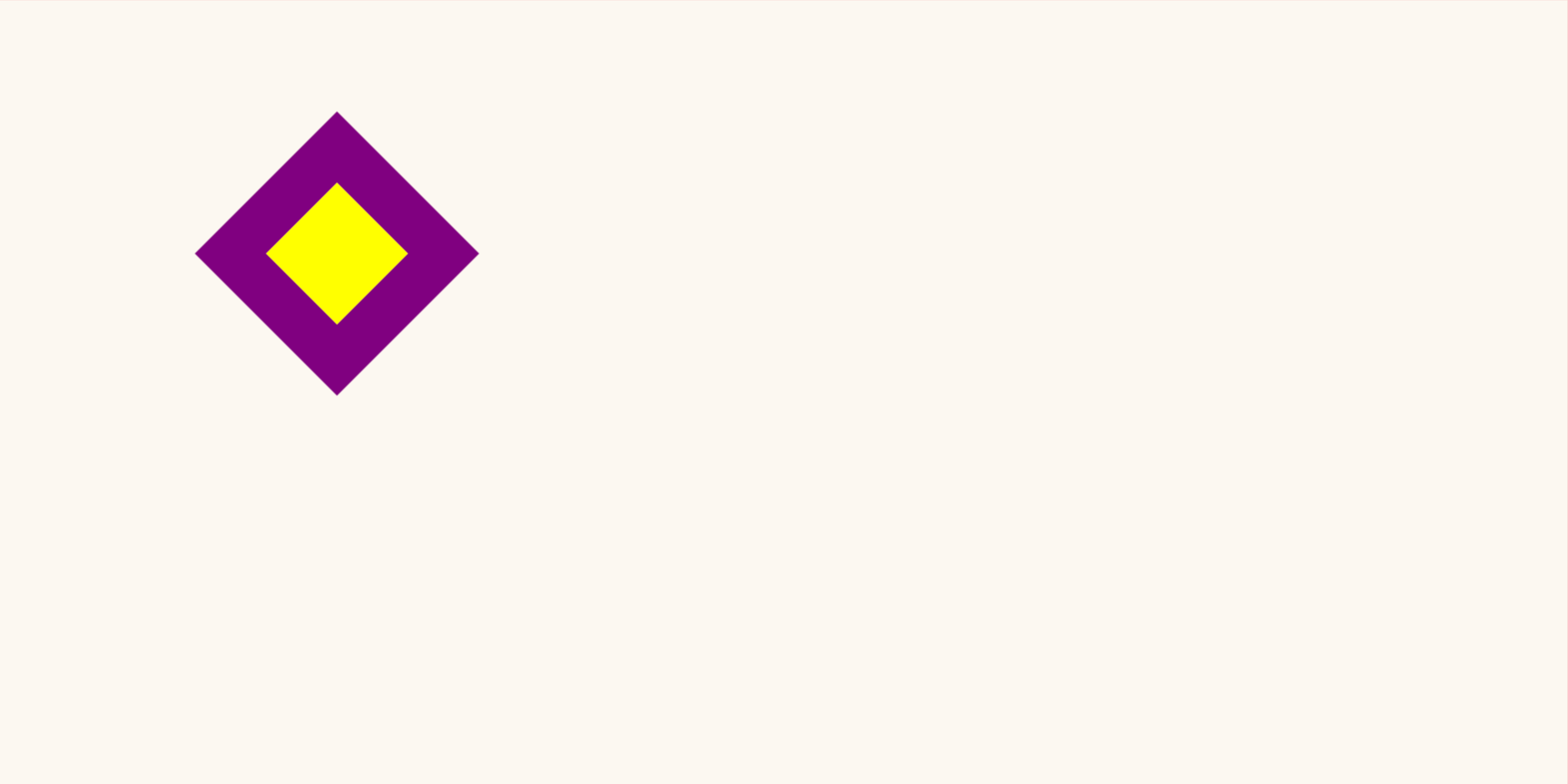
```
<body>
   <div>
      <svg width=“800” height=“400”>
         <g>
            <rect x=“80” y=“40”
                   width=“80” height=“80”
                   style=“fill: purple;” ></rect>
            <rect x=“100” y=“60”
                   width=“40” height=“40”
                   style=“fill: yellow;” ></rect>
         </g>
      </svg>
   </div>
</body>
```



THE SVG CANVAS - GROUPING



```
<body>
   <div>
      <svg width=“800” height=“400”>
         <g transform=“
                 translate(20,30)
                 scale(1.5,1.5)
                 rotate(45,120,80)
               ”>
            <rect x=“80” y=“40”
                    width=“80” height=“80”
                    style=“fill: purple;” ></rect>
            <rect x=“100” y=“60”
                    width=“40” height=“40”
                    style=“fill: yellow;” ></rect>
         </g>
      </svg>
   </div>
</body>
```



JAVASCRIPT REFRESHER

- Understand basic Javascript concepts
- Implement higher-order functions
- Include and run Javascript in webpages
- Debug Javascript via browser console

JS - WEB BROWSER CONSOLE

https://webmasters.stackexchange.com/questions/8525/how-do-i-open-the-javascript-console-in-different-browsers

JS - VARIABLES AND DATA STRUCTURES

Constants and Variables

```
/** Constants **/
const name = “Hamza”;
const age = 26, favColor = “blue”;



/** Variables **/
let name = “Zack”;
let age = 28, favColor = “white”;

favColor = “green”;
```

Arrays

```
let arr = [‘this’, ’is’, ’an’, ‘array’];

let empty = [ ]; // an empty array

// unfortunately, you can declare arrays
// with elements of varying type
let multi = [0, “This”, “is”, true, “…”];

// you can access an array’s length
let multiLength = multi.length;

//you can nest arrays
let nested = [ [1,2], [3,4], [5,6] ];

//extend arrays
arr.push(‘:)’);

//remove the last element
let lastElem = multi.pop();

//find index of entry
let index = arr.indexOf(”is”);
```

Objects

```
let obj = {
    key1: “value1”,
    key2: “value2”
}

//accessing object members
obj[ “key1” ];
obj.key1;

//dynamically extend objects
obj.key3 = 3;
```

JS - CONTROL STRUCTURES

If statements

```
if (23 == parseFloat(“23”)) {
    console.log( “First if”);
}
else if (24 == parseFloat(“25”)) {
    console.log(“Else if”);
}
Else {
    console.log(“Else”);
}
```

Ternary if operator

```
CONDITION
            ? HAPPENS_IF_TRUE
            : HAPPENS_IF_FALSE

4 % 2 == 0
            ? console.log(true)
            : console.log(false);
```

Switch statements

```
let c = “some case”;

switch(c) {
    case ”a possible case”:
            console.log(“first case”);
            break;
    case “some case”:
            console.log(“second case”;
            break;
    default:
            console.log(“default case”);
}
```

JS - LOOPS

For loops

```
let output = “”;

for (let i = 0; i < 10; ++i){
    output += i + “, “;
}

console.log(“For loop: “ + output);
```

While loops

```
let i = 3, output = “”;

while( i < 100) {
    output += i + “, ”;
    i = i * 2;
}

console.log(“While loop: “ + output);
```

ForEach loops

```
let skills = [
    “Javascript”,
    “d3.js”,
    “HTML”,
    ”CSS”
];

skills.forEach(function(elem, index){
    console.log(index + “: “ + elem);
})
```

JS - FUNCTIONS

Standard functions

```
function double( num ) {
    // x is only available inside this
    // function’s scope
    let x = 2;
    return x*num;
}
```

Functions as variables

```
let parity = function( num ) {
    if (num % 2 == 0) {
            return “even”;
    }
    else {
            return “odd”;
    }
}
```

Arrow Function Expressions

```
let divide = (num1, num2) => {
    return num1 / num2;
}

let multiply =
    (num1, num2) => num1*num2;

let halve = num => num / 2;
```

JS - HIGHER ORDER FUNCTIONS

Functions as Arguments

```
function applyFunc(input, func) {
    return func(input);
}

function addTwo(x) {
      return x+2;
}

applyFunc(3, addTwo);

applyFunc( 3, function(x){
    return x/2;
});

applyFunc( 3, x => 2*x );
```

Map, Filter, Reduce

```
let numList = [2,3,4];

numList.map(function(x){
    return 3*x;
})

numList.filter(function(x){
    return x % 2 == 0;
})

let sentenceElements = [
    ”This”,
    ”is”,
    “a”,
    “sentence.”
];

sentenceElements.reduce(
   (acc, curr) => acc + curr,
   “”
)
```

