[Lesson 11]

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[DAN.IT EDUCATION]

What we learnt last time?

- Working with DOM
- DOM Tree
- Searching nodes

[Our targets for today]

- Working with DOM
- Inserting, moving, removing and cloning nodes
- Attributes
- Page Geometry

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Custom DOM Properties

- DOM nodes are regular JavaScript objects
- We can add our own properties and methods to them
- For instance, let's create a new property in document.body:

```
document.body.myData = {
    name: 'Ceaser',
    title: 'Emperor'
};
alert(document.body.myData.title); // Emperor
```

- We can also modify built-in prototypes like Element.prototype, and add new methods to all elements:

```
Element.prototype.sayHi = function () {
    alert(`Hello, I'm ${this.tagName}`);
};

document.documentElement.sayHi(); // Hello, I'm HTML
document.body.sayHi(); // Hello, I'm BODY
```

[HTML Attributes]

- When the browser loads the page, it “parses” HTML text and generates DOM objects from it
- For element nodes most standard HTML attributes automatically become properties of their corresponding DOM objects
- But the attribute-property mapping is not one-to-one!
  - For example, HTML attribute values are always strings while DOM properties are typed
  - If an HTML attribute is non-standard, there won’t be DOM-property for it
- All HTML attributes are accessible using following methods:
  - **elem.hasAttribute**(name) – checks for existence
  - **elem.getAttribute**(name) – gets the value
  - **elem.setAttribute**(name, value) – sets the value
  - **elem.removeAttribute**(name) – removes the attribute

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[HTML Attributes]

- Example for working with HTML attributes:

```
<div id="elem" about="Elephant"></div>
<script>
    alert(elem.getAttribute("about")); // 'Elephant', reading
    elem.setAttribute("Test", 123); // writing

    for (let attr of elem.attributes) { // list all attributes
        alert(`${attr.name} = ${attr.value}`);
    }
</script>
```

- The HTML attribute may differ from its corresponding DOM property, for example the style attribute is a string, but the style property is an object:

```
<div id="div" style="color:red;font-size:120%">Hello</div>
<script>
    alert(div.getAttribute('style')); // color:red;font-size:120%
    alert(div.style); // [object CSSStyleDeclaration]
    alert(div.style.color); // red
</script>
```

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HTML Custom Attributes

- There is a possible problem with custom attributes
- What if we use a non-standard attribute for our purposes, and later the standard introduces it and makes it do something?
- To avoid conflicts, there exist **data-*** attributes
- All attributes starting with “data-” are reserved for programmers’ use
- They are available in the **dataset** property:

```
<div id="elem" data-about="Elephants">
    <script>
        alert(elem.dataset.about); // Elephants
    </script>
</div>
```

- Multiword attributes like data-order-state become camel-cased: dataset.orderState

Exercise (1)

→ Write the code to select the element with data-widget-name attribute from the document and to read the attribute's value

```
<!DOCTYPE html>

<html>
<body>
    <div data-widget-name="menu">Choose the genre</div>

    <script>
        /* your code */
    </script>
</body>
</html>
```

[Element Style]

- The property elem.style is an object that corresponds to what's written in the "style" attribute
  - → Setting elem.style.width="100px" works as if we had in the attribute style="width:100px"
- For multi-word property, camel casing is used:

```
background-color => elem.style.backgroundColor
z-index => elem.style.zIndex
border-left-width => elem.style.borderLeftWidth
```

- For instance, the following script lets the user change the page's background color:

```
<script>
    document.body.style.backgroundColor = prompt('Background color?');
</script>
```

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[Mind the Units]

- CSS units must be provided in style values
- For instance, we should not set elem.style.top to 10, but rather to 10px

```
<div id="elem">
    Hello world
</div>

<script>
    // doesn't work!
    elem.style.margin = 20;
    alert(elem.style.margin); // '' (empty string, the assignment is ignored)

    // now add the CSS unit (px) - and it works
    elem.style.margin = '20px';
    alert(elem.style.margin); // 20px

    alert(elem.style.marginTop); // 20px
    alert(elem.style.marginLeft); // 20px
</script>
```

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Styles and Classes

- There are generally two ways to style an element:
  - Create a class in CSS and add it:
  - Write properties directly into style:
- CSS is always the preferred way – not only for HTML, but in JavaScript as well
- We should only manipulate the style property if classes “can’t handle it”
- For instance, style is acceptable if we calculate coordinates of an element dynamically and want to set them from JavaScript, like this:

```
let top = /* complex calculations */;
let left = /* complex calculations */;
elem.style.left = left; // e.g '123px'
elem.style.top = top; // e.g '456px'
```

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[className]

- In the ancient time, there was a limitation in JavaScript: a reserved word like "class" could not be an object property
- So the property “className” was introduced: **elem.className** corresponds to the "class" attribute
- For instance:

```
<h1 id="elem" class="header main"></h1>
<script>
    alert(elem.className); // header main
</script>
```

- If we assign something to elem.className, it replaces the whole strings of classes

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[classList]

- Sometimes we only want to add/remove a single class
- There's another property for that: **elem.classList**
- Methods of classList:
  - **elem.classList.add/remove**("class") – adds/removes the class
  - **elem.classList.toggle**("class") – if the class exists, then removes it, otherwise adds it
  - **elem.classList.contains**("class") – returns true/false, checks for the given class
- For instance:

```
<h1 id="elem" class="header main"></h1>
<script>
    elem.classList.add("article");
    alert(elem.className); // header main article
</script>
```

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[Computed Styles]

- The **style** property operates only on the value of the "style" attribute, without any CSS cascade
- So we can't read anything that comes from CSS classes using elem.style
- For instance, here style doesn't see the margin:

```
<head>
    <style>
        body {
            color: red;
            margin: 5px
        }
    </style>
</head>
<body>
    The red text
    <script>
        alert(document.body.style.color); // empty
        alert(document.body.style.marginTop); // empty
    </script>
</body>
```

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Computed Styles

→ The method **getComputedStyle**(element) returns an object with style properties, like elem.style, but with respect to all CSS classes:

```
<head>
    <style>
        body {
            color: red;
            margin: 5px
        }
    </style>
</head>
<body>
    The red text
    <script>
        let computedStyle = getComputedStyle(document.body);

        // now we can read the margin and the color from it
        alert(computedStyle.marginTop); // 5px
        alert(computedStyle.color); // rgb(255, 0, 0)
    </script>
</body>
```

Computed and Resolved Values

- There are two concepts in CSS:
  - A *computed* style value is the value after all CSS rules and CSS inheritance is applied, as the result of the CSS cascade. It can look like height:1em or font-size:125%.
  - A *resolved* style value is the one finally applied to the element. Values like 1em or 125% are relative. The browser takes the computed value and makes all units fixed and absolute, for instance: height:20px or font-size:16px
- Originally, getComputedStyle() was created to get computed values, but it turned out that resolved values are much more convenient, and the standard changed
- Nowadays getComputedStyle() returns the resolved value of the property

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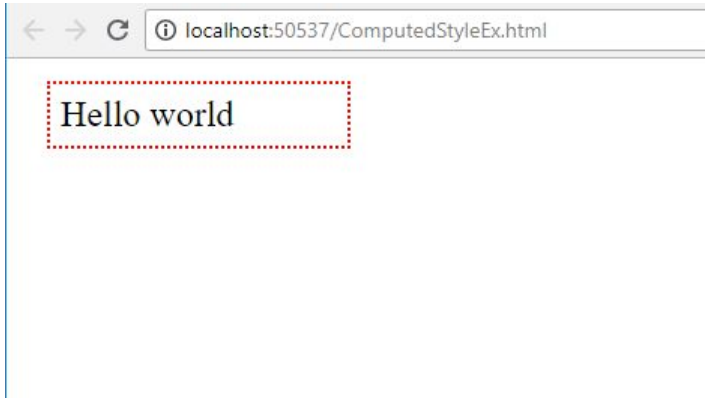
[Exercise (2)]

→ Move the following div 20px to the right, by increasing its margin-left property

→ Hint: first use getComputedStyle() to get its current marginLeft value

```
<head>
    <style>
        #div1 {
            border: red dotted 1px;
            width: 20%;
            margin: 10px;
            padding: 5px;
        }
    </style>
</head>
<body>
    <div id="div1">
        Hello world
    </div>
</body>
```



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Creating Elements

- **document.createElement(tag)** creates a new element with the given tag:

```
let div = document.createElement("div");
```

- After that, we have a ready DOM element
- To make the element show up, we need to insert it somewhere into document
- There are several methods for inserting a node into a parent element

Method	Description
parentElem.appendChild(*node*)	appends *node* as the last child of *parentElem*
parentElem.insertBefore(*node*, *nextSibling*)	inserts *node* before *nextSibling* into *parentElem*
parentElem.replaceChild(*node*, *oldChild*)	replaces *oldChild* with *node* among children

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Creating Elements

→ The following example adds a new <li> to the end of <ol>:

```
<ol id="list">
    <li>0</li>
    <li>1</li>
    <li>2</li>
</ol>

<script>
    let newLi = document.createElement("li");
    newLi.innerHTML = "Hello, world!";

    list.appendChild(newLi);
</script>
```

1. 0
2. 1
3. 2
4. Hello, world!

Creating Elements

→ The following code inserts a new list item before the second <li>:

```
<ol id="list">
    <li>0</li>
    <li>1</li>
    <li>2</li>
</ol>

<script>
    let newLi = document.createElement("li");
    newLi.innerHTML = "Hello, world!“;

    list.insertBefore(newLi, list.children[1]);
</script>
```

1. 0
2. Hello, world!
3. 1
4. 2

Insertion Methods

→ There is another set of methods that provide more flexible insertions:

Method	Description
node.append(...*nodes* or *strings*)	appends *nodes* or *strings* at the end of node
node.prepend(...*nodes* or *strings*)	inserts *nodes* or *strings* into the beginning of node
node.before(...*nodes* or *strings*)	inserts *nodes* or *strings* before the node
node.after(...*nodes* or *strings*)	inserts *nodes* or *strings* after the node
node.replaceWith(...*nodes* or *strings*)	replaces node with the given *nodes* or *strings*