Sort

```
let names = [“Zack”, “Hamza”];

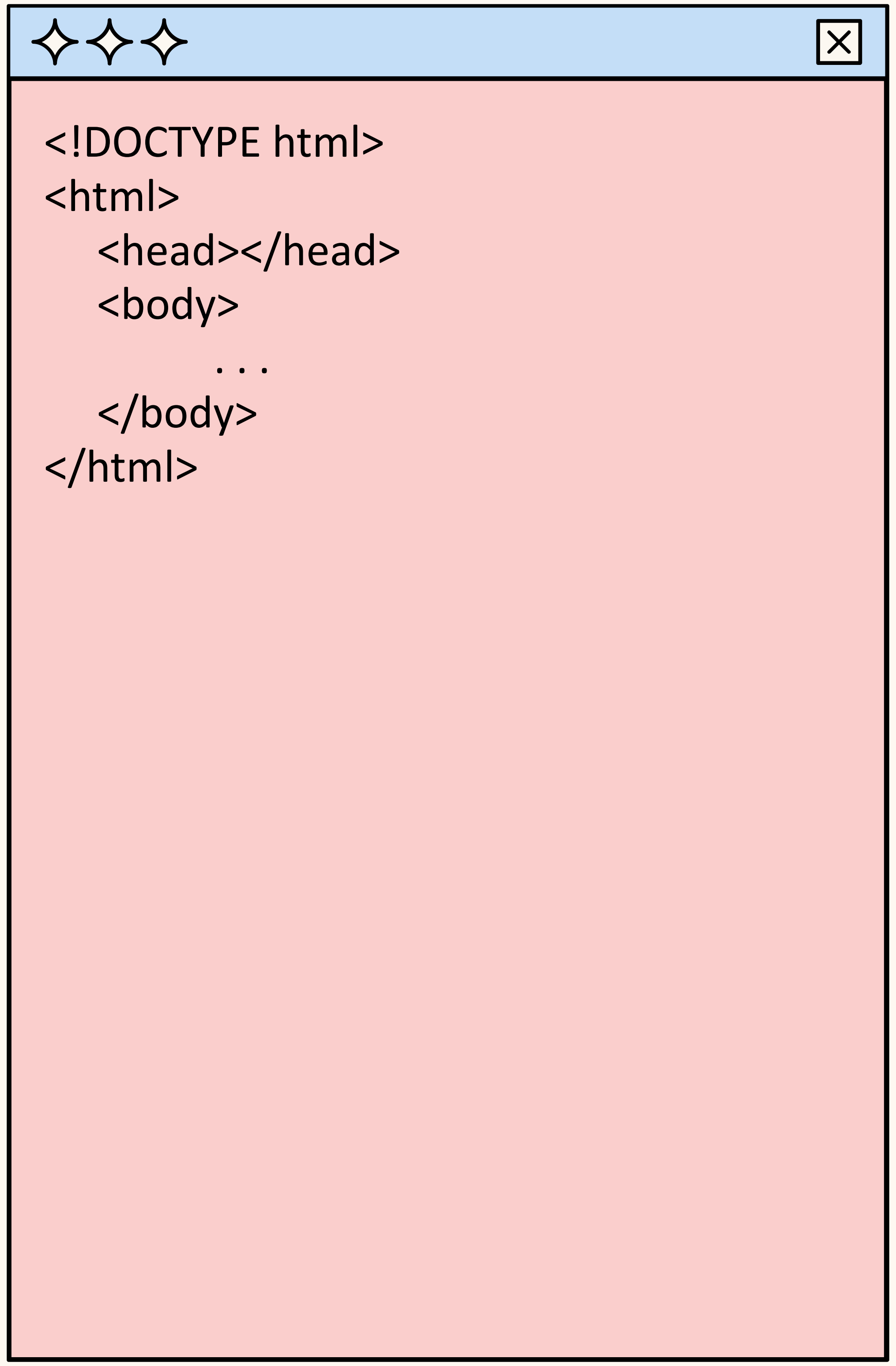
names.sort();

let products = [
    { name: “laptop”, price: 1400 },
    { name: “phone”, price: 1000 },
    { name: “tv”, price: 800 }
]

// sort ascending by ‘price’
products.sort(function(a,b) {
    return a.price - b.price;
})

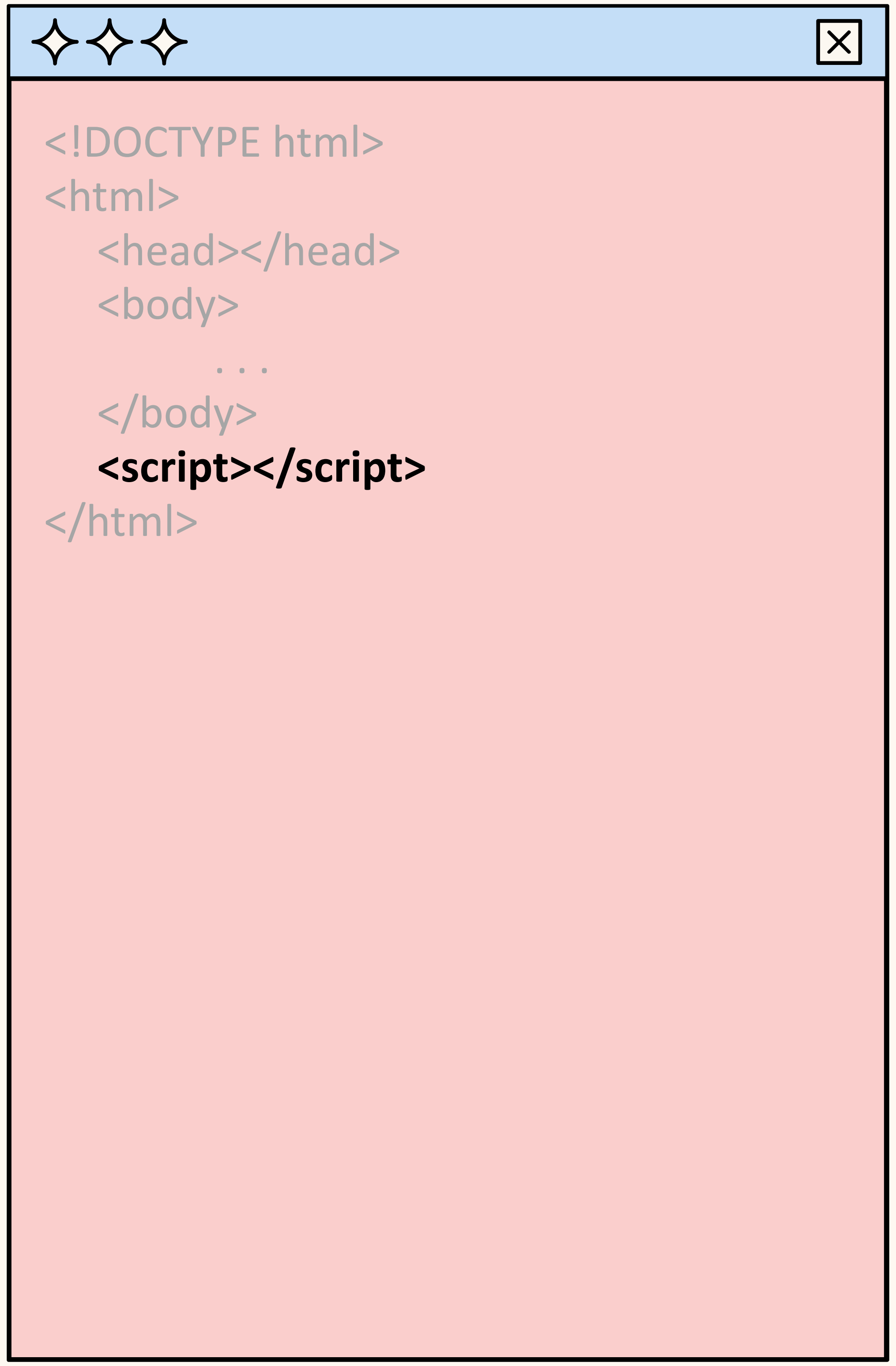
// sort descending by ‘price’
products.sort(function(a,b) {
    return b.price - a.price;
})
```

JAVASCRIPT IN HTML



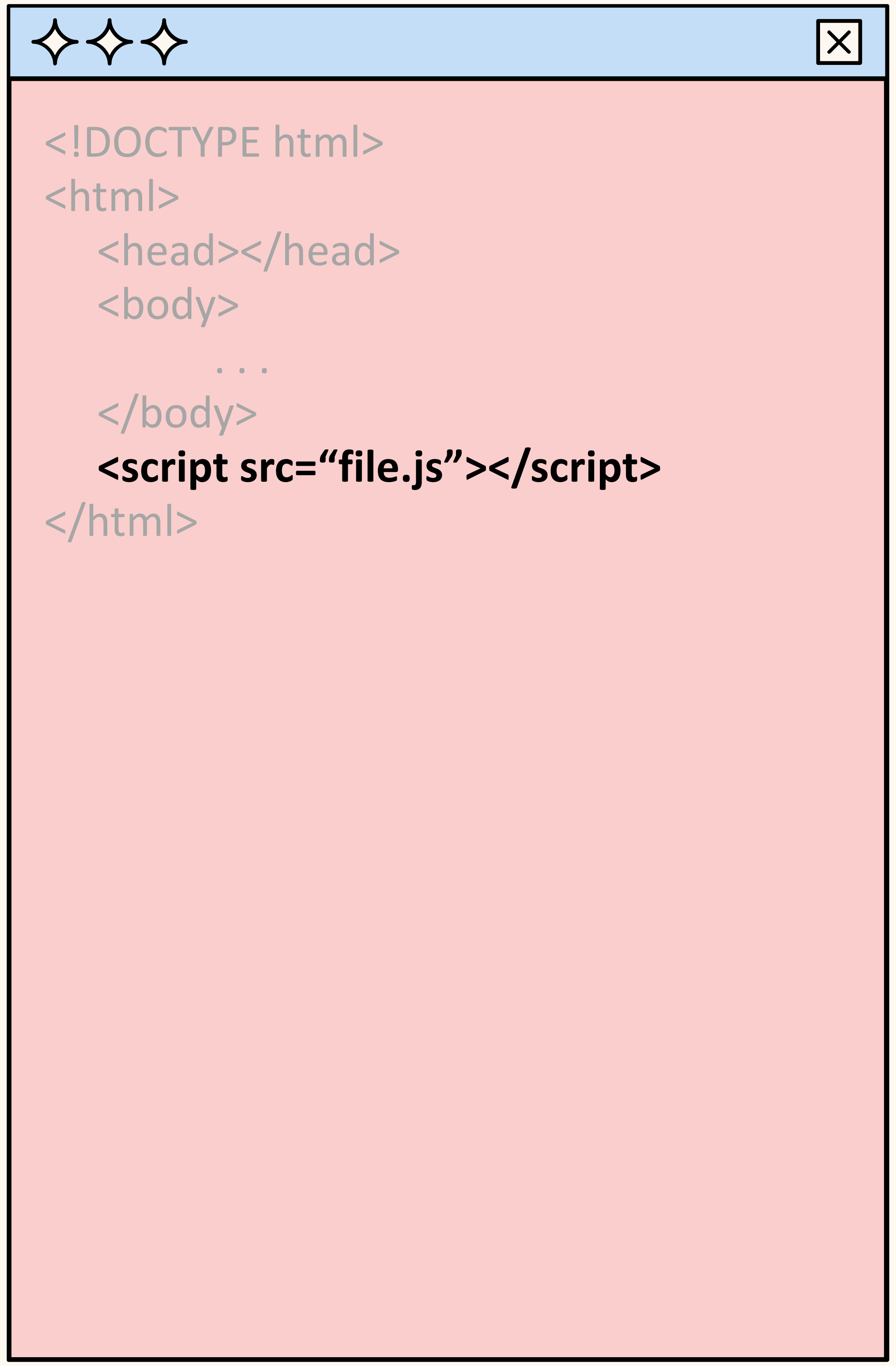
```
<!DOCTYPE html>
<html>
    <head></head>
    <body>
            . . .
    </body>
</html>
```