[Insertion Methods]

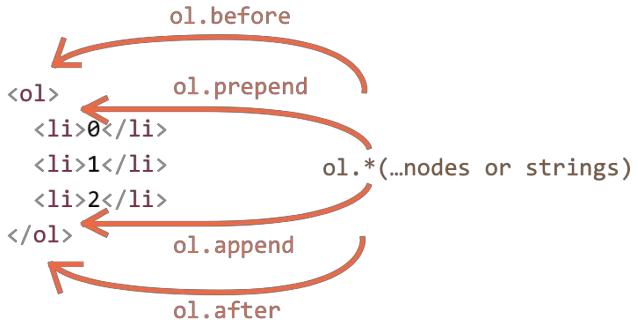
→ Here's an example of using these methods to add more items to a list and the text before/after it:

```
<ol id="list">
    <li>0</li>
    <li>1</li>
    <li>2</li>
</ol>

<script>
    list.before("before");
    list.after("after");

    let prepend = document.createElement("li");
    prepend.innerHTML = "prepend";
    list.prepend(prepend);

    let append = document.createElement("li");
    append.innerHTML = "append";
    list.append(append);
</script>
```



before

1. prepend
2. 0
3. 1
4. 2
5. append

after

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[Cloning Nodes]

- Sometimes when we have a big element, it may be faster and simpler to clone it rather than create a new element
- **elem.cloneNode(true)** creates a “deep” clone of the element
  - with all attributes and subelements
- **elem.cloneNode(false)** creates a clone without child elements

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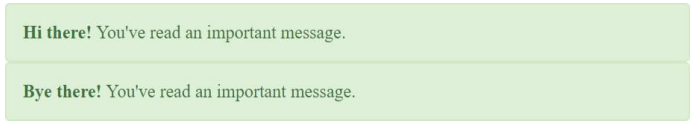
Cloning Nodes

→ An example of copying a tag showing a message:

```
<head>
    <style>
        .alert {
            padding: 15px;
            border: 1px solid #d6e9c6;
            border-radius: 4px;
            color: #3c763d;
            background-color: #dff0d8;
        }
    </style>
</head>
<body>
    <div class="alert" id="div">
        <strong>Hi there!</strong> You've read an important message.
    </div>
    <script>
        let div2 = div.cloneNode(true); // clone the message
        div2.querySelector('strong').innerHTML = 'Bye there!'; //
change the clone
        div.after(div2); // show the clone after the existing div
    </script>
</body>
```



Removal Methods

- To remove nodes, there are the following methods:

Method	Description
parentElem.removeChild(*node*)	removes *elem* from *parentElem* (assuming it's a child)
node.remove()	Removes the node from its place

- The second method is much shorter. The first one exists for historical reasons.
- For example, let's make our message disappear after a second:

```
<div class="alert" id="div">
    <strong>Hi there!</strong> You've read an important message.
</div>

<script>
    setTimeout(() => div.remove(), 1000);
</script>
```

Moving Nodes

- If we want to *move* an element to another place – there's no need to remove it from the old one.
- All insertion methods automatically remove the node from the old place
- For instance, let's swap elements:

```
<div id="first">First</div>
<div id="second">Second</div>

<script>
    // no need to call remove
    second.after(first); // take #second and after it - insert
    #first
</script>
```

Second
First

[Exercise (3)]

→ Create a function **clear(elem)** that removes everything from inside the element (but keeps the element itself)

```
<ol id="list">
    <li>Hello</li>
    <li>World</li>
</ol>

<script>
    function clear(elem) { /* your code */ }

    clear(list); // clears the list
</script>
```

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[Exercise (4)]

→ Write the code to insert the elements 2 and 3 between the two <li> here:

```
<ul id="ul">
    <li id="one">1</li>
    <li id="two">4</li>
</ul>
```

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[Exercise (5)]

- Write a function **createCalendar**(elem, year, month)
- The call should create a calendar for the given year/month and put it inside elem
- The calendar should be a table, where a week is <tr>, and a day is <td>
- The table top should be <th> with weekday names
- For instance, createCalendar(cal, 2018, 6) should generate in element cal the following calendar:

SU	MO	TU	WE	TH	FR	SA
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

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Element Geometry

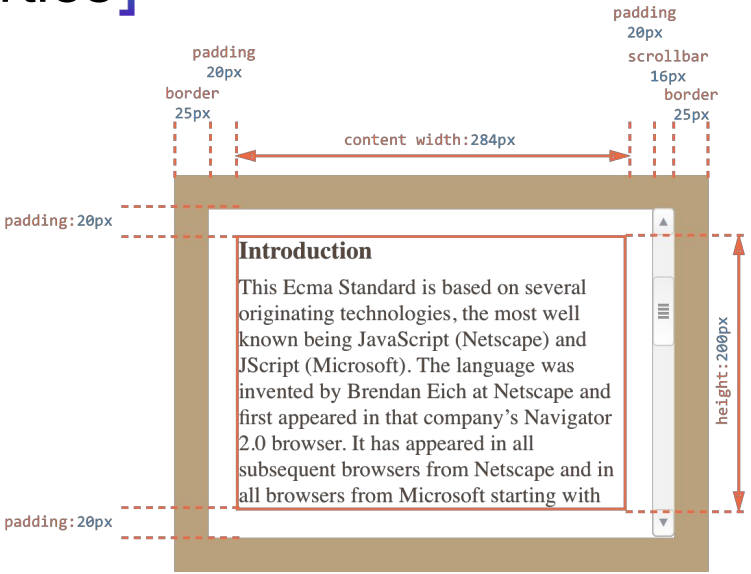
- There are many JavaScript properties that allow us to read information about element width, height and other geometry features
- We often need them when moving or positioning elements in JavaScript, to correctly calculate coordinates
- As a sample element to demonstrate properties we'll use the one given below:

```
#example {
    width: 300px;
    height: 200px;
    overflow: auto;
    border: 25px solid #E8C48F;
    padding: 20px;
}

<div id="example">
    ...Text...
</div>
```