JAVASCRIPT IN HTML



```
<!DOCTYPE html>
<html>
    <head></head>
    <body>
            . . .
    </body>
    <script></script>
</html>
```

JAVASCRIPT IN HTML



```
<!DOCTYPE html>
<html>
    <head></head>
    <body>
            . . .
    </body>
    <script src="file.js"></script>
</html>
```

USING D3

- Understand basic D3 concepts
- Integrate D3 into a website
- Run python server to serve D3 website

SIMPLE HTTP SERVER

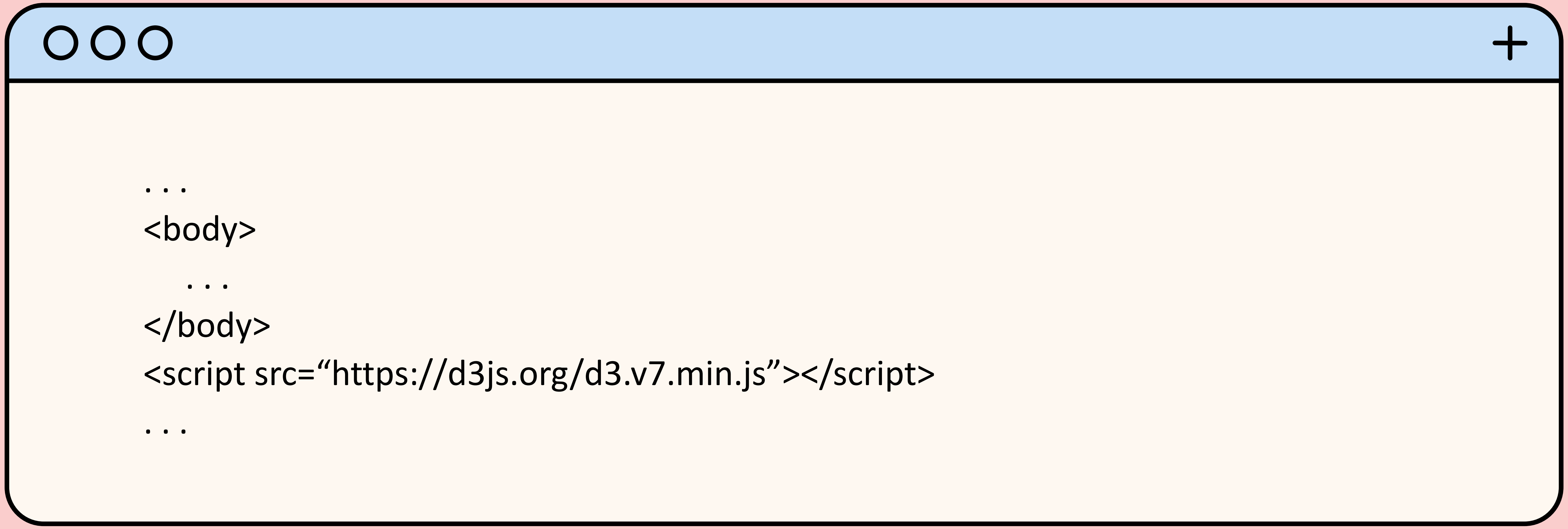
WHAT IS D3?

- **Load** data into a browser's memory
- **Bind** data to HTML elements
- **Create** new HTML elements dynamically
- **Transform** those elements
- **Transition** elements between states in response to user input

WHAT IS D3?

- **Load** data into a browser’s memory
- **Bind** data to HTML elements
- **Create** new HTML elements dynamically
- **Transform** those elements
- **Transition** elements between states in response to user input

INCLUDING D3 IN HTML



```
. . .
<body>
    . . .
</body>
<script src=“https://d3js.org/d3.v7.min.js”></script>
. . .
```

D3 - LOADING DATA FILES

```
d3.csv(“file.csv”);

d3.json(“file.json”);

d3.tsv(“file.tsv”);
```

Data Loading is Asynchronous

```
d3.csv( csvfile )
   .then(function(data){
          /* code that depends on
             the data should only
             be contained within
             this function */
   })

/* code here might run before d3.csv
loads the data */

/* code here will also not have access to
the data */
```

D3 - METHOD CHAINING

Chained Code

```
d3.selectAll( “circle” )
          .attr(“r”, 10)
          .style(“fill”, “#000”)
```

Non-chained code

```
let circles = d3.selectAll(“circle”);

circles.attr(“r”, 10);

circles.style(“fill”, “#000”);
```

D3 - SELECTIONS

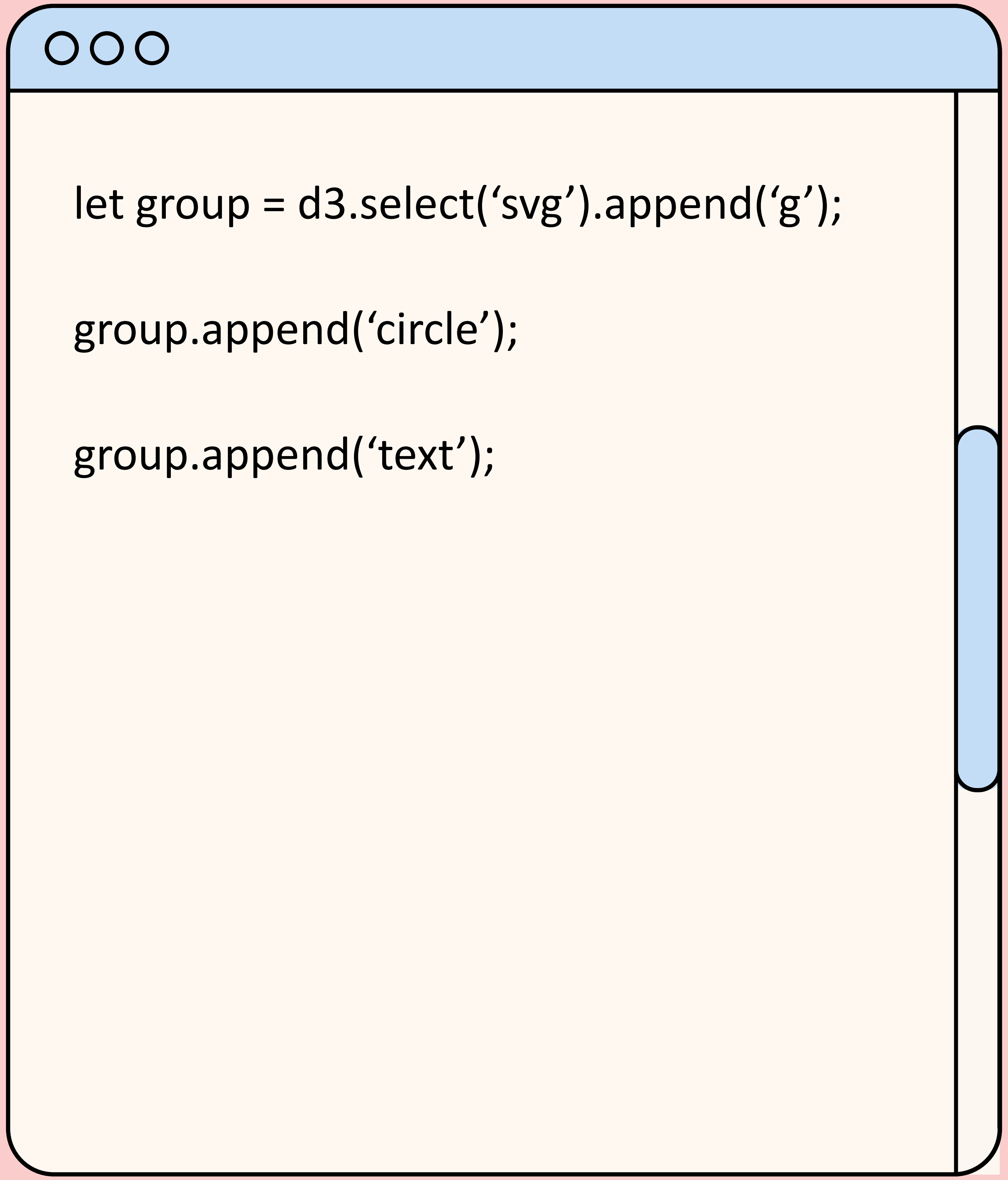
```
d3.select(‘p’)
          .style(‘font-size’, 20)
          .text(‘First Paragraph’);

// Only selects the first paragraph element
```

```
d3.selectAll(‘p’)
          .style(‘font-size’, 20);

// Selects all paragraph elements
```

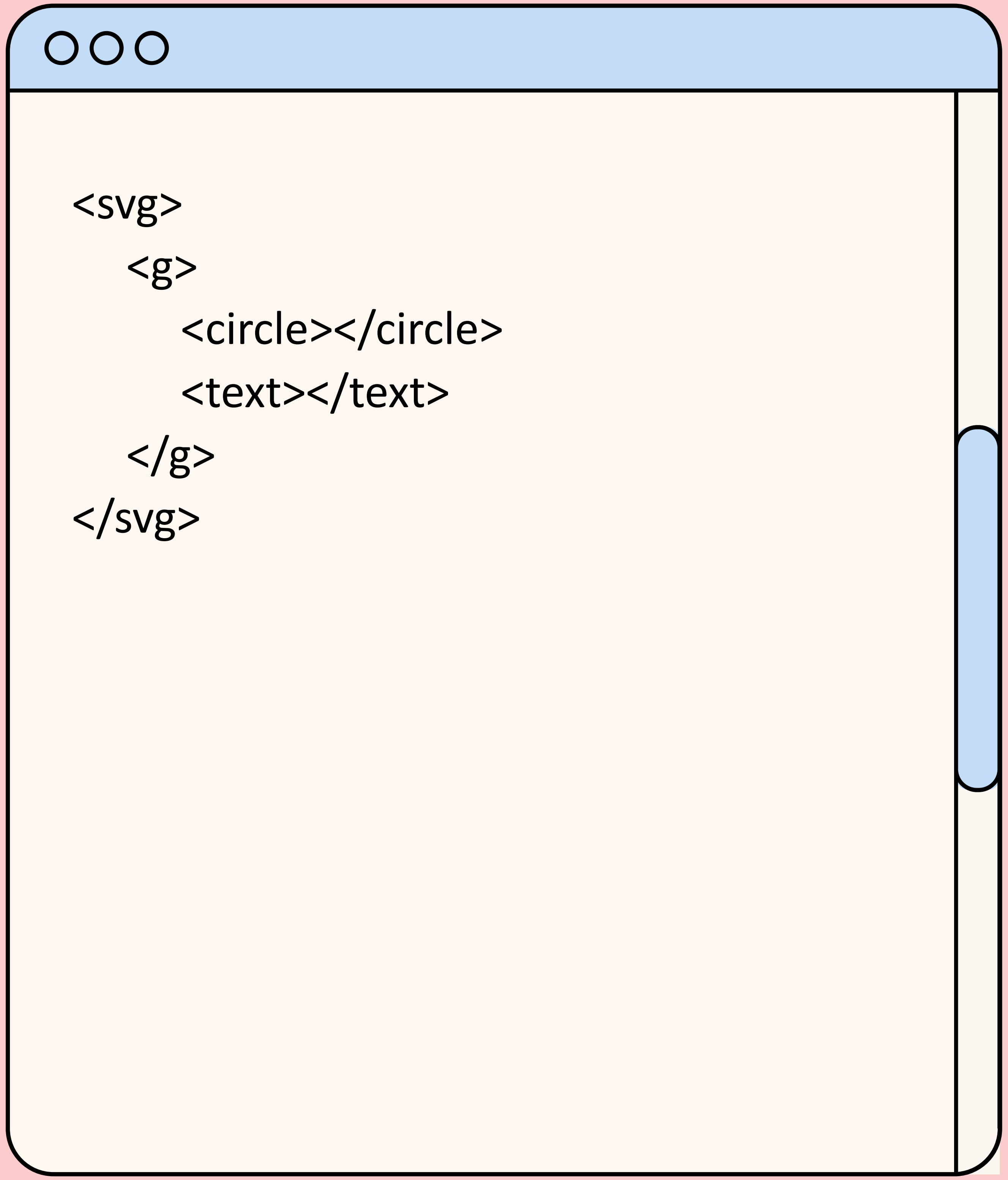
D3 - APPEND ELEMENTS



```
let group = d3.select(‘svg’).append(‘g’);

group.append(‘circle’);

group.append(‘text’);
```



```
<svg>
    <g>
        <circle></circle>
        <text></text>
    </g>
</svg>
```

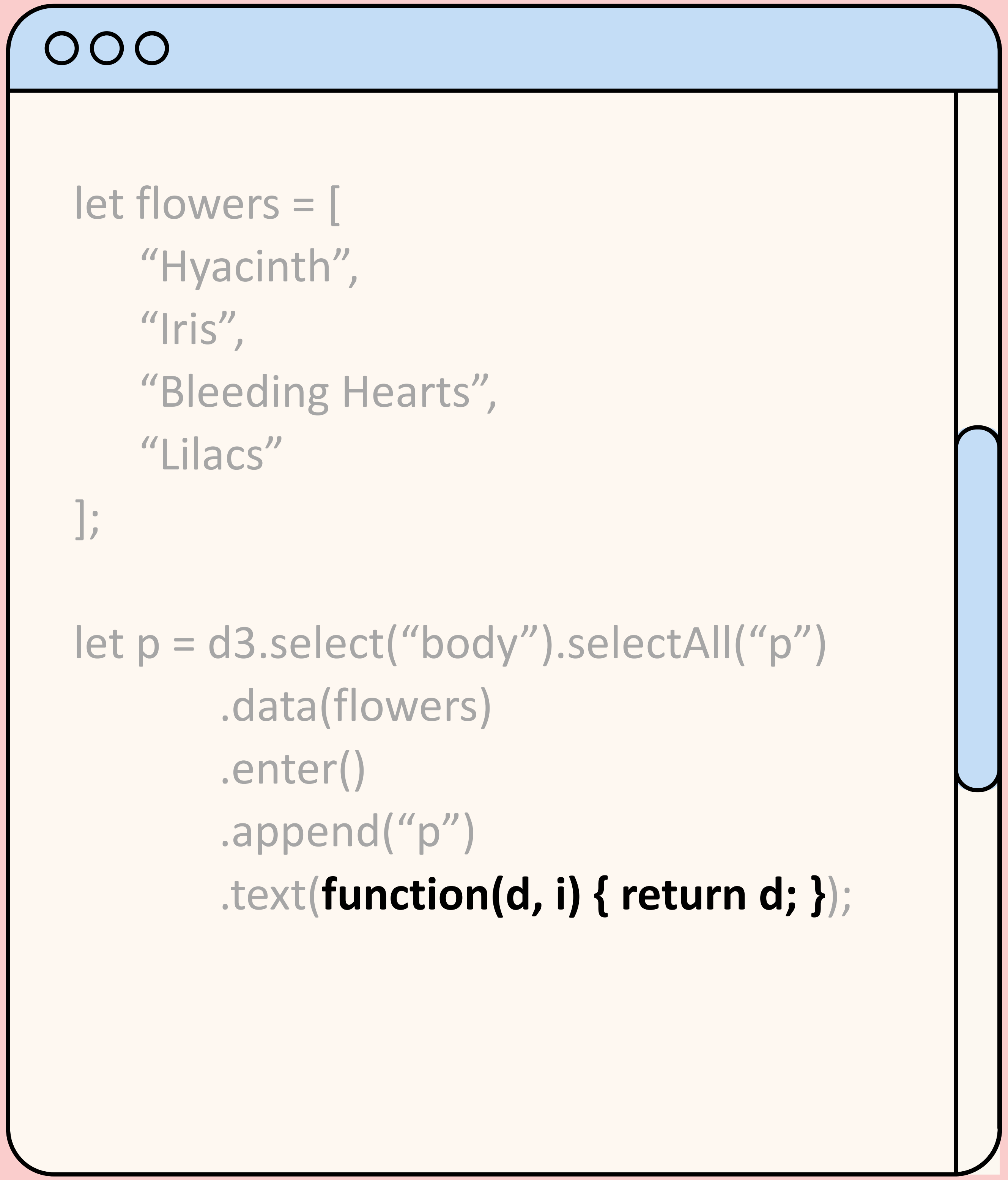
D3 - BIND DATA

```
let flowers = [
     “Hyacinth”,
     “Iris”,
     “Bleeding hearts”,
     “Lilacs”
];

let p = d3.select(“body”).selectAll(“p”)
          .data(flowers)
          .enter()
               .append(“p”)
               .text(“Array Element”);
```