[Element Geometry Properties]

- The element looks like this:



- Mind the scrollbar: most browsers reserve the space for it by taking it from the content, so if the scrollbar is 16px width (the width may vary between devices and browsers) then only 300 – 16 = 284px remains for the content

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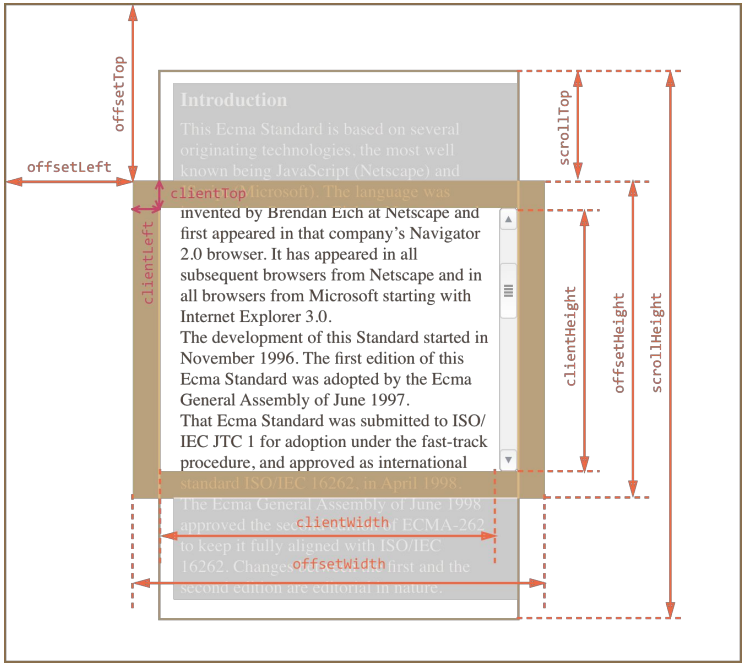
[Element Geometry Properties]

→ Element properties that provide width, height and other geometry are always numbers.

They are assumed to be in pixels.



[offsetParent, offsetLeft/Top]

- These are the “most outer” geometry properties
- The **offsetParent** is the nearest ancestor that is:
  - CSS-positioned (position is absolute, relative or fixed),
  - or <td>, <th>, <table>
  - or <body>
- **offsetLeft/offsetTop** provide x/y coordinates relative to the parent’s left-upper corner
- In the example below inner has <main> as offsetParent and offsetLeft/offsetTop shifts from its left-upper corner (180)

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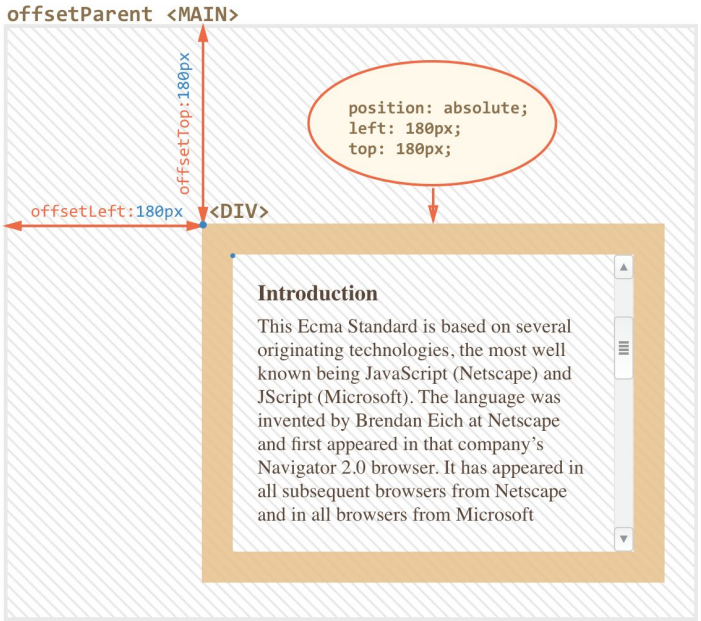
[offsetParent, offsetLeft/Top]

```
<main style="position: relative" id="main">
     <article>
          <div id="example" style="position: absolute; left:  180px; top: 180px">
               Text...
          </div>
     </article>
</main>
<script>
     alert(example.offsetParent.id); // main
     alert(example.offsetLeft); // 180 (note: a number, not a string "180px")
    alert(example.offsetTop); // 180
</script>
```



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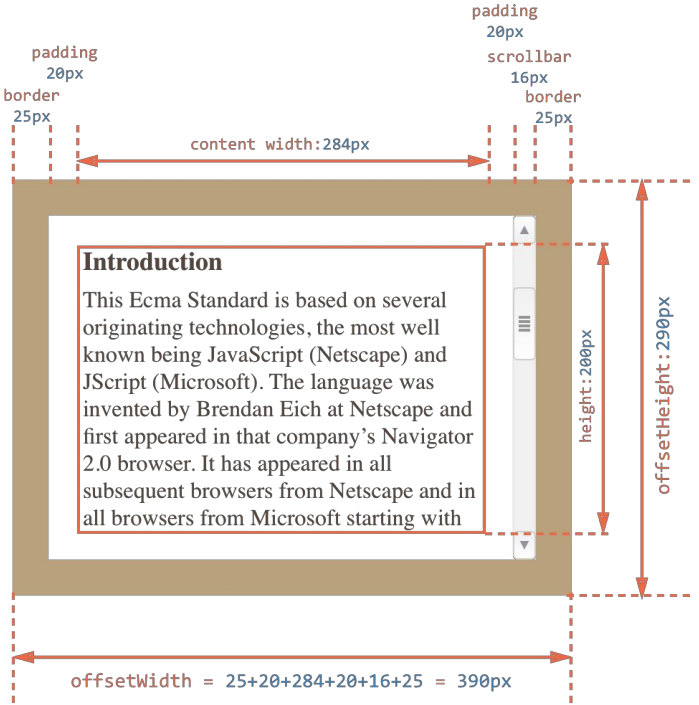
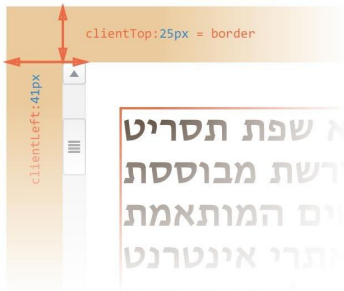
[offsetWidth/Height]

- The properties **offsetwidth** and **offsetheight** provide the “outer” width/height of the element, i.e., its full size including borders
- The offsetWidth is calculated as inner CSS- width (300px) plus paddings (2 * 20px) and borders (2 * 25px)



[clientTop/Left]

- The properties **clientTop** and **clientLeft** measure the border size
- In our example:
  - clientLeft = 25 – left border width
  - clientTop = 25 – top border width
- To be precise – they measure the relative coordinates of the inner side from the outer side
- When the document is right-to-left, the scrollbar is then on the left, and then clientLeft also includes the scrollbar width
  - e.g., in the page on the right the clientLeft also includes the scrollbar width: 25 + 16 = 41



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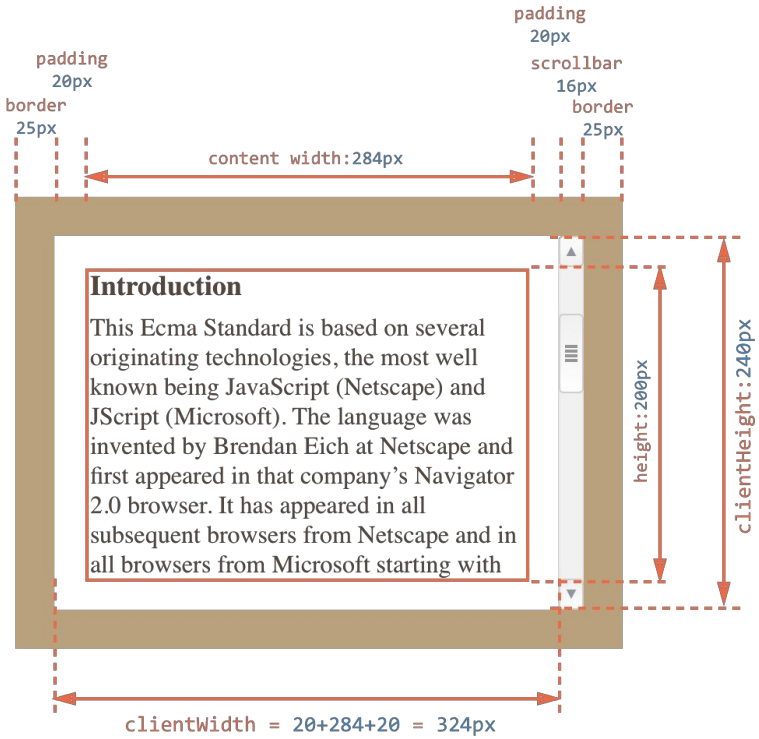
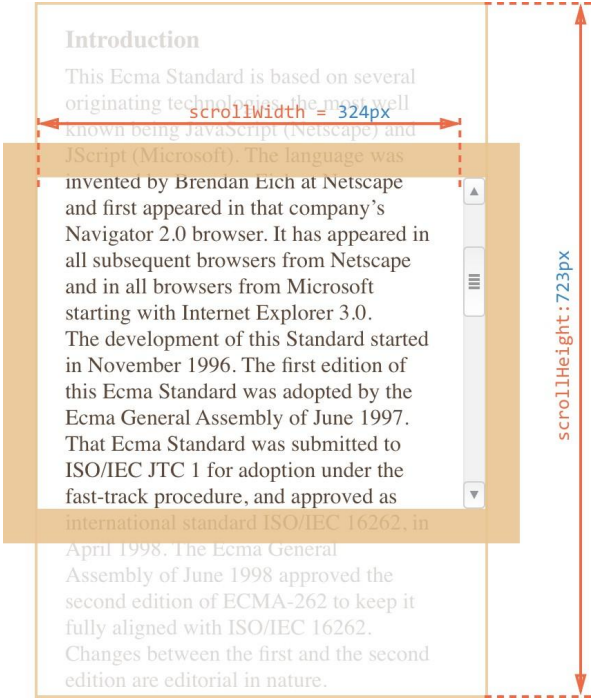
clientWidth/Height