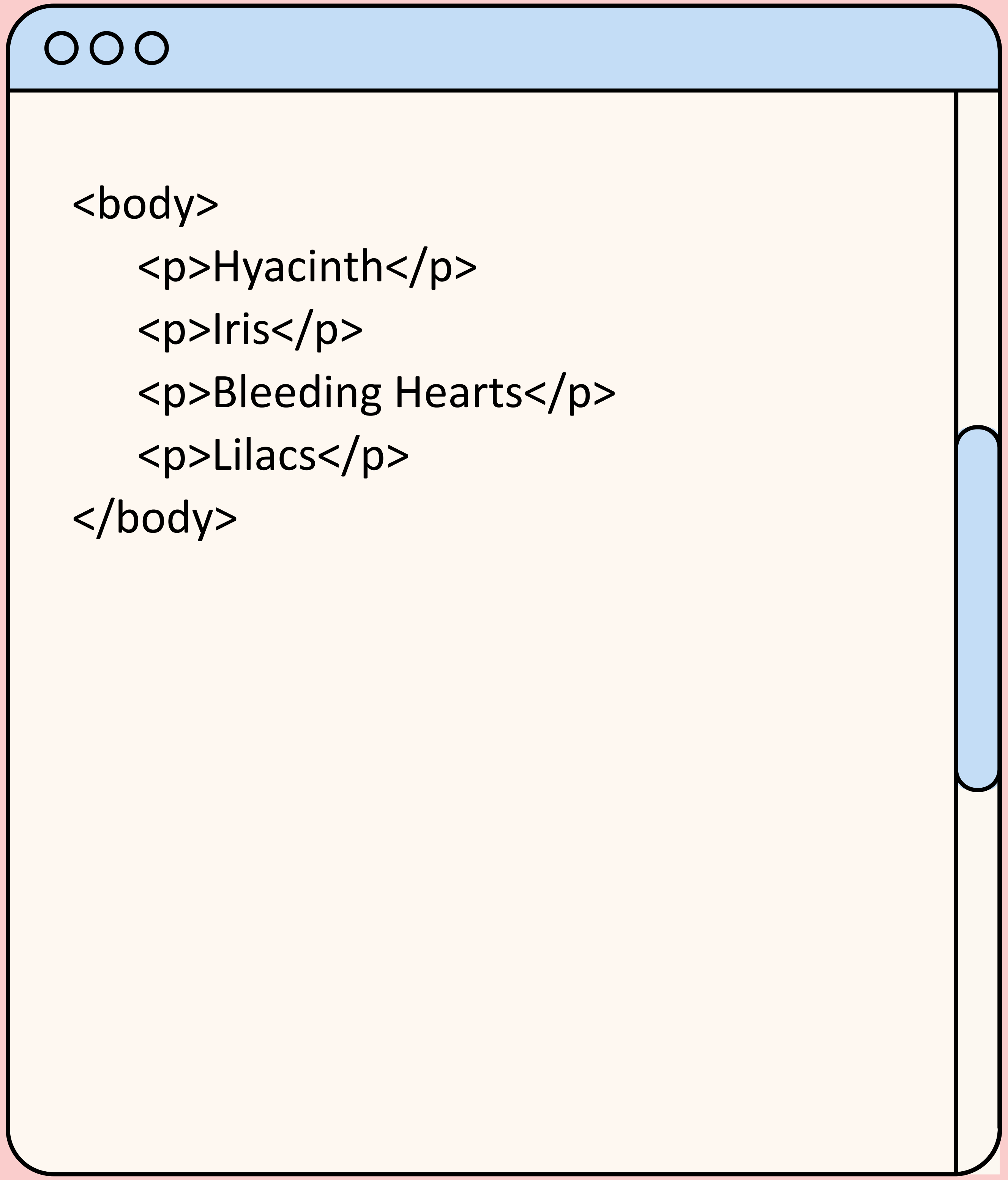
```
<body>
     <p>Array Element</p>
     <p>Array Element</p>
     <p>Array Element</p>
     <p>Array Element</p>
</body>
```

D3 - BIND DATA



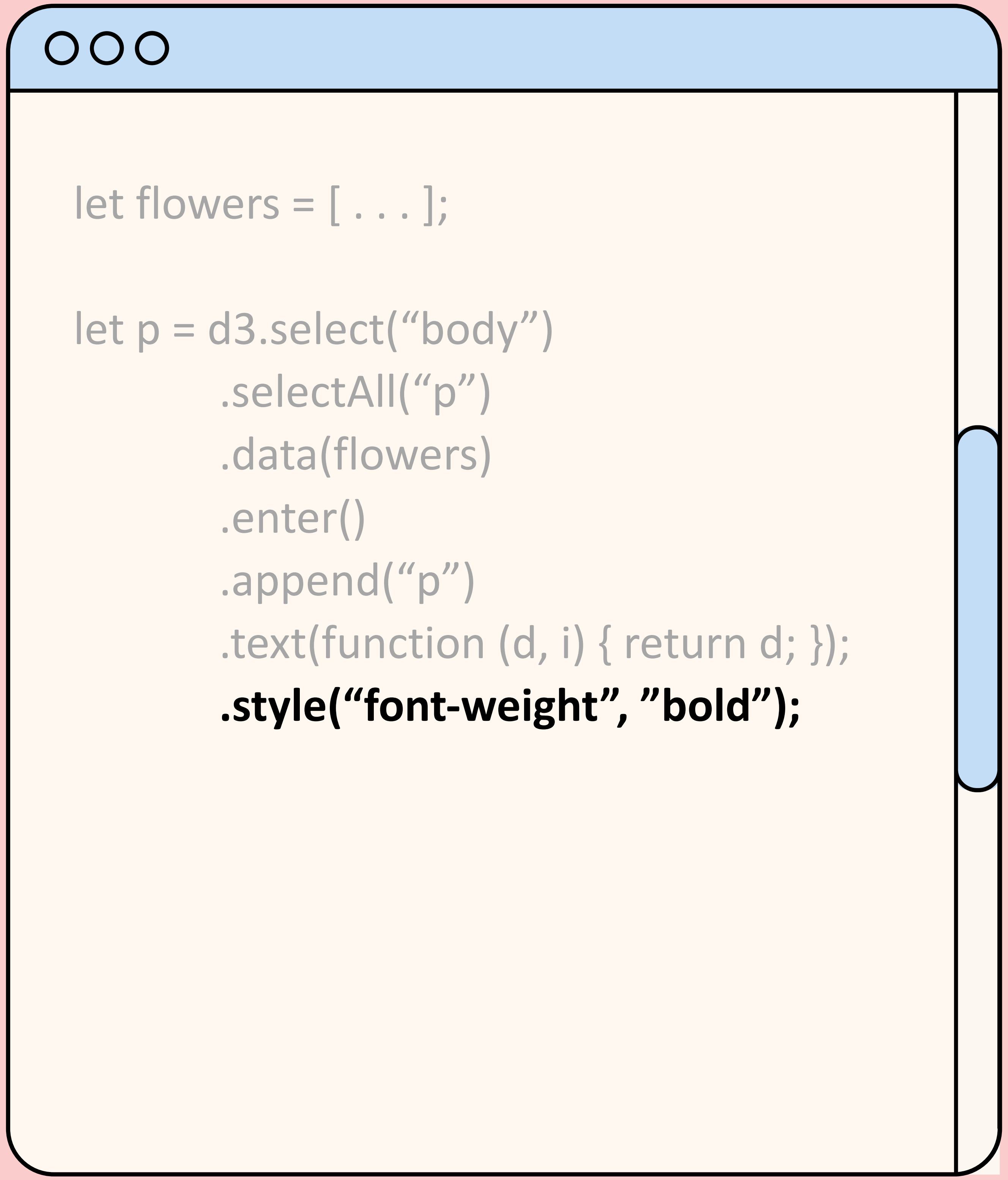
```
let flowers = [
     “Hyacinth”,
     “Iris”,
     “Bleeding Hearts”,
     “Lilacs”
];

let p = d3.select(“body”).selectAll(“p”)
           .data(flowers)
           .enter()
           .append(“p”)
           .text(function(d, i) { return d; });
```



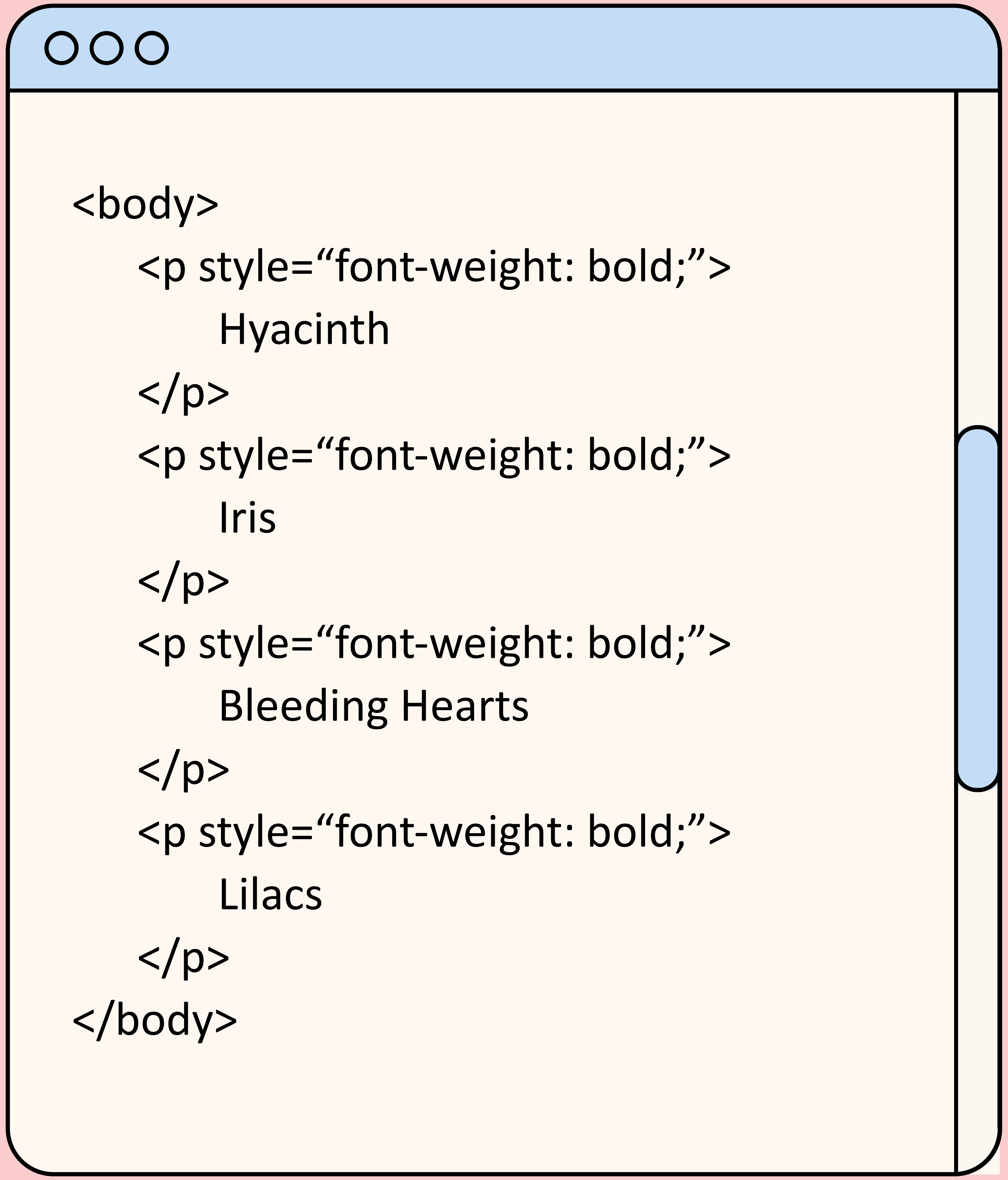
```
<body>
     <p>Hyacinth</p>
     <p>Iris</p>
     <p>Bleeding Hearts</p>
     <p>Lilacs</p>
</body>
```

D3 - STYLING



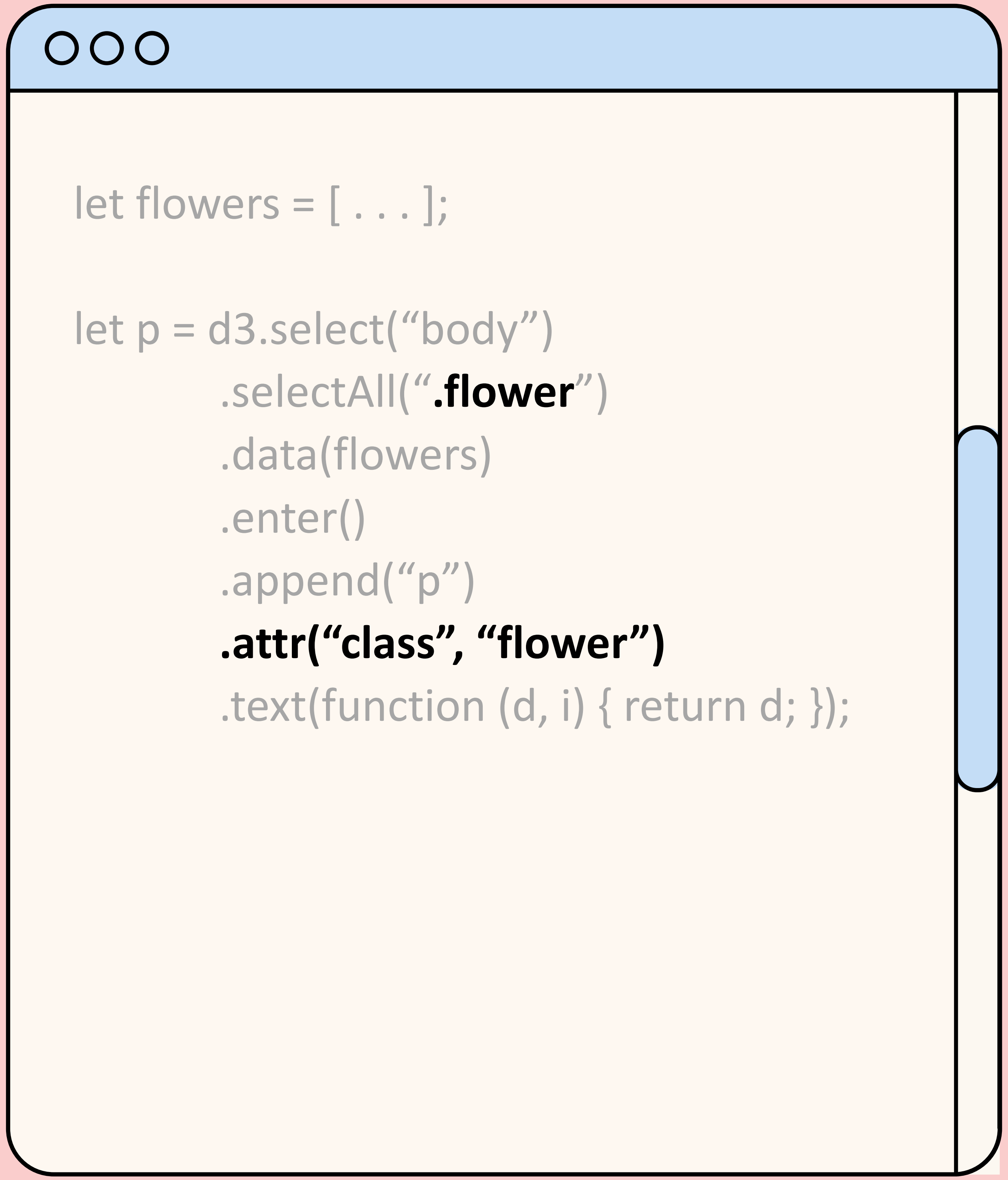
```
let flowers = [ . . . ];

let p = d3.select(“body”)
          .selectAll(“p”)
          .data(flowers)
          .enter()
          .append(“p”)
          .text(function (d, i) { return d; });
          .style(“font-weight”, ”bold”);
```



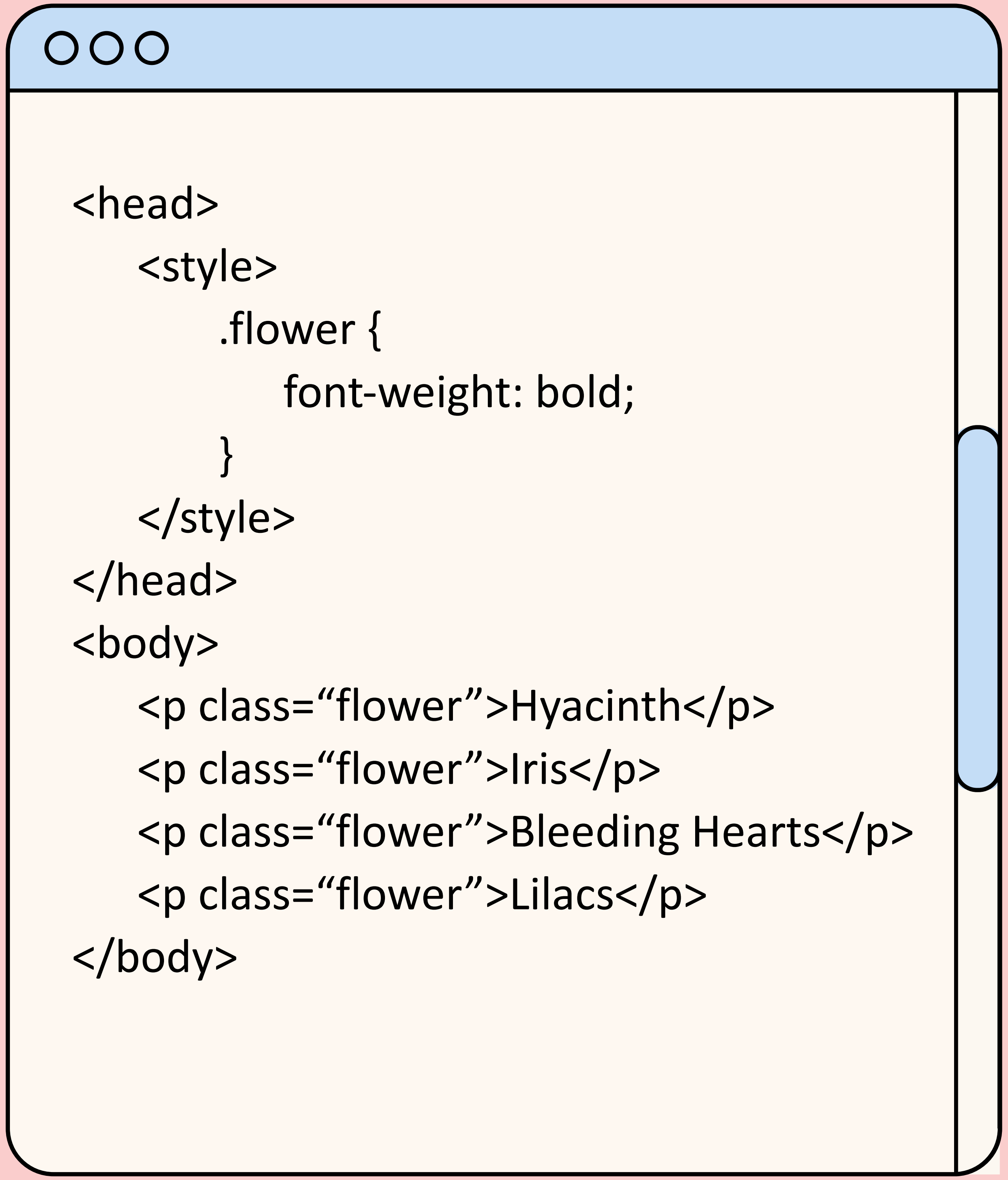
```
<body>
    <p style=“font-weight: bold;”>
         Hyacinth
    </p>
    <p style=“font-weight: bold;”>
         Iris
    </p>
    <p style=“font-weight: bold;”>
         Bleeding Hearts
    </p>
    <p style=“font-weight: bold;”>
         Lilacs
    </p>
</body>
```