- These properties provide the size of the area inside the element borders
- They include the content width together with paddings, but without the scrollbar
- If there are no paddings, then clientWidth/Height is exactly the content area, inside the borders and the scrollbar (if any)



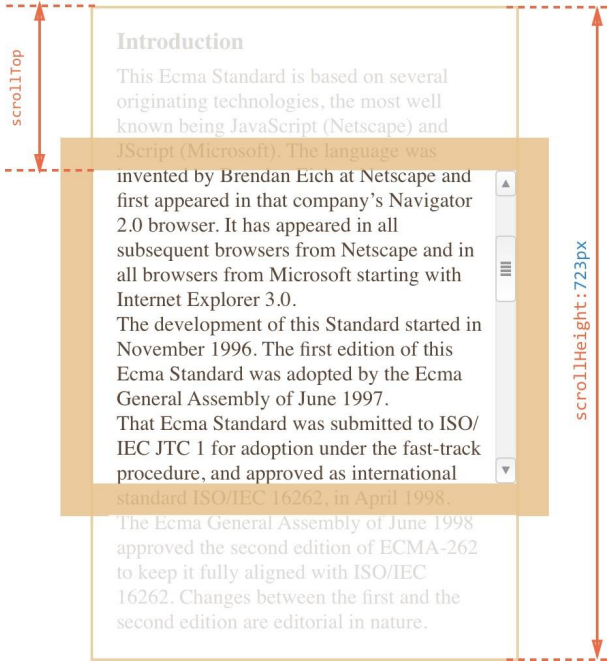
[scrollWidth/Height]

- Properties clientWidth/clientHeight only account for the visible part of the element.
  - Properties **scrollWidth/scrollHeight** also include the scrolled out (hidden) parts
- On the picture on the right:
  - scrollHeight = 723 – is the full inner height of the content area including the scrolled out parts
  - scrollWidth = 324 – is the full inner width, here we have no horizontal scroll, so it equals clientWidth
- We can use these properties to expand the element wide to its full width/height:
  - element.style.height = `${element.scrollHeight}px`;



[scrollLeft/Top]

- Properties **scrollLeft/scrollTop** are the width/height of the hidden, scrolled out part of the element
- On the picture on the right we can see scrollHeight and scrollTop for a block with a vertical scroll
- scrollLeft/scrollTop can be changed, and the browser will scroll the element



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[Don’t Take Width/Height from CSS]

- We’ve just covered geometry properties of DOM elements
- They are normally used to get widths, heights and calculate distances
- But as we know, we can read CSS-height and width using getComputedStyle()
- Why should we use geometry properties instead? There are a few reasons:
  - First, CSS width/height depend on another property: box-sizing that defines “what is” CSS width and height. A change in box-sizing for CSS purposes may break such JavaScript.
  - Second, CSS width/height may be auto, for instance for an inline element:

```
<span id="elem">Hello!</span>
<script>
    alert(getComputedStyle(elem).width); // auto
</script>
```

- Third, clientWidth/clientHeight take the scrollbar size into account, while in some browsers (e.g., Firefox) getComputedStyle(elem).width returns the CSS width (ignore the scrollbar)

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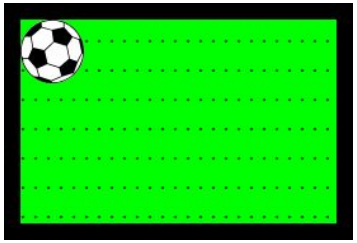
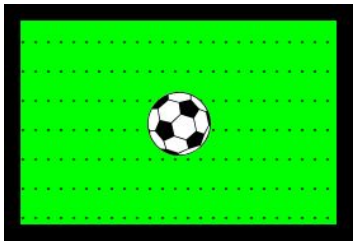
[Exercise (6)]

- What are the coordinates of the field center?
- Calculate them and use to place the ball into the center of the field
- The element should be moved by JavaScript, not CSS
- The code should work with any ball size (10, 20, 30 pixels) and any field size, not be bound to the given values
- Start with the HTML page on next slide





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Exercise (6)