D3 - STYLING



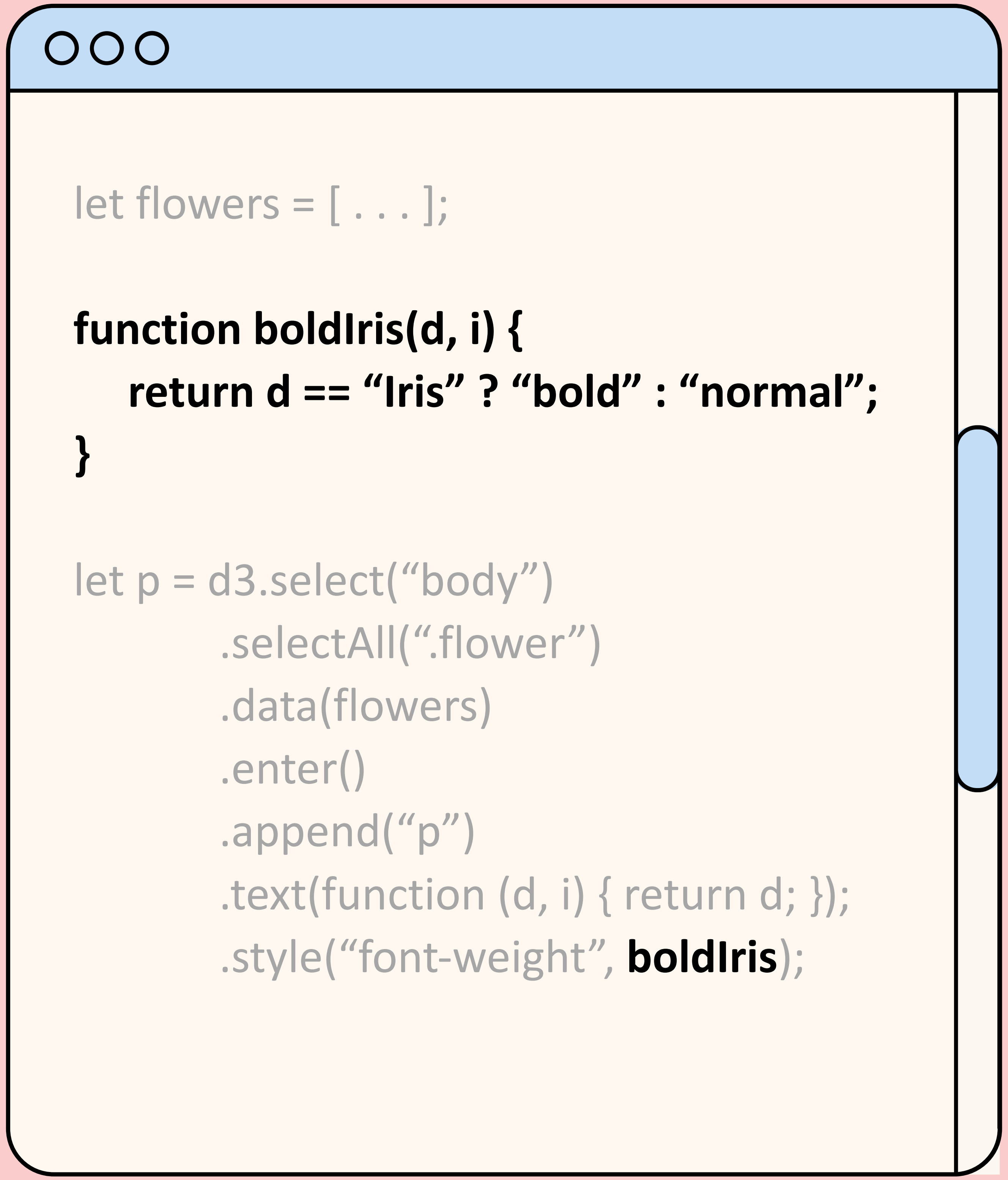
```
let flowers = [ . . . ];

let p = d3.select(“body”)
          .selectAll(“.flower”)
          .data(flowers)
          .enter()
          .append(“p”)
          .attr(“class”, “flower”)
          .text(function (d, i) { return d; });
```



```
<head>
    <style>
         .flower {
              font-weight: bold;
         }
    </style>
</head>
<body>
    <p class=“flower”>Hyacinth</p>
    <p class=“flower”>Iris</p>
    <p class=“flower”>Bleeding Hearts</p>
    <p class=“flower”>Lilacs</p>
</body>
```