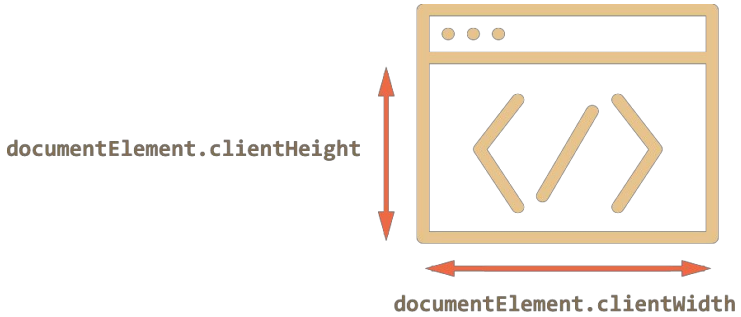
```
<!DOCTYPE HTML>
<html>
<head>
    <style>
        #field {
            width: 200px;
            border:  10px  groove  black;
            background-color:    #00FF00;
            position: relative;
        }

        #ball {
            position: absolute;
        }
    </style>
</head>
<body>
    <div id="field">
        <img src="https://en.js.cx/clipart/ball.svg" width="40" height="40" id="ball">
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . .
    </div>
</body>
</html>
```

Window Geometry

- From the DOM point of view, document.documentElement corresponds the root <html> tag, and has geometry properties described previously
- In some cases we can use it, but there are additional methods and peculiarities important enough to consider

[Width/Height of the Window]

- Properties clientWidth/clientHeight of document.documentElement provide the width/height of the window, ignoring any scrollbars



- Browsers also support properties window.innerWidth/innerHeight, which provide the full window width/height (including scrollbars)
- Typically we need the available window width to draw or position something, i.e., inside scrollbars if there are any

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[Width/Height of the Document]

- Due to browser inconsistencies, to get the width/height of the whole document, with the scrolled out part, we should use the following code:

```
let scrollHeight = Math.max(
    document.body.scrollHeight,
    document.documentElement.scrollHeight,
    document.body.offsetHeight,
    document.documentElement.offsetHeight,
    document.body.clientHeight,
    document.documentElement.clientHeight
);

alert("Full document height, with scrolled out part: " + scrollHeight);
```

- To get the current scroll state, use the special properties window.pageXOffset/pageYOffset:

```
alert("Current scroll from the top: " + window.pageYOffset);
alert("Current scroll from the left: " + window.pageXOffset);
```

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Changing the Current Scroll

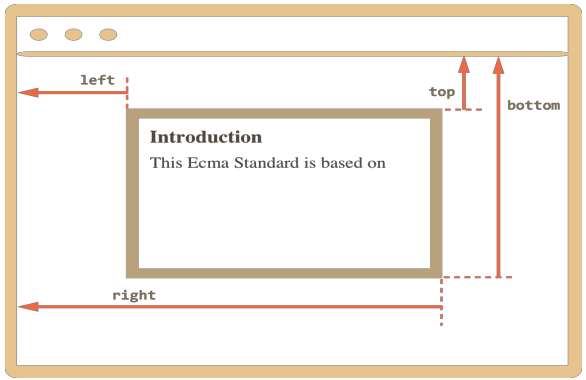
- To change the current scroll use one of the following methods:
  - **window.scrollTo**(pageX,pageY) – absolute coordinates
    - For instance, to scroll to the very beginning of the page, can use scrollTo(0,0)
  - **window.scrollBy**(x,y) – scroll relative the current place
    - For instance, scrollBy(0,10) scrolls the page 10px down
  - **elem.scrollIntoView**(top) – scroll to make **elem** visible (align with the top/bottom of the window)

Coordinates

- To move elements around we should be familiar with coordinates
- Most JavaScript methods deal with one of two coordinate systems:
  - Relative to the window (or another viewport) top/left
  - Relative to the document top/left
- It’s important to understand the difference and which type is where

Window Coordinates

- Window coordinates start at the left-upper corner of the window
- The method **elem.getBoundingClientRect()** returns window coordinates for elem as an object with properties:
  - **top** – Y-coordinate for the top element edge
  - **bottom** – Y-coordinate for the bottom element edge
  - **left** – X-coordinate for the left element edge
  - **right** – X-coordinate for the right element edge



- When we scroll the page, and the element goes up or down, its *window coordinates change*

Window Coordinates

→ Click the button to see its window coordinates:

```
<style>
      body {
          height: 1000px;
      }
      #btnTest {
          margin-top: 200px;
      }
</style>

<button id="btnTest">Show coordinates of this button</button>
<script>
      btnTest.onclick = function () {  showRect(this);
      }
      function showRect(elem) {
          let r = elem.getBoundingClientRect();
          alert("{top:" + r.top + ", left:" + r.left + ", right:" + r.right + ", bottom:" + r.bottom + "}");
      }
</script>
```

Show coordinates of this button

→ If you scroll the page, the button position changes, and window coordinates as well

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elementFromPoint

- The call to **document.elementFromPoint(x, y)** returns the most nested element at window coordinates (x, y)
- For instance, the code below highlights and outputs the tag of the element that is now in the middle of the window:

```
let centerX = document.documentElement.clientWidth / 2;
let centerY = document.documentElement.clientHeight / 2;
let elem = document.elementFromPoint(centerX, centerY);

elem.style.background = "red";

alert(elem.tagName);
```

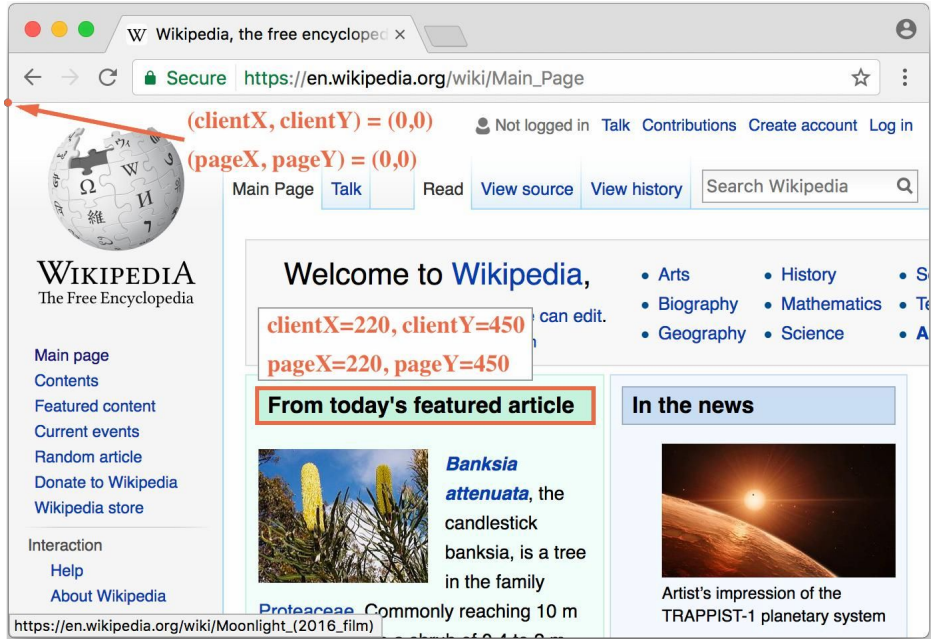
  - As it uses window coordinates, the element may be different depending on the current scroll position

Document Coordinates

- Document-relative coordinates start from the left-upper corner of the document, not the window
- In CSS, window coordinates correspond to position:fixed, while document coordinates are similar to position:absolute
- We can use position:absolute and top/left to put something at a certain place of the document, so that it remains there during a page
- For clarity we'll call window coordinates **(clientX,clientY)** and document coordinates **(pageX,pageY)**

[Document Coordinates]

→ When the page is not scrolled, then window coordinate and document coordinates are actually the same:



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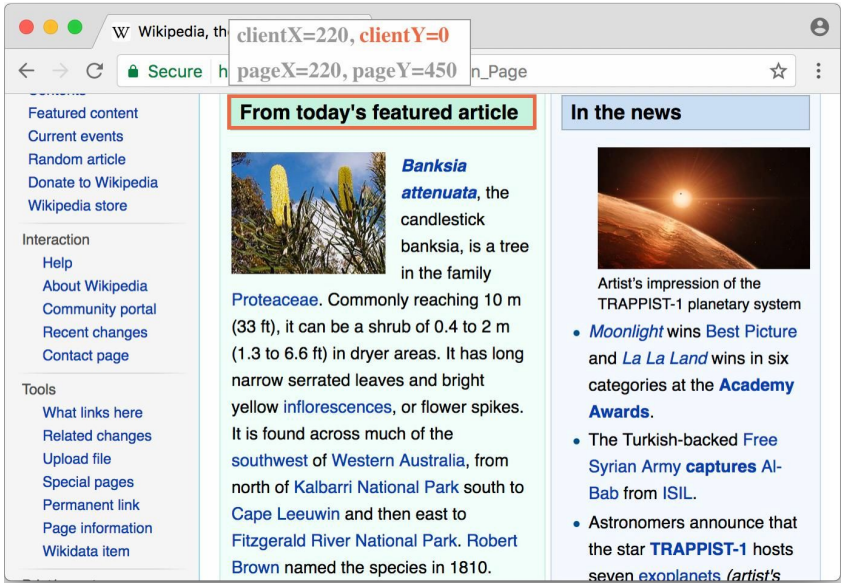
Document Coordinates

- And if we scroll the page, then (clientX,clientY) change, because they are relative to the window, but (pageX,pageY) remain the same
- Here's the same page after a vertical scroll:



Getting Document Coordinates

- There's no standard method to get document coordinates of an element
  - But it's easy to write it
- The two coordinate systems are connected by the formula:
  - pageY = clientY + height of the scrolled-out vertical part of the document
  - pageX = clientX + width of the scrolled-out horizontal part of the document
- The following function takes the window coordinates from getBoundingClientRect() and adds the current scroll to them:

```
// get document coordinates of the element
function getCoords(elem) {
    let box = elem.getBoundingClientRect();

    return {
        top: box.top + pageYOffset,
        left: box.left + pageXOffset
    }
}
```

Control questions

1. What is attribute?
2. What is the difference between class and className?
3. How can we move a node?
4. How can we remove a node?
5. What is the difference between clientX and pageX?