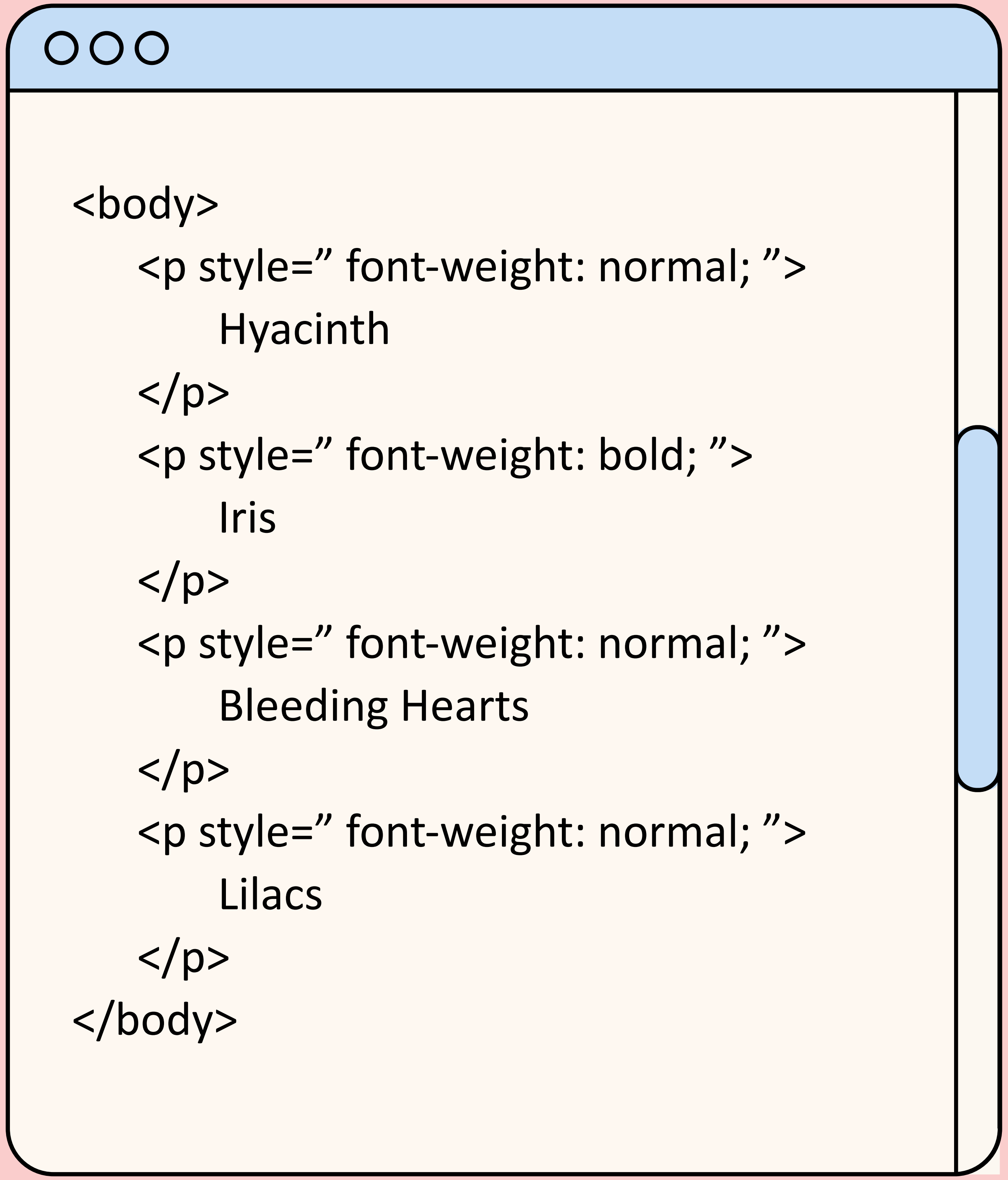
D3 - STYLING



```
let flowers = [ . . . ];

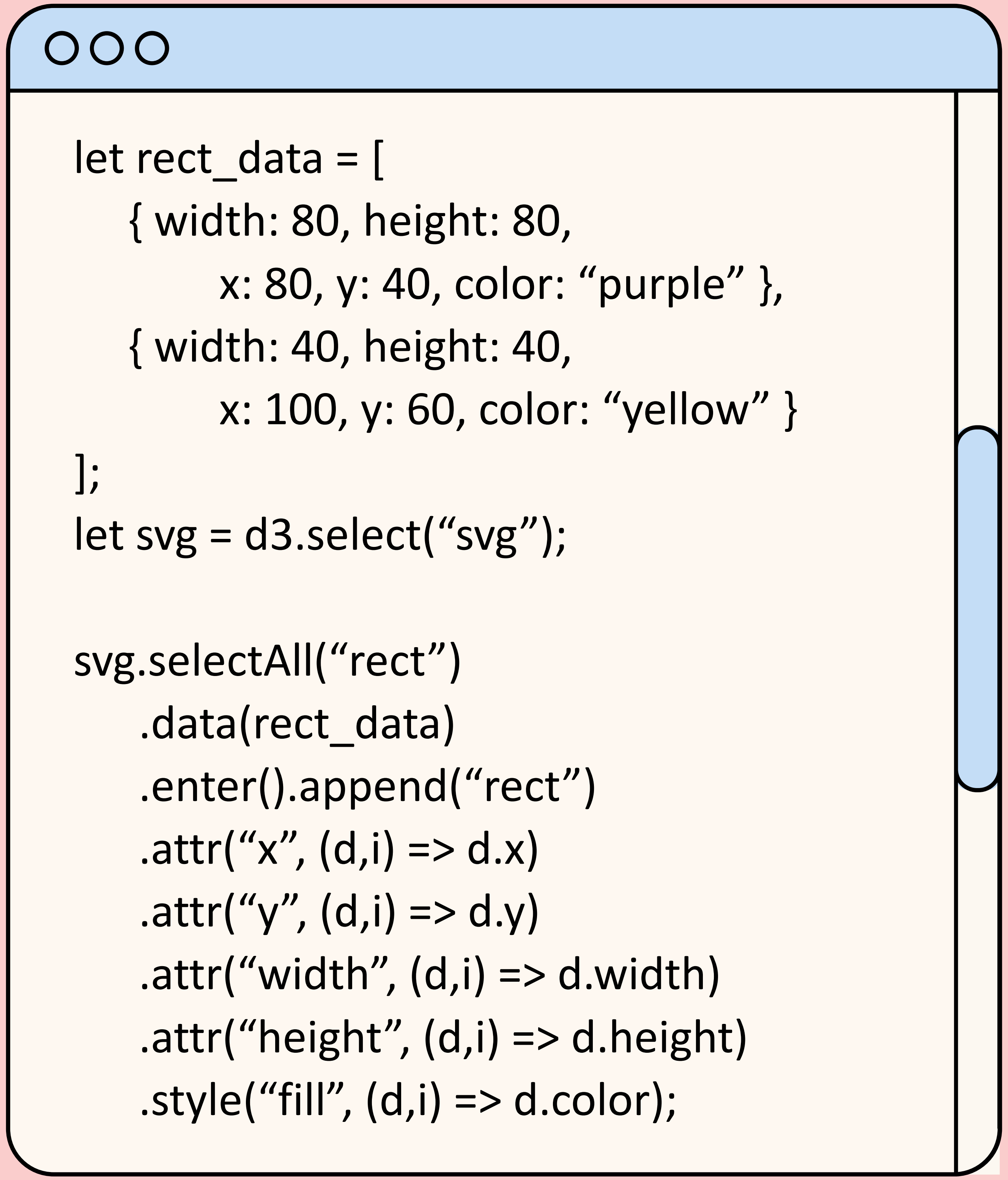
function boldIris(d, i) {
    return d == “Iris” ? “bold” : “normal”;
}

let p = d3.select(“body”)
          .selectAll(“.flower”)
          .data(flowers)
          .enter()
          .append(“p”)
          .text(function (d, i) { return d; });
          .style(“font-weight”, boldIris);
```

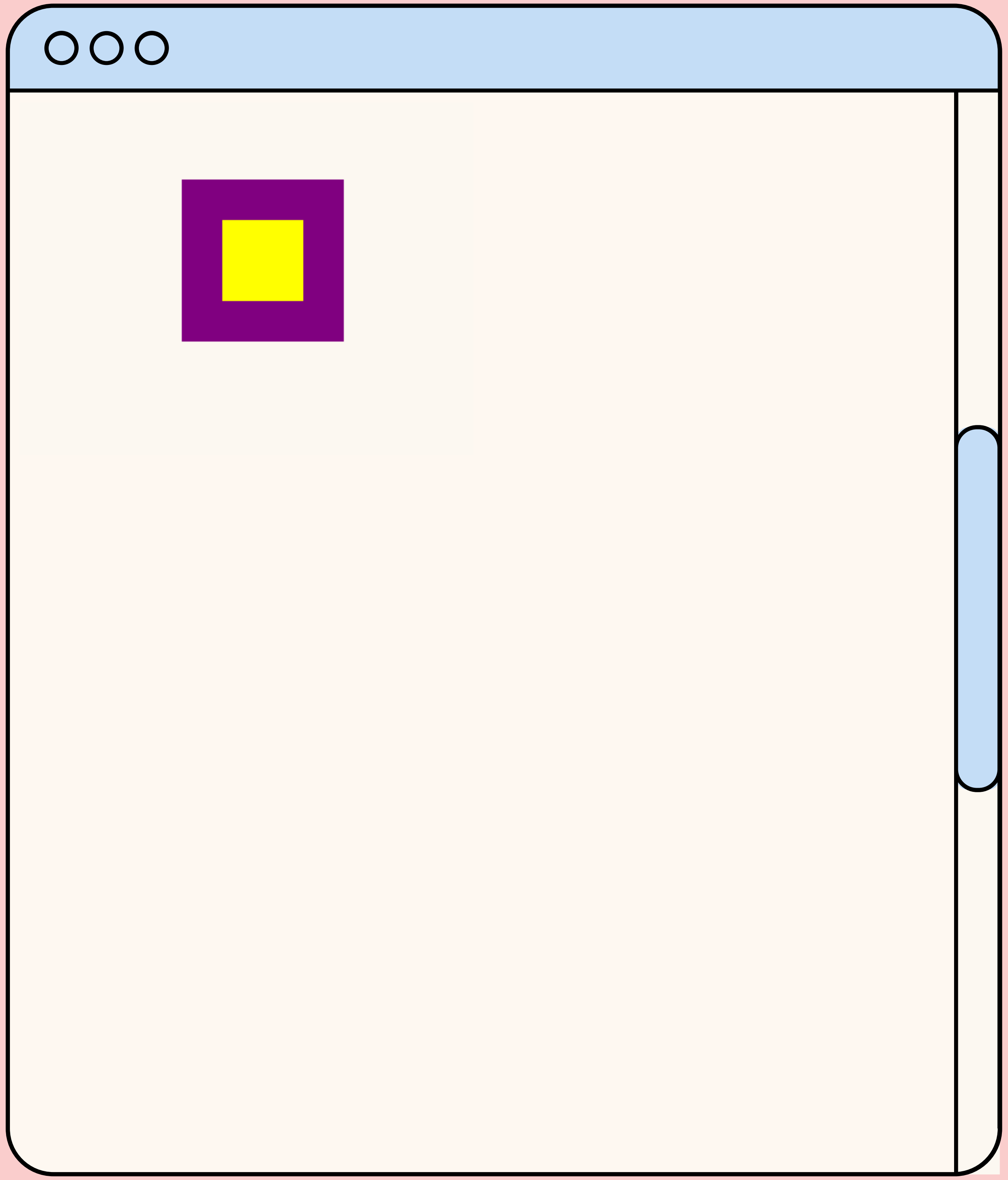


```
<body>
    <p style=” font-weight: normal; ”>
        Hyacinth
    </p>
    <p style=” font-weight: bold; ”>
        Iris
    </p>
    <p style=” font-weight: normal; ”>
        Bleeding Hearts
    </p>
    <p style=” font-weight: normal; ”>
        Lilacs
    </p>
</body>
```

D3 - SHAPES



```
let rect_data = [
    { width: 80, height: 80,
          x: 80, y: 40, color: “purple” },
    { width: 40, height: 40,
          x: 100, y: 60, color: “yellow” }
];
let svg = d3.select(“svg”);

svg.selectAll(“rect”)
     .data(rect_data)
     .enter().append(“rect”)
     .attr(“x”, (d,i) => d.x)
     .attr(“y”, (d,i) => d.y)
     .attr(“width”, (d,i) => d.width)
     .attr(“height”, (d,i) => d.height)
     .style(“fill”, (d,i) => d.color);
```